MASTER

Is it necessary to separate antenna-sites from the mobile network operators?

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in Technology and Policy

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Is it necessary to separate antenna-sites from the mobile network operators?
EXECUTIVE SUMMARY

The subject of infrastructure competition is extensively discussed in the economic and policy literature. Infrastructure competition is a broad concept that lies in the heart of policy making since the start of the 20th century. Infrastructure is an essential part of the economy and welfare in the modern society. The energy, water, public transportation and telecommunications are examples of markets where infrastructure is important. All these infrastructure based markets were considered a natural monopoly, with the consequence that many EU countries chose to nationalize these monopolies. Two decades ago, in the 1980s and 1990s the EU started to liberalize these markets with the aim to end regional monopoly and create a common European market. One of the main discussions carried out in policy circles is the discussion concerning structural separation. Structural separation is the separation of the infrastructure of the service into two different firms, instead of one. This is one of the ways to introduce competition on the infrastructure.

The focus of this thesis lies in the Dutch mobile telecommunications sector, which is identified as an infrastructure based sector. This sector depends on physical infrastructure (base station, fixed network and antenna-sites) and non-physical infrastructure, which is the spectrum. This research addresses the vertical integration between the antenna-sites and the mobile telecommunications market. This is an interesting matter, because the demand for antenna-sites is expected to increase, while the place where antenna-sites are supposed to be build is limited. This creates an extra dimension to the competition on the infrastructure in this case.

The mobile telecommunications market and the antenna-sites market are addressed separately in this thesis to study the competition inside these markets. Each of these markets is studied as a case using the Porter model as a framework. To be forward looking, a case study is added with expected future developments that could have an impact on competition in the mobile telecommunications market and the antenna-sites market.

The results out of the case studies are analyzed using an analysis scheme provided by (Bijl d. P., 2005) and (Mierlo, 2001). The main conclusion of this thesis is that there is limited competition on the infrastructure (the antenna-sites), because of the powerful position of mobile network operators in the antenna-sites market. Nevertheless, structural separation is not recommended, due to: (1) future developments that create a good opportunity for new entry. (2) A possible shift of business focus of mobile network operators from infrastructure competition to service competition that might lead to separation without government intervention and finally (3) possible negative welfare consequence that accompany heavy government intervention.
Is it necessary to separate antenna-sites from the mobile network operators?
I would like to thank my supervisors at the Eindhoven University of Technology and at Stratix for their support, and expertise that allowed me to conduct this study successfully. I would also like to thank all the experts that I have interviewed for their useful input for this research. And then I would like to thank, my student colleagues at the K-gang and N-gang for the discussions, the productive weekends and the coffee breaks. Finally, without the help and patience of my boyfriend and family, I would have never been able to graduate.

Thank you all, I have learned much this year, about the subject and about myself.

Hind
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1 Introduction

The subject of infrastructure competition has been extensively discussed in the economic and policy literature. Infrastructure competition is a broad concept that lies in the heart of policy making since the start of the 20th century. Infrastructure is an essential part of the economy in the modern society. The energy, water, public transportation and telecommunications are examples of markets where infrastructure is important. Infrastructure based markets raise many competition and regulatory issues in the European Union. One of these issues is the vertical integration between the infrastructure and the service provided for consumers that make use of this infrastructure.

The telecommunications sector is considered one of the most important for the future economy in Europe. Telecommunications is an indispensable part of our daily lives, communications and being a part of the global economy. Europe commissioner Viviane Reding has emphasized this development in many of her speeches. Because of the importance of this sector to the entire economy, the focus of this thesis is drawn to telecommunications.

Many services known today are a part of the telecommunications sector. Fixed and mobile telephony, internet, TV and Radio broadcasting are some of these services. In the telecommunications sector, many former state monopolies and early entrants have, at the same time, control over the network of infrastructure and offer services over these networks to the consumers. Services providers that do not own physical infrastructure do not automatically gain access to the network. This is one of the reasons regulations exist in this sector. The European Commission has established a policy framework for telecommunications (officially electronic communications) to create a level playing field between the service providers with and without a network. This is done on many levels of intervention, starting from only supervising the market to structurally separating the infrastructure from the service.

In this thesis, the market chosen is the mobile telecommunications market and the vertical integration is between this market and the antenna-sites (which are a part of the infrastructure). These networks of infrastructure might form a bottleneck for service providers and network operators that desire to enter the market.

Many regulations are already designed to make sure that these service providers gain access to the network. Nevertheless, for the mobile telecommunications market, regulation is limited, because there is competition on service level (DGET, 2008). For this reason, this thesis will address the issue of competition, not only on service level, but focusing on competition on antenna-sites (infrastructure).
1.1 Research justification

Mobile network operators (MNOs) need an extensive network of antenna-sites in order to have nationwide coverage for their mobile services. These antenna-sites are expensive according to MNOs and might become scarce due to public's concern with health issues. Because MNOs currently own most part of the antenna-sites, early mover's advantage is created. Entry to this market is then discouraged because access to the infrastructure could be limited by the incumbents, who own the infrastructure. MNOs are expected to provide access, when needed, to other firms in order to be able to compete in this market.

This can form a high barrier to entry to the MNO market and raise competition issues. The issues that concern competition in this sector are listed below:

1. Due to the control firms in the mobile telecommunications market have over the access to most antenna-sites, it might become difficult for new firms to enter the market of mobile telecommunications.
2. Another issue is competition in the antenna-sites market. Building new antenna-sites is facing much resistance because of the possible negative effects of radiation coming from these antennas. While the demand for antennas are expected to increase.
3. Competition in the mobile telecommunications market seems limited because there are only three firms that control both the mobile telecommunications market and the antenna-sites market.

This thesis will address these concerns and study whether regulation is necessary in this market due to the concerned raised above. Beside the question of government intervention is necessary; this study can be placed in a broader context, which will be explained below.

1.1.1 Scientific relevance

The use of industrial organization models is quite common in policy studies. Most of these studies make use of the Structure-Conduct-Performance model (Scherer and Ross, 1982) to investigate, among other things, what influence policies have on the performance of industries. This study, however, makes use of the Porter model in order to determine the competitiveness level (performance) of the studied markets and then to determine whether government intervention is necessary. Applying the Porter analysis as an industry structure analysis is not unique in itself. However, Porter’s applicability to infrastructure based markets is considered quite unique. Porter’s model is not specifically designed for such markets; especially the study of vertical integration between the infrastructure and the service layer in such markets is not one of the main goals of this model. Nevertheless, Porter’s model offers a great amount of flexibility and the field of industrial organization offers tools to adjust the model in a way that suites this research, if needed of course.

Further on, this study contributes to the general understanding of competition infrastructure based markets and the underlying assumption is that vertically integrated firms would deter competition in downstream markets.

1.1.2 Social relevance

The social relevance of this research lies within the discussion of market failure and government failure. Finding the right balance between these two extremes in order to ensure welfare for the consumers has been always a key discussion for policy makers and economists in general. In studying the need of government intervention to remove entry barriers, this research hopes to contribute to the broader discussion about regulating infrastructure based markets and government intervention in general.

1.2 Research question and objectives

The main goal of this thesis is to find out into what extend government intervention is needed to remove bottlenecks of competition regarding the vertical integration between the mobile telecommunications market and the antenna-sites market. The main research objectives are:

- To provide knowledge about competition in both the mobile telecommunications market and the antenna-sites market.
- To examine whether antenna-sites withhold competition in the mobile telecommunications market by being an essential facility (see chapter 3).
- To provide a regulatory framework to examine the vertical integration between the mobile telecommunications market and the antenna-sites market.
- To provide policy recommendation to remove possible bottlenecks in the mobile telecommunications market.

The main research question is:

How should the regulator react to competitive issues raised by the vertical integration of the mobile telecommunications market and the antenna-sites market?

The research is divided in three parts, a theoretical part, an empirical part and the analysis part. Each of these parts has a sub question and together all these questions will answer the main question:

**Theoretical part**

1. Which economic theories are there to help understand competition in an infrastructure-based market? And what indicators do these theories provide to analyze competition in these markets?
   - A. What is perfect competition?
   - B. What approaches are most suitable to analyze competition?

2. What are the motivations and instruments to regulate competition in infrastructure based markets?
   - A. Why is competition regulated in infrastructure based market?
   - B. In what level of competition is government intervention necessary?
   - C. What regulatory instruments are there to regulate competition in infrastructure based markets?

**Empirical part (Three case studies)**

3. What competition level does the mobile telecommunications market finds itself and what competition issues (for regulation) does this market raise?
   - A. What are the main characteristics of the mobile telecommunications market?
   - B. What competition level is the mobile telecommunications market according to Porter’s model?

4. What is the competition level of the antenna-sites market according to Porter’s analysis and how might this influence the mobile telecommunications market?
   - A. What are the main characteristics of the antenna-sites market?
   - B. In what competition level is the mast towers market according to Porter’s model?
   - C. In what competition level is the rooftops market according to Porter’s model?
   - D. What competition issues do these markets raise for the mobile telecommunications market?

5. What are the most important expected future developments in the field of mobile telecommunications and antenna-sites and how are these developments expected to influence competition in the mobile telecommunications market?
1.3 The scope of the research

In order to delimit the scope of this research, a brief description of the mobile sector will put the situation into perspective first.

There are two kinds of products coming from the mobile telecommunications sector; voice services and non-voice services like mobile broadband Internet access, mobile email and instant messaging, mobile payment, mobile TV streaming and broadcasting, music and SMS.

The OPTA, which is the Dutch NRA\(^1\), has defined two important product markets in the mobile sector. These markets were defined according to three levels in the mobile telecommunications market that are shown in figure 1.

\[\text{Network level} \rightarrow \text{Service level} \rightarrow \text{Retail market}\]

In this market products are offered at two levels, the wholesale level products and the retail level products (shown in figure 1 as two arrows). The OPTA defines products at wholesale level as access to the network. Access to the network enables a firm to communicate through the operator’s network and a mobile service is then offered to the end users. Mobile services are divided into voice and non-voice services. Voice services are the ability to call and to be called, while non-voice services include SMS, MMS and mobile internet. Mobile services are the products at retail level.

The MNOs (mobile network operators) have licenses to frequencies of the radio spectrum and own a physical network of infrastructure (e.g. antenna-sites). MNOs offer access to their network to the firms at service level. Firms at this level offer mobile services to end users and can be divided into two categories, service providers (SPs) and mobile virtual network operators (MVNOs). Service providers buy minutes from MNOs and resell them to end users. Service providers can be owned by one of the MNOs or be independent. MVNOs have an incomplete network of their own. MVNOs make use of parts of networks of MNOs together with parts that they own to offer mobile services to the end users. Figure 1 shows the different levels and the interaction between them.

This research will focus on MNOs and their position in both the wholesale and retail market. Also, because of the focus on vertical integration between infrastructure and service, the position of MNOs in the

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\(^1\) NRA is the National Regulatory Authorities. Their task is to coordinate and supervise sector specific regulatory issues in the telecommunications sector.
antenna-sites market is studied too. This research will consider antenna-sites as the main infrastructure for mobile telecommunications, because antenna-sites are the part of the infrastructure that copes with possible public resistance.

1.4 Methodology

For this research, a explorative qualitative research method is chosen, because quantitative methods to analyze competition in an infrastructure based market is not available yet. With quantitative data, the research would decrease the scope of the research. Explorative qualitative methods have a broader perspective. In qualitative explorative research, tools like document collection and semi-structured interviews are expected to be used in an iterative way. The focus of such kind of research is knowledge accumulation rather than examining (Baarda, Goede, & Teunissen, 2000).

At the start of this research, mainly policy documents (from EZ, OPTA, NMA, Ofcom, and European Commission) and scientific articles from journals (like Telecommunications Policy and Communications and Strategy) were used for orientation in the subject. Then nine semi structured interviews with important actors were conducted (a list of interviews is provided in appendix 1 and the question list in appendix 2). The choice for actors to interviews was based on a quick scan and brief discussions with my colleagues at Stratix and my supervisor at the TU/e. After the interviews, a more detailed literature research was conducted to complete the case studies and the analysis.

Because of the fast changing character of this market, news websites were also used as a source. However less accurate than scientific articles, news websites are more up to date.

1.5 Outline of the thesis

This thesis starts with an introduction into the problems and the sector. After the introduction, a conceptual framework is being made based on both the theoretical framework (chapter 2) and the regulatory framework (chapter 3). Using this conceptual framework, three case studies are conducted (chapter 4 through 6). These three case studies will shed a light on the competition issues in the mobile telecommunications market and the antenna-sites market that need to be regulated. The expected future developments are important to explain too, because of the dynamic character of the mobile sector. Competition issues that need to be regulated are summarized and interpreted in section 8.1. Section 8.2 (regulatory analysis) analyzes whether government intervention is needed and which of the regulatory instruments (introduced in chapter 3). Chapter 8 ends with a conclusion and methodological reflection on the research. Figure 2 shows the outline of the thesis in a roadmap.
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**Case Studies**

- **Antenna-sites market**, Chapter 5, (Important supplier of the Mobile telecommunications market)
  - Mast towers market (section 5.2)  
  - Porter Analysis (only three forces: Rivalry, Threat to Entry, and Threat of substitute technologies)

- **Roofops market** market (section 5.3)

- **Mobile telecommunication ions market**, Chapter 4 (Important buyer of the antenna-sites market)
  - Porter Analysis (only two forces: Rivalry and Threat to Entry)

**Future Developments**, Chapter 6 (Three important future events and their influence on competition in the mobile telecommunications market)

**Regulatory Framework**

- **Intervention level** (Section 3.2, intervention level depends on competition model)

- **Regulatory instruments** (Section 3.3)
  - Spectrum governance
  - Essential facility doctrine
  - Market analysis and SMP

**Analyses**

- **Competition issues** (Section 7.1) to be regulated and competition level
  - Porter Analysis (section 4.2, five forces)

- **Regulatory Analysis** (Section 7.2, level of government intervention and the suitability of discussed regulatory instruments (7.3) to solve competition issues)
2 THEORETICAL FRAMEWORK

In order to be able to analyze competition in this thesis, it is important to learn more about the concept of competition. There are many theoretical views of what competition is in the economic literature and what the most important market structures that belong to these views. The most important is the neo-classical view of free competition (Viscusi, Harrington, & Vernon, 2005), which is also called perfect competition. This concept is the background of many policies in the developed economies and much of the belonging economic literature. Beside the views about competition in different market structures, the economic literature provides many models to analyze competition in markets. The main goal of this chapter is to understand the relationship between perfect competition and market structures and to provide useful models and instruments to analyze competition.

Before going any further into the issues of the antenna-site market and the mobile telecommunications market, it is important to gain knowledge about the concept of competition, the relation of competition and market structures and the possible models to use to analyze competition in markets or industries. Therefore, the main question in this chapter is:

1. Which economic theories are there to help understand competition in an infrastructure-based market? And what indicators do these theories provide to analyze competition in these markets?
   A. What is perfect competition?
   B. Approaches to analyze competition

This chapter is divided into three sections. In section 2.1 the main assumptions of perfect competition (also called free competition) according to the neo-classical economic view is discussed. Then, different approaches to analyze competition are presented, and two of these approaches are further explained.

2.1 Perfect competition and market structures

1. A: What is perfect competition?

The concept of perfect (free) competition is important, because economic policies are often based on this notion. To understand the implications of competition on economic policy, it is necessary to understand the main assumptions of perfect competition.
Basically, the main stream theories of economy, define competition as the level in which a firm is able to influence price (Stigler, 1972). A market structure should meet the following criteria to be in a state of perfect competition:

- The market consists of a large number of firms.
- Each individual firm is a price taker (it has such a small market share, that it cannot influence price).
- All firms produce homogeneous products (the products seem the same for consumers).
- Consumers have perfect information (they are able to compare quality and price of all products in the market with each other).
- Incumbent firms and new entrants have equal access to resources.
- There is no divergence between private and social costs (e.g. no environmental damage).
- Profits should be zero (this is also called normal profits).

So, competition increases when the number of firms in an industry increases. In addition, a market is more likely to be competitive when market shares of firms are equally distributed.

The level of competition in markets varies between perfect competition as described above, and pure monopoly where there is only one firm that controls the market (Viscusi, Harrington, & Vernon, 2005). These two extremes almost never occur in practice. Between these two extremes there are other market structures that are more common, which are oligopoly and monopolistic competition. A definition of oligopoly is:

“... a market having few firms (but more than one firm) on the supply side and a very large number of buyers on the demand side, each of whom makes a negligible contribution to the market function.” (Friedman, 1983, p.1).

Monopolistic competition is defined as a:

“Market situation in which there may be many independent buyers and many independent sellers but competition is imperfect because of product differentiation, geographical fragmentation of the market, or some similar condition.” (Encyclopaedia Britannica, 2008).

The mentioned market structures are compared to each other in table 1.

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Perfect competition</th>
<th>Monopolistic competition</th>
<th>Oligopoly</th>
<th>Pure monopoly</th>
</tr>
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<tbody>
<tr>
<td>Profit maximization</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Barriers to entry and exit</td>
<td>None</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Number of firms</td>
<td>Many</td>
<td>Large</td>
<td>Few</td>
<td>One</td>
</tr>
<tr>
<td>Price-takers</td>
<td>Yes</td>
<td>Not entirely</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Size of firms relative to the market</td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td>Large</td>
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<td>Product homogeneity</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Profits in the long run</td>
<td>Normal</td>
<td>Above-normal</td>
<td>Above-normal</td>
<td>Above-normal</td>
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</table>

2.2 Approaches to analyze competition

1. B: What approaches are most suitable to analyze competition?

The main assumption, of main stream economics, is that the market will always be in a state of equilibrium. In reality though, this is not the case. Foss & Mahnke (1998) argue that competition analysis must be based on approaches that have dynamic assumptions. Because markets and firms are continually changing and innovating, an equilibrium would be impossible to reach in an industry. They also emphasize the relation between firms’ strategic behavior and competition in industries (or markets). The way firms behave, can affect competition in an industry or market. This has been an important subject in economic literature. Foss & Mahnke (1998) provide an overview of these different approaches. A summary of these approaches is displayed in table 2.
The different approaches are divided into two main groups, the equilibrium based approaches and the market process based approaches. The first group shares many of their theoretical assumptions with the perfect competition assumptions discussed in section 2.1 on page 7. The market process based approaches share the assumption that competition is dynamic in the sense that firms are always changing. Also, they share the assumption that competition is there to enable firms to innovate (Foss & Mahnke, 1998). These approaches sometimes overlap with each other.

Policy assumption are still mostly based on the equilibrium approaches of competition (Audretsch, Baumol, & Burke, 2000). To be able to make sound policy recommendations, the analysis is perihered to be equilibrium based too. The choice fell on the industry structure analysis of Porter (the five forces model). The next section will go further into this model and explains how this model can be applied.

**The Five Forces model**

The model of the Five Forces was developed by Michael E. Porter in his book ‘Competitive Strategy: Techniques for Analyzing Industries and Competitors’ in 1980. Since then, this model has become an important tool for managers that develop firm strategy. Porter emphasizes that managers could not develop sound strategies without knowledge of the industry structure their firms are located in (Porter, 1992). In his analysis, industries consist of firms that produce homogenous products and the firms’ environment has a common structure that is consisted of five competitive forces shown in figure 3.

Porter designed the five forces model for business strategy development. His industry analysis shows the attractiveness of an industry or market by means of profitability of the industry. In his analysis, the five forces are positively correlated with competitiveness. In other words, the higher the forces are, the higher competition would be. Normally, after applying the five forces model, porter suggests three main strategies for firm’s positioning (Orges & Stringa, 2008). In this thesis, the industry structure analysis is of most interest for the subject. Porter’s model provides a systematic analysis tool for market structures and competitive situations. For this research the analysis aims to get
a sense of the competitiveness level in the markets under study. Porter’s analysis as shown in figure 3 is therefore most suitable. Each of the forces consists of several indicators; in this thesis the following indicators are used:

<table>
<thead>
<tr>
<th>Forces</th>
<th>Indicators</th>
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<tbody>
<tr>
<td>Rivalry</td>
<td>Marker concentration</td>
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<tr>
<td></td>
<td><em>Number of firms</em></td>
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<td></td>
<td><em>Size distribution</em></td>
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<td></td>
<td>Industry growth</td>
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<tr>
<td></td>
<td>Product differentiation</td>
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<tr>
<td></td>
<td>Asset specificity and exit barriers</td>
</tr>
<tr>
<td></td>
<td>Homogeneity of strategies of rivals</td>
</tr>
<tr>
<td></td>
<td>Changing supply and demand</td>
</tr>
<tr>
<td>Threat to entry</td>
<td>Expectation about the reaction of incumbents to entry</td>
</tr>
<tr>
<td></td>
<td><em>Economies of scale</em></td>
</tr>
<tr>
<td></td>
<td><em>Capital requirements</em></td>
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<tr>
<td></td>
<td><em>Reputation of the incumbents</em></td>
</tr>
<tr>
<td></td>
<td>Sources of incumbent advantage</td>
</tr>
<tr>
<td></td>
<td>Government Policy</td>
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<tr>
<td>Bargaining power of suppliers</td>
<td>Supplier concentration</td>
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<td>Product differentiation</td>
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<td></td>
<td>Threat of forward integration</td>
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<tr>
<td>Bargaining power of buyers</td>
<td>Negotiating leverage</td>
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<td></td>
<td><em>Buyer concentration versus firm concentration</em></td>
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<td></td>
<td><em>Product differentiation</em></td>
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<td></td>
<td><em>Buyers switching costs</em></td>
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<td></td>
<td><em>Ability of backward integration</em></td>
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<td></td>
<td>Price sensitivity</td>
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<td></td>
<td><em>Product’s impact on quality</em></td>
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<tr>
<td></td>
<td><em>Product’s impact on price</em></td>
</tr>
<tr>
<td>Threat of substitute technologies</td>
<td>Buyers’ switching costs</td>
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<tr>
<td></td>
<td>Buyer propensity to substitute</td>
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<tr>
<td></td>
<td>Perceived level of product differentiation</td>
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</tbody>
</table>

Rivalry is an endogenous force that is concerned with the dynamics from within a market. The main assumptions of this force in the Porter analysis are similar to the assumptions of the perfect competition model. Here, market share concentration and firm size distributions are the main measures for the competitiveness inside a market. Market concentration is measured by the C4, which is the total of market shares of the largest four firms in a market. The higher the C4, the higher the market concentration. The Herfindahl-Hirschmann index (HHI) is used to investigate the size distribution among the market players. The HHI is calculated using the following equation:

$$HHI = \sum_{i=1}^{n} S_i^2$$

Where S is market share of each market player. The HHI is a number between 0 and 10,000 where 0 means complete competition and 10,000 means monopoly. Competition authorities use the HHI as a measure when mergers occur in an industry. Competition authorities are allowed to stop the merger if the chance for market domination by one firm would grow as a result of the merger. The following norms are used in different countries:
If the HHI in a European market is higher than 2000 and a merger, in that same market, increases the HHI more than 150 points, then competition authorities in Europe considers the situation a threat to competition and interfere with the merger by conducting a research or forcing other obligations. In the Netherlands, the NMA and the OPTA take mostly the EU norms. However, they refer to the American norms too sometimes. The American norms are used the most in Economic literature, this is why, also in the Netherlands, the OPTA and NMA take these norms into account. Exceptions are made in applying the HHI norms sometimes. For the energy sector, for example, a threshold of 2500 points is used (DTe, 2005).

Furthermore, the main hypotheses to keep in mind in this force (rivalry) are:
- Intense rivalry among firms in an industry reduces average profitability
- Large numbers of firms in a market reduces collusion
- In general, in industries in which the major firms are all similarly sized, rivalry is more intense
- The more similar are firms in a market, the easier will be coordination of those firms.
- Industries which have substantial specific assets exhibit high barriers to exit and intensified rivalry
- Variability in demand creates more rivalry within an industry

The threat of new entrants is the second force of Porter’s model. This is an important force to competition. If the threat to entry is low, competition will be low too. New firms have little information about a market when they want to enter. They base their decision for entering on their assessment of the possible barriers to entry in the market they are entering, like high entry costs, economies of scale and high exit costs. Moreover, their decision is also based on their expectations about the reaction on the incumbent firms in the market, this information they can get from the reputation of the incumbent firms for example.

The bargaining power of buyers and suppliers of a certain market is also important, especially if the buyers or suppliers are to integrate backward or forward into the industry. Also if the groups of buyers and suppliers are dominated by few firms and are more concentrated than the industry they are selling to or buying from. If these powers are too low then the competitiveness in the market will decline.

Finally, substitute products compete with the markets’ products and are a threat especially when substitutes offer the same quality of products as the product offered inside the market for a cheaper price.

The combined powers of these forces form the level of pressure on rivals in an industry or market. When these forces are high, the pressure on the rivals within the industry will increase. With the increased pressure on firms inside an industry, these firms are then expected to perform better increasing the level of competition within a market.

### 2.3 Conclusions of the theoretical framework

At the start of this chapter the following question was asked:

1. Which economic theories are there to help understand competition in an infrastructure-based market? And what indicators do these theories provide to analyze competition in these markets?

In this chapter, first the main assumptions of perfect competition are discussed. Further on, many approaches of understanding and analyzing competition were discussed briefly. The models were divided in two main categories; the equilibrium based approaches and the market process economics. The main difference in these two categories is their economic theoretical background. Where the equilibrium based approaches are based on the assumption that markets are in a stable state of equilibrium in long term, the
market process economics are based on the assumption that markets are in continuous state of movement.

Because economic policies are still based on equilibrium based approaches of competition analysis, the choice fell on Porter’s model. This model provides a systematic method to view the market structure and evaluate competition in an industry. This is a useful model because of it is relatively easy to apply in a case study. The Porter model is divided into five forces and each force has its own indicators. For this research the following package of forces and indicators will be applied in the analysis of competition in the mobile telecommunications market and the antenna-sites market:

Table 5: The Porter’s model in detail as it will be used in this thesis

<table>
<thead>
<tr>
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<th>Indicators</th>
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</table>
Economic literature provides a framework on how competitive markets should behave and what the consequences are of lack of competitiveness to welfare. The relation of competition and economic efficiency can be found appendix 3. In this chapter, economic reasons are presented of why government interference is desirable in some market structures and three instruments to regulate markets are introduced. The following questions are central to this chapter:

2. What are the motivations and instruments to regulate competition in infrastructure based markets?

   A. Why is competition regulated in infrastructure based market? (3.1)
   B. In what level of competition is government intervention necessary? (3.2)
   C. What regulatory instruments are available to regulate competition in infrastructure based markets? (3.3)

Governments choose to regulate markets to eliminate market failure (Viscusi, Harrington, & Vernon, 2005). Market failure is the situation where allocation of production by the free market is not efficient. Economic efficiency implies that a market meets the following conditions (Pareto Efficiency):

- No one can be made better off without making someone else worse off.
- More output cannot be obtained without increasing the amount of input.
- Production proceeds at the lowest possible per-unit cost.

Market failure takes place for three main reasons, according to mainstream economic analysis (Viscusi, Harrington, & Vernon, 2005):

- First, when one or few firms in a market gain market power, allowing them to control price. This leads to inefficiencies because of imperfect competition.
- Second, firm’s production methods or the market conditions could cause negative externalities.
- Third, market failure can occur because of the nature of certain goods, or the nature of their exchange. For instance, while its goods may display attributes of public goods or common-pool resources, the market may suffer from high transaction costs, or informational asymmetry. In general, these situations can cause inefficiencies resulting in market failure.

Market failure and economic inefficiencies are expected to have a negative effect on welfare in a society and therefore government intervention would be necessary to correct this failure. However, government intervention might also lead to economic inefficiencies; government failure. The economic and political
Is it necessary to separate antenna-sites from the mobile network operators?

The discussion of market failure versus government failure is interesting, however, it goes beyond the scope of this thesis. Viscusi, Harrington, & Vernon (2005), Stigler (1972) and Baumol & Sidak (1994), among many others, provide a detailed discussion on this subject.

In this section, characteristics of infrastructure based market that are expected to cause market failure are discussed. Also several models of infrastructure competition and regulatory instruments are studied in this section to form a framework of regulatory analysis.

### 3.1 Special characteristics of infrastructure based markets

Access to the mobile telecommunications market is depended on access to the network of infrastructure. This makes this market an infrastructure based market. Few examples of these markets are the electricity sector, water sector, railways, sea harbors and airports. Not more than a few decades ago, infrastructure based markets were characterized to be natural monopolies due to the heavy amount of sunk costs involved in these markets and the semi-public character of the services involved (especially the energy sector). For these reasons, in some countries (including the Netherlands), these market were state owned monopolies until the 1980s and 1990s. The choice for a state monopoly is furthermore a societal and political choice according to Twist & Veeneman (1999). The main characteristics of infrastructure based markets are summed up below and thereafter the related assumptions are explained.

- Universal service
- High initial costs
- Economies of scale
- Vertical integration

#### Universal service

Because of the desire to universal services; Twist & Veeneman (1999) argue that it might not be desirable to introduce free competition into these sectors, because private firms would not invest in utilities in places where it is not profitable, for example public transportation in rural areas. Moreover, regulators argued that utilities are so important for the public, that it is a high risk to leave it up to the market. However, Twist & Veeneman (1999) argue that this argument is not relevant because homes and food are also primary necessities of life for the public and still they are left for the market.

#### High initial costs

A second reason for intervention in infrastructure based markets is the high initial cost that consists of the investments in building a network of infrastructure. Physical infrastructure can be seen as highly specific assets, which cannot be transferred to other markets (Martin, 1989). Startup costs in infrastructure based markets are also sunk. Sunk costs are defined by (Baumol, 1982) as the costs that are not retrievable for a firm after entering a market.

>Sunk costs are costs that (in some short or intermediate run) cannot be eliminated, even by total cessation of production. As such, once committed, sunk costs are no longer a portion of the opportunity cost of production” (Baumol, Panzar, & Willig, 1982, p. 280)

Sunk costs form a high barrier to entry, because they do not only increase the entry costs of entrants, but also the entry risks (Baumol & Willig, 1981).

#### Economies of scale

Economies of scale are an important characteristic of infrastructure-based markets. Economies of scale occur when the cost per unit decrease while the output increases. The costs of a network of infrastructure are fixed for a firm; therefore the cost per unit will decline as the number of users of such a network increase. Economies of scale are considered a barrier to entry Porter (1980).

---

2 “A "natural monopoly" is defined in economics as an industry where the fixed cost of the capital goods is so high that it is not profitable for a second firm to enter and compete. There is a "natural" reason for this industry being a monopoly, namely that the economies of scale require one, rather than several, firms. Small-scale ownership would be less efficient.” (Viscusi, Harrington, & Vernon, 2005)

---
**VERTICAL INTEGRATION**

Vertical integration means that a firm is operating on two or more levels of the production value chain in a market, like e.g. control over the distribution channel needed to sell the products of a firm. This could take place when a firm merges with its buyer or supplier. Vertical integration is an efficient way to create economies of scale for the firm. Meanwhile, vertical integration raises concerns for antitrust when this firm has a dominant position in the market. In this case, vertical integration creates barrier to entry that withholds competition.

Vertical integration occurs frequently in network markets because these markets were state monopolies before the privatization and liberalization of the network markets in the 1980s. Monopolies are often vertically integrated to control its inputs and its distribution channels. Moreover, network markets need large investments to build the network infrastructure and vertical integration provides cost reductions.

Vertical integration thus can be with firms of the downstream buyers or the upstream suppliers. The first form of vertical integration is forward integration and the second is backward integration. It is in general a strategic choice of firms to vertically integrate with their supplier or buyer firms. It provides the advantage of combining processes and therefore saving costs. More benefits of vertical integration are according to QuickMBA (2008):

- Improved coordination within the supply chain.
- More opportunities for product differentiation by means of increased control over inputs.
- Capture upstream or downstream profit margins.
- Create entry barriers to potential competitors, for example, if the firm can gain sole access to a scarce resource.
- Gain access to downstream distribution channels that otherwise would be inaccessible.
- Facilitate investment in highly specialized assets in which upstream or downstream players may be reluctant to invest.

The mobile telecommunications market and the antenna-site market were not separated markets before the privatization and liberalization policies. Both were a part of the value chain of mobile telecommunications firms. Gradually, after the liberalization of the mobile telecommunications market, a market for antenna-sites began to be established. Nevertheless, the firms in the mobile telecommunications market all own a part of the antenna-site park and are thus also active in the antenna-sites market.

Vertical integration raises competition issues because of the possible creation of barrier to entry by means of controlling access to vital assets, like in this case, the network infrastructure or important distribution channels. Vertical integration thus can provide firms with potential market power. Significant market power is regulated by means of European or national competition laws.

### 3.2 Models of infrastructure competition

Infrastructure based markets, as shown in the section 3.1, almost always need government intervention and regulations to manage competition. The level of government intervention depends on the level of competition in such markets. There are four general models of competition in infrastructure based markets. They are descending in the need for intervention, so the first model needs the lightest form of intervention whereas the last model needs the heaviest form of intervention. Table 6 shows the different models of competition in infrastructure based markets and the level of intervention. This section briefly explains each model of competition.
Table 6: Level of competition and level of intervention | adapted from Rutten & Poel (2002)

<table>
<thead>
<tr>
<th>Type of competition</th>
<th>What does it mean</th>
<th>Level of intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition between infrastructures</td>
<td>More infrastructures and more operators</td>
<td>Rather low</td>
</tr>
<tr>
<td>Competition on the infrastructure</td>
<td>More operators, one infrastructure</td>
<td>Moderate</td>
</tr>
<tr>
<td>Competition for the infrastructure</td>
<td>One monopolist, one infrastructure</td>
<td>High</td>
</tr>
<tr>
<td>Benchmarking</td>
<td>One monopolist and one infrastructure, splitting is impossible</td>
<td>Very high</td>
</tr>
</tbody>
</table>

**COMPETITION BETWEEN INFRASTRUCTURES**

In this type of competition, several networks of infrastructures are existent and end users can choose between several operators. This level of competition needs the least government intervention, because the existence of several networks and the choice freedom of end users (Rutten & Poel, 2002). A clear example is the competition between the coax network and the copper network to provide TV and fixed telephony services to end users. Convergence of technologies will probably lead to more of this form of competition in the future. Furthermore, there are no specific regulative instruments to ensure competition between infrastructures.

**COMPETITION ON THE INFRASTRUCTURE**

In this form of competition, there is only one infrastructure and few operators that compete to offer services on the same infrastructure. This form of competition results in an oligopolistic market that is controlled by few operators. To ensure competition, regulators have to monitor access to the infrastructure by open network provisions and access regulations. These measures ensure competition of services offered on the infrastructure. This form of competition is a typical form for the electronic communication sector (Veraart, 2007) and (Rutten & Poel, 2002), think of the obligation of KPN to offer access to its fixed telephony network. Sector specific regulative instruments are necessary to ensure competition on the infrastructure, like designating firms with significant market power, ensuring new entry to the market by access regulations, and asymmetric price regulations. These regulatory instruments will be discussed in section 3.3.

**COMPETITION FOR THE INFRASTRUCTURE**

At this type of competition, there is only one infrastructure and one monopolist. The contestable markets view of Baumol and the resource-based view of Demsetz show that competition is possible even though the number of players is low or even one. Their perspective implies creating competition in infrastructure based markets by tender procedure or auctioning a temporary license for infrastructure exploitation. There are two economic arguments that explain why competition is still possible here. First, as the number of bidders increase during tender procedures or auctions, the price of the license will become optimal (Demsetz, 1968). Second, the temporary monopolist would still function efficiently because there will always be a threat of new entrants at the end of the time period. The second explanation is only possible if the market in issue is a contestable market (Twist & Veeneman, 1999). Contestable markets are markets with no entry or exit restriction and therefore, the threat of entry is high at the moment an operator loses the exploitation license.

Licensing is a popular tool used by governments in the European Union to regulate infrastructure exploitation. A known example is the railways exploitation in the Netherlands, a license of 10 years is granted to the Dutch Railways company (NS) and the railways management firm (ProRail) to exploit large parts of the railways. Other firms have licenses for smaller parts of the railways.

**BENCHMARKING**

When competition for the infrastructure is not possible, because there is no contestable market, or because activities for the infrastructure cannot be regulated separately, regulators try to monitor monopolies by benchmarking them. This happens in the Dutch water sector where regional monopolies are compared to each other according to certain criteria or agreements (Rutten & Poel, 2002). Benchmarking
can also be used as an additional tool to guarantee more competition in the rest of types of competition discussed above (Veraart, 2007).

### 3.3 Instruments for regulation

Many of the infrastructure based market in the EU were liberalized during the 1980s and 1990s. To prevent the existence of firms with dominant position, foreclosure and other forms of anti competitive behavior, sector specific regulations were designed. Many countries have even sector specific competition authorities that supervise and watch competition in infrastructure based market.

Regulatory instruments can be used ex ante or ex post. Ex ante is in anticipation of anticompetitive behavior or a situation that could lead to anticompetitive behavior, e.g. in monopolistic markets, firms have dominant position and are expected to deter entry to its market. Ex post regulation is based on acting after an anticompetitive event has taken place. Such regulation is thus used after a complaint or a dispute between two firms in a market. This section focuses on a number of instruments that will most likely be usable to improve competition in the markets studied in this thesis.

#### 3.3.1 Market analysis and SMP

The European Commission has designed a sector specific regulatory framework to introduce more competition into the electronic communication sector in the European market. The new regulatory framework for electronic communications consists of five directives, these are:

- The "Framework Directive" includes all other directives.
- The "Authorization Directive" concerns the authorization of electronic communications networks and services.
- The "Access Directive" concerns access to electronic communications networks and services.
- The "Universal Service Directive".
- The "Directive on Privacy and Electronic Communications" concerns the processing of personal data.

One of the instruments that is the Market analysis. NRAs are expected to conduct a market analysis in markets where they suspect the existence of a firm with a significant market power (SMP). The European Commission has already identified 18 relevant markets, where NRAs are recommended to conduct market analyses. Appendix 4 shows a list of these markets. NRAs are also allowed to identify other markets to conduct market analysis on. These markets should meet the following criteria (European Commission, 2003):

The first criterion is the presence of high and non-transitory entry barriers whether of structural, legal or regulatory nature. However, given the dynamic character and functioning of electronic communications markets, possibilities to overcome barriers within a relevant time horizon have also to be taken into consideration when carrying out a prospective analysis to identify the relevant markets for possible ex ante regulation. Therefore the second criterion admits only those markets the structure of which does not tend towards effective competition within the relevant time horizon. The application of this criterion involves examining the state of competition behind the barriers of entry. The third criterion is that application of competition law alone would not adequately address the market failure(s) concern

A firm with a dominant position is in a “… position of economic strength affording it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers.” (European Parliament and of the Council, p. 15). The idea behind the market analysis tool is to create competition by asymmetric regulation; these are regulations that apply only to a part of the market. In this case, firms with a designation of SMP subjected to other regulations than other firms in the market. An NRA can, for example, oblige operators with dominance to provide access to their networks. NRAs can apply obligation

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3 Electronic communications includes fixed-line voice telephony, mobile and broadband communications and cable and satellite television. On the other hand, the content of services delivered over electronic communications networks, such as broadcasting content or financial services, is excluded, as is telecommunications terminal equipment (European Parliament and of the Council, 2002, p. 33)."

4 Significant Market Power (SMP) is called Aanmerkelijk Markt Macht (AMM) in Dutch.
from the Access Directive or the Universal Service Directive (European Commission, 2002). The following indicators are formulated by the Commission (2002) as a guideline to assess “significant market power” by using “market analysis”:

- Overall size of the undertaking
- Control of infrastructure not easily duplicated
- Technological advantages or superiority
- Absence of or low countervailing buying power
- Easy or privileged access to capital markets/financial resources
- Product/services diversification (e.g., Bundled products or services)
- Economies of scale
- Vertical integration
- A highly developed distribution and sales network
- Absence of potential competition
- Barriers to expansion

In conducting a market analysis, these criteria should not be applied as a checklist, but they help give an indication of what an NRA should consider. The Commission expects NRAs to be forward looking in their analysis, because of the fast changing technological development that is a main characteristic of the electronic communication sector.

The notion of dominance can be applied on a single firm, but also on more than one firm. This is called collective dominance.

“The Commission (it) would consider two or more undertakings to be in a collective dominant position when they had substantially the same position vis-à-vis their customers and competitors as a single company has if it is in a dominant position, provided that no effective competition existed between them”. (European Commission, 2002)

Collective dominance can occur in markets that have the following characteristics (European Commission, 2002):

- Mature market
- Stagnant or moderate growth on the demand side
- Low elasticity of demand
- Homogeneous product
- Similar cost structures
- Similar market shares
- Lack of technical innovation, mature technology
- Absence of excess capacity
- High barriers to entry
- Lack of countervailing buying power
- Lack of potential competition
- Various kind of informal or other links between the undertakings concerned
- Retaliatory mechanisms
- Lack or reduced scope for price competition

3.3.2 Spectrum policy

Spectrum policy concerns three broad issues (Smura, 2006): spectrum allocation (what kind of utilization should be allowed), spectrum assignment (which firms are allowed to operate allocated frequencies) and centralized vs. decentralized decision-making (should decision regarding allocation and assignment be made by the government or the firms who operate).

Spectrum policy has been a centralized by government in European counties. The European Commission, however, is planning to change this by introducing more flexible spectrum regulation (European Commission, Regulatory framework for radio spectrum policy, 2002) and introducing spectrum markets in the future (Smura, 2006). Spectrum allocation can happen by a beauty contest or an auction (Twist & Veeneman, 1999).
3.3.3 THE ESSENTIAL FACILITY DOCTRINE

The essential facility doctrine is a concept that originates from the US (1912) and is used in the EU since 1998 (Evrard, 2004). It is mostly used as a part of an ex post measure where market power due to access to infrastructure should be proven first before this regulation could be applied. However, according to Rutten & Poel (2002) it forms the basis of the regulation framework that is concerned with infrastructure based markets in general.

The following conditions have to be met if an asset to be called an essential facility:

- The facility is controlled by a dominant monopolist firm.
- The competitors cannot reasonably or practically duplicate the facility.
- The firm controlling the facility denies access to the use of the facility to competitors.

These criteria are mostly interpreted in a narrow way (Evrard, 2004) and (Temple Lang, 1994). The essential facility doctrine is useful form of regulation in this research. If antenna-sites are proven to be essential, competition could be introduced by bringing the vertical integration between antenna-sites market and the mobile telecommunications market to an end. The condition of essential facility will be used in the case study of the antenna-site market.

"Essentiality of a facility implies that access to the facility must be essential or crucial for the competitor seeking access to survive in that market. The refusal of access to that facility must constitute a barrier to entry. Secondly, "essential" implies that the facility must be incapable of being duplicated by the competitor or anyone else". Seema Nunkoo Policy and Research (2008)

The essential facility doctrine forms the basis of many sector specific regulations in infrastructure based markets (Rutten & Poel, 2002). It is used to separate the infrastructure and the service layer. There are three ways (gradaties) to deploy the essential facility doctrine, the legal separation, the economic separation and the administrative separation, where the legal separation is the 'heaviest' form of intervention. Legal separation is for example applied on the electricity sector, the economic separation on the railway sector and the administrative separation mainly in the fixed telephony sector (Rutten & Poel, 2002). In the Dutch telecom act one article is took up that has the essential facility as a basis, which is art.3.11 Site Sharing (Arrest Nozema Services N.V. vs. Broadcast NewCo Two B.V. (LJN: BD1064), 2008).

Within the European competition law the essential facility doctrine is interesting for this research because it is concerned with questions about vertical integration and infrastructure related assets. This doctrine aims to separate the vertical integration between service and infrastructure, if the infrastructure is considered essential. An essential facility is defined as “facility or infrastructure which is necessary for reaching customers and/or enabling competitors to carry on their business. A facility is essential if its duplication is impossible or extremely difficult due to physical, geographical, legal or economic constraints. Take for example a national electricity power grid used by various electricity producers to reach the final consumers: Since it would not be viable for these producers to build their own distribution network, they depend on access to the existing infrastructure. Denying access to an essential facility may be considered an abuse of a dominant position by the entity controlling it, in particular where it prevents competition in a downstream market.” (European Commission D. G., 2003)

An example is the media sector where the control over the infrastructure is separated from radio and TV broadcasting, so it is not done by the same organization. Another form of competition on the infrastructure is the financial or administrative separation between the construction and management of infrastructure.

The essential facility doctrine is an ex post regulatory instruments. This means that NRAs can only apply this instrument when a complaint or a dispute between two firms has taken place. The ex ante variant of the essential facility doctrine is the non-replicable assets approach. This approach is more flexible than the essential facility doctrine and it is allowed to be used on markets that are not pre-defined as relevant by the European Commission (OPTA & Economic Analysis Team, 2004).

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6 Since April 2008, article 3.11 has became article 4.12. However in this thesis 3.11 is still used because of it is known in the literature.
7 See a list of relevant markets in appendix 4
3.4 Conclusion of the regulatory framework

This section answers the main question posed at the start of this chapter by providing a brief summary and a conclusion of this chapter. The question posed at the start of this chapter is:

What are the motivations and instruments to regulate competition in infrastructure based markets?

The motivations to regulated infrastructure based markets are based on the idea of market failure. Infrastructure based markets have characteristics that allow market failure to be present. The most important characteristic were found to be:

- Universal service
- High initial costs
- Economies of scale
- Vertical integration

Government intervention can vary from light, only monitoring a market, to heavy, being even a part of the market. Government intervention in infrastructure based markets depends on the level of competition a market finds itself in. There are four levels of competition defined, the first is considered to need the lightest form of intervention, whereas the last needs to be regulated heavily. The four levels of competition are:

1. Competition between infrastructure
2. Competition on the infrastructure
3. Competition for the infrastructure
4. Benchmarking

Rutten and Poel (2002), have found the competition in the mobile sector finds itself mostly in the second and third level of competition. Therefore, there are three regulatory instruments chosen that fits into these two levels of competition:

- Market analysis and the significant market power (EC regulation)
- The Essential facility Doctrine (prevent dominant position by separating infrastructure and service)
- Spectrum governance (a tool that enables more access to the market)

These regulatory instruments will be used to solve competition bottlenecks in the markets under research.

With this chapter, a regulatory framework is established of which one can use to analyze the level of intervention needed in the vertically integrated mobile telecommunications market.

Some concluding remarks: This chapter has shown that infrastructure-based markets are always contend with characteristics that influence competition negatively. These characteristics allow governments to intervene with such markets in order to enhance competition. Because of these characteristics, government cannot define and measure competition in infrastructure based market using the restrictive definition of free competition (chapter 2). Because, in the restricted definition of free competition, infrastructure based market are considered not competitive. There are, however, others form of competition present in infrastructure based markets.

Concluding remarks regarding the theoretical part of the thesis

The theoretical framework provides a guideline to analyze competitiveness. We have seen many theories and chosen for the porter market structure analysis for this thesis. The models’ well defined structure and the easiness of its application have made it an attractive model to apply in this case studies. However, the Porter model had to be adapted to the situation of the case studies here.

The two markets analyzed are vertically integrated. The antenna-sites market supplies antenna-sites (which are an important part of the mobile network infrastructure) to the mobile telecommunications market. So, the bargaining power of supplier has been left out in the antenna-sites market. This is also done, because this thesis focuses on the relationship between these markets and not on the entire supply chain. Further on, the bargaining power of buyers in the antenna-sites market has been also left out, because the position of the buyers has already been extensively discussed in the analysis of the mobile telecommunications.
market (the actors of the mobile telecommunications market are the buyers of the antenna-sites market). This is done to prevent repetition in the text.

The antenna-sites market is divided into two submarkets; the mast towers market and the rooftops market. This was done, because of the difference in building permit obligation (chapter 5). To prevent repetition in the text, the threat of substitute technologies has been left out in the analysis of the rooftops market. The forces used in the mast towers market and the rooftops market are shown in figure 2. In the antenna-sites market, a barrier to entry is added too (this is not shown in the conceptual framework here below), which is the public opinion. This is an important force, because there have been worries of health issues around this subject (Bongers, et al., 2006).

The case studies contain two market analyses (mobile telecommunications market and the antenna-sites market) and an overview of the most important future developments and the affect on competition in the analyzed markets. The case studies will provide a list of bottlenecks or issues regarding competition in these markets and where government intervention would be needed, this is shown as the highest circle on the right side of figure 2.

The regulatory framework (chapter 3) provides four known levels of competition in infrastructure based markets. All four levels of competition need government intervention, but that varies from ‘light’ to ‘heavy’. Each level of intervention has its own set of regulatory instruments. There are three regulatory instruments discussed and will be used on the competition issues that were earlier defined. This is shown as the lowest circle at the right side of figure 2.
Is it necessary to separate antenna-sites from the mobile network operators?
4 THE MOBILE TELECOMMUNICATIONS MARKET

In this chapter, the mobile telecommunications market is analyzed using the five forces model of Porter. The main goal of this chapter is to find out the bottlenecks in this market that withhold competition and need to be regulated. The main question in this chapter is thus:

3. What competition level does the mobile telecommunications market find itself and what competition issues (for regulation) does this market raise?

Before analyzing the market according to Porter’s model, a short history of the market and the most related policies are discussed to create a framework of which the Porter analysis follows. The next questions in this chapter are:

3. A. What are the main characteristics of the mobile telecommunications market?
3. B. In what competition level is the mobile telecommunications market according to the Porter’s model?

The analysis focuses on the firms in the wholesale and retail market. Both markets are interesting because the main rivals in the mobile telecommunication market operate at both markets. The level of competition at each market differs however, mainly because the number of firms at each level is different. The wholesale market, which is the market for network access to the public mobile network and the retail market, which is the market for services offered to end users. In this analysis, the main focus is on the position of the MNOs in each of these levels and the forces that play the most important part in each level. This because the relationship of the MNOs with the antenna-sites market. The analysis in this chapter is therefore not split up into two market analyses, but only one analysis that shows the differences in these markets.

4.1 A quick scan of the mobile telecommunications market

This section will discuss the most important facts, policies, and actors in the mobile telecommunications market to answer the following sub question.

3. A. What are the main characteristics of the mobile telecommunications market?
4.1.1 **Brief History of the Dutch Telecommunications Policy**

In the 1980s liberalization of infrastructure-based markets began to take place in Europe. Since telecommunications is also considered an infrastructure-based market, it was liberalized too. Liberalization was done to create competition in these markets by allowing more firms to compete with state-monopolies and eventually returning state-monopolies to the private market. The liberalization movement started in 1983 in the UK and was eventually spread in all other European countries. Liberalization is a change in political and economic thinking. Where infrastructure-based sectors were mainly a monopoly, policy makers have tried to create new policies to give new firms a chance to enter these markets in order to increase competition in these industries. In this regulatory regime, the role of government shifted from owner of utilities toward supervisor of competition in utilities. In the telecommunications markets, NRAs (National Regulatory Authorities) were installed to do the supervision, until this market is considered to be competitive on its own (Heuvelhof, Jong, Kuit, & Stout, 2003). Soon after liberalization, privatization came. Privatization is a legal change, where the state owned firms became private owned firms. Furthermore, events like auctioning spectrum lots to give new firms a chance to enter the market were important to shape the Dutch mobile telecommunications market as we know it now. Figure 4 shows the discussed developments over the years.

![Figure 4: Policies for the mobile telecommunications market](DGET (2008))

4.1.2 **Facts and Figures**

The mobile telecommunications has grown significantly over the last ten years (figure 5). The total value of the mobile telecommunications market in terms of revenue is over six billion euro in 2008. The penetration rate (the number of mobile subscriptions comparing to the Dutch population) of the mobile telecommunications market in the Netherlands is over the 120% (figure 6) and it is even expected to grow to almost 140% with 22.8 million users (Telecompaper, Roer, & Achterberg, 2008).
4.1.3 Main actors

In the market analysis it is important to identify the actors first. For identifying the actors in the mobile telecommunications market and the antenna-sites market Porters framework can be used. A summary of the actors is shown below in table 7. The substitute technologies and products are not shown in the figure, because the firms that offer these technological substitutes are the same as the rivals and the potential entrants.

Table 7: Actors in the mobile telecommunications market

<table>
<thead>
<tr>
<th>Market rivals</th>
<th>Potential entrants</th>
<th>Buyers</th>
<th>Suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale market</td>
<td>KPN</td>
<td>MVNOs: Tele2, Debitel, Ay Yildiz</td>
<td>High building owners</td>
</tr>
<tr>
<td></td>
<td>Cable firms: Ziggo, UPC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vodafone</td>
<td>Wimax providers: Callmax, Worldmax, Smile BV</td>
<td>SPs: Rabo Mobiel, IDT Mobile, Lycamobile</td>
<td>Antenna-sites firms : Novec, Alticom</td>
</tr>
<tr>
<td>T-Mobile</td>
<td>Others: Tele2</td>
<td>See appendix 5 for a complete list</td>
<td>Equipment suppliers: Ericsson, Nokia-Siemens, networks Alcatel</td>
</tr>
<tr>
<td>Retail market</td>
<td>MVNOs: Tele2, Debitel, Ay Yildiz</td>
<td>Retailers</td>
<td>KPN</td>
</tr>
<tr>
<td></td>
<td>Retailers</td>
<td>Retailers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internet providers</td>
<td>Private consumers</td>
<td>Vodafone</td>
</tr>
<tr>
<td></td>
<td>See appendix 5 for a complete list</td>
<td>Financial institutions</td>
<td>Business consumers</td>
</tr>
<tr>
<td></td>
<td>Also: KPN, Vodafone, T-Mobile</td>
<td>Network equipment for the MVNOs</td>
<td></td>
</tr>
</tbody>
</table>

Rivals in the mobile telecommunications market

The mobile telecommunications market has a complicated structure, as the number of services activities is divers and there are many types of actors within the market. There are seven main service activities distinguished (Dool, Kuysten, & Geest, 2001), these are shown in table 8. There are also several kinds of

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8 A list of what each service activity means is found in appendix 6
actors shown in table 8, each kind differs in the range of activities it offers. Some can offer the whole range (MNOs) and some offer only one or two services like SPs and retailers. End users hardly notice the difference between all these types of actors and are mainly interested in the last shown service, which is: sales. In this section most important MNOs, MVNOs and SPs are discussed briefly.

Table 8: Services activities in the mobile telecommunications market | Dool, Kuysten, & Geest (2001)

<table>
<thead>
<tr>
<th>Service activity</th>
<th>MNO</th>
<th>MVNO</th>
<th>Other MNOs, (roaming)</th>
<th>Service provider (SP)</th>
<th>Retailer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobility management</td>
<td></td>
<td>MVNO</td>
<td>Other MNOs, (roaming)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Call conveyance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile subscriber (SIM) management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value added services provisioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract management</td>
<td></td>
<td></td>
<td></td>
<td>Service provider (SP)</td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td></td>
<td></td>
<td></td>
<td>Retailer</td>
<td></td>
</tr>
</tbody>
</table>

**MNOs**

At this moment, the market is divided among three mobile network operators (KPN, Vodafone and T-Mobile). The mobile network operators (MNOs) have access to the frequency spectrum and own a large deal of the network infrastructure. Each MNO has built its own mobile network infrastructure, because this was one of the conditions of the UMTS license in 2001. The demands of the UMTS auction are:

- Outdoor coverage in 95% of the cases, at a minimum of 144 kbit/s in the following areas:
- the built-up area in all cities with more the 25000 residents
- all main high ways, railroad and water roads
- all high ways to Germany and Belgium
- In and around the airports, Schiphol, Rotterdam and Maastricht

**KPN** is the first MNO in the Dutch market, because it was the state monopolist for post and telephony. Its mission statement is:

> “Our customers trust us to provide them with high-quality, reliable services to help them achieve their business and personal goals, and to enrich their work and leisure time” KPN mission statement 2008. (KPN, 2007)

Short after the liberalization of the mobile telecommunications market in 1989, KPN was given a license to access the GSM-900 frequencies it had its mobile network operating in 1994. KPN also acquired a GSM-1800 license in 1998 and a UMTS license in 2001. In 2005, KPN merged with Telfort, one of the newer MNOs that entered the market by obtaining a GSM-1800 license in 1998. Telfort was originally a cooperative undertaking between British Telecom and the Dutch railway (NS) that entered the market in 1998 by obtaining a GSM-1800 license. Telfort later changed its name to O2 in 2002 because the Dutch railways sold its stock to British Telecom. In 2003 British Telecom sold O2 to Greenfield Capital Partners and this firm has chosen to use the name Telfort again in the Netherlands. KPN/Telfort as one firm is a market leader at this moment. KPN also offers fixed telephony, TV broadcasting, Mobile TV and fixed internet to end users. Figure 9 shows the market shares in terms of end users in the mobile telecommunications market of the different rivals over the past ten years.

**Vodafone** is the second MNO that entered the Dutch mobile telecommunications market. Its mission statement is:

> “Our Vision is to be the world’s mobile communication leader – enriching customers’ lives, helping individuals, businesses and communities be more connected in a mobile world” (Vodafone, 2008).
It entered the market as Libertel in 1995 when acquiring the second GSM-900 license. Vodafone was the winner of the beauty contest\(^9\) held in 1995 to introduce a competitor against KPN. Vodafone also acquired a GSM-1800 license in 1998 and a UMTS license in 2001. Libertel became Vodafone in 2001. Also, it was the first MNO to offer UMTS services to the customer in February 2004 with its Vodafone Live! services.

T-Mobile (2008) is the third MNO currently active in the Dutch mobile telecommunications market. Its mission statement is:

“As the most highly regarded Service Company we mobilize personal, social and business networking” T-Mobile 2008.

It entered the market in 1998 when obtaining five small GSM-1800 regional licenses. T-Mobile, under the name BEN was supported by Belgacom and TeleDenmark and later by Deutsche Telekom. In 2001 it obtained a UMTS license too. In 2003 Deutsche Telekom became the sole owner of Ben and therefore changed the name to T-Mobile. T-Mobile was one of the first to offer MMS services and one of the market leaders in offering WiFi hotspots access in the Netherlands (T-Mobile, 2008). In October 2007, T-Mobile bought Orange. Orange was a small MNO who also entered the market in 1998 in obtaining a GSM-1800 license. It was called Dutchtone and was owned by France Telecom and it changed its name to Orange in 2003 (Feldmann, 2003).

**MVNOs, SPs and retailers**

An MVNO is a mobile provider that offers mobile services over the network of MNOs. MVNOs lease network capacity from MNOs and use these to offer services to end users. There are MVNOs who have deals only with one MNO and there are independent MVNOs who have dealt with more MNOs at the same time.

To be called an MVNO, a firm should meet the condition having a direct relation between end users and MVNO, including issuing SIM-cards. This is also called **subscriber management** (Dool, Kuysten, & Geest, 2001) and. Next to this, MVNOs have network equipment to be able to exploit these parts of networks they lease. If MVNOs own more network equipment, they become less dependent on MNOs and this would strengthen their position to compete with MNOs (Theeuwes, Eijk, Felsö, Hinloopen, & Jaspers, 2001).

SPs and retailers operate on a lower level, as they buy minutes from MNOs to resale to end users. The main difference between SPs and retailers is the fact that SPs have contract management with end users, while retailers’ role end with the sale of the mobile telecom deal to end users (Dool, Kuysten, & Geest, 2001).

**Aspirant entrants:** Worldmax, Ziggo, UPC, Smile Telecom, and Tele2 (Mulder, 2008) and (SmileTele.com, 2008). Some of these aspirant entrants have already a technological specialization, like WiMAX. For example Worldmax is already competing on regional level. Cable companies are also expected to take a part in the 2.6 GHz auction to broaden their product arrangement. This is because of the trend toward convergence of services. Tele2 is one of the current MVNOs and has shown it interest in the 2.6 GHz auction in a newspaper article on its homepage. SmileTelecom has also announced to be interested in WiMAX on its homepage.

**BUYERS**

MVNOs and SPs are buyers from the wholesale market. End users are buyers for the retail market and they consist of private persons or businesses.

**SUPPLIERS**

When access to the spectrum is obtained, a network operator still needs a physical network to be able to exploit the spectrum. The suppliers of infrastructure are found in the antenna-sites market, which is more elaborated in the next chapter. This supplier group consists of three main parts: the MNOs themselves, firms that own of mast towers, and finally all owners of high buildings.

In the Netherlands, network operators have build their own physical networks consisting of antenna-sites and fixed network to connect the different sites. Antenna-sites are in two kinds; mast towers (higher than 5
Is it necessary to separate antenna-sites from the mobile network operators?

**The substitute technologies**

There are three potential technological substitutes for mobile telephony. These are, Wifi, WiMAX, and Fixed telephony. **Wifi** is generally more suitable transmitting data than voice. However, by using the VoIP protocol, one could use Wifi to make a phone call. Wifi hotspots are increasing in the Netherlands, however most mobile phones are not able to handle Wifi. Only Smartphones, PDAs, netbooks and notebooks are able to use Wifi. Mobile WiMAX (standard IEEE 802.16e) is a potential substitute technology that is possibly able to compete with the current GSM and UMTS standards. WiMAX is technically comparable to LTE and HSPA (Smura, 2006) and (Boogert, 2006) which are evolutionary technologies for UMTS. The business case of WiMAX is potentially successful. Fixed telephony are also potential substitutes for mobile voice services. This is only partly, because fixed services are only suitable for inside homes and offices. However, due to conversion, fixed services are becoming cheaper, which might influence the position of this technology against mobile technologies.

4.2 Market structure analysis of the MOBILE TELECOMMUNICATIONS MARKET

In this section, the Porter model of five forces is applied on the mobile telecommunications market. For each force, several indicators are examined and the conclusion will discuss the effect of these forces on the whole level of competition in this market.

4.2.1 Rivalry

Rivalry depends on several indicators that are shown in the figure on the right side of this paragraph (Porter, 1980). All these indicators will be discussed in this section.

**Market concentration**

Market concentration is an important factor to determine the level of rivalry in markets. Regulators all over the world use market concentration to determine whether it is needed to intervene in a market. This section examines the market concentration in the mobile telecommunications market.

**Number of competitors**

The market for mobile telecommunications is proven to be a difficult market to compete in, with two of the five operators not surviving the competition within a short time after obtaining the UMTS licenses. With the remaining three operators in power, the mobile telecommunications market is considered to be a highly concentrated market, which according to economic theories of free competition means that the level of competition is lower. If an industry is concentrated, the level of rivalry is low (Porter, 1980). Because all three players are involved in several sub-markets at different levels within the mobile telecommunication market, it is complicated to measure the intensity of competition. It is useful to take a look at the number of competitors at each level.

<table>
<thead>
<tr>
<th>Industry level</th>
<th>Firm character</th>
<th>Number of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network level</td>
<td>MNOs</td>
<td>3</td>
</tr>
<tr>
<td>Service level</td>
<td>MNOs/MVNOs/SPs</td>
<td>47 (Appendix 5)</td>
</tr>
<tr>
<td>Retail level</td>
<td>MNOs, MVNOs, SPs and retailers</td>
<td>&gt; &gt; 47</td>
</tr>
</tbody>
</table>

Conclusion: the number of competitors is low at network level. A low number of competitors mean a lower level of competition among MNOs. At service level, the number of firms is higher than at network level. This looks positive for the competition at this level, nevertheless, it is important to know that 37 of the 47 firms at service level have deals or are owned by KPN. So, the number of competitors does not tell the whole story. With the size distribution of the firms, the level of rivalry becomes clearer.
Size distribution

The data acquired in this section consists of the market shares of the MNOs in terms of numbers of subscribers (postpaid and prepaid) per MNOs. There was no data available about market shares of MVNOs and SPs. Therefore, in this paragraph the focus is only at the firms in network level (MNOs).

Size distribution is measured by the Herfindahl–Hirschman index (HHI). The HHI is a number between 0 and 10,000\(^{10}\) that is calculated by squaring the individual market shares of firms in the market and summing them up \(10000\sum S_i^2\). The higher the number, the more concentrated is a market; so, the HHI says something about market concentration. Competition authorities consider markets that have a HHI higher than 1800 as highly concentrated. The chance of the existence of a dominant market player is then higher for such markets (more about the HHI is found in chapter 2). The Dutch mobile telecommunication market has a HHI of about 3300 in the third quarter of 2008 (Telecompaper). Figure 7 shows where the Dutch mobile telecommunication market is on the scale of HHI.

<table>
<thead>
<tr>
<th></th>
<th>% number of subscribers</th>
<th>% of turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPN</td>
<td>45.9</td>
<td>45.8</td>
</tr>
<tr>
<td>Vodafone</td>
<td>21.8</td>
<td>29.4</td>
</tr>
<tr>
<td>T-Mobile</td>
<td>26.3</td>
<td>24.9</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 10: Market shares of MNOs 2008 Q3 | Telecompaper

The development of the HHI during the past ten years is done and shown in figure 8. Due to lack of data, are the years 2004 and 2006 missing in this figure. Figure 8 shows that the HHI is decreased over the past ten years, but it increased again in 2007 to the same level of 1999. This is probably due to the two mergers that occurred in this market after 2005 (KPN with Telfort and T-Mobile with Orange). The change in the individual market shares that led to a higher HHI after 2005 is shown in figure 9. This figure shows a remarkable increase in the market shares of KPN and T-Mobile after the mergers in 2005. T-Mobile’s market share increased by 77% after 2005 and KPN’s market share increased by 27% after the merger with Telfort in 2005.

\(^{10}\) This is the American notation. European economists use a number between 0 and 1. The difference lies in the notification of market shares. Nevertheless, we choose to use the American notation, because the NMA and OPTA use these in their reports too.
Is it necessary to separate antenna-sites from the mobile network operators?

Because none of the market rivals has a market share that is above 60%, competition authorities cannot interfere in this market (NMA - KPN/Telfort merger). Still, the size distribution looks quite negative for the competition level in this market. The chance that KPN acquires a dominant position is high, as figure 8 shows the great difference between the market shares of KPN compared to the other two MNOs.

**Industry growth**

Another factor to determine the intensity of competition is the rate of industry growth. According to Yankee Group (2006) the number of voice connections is stabilizing in most of the EU counties and also in The Netherlands. The number of minutes in phone calls, together with data traffic is increasing; however the prices/turnover is decreasing, which shows signs of maturity of the industry. However the data use for purposes like mobile internet is still is a young status. Because of the maturity of industry, the interviewed actors have witnessed a movement of the focus of business activities.

The products of the mobile telecommunications market can be divided into two categories: voice and non-voice services. For each of these products the market situation differs. While the voice market is a mature market with a penetration rate of 120% (figure 6), the non-voice market is still growing making up 26% (calculation of data from telecom paper report for Q2 2008) of the total market revenues.

**Product differentiation**

Products sold from MNOs to MVNOs and SPs consists mainly of access to the network of the MNOs or of minutes that can be resold to end users. These are the wholesale products (categorization by the OPTA). Product differentiation is low at this level of products, which makes rivalry higher.

The products offered to the end users, at the other hand, can be divided into voice services and non-voice services. Voice services include postpaid and prepaid packages, these could include a mobile device or not. For end users the products are similar and therefore competition at this level is mainly based on price. Firms at this level (MNOs and MVNOs/SPs) compete with each other to sell similar products to end users. The lack of products differentiation increases the rivalry level.

**Asset specificity and Exit barriers**

The asset specificity in the mobile telecom sector is high, not only because of the large investments in frequency licenses, and infrastructure, making exit an expensive activity. But the fact that these assets are only usable for mobile communication makes them specific assets. At consumer level, though, there are no specific or highly expensive assets involved, because MVNOs buy access to the network from the larger companies.

The mobile telecommunication industry is also characterized by high exit barriers; Exit barriers lead to more intensive competition, because firms tend to continue competing with each other even though they suffer from low earnings and this effects the profitability of the “healthy firms” negatively (Porter, 1980).

**Homogeneity of strategies of rivals**

The homogeneity of strategies of rivals plays a crucial role in how far the firms tend to behave in the same way, according to Porter (1992). The hypothesis here is, the higher homogeneity of strategies of rivals, the lower is rivalry Porter (1992). The three rivals, KPN, Vodafone and T-Mobile all offer products on two levels of the market; the wholesale level and retail level. On wholesale level, they offer access to their network to MVNOs and SPs. On retail level, they offer mobile voice and non-voice services to end users.

Though the product differentiation is low, the strategies of rivals differ on both levels. On wholesale level, KPN has deals with 37 MVNOs and SPs (including own brands and SPs) (Appendix 5). Vodafone has deals with 6 and T-Mobile has deals with 5 (Appendix 5). SPs have a different market segment and different target group. In this case, KPN has more market segments than Vodafone and T-Mobile, and tries to react to the different demands of its customers. All three rivals have more postpaid then prepaid customers according to Telecompaper. On retail levels, competition is more fierce, because, the SPs and MVNOs compete with the MNOs to sale minutes to end users.

KPN has the advantage of economies of scope because it has its background in fixed telephony. Also, KPN offers ADSL for homes and businesses in the Netherlands. KPN is able to spread its fixed costs among the different business activities within KPN.
The MNOs in this market differ from each other. The differences lay between the former state monopolists (KPN) and the other two MNOs (Vodafone and T-Mobile). The differences are not extremely large, so one can conclude that the homogeneity of firms is medium, which means that it does not affect rivalry negatively nor positively.

**Changing conditions of supply and demand**
The variability of demand requires flexibility by the industry players, even if it is regarding a cyclical demand (Oster, 1999). In the Dutch mobile telecommunications market, the demand by end users is stabilizing (Yankee Group, 2006), which gives an indication of decreased rivalry. At the supply side, though, the Dutch mobile telecommunications market is experiencing uncertain times with the 2.6 GHz frequencies auction at the door (more about this subject in section 6.1). Fluctuations at the supply side cause additional uncertainty, which increases the rivalry by making coordination uneasy to maintain among the industry firms.

**Summary of rivalry**
It is better to split the analysis into two levels, the wholesale level and the retail level. There are seven factors examined to determine the intensity of competition, for each of these factors the two market levels (wholesale and retail) are taken into account.

Table 11: Rivalry in the mobile telecommunications market

<table>
<thead>
<tr>
<th></th>
<th>Wholesale market</th>
<th>Retail market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market concentration</td>
<td>High</td>
<td>medium</td>
</tr>
<tr>
<td>Industry growth</td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td>Product differentiation</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Asset specificity and exit barriers</td>
<td>High</td>
<td>Low to medium</td>
</tr>
<tr>
<td>Homogeneity of strategies of rivals</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Changing supply and demand</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Following from this table, it seems that the mobile telecommunications industry has reduced rivalry at wholesale market level while the retail market level is characterized by more intense competition. At the wholesale market, rivalry is low because of the high market concentration (HHI = 3300 and low number of rivals) and the high exit barriers due to asset specificity. This low rivalry however, is balanced by the low product differentiation and the stability of demand (mainly voice).

**4.2.2 Threat of entry**
In chapter 3 a discussion was made about the characteristics of infrastructure-based markets that raise the need of government intervention. Almost all these characteristics result in higher barriers to entry. Porter’s barriers to entry might overlap with the characteristics of infrastructure-based markets.

Entry to an industry is one of the most important factors to increase and sustain a competition. Porter (1992), divides the barriers to entry into three categories: expectation about the reaction of incumbents to entry, sources of incumbent advantage and government policy. The figure on the right side of the page shows which factors belong to what category.

**Expectation about the reaction of incumbents to entry**
Expectations of entrants are depended on the small amount of information provided about the incumbents. This section is divided into three sub sections that all form a general idea of what an entrant might expect in this market.
Is it necessary to separate antenna-sites from the mobile network operators?

“This risk of losing unrecoverable entry costs, as perceived by a potential entrant, can be increased by the threat (or the imagined threat) of retaliatory strategic or tactical responses of the incumbent.” (Baumol & Willig, 1981, p. 418)

Capital requirements
As earlier discussed, the mobile telecommunication industry is characterized by specific assets, which is mainly the network infrastructure that is not usable in other markets except this one. In general, specific assets enable firms to serve their market and also to predict easily the threat of entry. It also increases commitment to the market by incumbent firms in order to protect these assets and therefore, it reduces the attractiveness of the industry for entry.

Economies of scale
Economies of scale discourage entry by forcing the aspirant firm to come in large scale or to suffer disadvantage (Porter, 1980). Economies of scale technically mean that the cost per unit decreases as the number of units increase. The unit in this industry would be call minutes or data traffic to the end user. The mobile telecommunication sector is characterized by economies of scale, due to the high fixed costs, which are the costs of acquiring, building and maintain the infrastructure, and the high sunk costs that firms loose in acquiring the license for spectrum use. Furthermore, both of these costs would force an entrant to high starting costs that could discourage firms from entering the market.

Reputation of the incumbents
Finally, reputation effects of the incumbent firms have influence on the expectation by the entrants. The Dutch mobile industry has a reputation of anti-competitive behavior at some occasions in the past. An example is the reaction of Telfort to Versatel, a potential entrant at the time, during the UMTS auction in 2000 (Klemperer, 2002). Versatel (a small telecom firm) tried to enter the mobile telecommunications market in 2000 and said the following in a news article “Versatel disappointed with Dutch UMTS auction tomorrow” in July 2000:

“given the nature of the auction as it stands today, we doubt businesses or consumers will be allowed an alternative to the incumbent providers. Versatel fears it is defining the success of failure of the auction. We would however not like to see that we end up with nothing whilst other players get their licenses for free. Versatel invites the incumbent mobile operators to immediately start negotiations for access to their existing 2G networks as well as entry to the 3G market either as a part owner of a license or as a Mobile Virtual Network Operator” (Damme, Het spel van Versatel, 2000).

As a reaction, Telfort snet the following to Versatel:

“Expert opinion indicates to Telfort that you will soon reach a bid level that is not in the interest of your company and its shareholders (...) Telfort is of the opinion that the only conceivable reason why Versatel would place a bid at or above such level is that your company believes that its bids will always be surpassed by bids of the other participants in the auction (...) As a result the ulterior motive for such a bid must be that Versatel is attempting to raise its competitors’ cost or to gain access to their 2G or 3G networks. Versatel’s own press release of July 5 even appears to link its behavior in the auction to gaining concessions from other participants (...) A bid strategy with such a motive constitutes a tort towards Telfort, who will hold Versatel liable for all damages as a result of this (...) To conclude, Telfort intends to treat the matter as strictly confidential in the interest of the proper course of the auction” (Damme, Het spel van Versatel, 2000).

Versatel interpreted this letter as a threat and withdraw from the UMTS auction. Due to such incidents, a new entrant might be discouraged to enter the market now.

11 pre-paid or subscription
Sources of incumbent advantage

This section discusses possible incumbent advantages in the Dutch mobile telecommunications market. Incumbent advantage might be there due to learning curves, better access to distribution channels or brand loyalty.

The Dutch mobile telecommunications market is characterized by early mover advantage (Bijwaard, Janssen, & Maasland, 2008). Market shares of incumbents that entered the mobile telecommunications market when penetration rates were low are still higher than those who entered the market later. Bijwaard, Janssen, & Maasland (2008) used the HHI and the concentration of the market to empirically test the advantage by penetration rate and market share of the incumbents across Europe vis-à-vis the later entrants. The reasons for this incumbent advantage were not mentioned in his research though. This may lie in the fact that capital intensive sectors are characterized by having a learning curve. There is also connection found between high economies of scale and the existence of learning curves (Oster, 1999). Although it is not sure whether there is a learning curve in the mobile telecommunications market, one could assume that because of the existence of economies of scale in this industry, a learning curve should also exist here.

Another incumbent advantage is the fact that MNOs possess a complete national network of infrastructure. They entered the market when public resistance was still low (Dommering, 2003). New entrants will probably face a more difficult time in building a new network of infrastructure.

Government policy

The frequency license, which is allocated through auction by the government, forms the most important barrier to entry in the mobile telecommunication sector. In other words, government policy forms a barrier to entry in this case. On wholesale level, a firm would not be able to build up a wireless network for mobile communication without a license and therefore it is virtually impossible for an entrant to enter the market without a license. Licensing gives firms a monopoly to exploit the frequency for a fixed period of time and therefore it creates asymmetry within the industry between holders (incumbents) and non-holders. In theory, the frequencies will be auctioned again when the license expires, in practice, this is not occurred yet. These licenses have proven to be expensive, as seen with the UMTS auctions in The Netherlands where a total of 2.6 billion euro has been spent, and the 2.6 GHz auction in Sweden where about EUR 12 billion has been the revenue for the government as a result of this auction. Moreover, licensing stimulates rent-seeking behavior with incumbents spending resources just to secure their position in the market.

Summary of the threat of entry

There are six possible barriers to entry examined in this paragraph. If the barriers to entry are high, the threat of potential entrants will lower down. Threat of potential entrants is an important measure for competition.

| Table 12: Threat of entry in the mobile telecommunications market |
|-----------------|-----------------|-----------------|
| Wholesale market | Retail market |
| Expectation about the reaction of incumbents to entry | Not positive for the potential entry | Neutral to the potential entrant |
| Sources of incumbent advantage | High, because of learn curves and other early market advantage | Medium, the reputation to the consumer is important |
| Government policy | Negative, spectrum access forms a high barrier | Positive for potential MVNOs and SPs, network operators are encouraged (sometimes obliged) to share (part of) their networks |
| Total | Low | Medium |

4.2.3 Bargaining power of the suppliers

The main hypothesis of this force is that if the bargaining power of the supplier increases, the pressure on the firms in the market will increase and therefore the competition level in the market too. There will be four indicators of the power of supplier discussed in this section as shown in the table on the right side of this page.
Supplier concentration
All MNOs own a large part of the infrastructure (antenna-sites), which makes them a supplier for each other. There are only two (known) firms that supply mast towers, these suppliers have less mast towers than the MNOs together. This means that the supplier concentration versus the firm concentration is low.

Product differentiation
The infrastructure on the other hand is more differentiated. The technology of antennas does not differ. The main differentiation here would be the location of an antenna-site. Antenna-sites are divided into two categories, mast towers and rooftops. Mast towers are more difficult to obtain than rooftops, due to regulation in building permits. Especially mast towers in rural areas, where there are no high buildings, are most desired by operators, because in rural areas there are not many high building to build antenna-sites on. Network equipments are mostly standard products too.

Threat of forward integration
There is low threat to forward integration from the suppliers of network equipments or antenna-sites. These firms have a core business values that do not include offering mobile communications. When it comes to the retail market, MNOs are the supplier here and they are already vertically integrated into the retail market.

SUMMARY OF THE BARGAINING POWER OF SUPPLIERS
The power of suppliers to MNOs (wholesale market) is low in general, because of the vertical integration between MNOs and the antenna-sites market. If one assumes the Dutch government as ‘supplier’ of spectrum, then this would be the only supplier with very high power. Only, the role of the government is discussed in the threat to entry section (31), so it is not considered here. Table 13 shows the details of the power of suppliers.

<table>
<thead>
<tr>
<th></th>
<th>Wholesale market</th>
<th>Retail market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier concentration</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Product differentiation</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Threat of forward integration</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Total</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

When it comes to the retail market, MNOs themselves are suppliers here to MVNOs and SPs. In this market MNOs (as suppliers) are more powerful than MVNOs, because they provide an essential product for the business of MVNOs and SPs. Moreover, the concentration of the MNO market is much higher than that of MVNOs and SPs market. So, this is why the power here is high.

4.2.4 BARGAINING POWER OF THE BUYERS
The buyers of MNOs can be divided into two categories: MVNOs / SPs (buyers of the wholesale market) and end users (buyers of the retail market). The indicators as defined by Porter (1980) are shown in the table here beside. These indicators are divided in two categories, Negotiating leverage and Price sensitivity.

Negotiating leverage
The negotiating leverage is an important indicator for the bargaining power of the buyers. If buyers have a high negotiating leverage, they could pressure the rivals in the market to, for example, produce efficiently or lower prices. The negotiating leverage of the buyers studied in this section consists of the: buyer

---

12 The categorization in antenna-sites is explained in detail in chapter 5.
concentration versus the firms concentration of the industry, product differentiation, the buyers’ switching costs, and the ability of buyers to backward integration.

**Buyer concentration versus firm concentration**

There are about 24 MVNOs and 23 SPs (Appendix 5) buying wholesale products (*access to the network* and *minutes*) from three MNOs. The buyer concentration comparing to the MNO concentration is rather low. When it comes to the end users as buyers of the retail products, the end users concentration is much lower than that of wholesale buyers.

**Product differentiation**

The wholesale products offered to MVNOs and SPs are quite standard products. The retail products offered to end users, however, have slightly product differentiation. The product differentiating here consists of the package deals (the combination of minutes and a mobile device) that differ among the different providers. There is also clear segmentation between deals for private end users and deals for business end users (Appendix 5).

**Switching costs**

Switching costs for wholesale buyers are higher than these of end users. Independent MVNOs and SPs make long term commitment with MNOs. Nevertheless, NMA (2005) mentioned that MVNOs are able to switch between networks:

> “Out of a market research among MNOs and MVNOs, it became clear that switching is an actual possibility despite of the switching costs involved” (NMA, 2005).

**Ability for backward integration**

There is a significant chance to backward integration of MVNOs to MNOs. MVNOs already own a small part of the physical network. With the soon following 2.6 GHz auction in the Netherlands, MVNOs have a chance to enter the MNO market (Stratix, 2007). End users do not form a threat to backward integration to the MVNO and SP market.

**Price sensitivity**

The product *access to the network* is the almost the most important part of the MVNOs business. Therefore, the MVNO’s power to bargain is low here. SPs are also dependent of the MNOs product *minutes*. The market of mobile services to end users has become more transparent in the last few years. Also, number portability is now obliged by the OPTA and subscriber’s contracts are never longer than two years (private end users). The power of end users in this market has increased, but still the end users in this market have substantially lower bargaining power comparing to the MNOs.

**Summary of the power of buyers**

The total power of buyers in the wholesale market is medium, because of the existence of independent MVNOs and SPs. MVNOs and SPs have a known brand name and could influence competition if they would switch of providers. Also, Tele2 (an MVNO) announced recently to be interested to become an MNO buy bidding in the 2.6 GHz auction (see section 6.1), which enlarges the threat of backward integration. In the retail market, the power of buyer is low, mainly because of the low concentration of end users comparing to providers.

<table>
<thead>
<tr>
<th></th>
<th>Wholesale market</th>
<th>Retail market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negotiating leverage</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Price sensitivity</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Total power of buyer</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>

Table 14: Bargaining Power of buyer in the mobile telecommunications market
4.2.5 Threat of substitute technologies

There are two kinds of mobile services offered to end users of this market; voice services and non-voice services. GSM and UMTS are the dominant technologies for voice services. Mobile devices choose the suitable technology to use dependent of the availability of the network at the time. The dominant technology used for non-voice services is UMTS and in less matter GPRS. Transmitting data over GPRS is slower than UMTS. The main potential substitute technologies for voice services are WiFi, WiMAX and fixed telephony. For non-voice services, the main potential substitute technologies are WiFi and WiMAX. All these technologies are explained at the beginning of this chapter.

Buyer switching costs

End users that desire to switch from GSM/UMTS to WiFi or WiMAX need to have a mobile device that can cope with these technologies. WiFi devices (Smartphone and PDAs) are available in the Netherlands, but mostly more expensive than regular mobile phones. Netbooks and notebooks are more suitable for business end users and not for private use. These are larger devices that are less mobile than phones. Mobile phones that are suitable for WiMAX are not available yet in the Netherlands.

Buyer propensity to substitute

Research done by order of the Ministry of Economic Affairs shows those end users younger than 30 expect to use internet on their mobile devices within two years. The report, however, does not specify which technology will be used. It is not known yet whether users will be willing to substitute. The buyers’ willingness to substitute with WiFi is depended on the availability of WiFi hotspots and mobile devices that are able to communicate using WiFi. This is not the case yet in the Netherlands, making WiFi a less serious threat as a substitute.

According to ‘Free Novation’ when the WiMAX market matures, the price of WiMAX will be lower than UMTS and the speed will be higher (Boogert, 2006). At that point, end users are expected to be willing to substitute. However, this point will take long years (Boogert, 2006), so at the moment, WiMAX is not a serious threat to substitute GSM and UMTS. Its main difficulty is facing the first mover advantage of LTE (Long Term Evolution). The current mobile network operators are expected to upgrade their networks using LTE in the future, because this technology is applicable on the current antenna infrastructure they already have. WiMAX operators do not have a full operative infrastructure network yet.

Perceived level of product differentiation

If mobile devices would work on all technologies, end users are not expected to perceive differences. This is, however, not the case yet and end users will have to take this into account when acquiring a new mobile device. Most mobile devices still work only on GSM and UMTS, so substitution will be made easy if mobile device manufacturers would allow different standards on their devices.

Summary of the threat to substitute

All discussed substitutes do not form a serious threat to the current technologies. WiMAX is still to be rolled out in the Netherlands. WiFi is still too expensive to use and have high switching costs because of the devices. Fixed telecommunication is cheaper, but it is not mobile. Therefore, it can only be a substitute inside homes and offices. The summary is displayed in table 15.

<table>
<thead>
<tr>
<th>Threat of substitute technologies</th>
<th>WiFi</th>
<th>WiMAX</th>
<th>Fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buyer switching costs</td>
<td>Still high</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Buyers propensity to substitute</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Perceived level of product differentiation</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Total threat of substitution</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>
4.2.6 SUMMARY OF THE MARKET STRUCTURE ANALYSIS

In this chapter, two submarkets of the mobile telecommunications market are analyzed using the Porter five forces model. The analysis shows that the competition level of the wholesale market\(^\text{13}\) is low compared with the MVNO/SP market\(^\text{14}\). The rivalry level is low because of the high market concentration. The threat to entry is low because of the high barriers to entry consisting of regulated access to the spectrum (frequency license). Incumbent advantage is high in this market due to the high penetration rate and economies of scale in the roll out of mobile networks. The chance that new firms will enter the market is exciting due to the expected 2.6 GHz auction (more about this in chapter 6). However, new entrants will have to roll out their network first to form a real threat to the incumbent firms. Looking at the progress of the entrants after 1999 compared to the incumbents that were in the market before 1999 (figure 9) The market shares of T-Mobile (Ben in 1999) became larger than that of Vodafone (Libertel in 1999) in about eight years. Maybe the new entrants will take a shorter time to accomplish this. Nevertheless, they are not expected to be able to do that within a year. This is why, the overall threat to entry is still judged as low in this study. The bargaining power of the suppliers is low because of MNOs own most of the physical infrastructure. The bargaining power of the buyers is medium because of the threat of backward integration of MVNOs. This threat is notable because of the 2.6 GHz auction that is expected to allocate new licenses to MVNOs, among others. The threat of substitute technologies is low too. This is because the expected long time to roll out a network of new technologies. The results of the Porter analysis are shown in the table here below:

<table>
<thead>
<tr>
<th></th>
<th>Wholesale market</th>
<th>Retail market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivalry</td>
<td>medium</td>
<td>High</td>
</tr>
<tr>
<td>Threat to entry</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Bargaining power of suppliers</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Bargaining power of buyers</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Threat of substitute technologies</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Total competition level</strong></td>
<td>Low to medium</td>
<td>Medium to high</td>
</tr>
</tbody>
</table>

Porter’s model states that the lower a force is, the lower is competition in the market under study. As table 16 shows, none of the five forces at the MNO market (left column) are high. This means that the competition level is low in this market.

4.3 Conclusion of the case study (mobile telecommunications market)

In this chapter, the mobile telecommunications market is analyzed using mainly the Porter five forces analysis. The analysis took two levels of the mobile telecommunications market into account, the wholesale level and the retail level.

3. In what competition level does the mobile telecommunications market finds itself and what competition issues (for regulation) does this market raise?
   A. What are the main characteristics of the mobile telecommunications market?
   B. In what competition level is the mobile telecommunications market according to the Porter’s model?

The mobile telecommunications market is shown to be a dynamic market that has changed dramatically over the past ten years. There was fast growth in the penetration rates and the entry of new MNOs and MVNOs has improved the competition. However, over the past few years, consolidation has been taking place resulting in high market concentration at the wholesale market. This fact combined with the high barriers to entry (spectrum access, asset specificity, and earlier mover advantage) raises concerns with the competition in this market. The competition level as found in the conducted market analysis shows that the

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\(^{13}\) This is the market where MNOs (network level) sale network access or minutes to MVNOs and SPs (service level).

\(^{14}\) The market of MVNOs and SPs is the market where MVNOs, SPs and MNOs (service level) compete with each other to sale subscriptions to consumers (retail level)
wholesale level of the market is the most worrying with low to medium competition level. To sum up, the following competition issues are found at the wholesale level market:

- Market concentration
- Vertical integration with the supplier market
- Government policy concerning spectrum allocation
- Large investments (spectrum)
- Overall incumbent advantage

The competition in the retail market is found to be medium to high. This market can be seen as a pressuring buyer market of the wholesale market. Nevertheless, one must not forget that access to the network is still a main necessity for this market to be able to function. This, thus, weaken the position of the retail market comparing to the wholesale market.

In the following chapter, competition on the infrastructure is studied by analyzing the antenna-sites market. In the conclusion chapter these two case studies will be interpreted together.
In this chapter, the antenna-site market is analyzed using Porter’s model. The goal is to gain insight in the level of competition of this market by answering the following question:

4. What is the competition level of the antenna-sites market according to Porter’s analysis and how might this influence the mobile telecommunications market?
   A. What are the main characteristics of the antenna-sites market?
   B. In what competition level is the mast towers market according to Porter’s model?
   C. In what competition level is the rooftops market according to Porter’s model?
   D. What competition issues do these markets raise for the mobile telecommunications market?

The antenna-sites discussed in this chapter are those one especially built for mobile telecommunications, using GSM, GPRS, UMTS, HSDPA, and in the future WiMAX. There are other types of antennas, like C2000 (for ambulance and police systems) and radio/TV broadcasting antennas. These types will not be taken into account in this thesis.

Building permit conditions distinguishes three kinds of antenna-sites based on the height of the site that must be built (table 17). The height of the antenna-site is measured from the point it is built on, this means that antenna-sites that are themselves smaller than five meter, but are built on a building higher than five meter would still not need a building permit.

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
<th>Construction Regulations</th>
<th>Sit-sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 m</td>
<td>Each mast on a high building</td>
<td>Only approval of building inhabitants needed</td>
<td>Not obliged</td>
</tr>
<tr>
<td>5-40 m</td>
<td>Mast towers</td>
<td>Light building permit</td>
<td>Obliged by law</td>
</tr>
<tr>
<td>&gt; 40 m</td>
<td>larger mast towers (Radio/TV)</td>
<td>Fully building permit</td>
<td>Obliged by law</td>
</tr>
</tbody>
</table>

The analysis will distinguish only between antenna-sites lower or higher than five meter. Due to the different permit regulations, building antenna-sites lower than five meter has became much easier than building of antenna-sites higher than five meter. This changes the position of different actors in this market. Moreover, site-sharing obligation also differs here, and that makes the position of mast owners different than rooftops owners for example. For the readability of this chapter, antenna-sites lower than
Is it necessary to separate antenna-sites from the mobile network operators?

five meter will be referred to as rooftops and antenna-sites higher than five meter will be referred to as mast towers. In this chapter, the distinction between rooftops and mast towers is made by analyzing each of these types separately. So, there will be two Porter analyses, the first for mast towers market and the second for the rooftops market.

5.1 Quick scan of the antenna-sites market

The spread of antenna-sites is not merely a technical problem of the operators anymore, but a societal issue that concerns many different stakeholders. Especially after the UMTS auction in 2001 this issue became relevant (Bongers, et al., 2006). Together with the growth of mobile phone use by end users, the anxiety toward growth of antennas in The Netherlands (and the rest of Europe) began to grow. In this section, the main facts and figures known about antennas, the main events in the Netherlands and most important policies and actors are discussed.

5.1.1 Facts and figures

Figure 10 shows the progress of the number antennas since 2002. In 2002 the roll out UMTS networks began to take place in the Netherlands. During this roll out, the number of UMTS antennas increased, replacing a part of the established GSM 900 and GSM 1800 antennas. Mind you, the numbers shown in figure 10 are the numbers of antenna installations in the Netherlands. The number of antenna-sites however, differs from the number of antenna installations. One antenna installation is defined by the antennebureau as: the combination of three sub-antennas that each covers 120 degrees (3 x 120 = 360 degrees) and the accompanying equipment to connect the antenna with the fixed network.

5.1.2 Important antenna policies

In this section two of the most relevant policies regarding competition and antenna-sites are explained. The first is designed to regulate site-sharing for antenna-sites higher than five meter and the second regards regulating antenna-sites smaller than five meter.

Article 3.11 of the Telecommunication Act

This article is created due to a dispute between radio and TV broadcasting firms (Nozema versus KPN Broadcasting, 2008). Article 3.11 of the Telecommunications Act obliged owners of mast towers (antenna-sites higher than five meter) to share their antenna-sites according to the cost price (private communications).

The antenna covenant

The antenna covenant was created in 2002 to manage site building of for antenna-sites lower than five meter. Antenna-sites lower than five meter do not need a building permit, the antenna covenant provides guidelines for both network operators as building owners and habitants.

There are eight stakeholders that signed the antenna covenant; these are the Ministry of Economic Affairs (EZ), the Ministry of Housing, Spatial Planning and the Environment (VROM), Association of Netherlands Municipalities (VNG) and the mobile network operators (MNOS), KPN/Telfort, Vodafone, and T-Mobile/Orange).

The main conditions of the antenna covenant are:
1. **Radio and antenna planning:** This condition obliges the MNOs to provide each municipality of an antenna plan where the MNO explains whether it is planning to place an antenna, the necessity of placing that antenna on a certain building.

2. **Visual adaption:** To prevent spatial pollution of antennas, municipalities are allowed to demand certain colors and shapes of antennas and other visible network equipment to fit into the space where an antenna is placed. This is also regulated in the Housing Act (woningwet).

3. **Approval procedure:** In rental housing, approval is needed of at least 50% of the inhabitants of the building when an antenna needs to be placed on the roof of the building. The approval procedure should be managed by an independent bureau and not by the MNO itself. Only two approval procedures are allowed per building a year.

4. **Exposure limits:** exposure limits as recommended by the European Commission guidelines for electromagnetic fields are not to be crossed in freely accessible areas.

### 5.1.3 Main actors

There are three major groups of rivals in the mast’s market based on firm type: MNOs, antenna firms and government institutions.

Originally the infrastructure for all telecommunication was integrated in the same organization that offers the services to the end users. This was, and is still for a large part, also the case in the mobile telecommunications market. This is why the mobile network operators are also competitors in this market.

<table>
<thead>
<tr>
<th>Table 18: Actor list in the antenna-sites market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market rivals</strong></td>
</tr>
<tr>
<td><strong>Antenna tower market</strong></td>
</tr>
<tr>
<td><strong>Antenna firms:</strong> (Novec, Alticom)</td>
</tr>
<tr>
<td><strong>Governments:</strong> Directorate-General for Public Works and Water Management, Ministry of Internal Affairs, Ministry of Defense</td>
</tr>
<tr>
<td><strong>Rooftops Market</strong></td>
</tr>
<tr>
<td><strong>Social housing cooperation’s</strong></td>
</tr>
<tr>
<td><strong>High building owners</strong></td>
</tr>
</tbody>
</table>

Antenna-sites have been an issue for different actors in the 1990s. All institutions involved tried to inform the public to reform the misconceptions about antenna-sites.

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15 KPN claims to have 4543 2.5G and 2729 3G sites (not known if this is rooftops or mast towers and where GSM and UMTS antennas on one location are counted as separate sites), (KPN, Annual Report and Form 20-F 2007, 2007)
Antenna firms are the firms that own infrastructure and rent these to MNOs. These firms own high mast towers that were meant for other purposes like electricity or Radio/TV broadcasting. These mast towers can also be used as antenna-sites for the mobile telecommunications market. This is why these firms are competitors in this market. There are two firms currently active in this area, which are NOVEC B.V. and Alticom TDF. NOVEC is established as an infrastructure management firm due to separating the service from the antenna-sites in the radio/TV broadcasting market (Arrest Nozemla Services N.V. vs. Broadcast NewCo Two B.V. (LJN: BD1064), 2008). Recently, NOVEC has 110 masts that used to belong to Telfort (NOVEC website). Alticom manages electricity masts and lease some locations to MNOs. Alticom has control over only 35 masts (website Alticom). Finally government institutions are also competitors in the antenna-sites market, because several ministries own mast towers. These mast towers are for alarm, police communications or defense purposes. Also these mast towers can be used as antenna-sites for the mobile telecommunications market by sharing them with MNOs (more antennas can be situated on one mast tower).

5.2 Market structure analysis of the MAST TOWERS MARKET

In this section, the mast tower market is analyzed using the Porter five forces model. The Porter analysis is slightly adapted to the case of this market. In order to delimit the research it is chosen to consider the antenna-sites market (including the mast towers market) as the supplier for the mobile telecommunication rivals. Therefore, the bargaining power of suppliers is not dealt with in this section.

5.2.1 Rivalry

For Rivalry and intensity of competition, Porter (1980) defined the following indicators: market concentration, industry growth, homogeneity of strategy of firms, asset specificity and changing supply and demand. Each of these indicators will be discussed for mast towers market.

Market concentration

In this section, market concentration is measured by using the number of competitors in the mast towers market and the size distribution. Size distribution is usually measured by comparing the market shares of different competitors in the market. In this section, market shares in terms of the number of mast towers are used to determine the size distribution.

Number of competitors

As shown in table 18 earlier in this chapter, there are three groups of rivals in the mast towers market. These three groups contain eight major rivals in this market, three mobile network operators (MNOs) who have built their own mast towers, two main antenna firms who build and lease antenna towers to MNOs and three ministries that own mast towers for defense and other communication services. The number of competitors is not high enough to speak of a perfect competition where many firms should exist (Section 2.1 and appendix 3 explain more about perfect competition). Nevertheless, competition between these competitors may still exist and also contestability might still be there if barriers to entry and exit are low.

Size distribution

The antenna-sites market is not defined as a relevant market by the recommendations of the European Commission (2003), which is why market shares in this market are not monitored by the OPTA. The number of mast towers owned by the different rivals is also a way to study size distribution. However, this information is considered sensitive information for the MNOs and therefore it is difficult to judge this issue accurately.

\[16\] There are other smaller firms in this market, but they do not count here because they own a very low number of antenna towers.
Industry growth
The demand for antenna-sites might increase despite the consolidation in the mobile telecommunications market. This is because the need for more bandwidth is expected to increase, as more data services, like email, internet, and mobile TV are being used by consumers. A mobile network consists of a number of base stations each covering a certain geographical area, this is called a cell. Each cell serves a number of users with limited bandwidth. If the number of users and their data traffic increases, users have to share the available bandwidth within a cell. A way to solve this problem is decrease the size of a cell resulting in the coverage of a smaller geographical area. This means that fewer users will use the same available bandwidth resulting in a higher bit rate per user. This is shown in figure 11 here below. For each cell, an operator needs an antenna, and this would result in a larger number of antennas.

Product differentiation
The location of a mast tower is the most important product differentiation. Mast towers in rural areas are valuable, because in such areas there are no high buildings to build antenna-sites on. Building mast towers requires a building permit from the municipality of the town where it is build. So, it would save providers the trouble of obtaining a building permit to build their own mast and they would then try to lease an antenna-site in this mast. Concluding, one could say, there is a considerable product differentiation.

Asset specificity and exit barriers
The asset specificity in this market is high, because the cost of building a mast tower is high. Moreover, a building permit from the local government is needed before a mast is build. These permits are said (interviews) hard to get from, and even near impossible in some small villages. Finally mast towers that are especially built for mobile telecommunications cannot be used in other sectors than the mobile telecommunications. If a firm exits this market it could sell its mast towers to one of the other rivals or the mast towers have to be destroyed. The asset specificity increases the exit costs in this market.

Homogeneity of strategies of rivals
As earlier explained, there are three groups of rivals based on firm type; MNOs, antenna firms (NOVEC and Alticom) and government institutions. These three groups each have different business origin; the MNOs’ core business is to provide mobile communication to end users. This means that building mast towers is a necessity and not a core business. Antenna firms build and manage mast towers as core business with the goal to provide MNOs with national mobile coverage. Finally government institutions build mast towers to provide citizen service (ambulance, defense, etc.).

Changing supply and demand
Although the mobile communications are expected to increase and with it the number of antennas needed might increase as well, the mast towers market is still considered a relatively stable market. To build new mast towers and increase the supply side, a building permit is needed. Building permits tend to have long execution time making this market a less dynamic market over all. Municipalities prefer to avoid building new mast towers (Gemeente Twenterand, 2004) because they ruin the view and thus the appearance of their cities landscape.
**SUMMARY OF RIVALRY OF THE MAST TOWERS MARKET**

This section summarizes the indicators examined to determine the level of rivalry in the mast towers market. Besides, it evaluates each of the examined indicators and provides a sub conclusion about the rivalry in this mast towers market.

The market concentration is considered high in this market, because the limited number of firms active in this market. The industry growth is evaluated medium, because although the number of mobile communications is expected to increase in the near future, and with it the number of antennas it is not expected that the number of mast towers will increase. Still, because owners of mast towers are obliged to share their sites, it is possible that there will be no need to build new mast towers. The asset specificity and mast towers require heavy investment of resources and are not flexible to be used in other markets than mobile communication (including Radio/TV), which increases the exit barriers in this market. The homogeneity of firms as also evaluated as medium. Firms in this market have slightly different strategies because the background and the characteristics of these firms. MNOs are expected to coordinate their activities in this market in order to serve their mobile services activities, while antenna management firms are solely active in this market and have main strategies to serve the MNOs needs for better locations, and better radio planning. The changing supply and demand are both regarded as high.

High market concentration and medium industry growth are considered to reduce rivalry. While medium homogeneity of firms, high asset specificity, and the changing supply and demand enhance competition in general. To sum up, table 19 shows the strength each indicator examined to evaluate rivalry this market. The left column shows each of the discussed factors that have influence on the level of rivalry in the mast tower market. The right column shows the strength of the factor studied.

### Table 19: Rivalry in the mast towers market

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market concentration</td>
<td>High</td>
</tr>
<tr>
<td>Industry growth</td>
<td>Medium</td>
</tr>
<tr>
<td>Asset specificity and exit barriers</td>
<td>High</td>
</tr>
<tr>
<td>Homogeneity of firms</td>
<td>Medium</td>
</tr>
<tr>
<td>Changing supply and demand</td>
<td>High</td>
</tr>
<tr>
<td><strong>Total rivalry</strong></td>
<td><strong>Medium</strong></td>
</tr>
</tbody>
</table>

5.2.2  **THREAT OF ENTRY**

In this section, the threat to entry to the mast towers market is discussed. The threat to entry is divided in three categories: *Expectation about the reaction of incumbents to entry*, *Sources of incumbent advantage* and *Government Policy*. Each of these categories has several indicators as shown in the figure on the right of this page. Next to these categories, *Public Opinion* is added, because the importance of public opinion in the field of antenna-sites.

*Expectation about the reaction of incumbents to entry*

Specific market characteristics form the first impression of the expectations of a new entrant to a market. In this section, three main characteristics are discussed, *economies of scale, capital requirements and reputation of the incumbents*. Because, it is such a small discussion it is chosen to group all sub indicators into one paragraph.

**Economies of scale** are an issue here, because of the high investments in time and construction costs of mast towers and other equipment. **Capital requirements**, These investment costs are earned back when more users are using the mast. Mast towers are expensive capital. It should be something about 200,000 Euro according to private communication. **Reputation of the incumbents**, in this market the incumbents are also the network operators that are already discussed in the mobile telecom market. These organizations own the most mast towers. These firms have the reputation to hold on their assets, nevertheless, they share the mast towers with other network operators.
Sources of incumbent advantage

The mast towers market incumbents are characterized by the fact that they already have the best locations. Moreover, they were active in the market before building permits became obliged and also before public resistance because of health risks became an issue. The incumbents in this market are also the incumbent of the mobile telecommunications market, which gives them the benefits of vertical integration, in terms of improving coordination in the supply chain, capturing upstream profit margins and most importantly withholding entrants into the downstream market (the mobile telecommunications market in this case).

Government Policy

In theory, the market of antenna-sites is an independent market, because everyone could buy mast towers and offers them for rent. However, gaining success in this market depends on the demand of the mobile telecommunication market to larger traffic volume. The more connections needed for that market, the more antenna sites are needed, and thus more profit could be gained. Access to this market was limited to the network operators with a license to exploit the radio spectrum.

A different kind of licensing applies more to this market, which is the need for a building permit to be able to build an antenna-site. The distinction made earlier was based on the conditions of these permits. A building permit is given by the local authorities, which means that getting a permit in some municipalities is easier than in other municipalities.

Public opinion

Next to the barriers to entry defined by Porter, in this market the public opinion plays a crucial role. Although building permits for mast towers were moderated, it is still hard for competitors in this market to build mast towers higher than five meter. This is mostly due to the high resistant of the public. After the auction of the UMTS frequency bands in the Netherlands, the public opinion about ‘harmful’ radiation coming from antennas has grown strong. The inhabitants of smaller municipalities have the largest influence on the administration of these municipalities. The network operators defined 100 problematic municipalities into their radio planning (private communications). There have been television documentaries about the health issues of antennas and two independent research reports have not proven correlation between health issues and UMTS antennas.

SUMMARY OF THE THREAT TO ENTRY OF MAST TOWERS

Table 20 provides a summary of the powers of each indicator and the total estimated threat to entry. The threat to entry for the mast towers is low because of the high costs and the building permits. Low threat of entry reduces competition in this market.

Table 20: Threat of entry in the mast towers market

<table>
<thead>
<tr>
<th>Expectation about the reaction of incumbents to entry</th>
<th>Negative to entrants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources of incumbent advantage</td>
<td>medium</td>
</tr>
<tr>
<td>Government policy</td>
<td>Building permits increase barriers to entry</td>
</tr>
<tr>
<td>Public opinion</td>
<td>Negative toward mast towers</td>
</tr>
<tr>
<td>Total threat to entry</td>
<td>Low</td>
</tr>
</tbody>
</table>

5.2.3 Threat of substitute technologies

Technological developments that can replace GSM and UMTS antenna-sites completely do not exist yet. There are, however, three technologies that can lead to decrease the demand for antennas and antenna-sites.

WiMAX antennas

The upcoming technology is WiMAX, and even for WiMAX antennas are still needed to spread the network. There are however, two technological developments that could influence the number of antennas needed for a 3G (or 4G) network.
**WiFi hotspots**
The first is the WiFi hotspots and more mobile devices that are able to communicate over WiFi. WiFi hotspots are yet to be spread all over the country. Once that happens, and if more and more end users have WiFi enabled devices, the demand for mobile internet over 3G would reduce. However, WiFi would only make a difference if offered costless. McDonalds in the UK and Starbucks in the US are planning to offer free WiFi as a kind of customer services. Both firms have had contracts with T-Mobile hotspots, which were not free of charge, and even though it was success, both firms chose to switch to free WiFi (The Guardian, Saturday October 6 2007 and Fox News February 12 2008). Free WiFi hotspots are also growing in the Netherlands, however, there is still no counting for free Wifi hotspot, because they are mostly offered by different firms.

**Femtocells and picocells**
With this kind of antennas, the indoor coverage of the mobile network could be supplied, so that the antenna-sites for GSM and UMTS could offer only outdoor coverage. This means, that the number of antenna-sites necessary for full indoor coverage will be reduced. This technology is not applied as often as WiFi yet (De Liefde, 2006).

**SUMMARY OF THE THREAT FOR SUBSTITUTE TECHNOLOGIES**
Generally, the threat of substitution is low, because even if WiFi hotspots and femtocells were used commonly, they only offer indoor coverage, whereas with the help of antenna-site for GSM and UMTS one could make use of mobile connections indoor and outdoor. Moreover, when it comes to WiMax, the ability to replace UMTS and GSM still has high uncertainty. Table 21 shows a summary of the power of substitutes in this market.

<table>
<thead>
<tr>
<th></th>
<th>WiMAX antennas</th>
<th>Femtocells</th>
<th>WiFi hotspots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total threat of substitutes</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>

### 5.2.4 SUMMARY OF THE MARKET STRUCTURE ANALYSIS OF THE MAST TOWERS MARKET
Because of the vertical integration between the antenna-site market and the mobile telecommunications market it is difficult to examine this market individually.

<table>
<thead>
<tr>
<th></th>
<th>Rivalry</th>
<th>Threat to entry</th>
<th>Bargaining power of buyers</th>
<th>Threat of substitutes</th>
<th>Total level of competition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium</td>
<td>Low</td>
<td>High (discussed in chapter 4)</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

If one takes a look at the antenna-site market on itself then it appears that this is a small specialized market where the supply and demand sides consists of only few firms. There are many firms involved around the management of antenna-sites though. However, the actual power is still concentrated in few firms that own antenna-sites and rent them.
5.3 **Market structure analysis of the ROOFTOPS MARKET**

This section analyzes the second sub market of the antenna-sites market, the rooftops market. This market is analyzed separately due to the difference in the regulations around the construction permit. In the antenna covenant (2002) it is stated that in order to build an antenna-site on a rooftop, approval of the inhabitants of that same building is needed.

5.3.1 **RIVALRY**

This section examines the level of rivalry between the actors in the rooftops market as a part of Porter five forced analysis. The indicators used are displayed in the table at the right side of this section.

*Market concentration*

Market concentration is determined by using the number of competitors and the size distribution. In this market, it is quite impossible to know the number of current (or potential) competitors, because all higher building owners are potential competitors. For the size distribution the number of potential antenna-sites owned by competitors is used as a measure for market share.

*Number of competitors*

From the point of urban planning, it is better that antenna-sites are shared as much as possible, however, from the point of view of competition, site-sharing could limit the competitive capacity of network operators. This could happen because network operators become less independent when changing the location of their antenna-sites or changing the angle of their antennas because of a change in their customer file.

*Size distribution*

For the size distribution the number of antenna-sites (mast towers and rooftops) is taken as a measure. It is important to nuance this observation, because rooftops are relatively easier to lease than building a mast, because rooftops are not obliged to be shared, however, it is possible that antenna-sites are existent on one roof, this is called co-location.

*Industry growth*

The demand for antenna-sites might increase despite the consolidation in the mobile telecommunications market. Because, although most people in the Netherlands already have a mobile phone, the need for more bandwidth will increase. As the use of data services is expected to increase, more antennas will be needed to meet the bandwidth demand for consumers.

The need for antenna-sites will logically increase the most in densely populated areas. High rooftops in such areas are not scares and therefore, supply will meet the increasing demand. Also, because more antennas will be needed for more bandwidth, they do not need to be high anymore.

*Product differentiation*

The competitors of this market offer technically the same products to their leasers. The differentiation here would be the location of the antenna-site offered. Some locations are more competitive than other locations, think about large cities with many end users and few high rooftops. The low product differentiation would have a positive effect on the total rivalry.

*Asset specificity and exit barriers*

Antenna-sites on rooftops are not considered specific assets, the costs for renting rooftops is less than EUR 10,000 a year (Liefde, 2006), which is not considered very high comparing with the revenues MNOs book. In 2007, KPN had revenue of wireless services to end users of total EUR 2692 million (KPN, Annual Report and Form 20-F 2007, 2007). KPN claims to have a total of about 7000 sites, if all these site were leased, they would have a cost of EUR 70 million a year. This is about 2.5% of their revenues. Antennas on rooftops are,
moreover, easier to be installed and removed from rooftops to be used at other rooftops if demand changes. Asset specificity is therefore lower here than in the case of mast towers. Exit barriers are also lower than mast towers because of the lower asset specificity and the relatively lower costs.

**Homogeneity of strategies of rivals**
The rivals in this market are building owners that provide a location to build an antenna-site on. Building owners see this as an opportunity to earn extra money. The firms that manage acquisition and building antenna-sites on rooftops are less visible than their buyers (leasing actually), which are the MNOs. Each building owner or real estate trades separately with MNOs. There is little known about their strategy, but one can assume that most of these firms have the strategy to earn extra incomes.

**Changing supply and demand**
This market is a dynamic market, because mobile network operators consistently need to adjust their networks to offer better coverage, especially indoors. This is for example the case when it comes to large end users like large firms that have a collective subscription to one network operators to provide all mobile telecom services. If such an end user switches to another provider, this mostly have an effect to the network plan (radio plan officially) and with is a new antenna-site should be build or removed.

**SUMMARY OF RIVALRY ROOFTOPS**
The level of rivalry in the rooftops market is high, because of the high changing supply demand, the low market concentration and the low homogeneity of firms. Also, the level of asset specificity is not as a high as in the mast towers market, because MNOs then only rent a site, and do not need to build the building too. Table 23 shows where rivalry stands in this market.

<table>
<thead>
<tr>
<th>Table 23: Rivalry in the rooftops market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market concentration</td>
</tr>
<tr>
<td>Industry growth</td>
</tr>
<tr>
<td>Homogeneity of firms</td>
</tr>
<tr>
<td>Asset specificity and exit barriers</td>
</tr>
<tr>
<td>Changing supply and demand</td>
</tr>
<tr>
<td><strong>Total rivalry</strong></td>
</tr>
</tbody>
</table>

### 5.3.2 Threat of entry

According to Porter (1980) new entrants deal with three major issues when trying to enter a new market; the expected reaction of the incumbent firms to entry, the source of incumbent advantage and government policy. Next to the defined barriers to entry by Porter, the public opinion forms an extra barrier to entry in this case and therefore it is added here.

**Expectation about the reaction of incumbents to entry**

In the rooftops market, the actors vary in their strategies and behavior. In this market, economies of scale do not play a crucial role, because the price of rent of antenna-sites on rooftops is not depended on the number of units rented from an actor.

**Sources of incumbent advantage**

The only source of incumbent advantage here would be that large housing cooperations would have control of more buildings than other small players.
Government Policy
When the antenna-site is lower than five meter, the permission of the building owner and residents is needed. This is regulated by the antenna covenant. Though for rooftops antenna-sites, the exit cost is less relevant. In the last case, it is dependent on the rent contacts’ conditions.

Public opinion
Public opinion plays a role her too. However, not as much as with mast towers, because building permits are published first for the public to give an opportunity for rejection. In building rooftops, only the inhabitants of the building have to approve the installation of an antenna-site on their roof. There is, in the case of rooftops, less chance of public rejection, because there are less people to reject comparing to mast towers.

SUMMARY OF THE THREAT TO ENTRY

The threat of entry is expected to be high in this market, because each building owner is a potential entrant. One only needs a permission from inhabitants of the building to put an antenna on the roof. It is for building owners a type of extra incomes that is considered welcome, if the inhabitants do not mind. To sum up, table 24 shows a summary for the threat of entry in this market.

5.3.3 SUMMARY OF THE MARKET STRUCTURE ANALYSIS OF THE ROOFTOPS MARKET

Because of the vertical integration between the antenna-site market and the mobile telecommunications market it is difficult to examine this market individually.

Table 25: Summary of the market structure analysis in the rooftops market

<table>
<thead>
<tr>
<th>Rivalry</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threat of entry</td>
<td>High</td>
</tr>
<tr>
<td>Bargaining power of buyers</td>
<td>High (discussed in chapter 4)</td>
</tr>
<tr>
<td>Threat of substitutes</td>
<td>Low</td>
</tr>
<tr>
<td>Total level of competition</td>
<td>High</td>
</tr>
</tbody>
</table>

If one takes a look at the antenna-site market on itself then it appears that this is a small specialized market where the supply and demand sides are only few firms. There are many firms involved around the management of antenna-sites though. However, the actual power is still concentrated in few firms that own antenna-sites and rent them.

5.4 Conclusion of the antenna-sites market (case study)

4. What way do the competitive forces in the antenna-sites market influence competition in the mobile telecommunications market?

A. What are the main characteristics of the antenna-sites market?
B. In what competition level is the mast towers market according to Porter’s model?
C. In what competition level is the rooftops market according to Porter’s model?
D. What competition issues doe these markets raise for the mobile telecommunications market?

The antenna-sites market, including the mast towers market and the rooftops market, is a dynamic market characterized by high asset specificity and high initial costs. Especially the mast towers market shows some signs of reduced competition level (table 26).
In this market, it is necessary to take a look at the position of the vertically integrated actors versus the non-vertically integrated actors. In the mast towers market, the MNOs are the vertically integrated actors and the mast towers management firms are the non-vertically integrated actors. Although the number of mast towers owned by the MNOs is not exactly known, we expect that the MNOs own the larger part of the mast towers. With this in knowledge, they gain a great deal of power versus the non-vertically integrated actors.

The reduced competition level in the mast towers market is mainly because of the vertical integration of the MNOs in this market. MNOs are estimated to still own the most part of mast towers, which makes it difficult for new entrants in this market, and also in the mobile telecommunications market. However, the reduced level of competition in the mast towers market is balanced with the high competition level in the rooftops market. One could consider this as *competition between infrastructures*. New entrants to the mobile telecommunications market can still roll out a large part of their networks using rooftops as antenna-sites instead of mast towers. This is not an unrealistic option, as in the Netherlands population density is considered to be high and one expects high buildings in large parts of the Netherlands. Femtocells could also offer a solution to the new entrants of the mobile telecommunications market, this subject is considered to be an expected future development and it is discussed in chapter 6.

Conclusion: The reduced levels of competition in the mast towers market, does not affect competition in the mobile telecommunications market as negatively as earlier expected, as it does not form the highest barrier to entry to the mobile telecommunications market.

<table>
<thead>
<tr>
<th></th>
<th>Mast towers market</th>
<th>rooftops market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rivalry</strong></td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>Threat of entry</strong></td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>Bargaining power of buyers</strong></td>
<td>High (discussed in chapter 4)</td>
<td>High (discussed in chapter 4)</td>
</tr>
<tr>
<td><strong>Threat of substitutes</strong></td>
<td>Low</td>
<td>Low (same as mast tower market)</td>
</tr>
<tr>
<td><strong>Total level of competition</strong></td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>
6 Expected Future Developments

There are three main issues that are important for the competitiveness in the mobile telecommunications market. These are: The 2.6 GHz frequency auction, the digital dividend suggested by the European Commission and the development of picocells and femtocells.

5. What are the most important expected future developments in the field of mobile telecommunications and antenna-sites and how are these developments expected to influence competition in the mobile telecommunications market?

6.1 The 2.6 GHz frequency auction

In this section, the 2.6 GHz frequency auction will be discussed. This auction is expected to be the most influential future developments on the competition in the mobile sector. First, this section will describe the most important features of the auction. The affect of the auction on competition will be explained at end of the section.

In February 2009, the 2.6 GHz (2500-2690 MHz) frequency band is expected to be auctioned. There will be no obligation of which technology to be used in these frequencies. The frequency (lot) can be used for WiMax, UMTS or LTE (Long Term Evolution), which is a faster variant of UMTS (Molenaar, 2008).

The 194.7 MHz of bandwidth that is available to be auctioned will be divided into 37 lots of 5 MHz and one of 9.7 MHz where all lots are allowed to be used for national coverage. Bidders are allowed to obtain more lots at ones to a maximum of 40 MHz, which is a maximum set by the Ministry of Economic affairs. This means that this auction will result in at least five licenses (4 of 40 MHz and 1 of 34.7 MHz) to be auctioned. At this moment (Dec 2008), there are three mobile network operators, so this there will be opportunity for two more firms to enter the mobile network operator market.

The main goals of the 2.6 GHz auction are formulated as follows:

- To enlarge the consumers’ choice for more broadband mobile services and (perhaps) more mobile providers
- To enlarge the freedom of choice for providers to innovate and with it, to serve the consumer optimally.
These operational goals show that the stimulate competition in this sector the ambition in order to give consumers better choice to more providers.

This auction is focused to give new players a chance to enter the market and possibly compete. There are two main instruments used to prevent defensive bidding: A usage obligation, an efficient bidding process, the possibility to trade the unused spectrum space. Excluding some incumbent to participate in this auction is not a necessary measure to ensure a fair process according to state secretary of the Dutch Ministry of Economic Affairs (Tweede Kamer der Staten-Generaal, 2008) he followed the consultation of the NMA and OPTA who performed a market analysis. An important measure to ensure fairness is the so called Cap, which is a maximum of MHz to be obtained by an operator. This maximum is set to 40 MHz per bidder.

**EXPECTED INFLUENCE OF THE 2.6 GHZ AUCTION**

The 2.6 GHz auction is expected to take place in 2010 (it was supposed to take place in 2008). This event will probably result in the addition of at least two new network operators that could compete with the current network operators. The Ministry of Economic Affairs expects new entrants to compete mainly on non-voice services, due to the technologies that can be used in the auctioned range of spectrum.

Not all frequency auctions were positively received. There was much critique the last time about the fact that there was no room preserved for new entrants into the mobile telecommunications market (Damme, 2002). The government wants to prevent criticism and designed this auction with more consideration for new entrants. In comparison with the UMTS auction, the 2.6 GHz auction is expected to be more positive to competition, because of (1) the technology neutral nature, providers are free to choose the technology to use, and this is expected to create more space for innovation. (2) There is a frequency cap of 40 MHz per provider to create a level playing field between smaller and larger firms. Larger firms cannot obtain more than 40 MHz in this auction. (3) In anticipation for collusion, bidders have no access to information about each other. (4) Instead of a coverage obligation, there is a usage obligation for the spectrum lot. This is could lead to regional competition instead of national competition of new entrants. Also, usage obligation is expected to minimize the need for new antenna-sites to be built. Providers might find other ways to provide the needed coverage, by site sharing or using femtocells (see section 6.2).

This auction is designed to encourage entry into the mobile telecommunications market and with this to improve competition within the mobile telecommunications market. The cap of 40 MHz and the small lots seem to create a better chance to enter the market. However, there are no price limitations of bidding, which means that small firms will still have smaller chance. The usage obligation instead of a coverage obligation fits into the state of infrastructure. In 2000, the mobile infrastructure was not complete yet. At this moment, there are three mobile networks operational (active), which means that there is no need to encourage building new networks.

In the intent of the government to treat all bidders equally, the government (in my opinion) is giving the incumbents a better chance than new comers. This is mainly because after the auction there are no regulations to ensure infrastructure sharing for new entrants. A design for asymmetric regulations after the auction is preferred to ensure that new entrants will be able to actively deploy their licenses. Another issue here is the tradability of the frequency lots. This is a positive thing of this auction. Tradability of spectrum is recommended by Baumol and Robyn (2006). However, to prevent incumbents to buy lots from new players a short time after the auction. In a situation where new players do not succeed in deploying their licenses, they can sell them to the incumbents and exit the market easily and with ‘small’ damages. However, if they would do that before they seriously try to deploy their new networks; this would give incumbents huge amounts of spectrum. To prevent this, it would be better to prevent tradability for the first years, or to investigate the spectrum trade if it would take place before the spectrum is really used of if it happened from new entrant to an incumbent. Tradability will increase the contestability of the market, with it also the ‘hit and run’ affect. New firms, who enter the market, make huge profits and the exit with minimum losses. This is the danger of spectrum tradability that this auction is creating.

To sum up, the auction is a positive development for the competition within the mobile telecommunications market. However, carrying out the auction and the period after the auction should be monitored by competition authorities to prevent abuse of the tradability of spectrum.
6.2 The ‘digital dividend’

The digital dividend is a collective name for all frequencies that be freed up by the switchover from analogue to digital division. The switchover is expected to happen by the end of 2012 in many European countries. Figure 12 shows the place of these frequencies on the radio spectrum (European Commission, 2007).

The European Commission considers the digital dividend as an important contribution to innovation and economic growth in the European Union. The Commission estimates the value of the services offered over the digital dividend to exceed 250 Euro billion a year (European Commission, 2007).

The digital dividend is located between 200 MHz and 1 GHz as to be seen in figure 12. Its place on the spectrum makes it an attractive frequency to work with. Higher frequencies (> 3 GHz) have lower range and lower coverage inside buildings. Lower frequencies (<200 MHz) have low capacity (the number of users is then low) and create more interference. The digital dividend offers an optimal balance between capacity and coverage. It is commercially attractive because these characteristics mean that a firm needs less infrastructures with higher capacity and range for possibly rural areas too (European Commission, 2007).

The digital dividend is suitable for many services in the field of mobile communication. Technologies that are suitable for use in the digital dividend are to be divided into three main categories (Council of the European Union, 2008):

- Wireless broadband communications.
- Additional terrestrial broadcasting services.
- Mobile multimedia.

Allocation of the digital dividend is one of the priorities of the Commission, because it fits into the goals of the Lisbon Strategy and the i2010 initiative. The main objective of the i2010 initiative of the European Commission is to “establish a Single European Information Space offering affordable and secure high-bandwidth communications, rich and diverse content and digital services.” (European Commission, 2007). There is still no tangible plan yet set up by the Commission. Until now the main plan is to allocate the digital dividend by auctions in each of the member states and to take preparatory work on various issues concerning the digital dividend.

This is however is a complex issue with “Legacy issues on both the broadcasting side and the mobile side with a risk to destabilize a delicate balance in spectrum assets between operators” Angelika Niebler: Chairwoman of the Committee on Industry, Research and Energy, European Parliament

**Expected influence of the ‘digital dividend’**

The development of the digital dividend is a positive influence on competition in the mobile telecommunications market. This is because with the digital dividend a new opportunity is created for firms to enter the mobile telecommunications market. The digital dividend is expected to increase demand to antenna-sites, which will form a pressure on the antenna-sites market, bringing more competition to the antenna-sites market.
6.3 Femtocells and Picocells

This section starts with a description of the last known developments and expectations about femtocells and picocells and ends with the expected influence on competition in the mobile telecommunications market.

Femtocells are small cellular base stations that can be used by private and business end users. They can be installed inside buildings to support and increase coverage of UMTS networks. These cells have access to the fixed part of the mobile network (the cables) through an IP connection and support 2-5 mobile devices (Tatara Systems, 2008). They provide access to the 3G network only inside buildings, because they have low power that guarantees coverage within a small circle only. The main differences between femtocells and picocells are shown in table 27.

<table>
<thead>
<tr>
<th>Installation</th>
<th>Picocells</th>
<th>Femtocells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission to operator’s network</td>
<td>Operator</td>
<td>Customer</td>
</tr>
<tr>
<td>Frequency/radio parameters</td>
<td>Centrally planned</td>
<td>Locally determined</td>
</tr>
<tr>
<td>Site rental</td>
<td>Operator</td>
<td>Customer</td>
</tr>
</tbody>
</table>

The main difference between femtocells and picocells is that femtocells are more autonomous than picocells. They can be self-installed by the user and are able to automatically determine the frequency and power to operate on. This is an advantage, because in this case there would be no need to adjust the master frequency plan every time a new femtocell is added or removed (Chambers, 2008). This advantage strengthens the business case of femtocells above that of picocells, because the autonomous character of femtocells lowers the installation costs for operators.

Femtocells and picocells are expected to revolutionize the mobile telecommunications market, because they would increase the 3G coverage inside buildings and with it decreasing the need for antennas outside (Sound Partners Research, 2008). Moreover, femtocells are expected to have a large influence on the mobile telecommunications because they are cheaper to install and maintain for consumer and provider.

What makes femtocells so attractive for network operators is the fact that they are mostly the responsibility of the end users. The purchase, installation and maintenance of these ‘home base station’ as they are often called, are all at the part of the end users. The cons of femtocells are among other things mainly billing and control by the operator.

Research agencies like Infonetics and IDATE estimate about 18 million femtocells to be sold by 2011, they expect mobile operators Vodafone, T-Mobile and Telefónica to be interested in this technology. These operators are already members of the Femto Forum (Waterkamp, 2007). Suppliers of femtocells and accompanying equipment are Netgear, Alcatel-Lucent, Motorola, Sisco systems and Samsung (Blommestein, 2008).

EXPECTED INFLUENCE OF FEMTOCELLS AND PICOCELLS

Indoor coverage seems irrelevant at first, but femtocells and picocells can influence the mobile telecommunications market positively. With better indoor coverage, MNOs can compete with fixed telephony providers. They also would need less antenna-sites, or weaker cells because indoor coverage would be already managed by femtocells.
6.4 Conclusion of the expected future developments

Three main future developments that are discussed here above are the 2.6 GHz frequency auction, the digital dividend and the picocells/femtocells. All three future developments have influence on the completion in the mobile telecommunications market and the antenna-sites market.

During the 2.6 GHz frequency auction, five lots of the frequencies between (2550-2650 MHz) will be auctioned. This auction creates the opportunity for two new entrants in the mobile telecommunications market. These entrants are potential competitors for the current MNOs. These two new firms are expected to have a disadvantage comparing with incumbents. Issues to take into account for competition regulation:

- The position of the new entrants versus incumbents after the 2.6 GHz auction.
- Tradability of the spectrum

The digital dividend is an extremely positive development. If handled well, it would increase competition in the mobile telecommunications market. It could also increase the pressure on the antenna-sites market, because new entrants would need antennas for broadcasting on the digital dividend. Nevertheless, it is too early to make a sound judgment. Finally, if picocells and femtocells became a common good, the need for antenna-sites would decrease. This could create an excess on antenna-sites. However, as earlier discussed in chapter 5, rooftops antenna-sites are relatively easy to move away. The only problem would be the costs of destroy of mast towers.
Is it necessary to separate antenna sites from the mobile network operators?
7 Conclusions

7.1 Interpretation of the results

The case studies conducted above show the level of competition in each studied market, where the upstream market is the antenna-sites market and the downstream market is the mobile telecommunications market. As explained earlier, in this thesis, the focus is on the vertical integration between these two markets and whether vertical integration withholds competition in the downstream market. To be able to judge whether vertical integration between the antenna-sites market and the mobile telecommunications market is harmful for the competition in the mobile telecommunications market, one should look at the position of the vertical integrated players versus the non-vertical integrated players in both the upstream and the downstream market.

In the case of the mobile telecommunications market (the downstream market), it is clearly shown in section 4.2 that the MNOs (the vertically integrated players in this market) have a more powerful position in the mobile telecommunications market. They compete both in the wholesale and in the retail market. Although the competition in the retail market is better than that of the wholesale market, it is still the matter that entry to the retail market is only possible through MNOs. The position of the MNOs as suppliers for service providers and MVNOs jeopardizes the competitiveness in the retail market and it shows that their position is more powerful than that of MVNOs and SPs. The three MNOs have an influential position in the antenna-sites market too. Although the exact numbers of antenna-sites owned (or controlled) by the MNOs is not known, it is not completely irrational to assume that the MNOs own (or control) most of antenna-sites in the Netherlands. Competition between the three incumbent MNOs in the antenna-sites market is present. However, their position compared to antenna management firms is far more powerful, as these firms do not offer a nationwide network of antenna-sites.

The distinction found between the mast towers market and the rooftops market is important to the conclusion of this report, as rooftops can be seen as a substitute to mast towers in the antenna-sites market. Rooftops are cheaper to construct, and are leased by the MNOs instead of completely owned. With this finding, one could nuance the fear of a dominant position by the MNOs.

The results of the case studies clearly show that vertical integration between the antenna-sites market and the mobile telecommunications market has an impact on competition in the mobile telecommunications market. Antenna-sites, however, are not the main bottleneck in the face of competition. Antenna-sites on rooftops are widely available and are leased by the incumbent operators and not owned. This nuances the gravity of antenna-sites as a bottleneck for competition. Obtaining access to the spectrum is found to be a
larger bottleneck in the mobile telecommunications market than antenna-site, because licenses are limited and expensive.

7.2 Regulatory analysis
This section analyzes the results as interpreted above in terms of model of competition as discussed in chapter 3. With the help of a logical scheme provided by (Bijl d. P., 2005) and (Mierlo, 2001) we can determine the level of government intervention necessary in this case. The rest of this section will look into the models of competition and whether and how these are present in the mobile telecommunications market and the antenna-sites market. The main thought behind the analysis are the basic assumption of essential facility. However, this analysis takes a broader meaning of essential facility and policy interventions as a remedy.

7.2.1 Competition between infrastructures
In this case, the antenna-sites are considered as infrastructure for the mobile telecommunications market. If we consider the rooftops antennas and the mast towers as substitutes for each other, then one could argue that there is competition between infrastructures.

In the mobile telecommunications market, there are three (almost) completely separate GSM and two and a half UMTS networks existent. One could also consider this as a form of competition between the infrastructures. However, MNOs have no complete access to each others’ networks, which makes competition between infrastructures questionable here. Also, access to these networks is not guaranteed for new entrants to the MNO market, which makes competition between infrastructures less effective.

7.2.2 Competition on the infrastructures
Competition on the infrastructure is limited and this is mainly caused by the way spectrum was allocated. MNOs were obliged to build their own infrastructure, which is positive to the position of MNOs but made trade in only antenna-sites less attractive. So, we conclude that spectrum licenses are the main reason why competition on the infrastructure is limited and with it also competition in the whole mobile telecommunications market.

This level of competition is existent in the mobile telecommunications market and it is not existent in the antenna-sites market. Competition on the infrastructure is in the mobile telecommunications market because MNOs provide access to parts of their networks to MVNOs and SPs. MVNOs, SPs and MNOs compete with each other by offering different services to the end users on the same infrastructure.

7.2.3 Competition for the infrastructure
This level of competition is also already existent in the mobile telecommunications market. In this case, the frequency spectrum is seen as one infrastructure. The frequency auctions allocate this infrastructure by giving a frequency license to MNOs. Although there are more than one MNO and one cannot speak of a monopoly, there is still competition around the infrastructure. The Dutch government interferes heavily at this level of the market, because it is officially still the ‘owner’ of the spectrum and MNOs operate on it in a time limit. To be able to make a sound judgment of whether government intervention is considered necessary in this case, the following analysis scheme is applied.

To solve the issue of infrastructure as a bottleneck and to be able to increase the level of competition on the infrastructure, the regulator could choose accounting separation. Accounting separation means that managing the infrastructure is separated from the main firm, but still owned by that firm. MNOs might choose for this form of separation themselves, but for efficiency reasons.
Although competition on the infrastructure is limited, there is still no critical reason to separate the infrastructure from the service structurally (meaning that infrastructure management is placed within a legally other firm). The analysis scheme shown in figure 13 presented shows that if there is any competition on the infrastructure, then structural (or legal) separation is not necessary. Although this scheme is based on a broader definition of essential facility, it is useful to look at the matter from the narrow criteria of the essential facility doctrine. The narrow criteria for essential facility are:

- **Facility is controlled by a dominant monopolist firm.**
- **The competitors cannot reasonably or practically duplicate the facility.**
- **The firm controlling the facility denies access to the use of the facility to competitors.**

One could clearly state that rooftops are no essential facility, even if we take the criteria broadly. Antennasites based on rooftops are relatively easier to duplicate and are also not owned by the MNOs. They are however in control of the MNOs but not for an indefinite period of time. Also co-location is possible, as rooftops can be shared.

When it comes to mast towers, first of all, in the Netherlands mast towers are not controlled by one dominant firm. A large part of them is controlled by the three MNOs. Although it is not an ideal situation, there is no intervention possible according to the narrow criteria of the essential facility doctrine. Second, the duplication of mast towers is not impossible. It is expensive, but according to all interviewed actors, still not too costly (there was no specification of numbers because these were business secrets). And third,
MNOs are obliged by the law (art.3.11) to share their mast towers with other firms for reasonable prices. These prices were determined by the OPTA as cost based prices.

7.3 **Policy recommendations**

Beside vertical integration, the case study show several bottlenecks that possibly withhold competition:

- Market concentration
- Government policy concerning spectrum allocation and
- Large investments (spectrum and infrastructure)
- Overall incumbent advantage (infrastructure, learning curve)

These bottlenecks can be summarized in two main competition issues, the level playing field vis-à-vis new entrants and access to the spectrum. Chapter 3 has shown several regulatory instruments that can be deployed in order to increase competition in the mobile telecommunications sector. The suitability of these regulatory instruments on the raised issues is summarized in table 28, where each column represents a competition issue and each row represents a regulatory instrument.

**Table 28: Raised competition issues and regulatory instruments**

<table>
<thead>
<tr>
<th>Competition Issue/Regulatory Instrument</th>
<th>Access to spectrum</th>
<th>Access to the market (wholesale level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum governance</td>
<td>Yes</td>
<td>Maybe, if more flexible</td>
</tr>
<tr>
<td>Market analyses and SMP</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### 7.3.1 **Spectrum governance**

Making spectrum tradability under certain conditions is an instrument for improving competition. Making spectrum tradable lowers the barrier to entry into the mobile telecommunications market. Free competition is then still difficult to realize in this market because of economies of scale. However, market contestability increases, which is according to the theory of contestability (par. 2.2.1) also sufficient to accomplish economic efficiency.

The spectrum is shown to be one of the main barriers to entry into the mobile telecom market. Entering the mobile telecom market is restricted by several economic, legal and technological barriers to entry. The most important is the frequency license, without a license a network operator is restricted to exploit the spectrum. The issue of contestable market is the discussion when it comes to allocating the radio spectrum. Both, Heuvelhof et al. and Van Twist has mentioned that allocating the radio spectrum via licensing for a certain period of time is appropriate because of the theory of contestability. Other industrial organization literature discusses the question of leasing or “owning” the spectrum or parts of it would be more efficient.

### 7.3.2 **Market analysis and significant market power**

The instrument of market analysis and defining a firm with a significant market power fits within the regulatory framework of the European Commission. This regulatory framework is especially designed for the information and communication sector with the main goal to increase competition in this sector.

The European Commission definition of competitive markets differs slightly with the neo classical economic definition of competition. The European Commission’s definition of effectively competitive markets is strongly connected with the existence of dominance in the market.

> “... the notion of effective competition means that there is no undertaking with dominance on the relevant market. In other words, a finding that a relevant market is effectively competitive is, in effect, a determination that there is neither single nor joint dominance on that market. Conversely, a finding that a relevant market is not effectively competitive is a determination that there is single or joint dominance on that market”.

( European Commission, 2002).

Because the mobile telecommunications market is an oligopoly (on wholesale level) and there is no clear monopolist in the market, the focus here is on the notion of ‘joint dominance’ and also called ‘collective dominance’. The European commission provides a list for assessing collective dominance in markets or the possibility that collective dominance would appear in a market. In our case, the MNOs could be suspected
for collective dominance in both the wholesale market of mobile telecommunications and in the antenna-sites market. When the expected 2.6 GHz auction will take place in 2010, at least two new mobile network operators are expected to enter the market (see chapter 6 for more details on this auction). The position of the new entrants versus the three current incumbent is expected to be weaker in both the wholesale level of mobile telecommunications and the antenna-sites market. Therefore, MNOs can be expected to hold collective dominance comparing to new entrants. A list of broad criteria to collective dominance is shown in section 3.3. This list is not meant as a checklist though, it is meant as a guideline. Each case should be judged individually and the situation might differ in certain market and other countries. The European Commissions’ guidelines admit that designation collective dominance is a difficult task.

Another matter, where the concept of collective dominance could be applied is the position of MNOs in the antenna-sites market. However, in practice, this is an even more difficult matter, because before being able to conduct a market analysis in order to assess if there was a firm (or more) with dominant position, the antenna-sites market should be defined as a relevant market first. If collective dominance is proven, the regulator can use several articles of the framework directive (2002/21/EC) one of the obligations below on MNOs:

- Transparency (Article 9): An operator might be obliged to publish its offers to other firms in terms of prices for access.
- Non-discrimination (Article 10): With this instrument, the regulator can ensure that the dominant firm offers access to other firms at the same condition it would provide for itself.
- Accounting separation (Article 11): A light form on separation the network from the service to end vertical integration.
- Obligations for access to and use of specific network facilities (Article 12): Something like article 3.11 TW

7.4 Conclusions

To conclude, the bottom line of this study is that the antenna-sites market is not the main bottleneck to competition and entry into the mobile telecommunications market. However, it contributes in strengthening the already powerful position of the main actors in the mobile telecommunications market. As a result of this conclusion, the main recommendation given is not to separate the antenna-sites structurally from the wholesale mobile telecommunications market. Structural separation in this case would influence the competition as a whole negatively, because it would give the new firm a possible dominant market position.

To increase competition in the wholesale market of the mobile telecommunications, this study’s recommends accounting separation, better spectrum allocation and market supervision. All these instruments are considered a light form of government intervention. These regulatory instruments were recommended because heavy government intervention in the form of structural separation is expected to be negative for welfare. The costs of structural separation are expected to be high for the incumbent firms and that price would be eventually charged to the consumer. The most important goal of competition regulation is to ensure consumer welfare.

7.5 Methodological Reflection and recommended future research

The study of vertical integration in infrastructure based market and its effects to policy, economic efficiency and welfare is a part of broader economic concepts. This study chose the Porter model to analyze vertical integration between two markets. Porter’s model was chosen, because with it one can determine the level of competitiveness of the studied market. Also, Porter’s model is one with a well defined structure that allows the researcher to study the case step by step. Porter’s analysis was however found to be hard to combine with other models provided in the industrial organization field. In this study we tried to combine Baumol’s model of contestable markets (see bibliography) with Porter’s model. The overlap between these two models was high and therefore a combination is difficult. For future research, it might be interesting to investigate this matter using Baumol’s model instead of Porter’s model.

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17 A list of all relevant market according to the recommendations of the European Commission is to be found in appendix 4 (this list is according to 2002 recommendations)
In this study we have chosen to apply the essential facility doctrine in the broad and the narrow definition to assess whether and how much government intervention is needed to solve the bottlenecks in competition. The essential facility doctrine is far more complicated than we have mentioned in this study. It lies in the field of European and American competition law. It is therefore interesting to study this matter only in the light of the essential facility doctrine and to broaden this subject in a European or even international context.
## Appendix 1: List of Interviews

<table>
<thead>
<tr>
<th>Interviewees</th>
<th>Function</th>
<th>Date of Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KPN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sico Enzler</td>
<td>Principal Regulatory Counsel</td>
<td>July 2008</td>
</tr>
<tr>
<td><strong>T-Mobile</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roderick van Houten</td>
<td>Manager External Relations</td>
<td>July 2008</td>
</tr>
<tr>
<td><strong>T-Mobile</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark Esters</td>
<td>Manager Property and infrastructure</td>
<td>July 2008</td>
</tr>
<tr>
<td><strong>Vodafone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jamal Tajaate</td>
<td>Contract &amp; SLA manger (Partner management Ericsson)</td>
<td>July 2008</td>
</tr>
<tr>
<td><strong>Novec</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rosalie Weijers</td>
<td>Business Development</td>
<td>June 2008</td>
</tr>
<tr>
<td><strong>Antennebureau</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rogier Brink</td>
<td>Perswoordvoerder</td>
<td>June 2008</td>
</tr>
<tr>
<td><strong>EZ</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dré van den Elzen</td>
<td>Senior Beleidsmedewerker Directoraat-Genraal Energie en Telecom Directie Telecommarkt</td>
<td>May 2008</td>
</tr>
<tr>
<td><strong>TUDelft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wolter Lemstra</td>
<td>Senior Research fellow Economics of infrastructure</td>
<td>April 2008</td>
</tr>
<tr>
<td><strong>TUDelft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jolien Ubacht</td>
<td>Economics of infrastructure</td>
<td>May 2008</td>
</tr>
<tr>
<td><strong>OPTA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bert Hilberts</td>
<td>Technisch toezichtsmedewerker</td>
<td>June 2008</td>
</tr>
<tr>
<td><strong>OPTA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niels Muselaers</td>
<td>Economisch toezichtsmedewerker</td>
<td>June 2008</td>
</tr>
</tbody>
</table>
Is it necessary to separate antenna-sites from the mobile network operators?
APPENDIX 2: QUESTIONS FOR THE SEMI-STRUCTURED INTERVIEWS

1. What are specific characteristics of the antenna-site market as it is now, according to Porter’s five forces model?
2. How is the demand side of antenna sites likely to develop in the next five to ten years as a result of the technological, user demand and regulatory changes?
3. What is the role of the policy maker in regulating such a market?
4. Do you find antenna-sites to be an essential facility for the mobile telecommunications market? Why? Why not?
5. What are the laws and regulations that are relevant to the subject of antenna-sites in the mobile telecom sector?
6. What challenges is the policy maker facing due to the current developments around the antenna-site market?
7. How, if at all, should the policy maker influence the creation of an antenna-site market?
Is it necessary to separate antenna sites from the mobile network operators?
APPENDIX 3: THEORETICAL DESCRIPTION OF PERFECT COMPETITION

The perfect competition model is based on a state of long run equilibrium where firms earn zero profits and there is no incentive for entering or exiting the market. In Figure 14, the left part shows the short run equilibrium of an industry or a market, where the supply (Ms) and demand (Md) curve are displayed. The right side of the figure shows the costs curves of an individual firm at the short run equilibrium. In the short run, firms are able to earn above-normal profits as shown in the shaded rectangle in Figure 14.

Due to the above-normal profits earned by the firms in the market, the market becomes attractive for new entry. New entrants increase supply and consequently the supply curve of the market will shift outwards as shown in the left part of Figure 15 as MS2. This causes the price to decrease until it reaches the level of average costs as shown in the right part of Figure 15.

At this level, equilibrium, as shown in Figure 16, will exist where firms only make normal (zero) profits and the incentive to enter or exit the market will disappear.
In a perfect competitive market, firms will use the minimum amount of resources needed to produce their output. In other words, the resources are allocated efficiently. This is also called economic efficiency. The official definition of economic efficiency is: "the state of affairs in which no opportunity to promote the general welfare has been neglected" (Baumol & Sidak, 1994, p. 24). The equilibrium that reaches economic efficiency is known as the Pareto efficiency or Pareto optimality. The official definition of Pareto efficiency is: a situation in which nobody can be made better off without making somebody else worse off. This concepts is often used as a basis for economic and competition policy in the modern welfare economics.
APPENDIX 4: LIST OF RELEVANT MARKETS DEFINED BY THE EC


RETAIL LEVEL
1. Access to the public telephone network at a fixed location for residential customers.
2. Access to the public telephone network at a fixed location for non-residential customers.
3. Publicly available local and/or national telephone services provided at a fixed location for residential customers.
4. Publicly available international telephone services provided at a fixed location for residential customers.
5. Publicly available local and/or national telephone services provided at a fixed location for non-residential customers.
6. Publicly available international telephone services provided at a fixed location for non-residential customers.

These six markets are identified for the purpose of analysis in respect of Article 17 of the Universal Service Directive. Together, markets 1 through 6 correspond to “the provision of connection to and use of the public telephone network at fixed locations”, referred to in Annex I (1) of the Framework Directive. This combined market is also referred to in Article 19 of the Universal Service Directive (for possible imposition of carrier call-by-call selection or carrier selection).

7. The minimum set of leased lines (which comprises the specified types of leased lines up to and including 2Mb/sec as referenced in Article 18 and Annex VII of the Universal Service Directive).

This market is referred to in Annex I (1) of the Framework Directive in respect of Article 16 of the Universal Service Directive (“the provision of leased lines to end users”).

A market analysis must be undertaken for the purposes of Article 18 of the Universal Service Directive which covers regulatory controls on the provision of the minimum set of leased lines.

WHOLESALE LEVEL
8. Call origination on the public telephone network provided at a fixed location. For the purposes of this Recommendation, call origination is taken to include local call conveyance and delineated in such a way as to be consistent with the delineated boundaries for the markets for call transit and for call termination on the public telephone network provided at a fixed location.

This market corresponds to that referred to in Annex I (2) of the Framework Directive in respect of Directive 97/33/EC (“call origination in the fixed public telephone network”).

9. Call termination on individual public telephone networks provided at a fixed location.

For the purposes of this Recommendation, call termination is taken to include local call conveyance and delineated in such a way as to be consistent with the delineated boundaries for the markets for call origination and for call transit on the public telephone network provided at a fixed location.

This market corresponds to the one referred to in Annex I (2) of the Framework Directive in respect of Directive 97/33/EC (“call termination in the fixed public telephone network”).

10. Transit services in the fixed public telephone network
For the purposes of this Recommendation, transit services are taken as being delineated in such a way as to be consistent with the delineated boundaries for the markets for call origination and for call termination on the public telephone network provided at a fixed location.

This market corresponds to the one referred to in Annex I (2) of the Framework Directive in respect of Directive 97/33/EC ("transit services in the fixed public telephone network").

11. Wholesale unbundled access (including shared access) to metallic loops and sub-loops for the purpose of providing broadband and voice services.

This market corresponds to that referred to in Annex I (2) of the Framework Directive in respect of Directive 97/33/EC and Directive 98/10/EC ("access to the fixed public telephone network, including unbundled access to the local loop") and to that referred to in Annex I (3) of the Framework Directive in respect of Regulation No 2887/2000.

12. Wholesale broadband access.

This market covers ‘bit-stream’ access that permit the transmission of broadband data in both directions and other wholesale access provided over other infrastructures, if and when they offer facilities equivalent to bit-stream access. It includes ‘Network access and special network access’ referred to in Annex I (2) of the Framework Directive, but does not cover the market in point 11 above, nor the market in point 18.

13. Wholesale terminating segments of leased lines.

14. Wholesale trunk segments of leased lines

Together, the wholesale markets 13 and 14 correspond to those referred to in Annex I (2) of the Framework Directive in respect of Directive 97/33/EC and Directive 98/10/EC ("leased line interconnection") and to those referred to in Annex I (2) of the Framework Directive in respect of Directive 92/44/EEC ("wholesale provision of leased line capacity to other suppliers of electronic communications networks or services").

15. Access and call origination on public mobile telephone networks

Referred to (separately) in Annex I (2) of the Framework Directive in respect of Directives 97/33/EC and 98/10/EC.

16. Voice call termination on individual mobile networks

This market corresponds to the one referred to in Annex I (2) of the Framework Directive in respect of Directive 97/33/EC ("call termination on public mobile telephone networks").

17. The wholesale national market for international roaming on public mobile networks

This market corresponds to the one referred to in Annex I (4) of the Framework Directive.

18. Broadcasting transmission services, to deliver broadcast content to end users.

Note

National regulatory authorities have discretion with respect to the analysis of the market for “Conditional access systems to digital television and radio services broadcast” in accordance with Article 6(3) of the Access Directive. Article 6(3) of the Access Directive provides that Member States may permit their NRAs to review the market for conditional access system to digital television and radio services broadcast, irrespective of the means of transmission.
**APPENDIX 5: LIST OF MVNOs AND SPs (Telecompaper)**

- MVNOs - Mobile Service Providers having their own switching infrastructure.
- ESPs - "Enhanced" Mobile Service providers having more branded customer interfaces.
- SPs - Traditional Mobile Service providers providing sales, marketing and customer support facilities.
- MVNEs – Mobile Virtual Network Enables, they provide infrastructure and related network services for MVNOs or SPs and they do not have contact with end users.

<table>
<thead>
<tr>
<th>Name</th>
<th>status</th>
<th>Prepaid</th>
<th>postpaid</th>
<th>Network</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACN</td>
<td>ESP</td>
<td>x</td>
<td>x</td>
<td>KPN</td>
<td></td>
</tr>
<tr>
<td>AH mobiel</td>
<td>ESP</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Telfort</td>
</tr>
<tr>
<td>Amatus</td>
<td>MVNO</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td>International calls</td>
</tr>
<tr>
<td>Aspider</td>
<td>MVNO</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td>Aspider Mobile has its own proposition within Aspider Communications and focuses on the postpay market with a SIM-only proposition. Aspider works with a distribution network of 600 agents for generation of 'warm' prospects.</td>
</tr>
<tr>
<td>Ay Yildiz</td>
<td>MVNO</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td>focusing on Turkish inhabitants</td>
</tr>
<tr>
<td>Baron</td>
<td>SP</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td>focusing on high end customers, makes use of Aspiders solutions as MVNE solutions.</td>
</tr>
<tr>
<td>Ben</td>
<td>unknown</td>
<td>x</td>
<td></td>
<td>T-Mobile</td>
<td></td>
</tr>
<tr>
<td>Blyk Netherlands</td>
<td>MVNO</td>
<td></td>
<td></td>
<td>Vodafone</td>
<td>focusing on youngsters, still in prelaunch</td>
</tr>
<tr>
<td>Call4care</td>
<td>ESP</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td>focusing on charity causes, via Aspider MVNE solutions</td>
</tr>
<tr>
<td>Carey</td>
<td>ESP</td>
<td></td>
<td></td>
<td>KPN</td>
<td>charity, sim-only</td>
</tr>
<tr>
<td>Chippie</td>
<td>ESP</td>
<td>x</td>
<td>x</td>
<td>KPN</td>
<td>NL, and Antilles, via Aspider MVNE solutions</td>
</tr>
<tr>
<td>Debitel</td>
<td>SP</td>
<td>x</td>
<td>x</td>
<td>KPN</td>
<td>largest</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T-Mobile</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td>Vodafone</td>
</tr>
<tr>
<td>Dekatel</td>
<td>SP</td>
<td></td>
<td></td>
<td>KPN</td>
<td>has 20.000 subscribers</td>
</tr>
<tr>
<td>Easer</td>
<td>Brand name</td>
<td>x</td>
<td></td>
<td>Debitel</td>
<td>focusing on seniors, via KPN MVNE</td>
</tr>
<tr>
<td>Easytel Mobile</td>
<td>MVNO</td>
<td></td>
<td></td>
<td>KPN</td>
<td>international calls</td>
</tr>
<tr>
<td>Erdee Mobiel</td>
<td>MVNO</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td>sim only, via Aspider MVNE solutions</td>
</tr>
<tr>
<td>Esprit Mobile</td>
<td>MVNO</td>
<td>x</td>
<td></td>
<td>KPN</td>
<td>via Aspider MVNE solutions</td>
</tr>
<tr>
<td>Euphony</td>
<td>MVNO</td>
<td></td>
<td></td>
<td>KPN</td>
<td></td>
</tr>
<tr>
<td>Galaxy business network</td>
<td>SP</td>
<td></td>
<td></td>
<td>KPN</td>
<td>Fixed and mobile for businesses</td>
</tr>
<tr>
<td>Company</td>
<td>Type</td>
<td>Operator</td>
<td>Description</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HEMA prepaid</td>
<td>ESP</td>
<td>x</td>
<td>KPN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>InterCity Communication</td>
<td>SP</td>
<td>KPN</td>
<td>Vodafone</td>
<td>targets SMEs, offers fixed, mobile, broadband and 3G solutions</td>
<td></td>
</tr>
<tr>
<td>Internet Overal</td>
<td>MVNO</td>
<td>KPN</td>
<td>Offers service package for business customers, prelaunch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lebara Mobile</td>
<td>MVNO</td>
<td>x</td>
<td>KPN</td>
<td>Focusing on international calls for multi-ethnic groups in the Netherlands and offers info in several languages via Aspider MVNE solutions</td>
<td></td>
</tr>
<tr>
<td>Iowcall.nl</td>
<td>mobile brand</td>
<td>x</td>
<td>Debitel</td>
<td>internet services, via KPN MVNE services</td>
<td></td>
</tr>
<tr>
<td>Lycamobile</td>
<td>MVNO</td>
<td>x</td>
<td>T-Mobile</td>
<td>calling cards for abroad</td>
<td></td>
</tr>
<tr>
<td>Miles2call</td>
<td>MVNO</td>
<td></td>
<td>KPN</td>
<td>women above 40 and young people between 12 and 18 years.</td>
<td></td>
</tr>
<tr>
<td>My Dad's phone company</td>
<td>MVNO</td>
<td>x</td>
<td>Vodafone</td>
<td>offering SIM-only and postpaid plan at the t for telecom shops.</td>
<td></td>
</tr>
<tr>
<td>Ortel Mobiel</td>
<td>ESP</td>
<td>x</td>
<td>KPN</td>
<td>very cheap international calls</td>
<td></td>
</tr>
<tr>
<td>Primus</td>
<td>SP</td>
<td>KPN</td>
<td>targets many different client types ranging from telecom carriers, ISPs, ASP's, but also businesses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qick</td>
<td>ESP</td>
<td>x</td>
<td>KPN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rabo mobiel</td>
<td>MVNO</td>
<td>x</td>
<td>KPN</td>
<td>anytime, anywhere approach</td>
<td></td>
</tr>
<tr>
<td>Scarlet Telecom</td>
<td>MVNO</td>
<td>x</td>
<td>T-mobile</td>
<td>Triple play offer</td>
<td></td>
</tr>
<tr>
<td>Simpel</td>
<td>MVNO</td>
<td>x</td>
<td>KPN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simyo</td>
<td>ESP</td>
<td>x</td>
<td>KPN</td>
<td>owned 100% by KPN</td>
<td></td>
</tr>
<tr>
<td>Stream Communications</td>
<td>MVNO</td>
<td></td>
<td>KPN</td>
<td>focusing elementary on Data via Aspider MVNE solutions</td>
<td></td>
</tr>
<tr>
<td>Sympac</td>
<td>ESP</td>
<td></td>
<td>KPN</td>
<td>focusing on business customer services for international calling</td>
<td></td>
</tr>
<tr>
<td>Tele 2 Mobiel</td>
<td>MVNO</td>
<td></td>
<td>KPN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telefoon Totaal</td>
<td>ESP</td>
<td>x</td>
<td>x</td>
<td>KPN</td>
<td>Business segments, via Aspider MVNE solutions</td>
</tr>
<tr>
<td>Tok Toe Mie Mobile brand</td>
<td>Mobile brand</td>
<td>Debitel</td>
<td>Targeting young people, via KPN MVNE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tommy Telecom</td>
<td>MVNO</td>
<td></td>
<td>KPN</td>
<td>charity, sim-only, via Aspider MVNE</td>
<td></td>
</tr>
<tr>
<td>Transatel</td>
<td>SP</td>
<td></td>
<td>KPN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trendcall</td>
<td>MVNO</td>
<td></td>
<td>KPN</td>
<td>focusing on expats, via MVNE Aspider Solutions en MVNE Teleena Nederland.</td>
<td></td>
</tr>
<tr>
<td>Vectone</td>
<td>MVNO</td>
<td></td>
<td>Vodafone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes Telecom</td>
<td>ESP</td>
<td></td>
<td>KPN</td>
<td>focusing on business customers via Vodafone</td>
<td></td>
</tr>
<tr>
<td>Yiggers Mobiel</td>
<td>MVNO</td>
<td>x</td>
<td>KPN</td>
<td>Low-cost postpaid no contract duration and inexpensive handsets via Aspider MVNE solutions</td>
<td></td>
</tr>
<tr>
<td>Youfone</td>
<td>MVNO</td>
<td>x</td>
<td>KPN</td>
<td>Bills per second</td>
<td></td>
</tr>
<tr>
<td>Ziggo Mobiel</td>
<td>MVNO</td>
<td></td>
<td>T-Mobile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 6: LIST OF SERVICE ACTIVITIES IN THE MOBILE TELECOMMUNICATIONS MARKET

The service activities according to Dool, Kuysten, & Geest (2001):

- **Radio access**: access to the spectrum and the mobile network
- **Mobility management**: communication with a mobile device, and the location of the mobile device on the network,
- **Call conveyance**: routing a call from a subscriber from its own network to an access point from another provider.
- **Mobile subscriber management**: maintaining a direct relationship with a subscriber and issue a SIM-card with a number.
- **Value added services provisioning**: value added services for consumers, like Unified messaging, Personal Number and VPN.
- **Contract management**, including upgrading prepaid call minutes and billing for postpaid consumers.
- **Sales**: including marketing, and combining with other sales services.
Is it necessary to separate antenna-sites from the mobile network operators?
APPENDIX 7: LAWS AND REGULATIONS

The antenna policy: The antenna policy note is an inter-departmental policy, which means that different departments within different ministries are responsible for implementing the policy. Unlike the frequency policy, the antenna policy is shattered between the different departments (Dialogic, 2005). Also, the goal of the antenna policy is different than that of the frequency policy and the telecommunication act.

The "Gedragslijn voor medegebruik van Rijksobjecten" had the goal to decrease the need for antenna-sites. Nevertheless, according to the evaluation of the antenna policy, it increased the antenna-site demand because if an operator does not succeed in placing an antenna in the "right" spot, then the involvement of the national government is according to dialogic (2005) decreased since 2002 when the antenna-covenant became active. The ministry of economic affairs became more involvement since 2004, because of the increasing societal concerns about antennas.

The societal concerns about the effect of antennas has increased since the COFAM research, short after the UMTS frequencies auction.

Limitation by the law, a contrast of the law is the fact that site-sharing is obliged only if there is a construction license needed for an antenna-site. Moreover, gaining a license for an antenna-site higher than 5 meters is becoming even more difficult due to municipalities local policies. The result of all this means that it became relatively easier for operators to build antenna-sites under 5 meter, which is a pollution for the spacious area and also not competitive, as operators are not obliged to share the "small" antennas.

The most important documents that have affect on the way laws and regulations around antenna-sites are arranged, are the National antenna policy (NAB) and the antenna covenant, where all issues are arranged around antenna-sites that are shorter than five meters. In the second place, the frequency policy has also a large influence on the way antenna-sites are arranged.

The antenna bureau is a government bureau that is institutionalized to inform and advise the public in issues around antennas. Issues such as, new laws, health problems, the rights and obligations of the different stakeholders around antennas. Furthermore, the bureau keeps a count of the number of antennas in The Netherlands.

The regional governments have also written policy concerning antennas. It is mainly about where and where not to build a mast.

In the legal database OPMAAT SDU, many law cases were found that were involving antennas, antenna-sites or one of the mobile telecom operators. Also site-sharing was used as a keyword for searching. Many cases were found were involving antenna-sites for the Radio/TV sector.

Most law cases that were involving antenna-site for mobile telecom, had the subjects of building permits; concerning giving a permit or not by the municipality, lease disputes; for example if there is no permission asked from inhabitants or when a GSM rent contract is used for UMTS, the estimation of values of the antenna and antenna-sites and finally whether antenna-sites are considered property (onroerende zaak). Many of these law suits are concerned with health issues. Also there are cases about estimating a property value when an antenna-site is built on its roof. At first glance, it seems that the number of disputes is quite
It is necessary to separate antenna-sites from the mobile network operators? (230) comparing to the number of antenna-sites (1+/− 15000). However, these disputes show the trend and the kind of relation between network operators and building owners, - inhabitants and municipalities.

There are three important policy documents that are specially designed for the antenna-site level. These documents are:

- The frequency policy
- The antenna policy
- The antenna covenant

All these three documents are not laws so, they will be compared to each other as follows, a distinction will be made between the following points; goals, responsibility division and field application. The first document to be discussed is the frequency policy (2005).

The frequency policy note of 2005 defines the way spectrum is traded to the end users. There are three domains of spectrum that is to be traded by the Ministry of Economic Affairs; the public domain, the license domain, the license-free domain.

Each of these domains is treated differently in matter of trade to end users. The license domain is the most important for this research because of the UMTS and GSM licenses that are relevant to the antenna-site as such.

At the end of the comparison, a short analysis of what these rules and regulation mean for the current and future market situation mean and what are the consequences of the current policy. In the recommendation and conclusion section some remedies for the current policy are offered.

European policy background

In the European White book the EU community, it became clear that in order to reach the intern European market, consensus must be reached in the liberalization, standardization, and harmonization in the telecommunication sector.

More specific European policy documents were written to utilize the full potential of the telecommunication sector in Europe. Unity and standardization of the mobile network standards and the mobile devices were the first two things dealt with by the EC. The liberalization and privatization of the PTTs was the next step. Regulations for the mobile telecommunication sector in the Netherlands is inspired by European regulation. The first important policy document by the European commission is the Green book Telecommunication in 1987.

The Green book specifies regulations to create a European mobile communication system that works in all Europe. This does not include only finding standards and devices that work in all countries, but also roaming agreements. In 1994 five important changes on the Green book on the mobile communication were implemented:

- abolition of all exclusive or special (unusual) rights in this sector
- removal of limitations on offering mobile services in the EU
- complete freedom for exploiting mobile networks in order to develop own infrastructure
- complete freedom for exploiting mobile networks in order to use own infrastructure (or that of others if one does not have access to the micro golf connections) for internal connections in their network

Dutch laws and policy document that concern antenna-site are the following:

- Convenant over vergunningvrije antenne-installaties voor mobiele communicatie;
- Wet op de ruimtelijke ordening;
- Woningwet;
- Wet Milieubeheer;
- Monumentenwet;
- Telecommunicatiewet;
- Arbeidsomstandighedenwet/Arbeidsomstandighedenbesluit;
- Aanbeveling 1999/519/EG van de Raad van Ministers van 12 juli 1999;
- Richtlijn 99/5/EG (CR & TTE) van het Europees Parlement en de Raad van Ministers van 9 maart 1999;
- mutual recognition of standards and approval on type of devices and coordination of licenses in order strengthen the pan-European mobile networks.

As explained in the analytical framework, the mobile telecommunication sector is one of the sectors that are faced with much regulation, due to the characteristics of this sector. The ministry of Economic Affairs tended to increase competition in all utilities, including telecommunication. Economic affairs has created institutions to make sure that competition in this sector will prosper; the OPTA is the Dutch NRA and is an independent institution that supervises the competition in the telecom sector.

Laws for the mobile telecommunications market

The telecommunications sector, and so also the mobile telecommunications, is influenced by rules and regulations on both European and national level. The condition to free movement of goods and persons is one of the fundamentals of the internal European market. Therefore, in 1984 the White book\(^{18}\) was formulated by the European Commission to realize these condition. Soon, the EC realized that telecommunications is an important sector in the EU, therefore in 1987 the Green book\(^{19}\) was formulated in order to realize the condition of free movement of goods and persons in this sector. In the Green book, policy instruments were formulated to privatize, liberalize and harmonize the sector in all involved countries. The movement of the role of government from regulator to supervisor was already mentioned in the theoretical framework. This applies to most of European countries.

The national regulations is thus inspired by the European regulation. It began with the PTT (KPN now) in the Netherlands in 1989, followed the privatization of KPN after the publication of the European guideline for open network provision (ONP).

Inspired by the European regulatory framework, the Dutch government opened up the mobile telecom market in 1995, realized easier entry to the fixed telecom market by changing the telecom Act (1998) and finally changing the telecom Act again in 2004 after new European laws appeared in 2002.

The national government plays a crucial role in the creation of the current telecommunication market, as access to spectrum the number one condition to enter this market. The government auctioned both GSM and UMTS licenses to enable firms to exploit the radio spectrum in The Netherlands. The GSM auction has resulted in the creation of five network operators and the UMTS auction has resulted in the same number of players. This year, another radio frequency will be auctioned, the 2.6 GHz frequency, which will probably lead to the entrance of new players in this industry.

They have several functions and goals. Their main goal is to look after the residents of their cities/villages. The municipalities are responsible for granting a permit to build mast towers and antenna-sites above the height of five meter. Moreover, they make sure that the permit free antenna-sites are placed to conform the antenna covenant.

\(^{18}\) European rules
\(^{19}\) European rules for telecommunications
Is it necessary to separate antenna-sites from the mobile network operators?
APPENDIX 8: TECHNOLOGICAL BACKGROUND INFORMATION

TECHNOLOGICAL TERMINOLOGY
In order for one to be able to make a phone call on his mobile phone, the phone needs to send and receive signals to a base station (antenna), with other words; the device needs to be able to communicate with the nearest base station. This is generally the idea. Currently, there are two networks in The Netherlands that are most used for mobile communication, these are the GSM network and the UMTS network. UMTS offers better solutions.

The radio spectrum
The electromagnetic spectrum is endless, only part of it is useable for mobile telecommunications. This part is the range between 9 kHz to 1000 GHz (EZ) and it is called the frequency spectrum (EZ). There are some basic properties one needs to know about the spectrum in general:

- the higher the frequency, the shorter the distance it can cover,
- obstacles like houses and low buildings become a problem with high frequencies.
- Information capacity is also called band width
- The greater the information capacity, the larger the band width
- The information capacity however increases with high frequencies
- therefore, the higher the frequency, the larger the band width.

A part of the spectrum is used for mobile communication. This band is divided into small plots that are suitable for certain services. The kind of services for each band is roughly world-wide agreed on. This is arranged by the ITU. The radio spectrum is scarce and therefore the government is responsible for dividing the plots for each band.

Table 29: Allocation of the Dutch mobile spectrum | NMA/OPTA (2006)

<table>
<thead>
<tr>
<th></th>
<th>GSM900 licenses till 2010</th>
<th>E-GSM licenses till 2013</th>
<th>DCS1800 licenses till 2013</th>
<th>UMTS licenses till 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPN</td>
<td>12.4 MHz</td>
<td>5 MHz</td>
<td>35 MHz</td>
<td>60 MHz</td>
</tr>
<tr>
<td>Vodafone</td>
<td>11.4 MHz</td>
<td>-</td>
<td>5.2 MHz</td>
<td>35 MHz</td>
</tr>
<tr>
<td>Orange</td>
<td>-</td>
<td>5 MHz</td>
<td>15 MHz</td>
<td>25 MHz</td>
</tr>
<tr>
<td>T-Mobile</td>
<td>-</td>
<td>-</td>
<td>16.8 MHz</td>
<td>25 MHz</td>
</tr>
</tbody>
</table>

Communication technologies

The most used technologies of mobile telecommunications are currently GSM and UMTS. GSM and UMTS are technologies that use different parts of the frequency spectrum. GSM is mostly used for voice mobile services, whereas UMTS can be used for both voice and non-voice mobile services. Also the antenna-sites market that is analyzed in this thesis is the market of antenna-sites that are used for GSM and UMTS transmission. The allocation of GSM and UMTS bands took place through auction. Let’s take a moment to zoom in on some of the specific properties of GSM and UMTS.

GSM is originally a European standard for mobile phone communication. Lately, it became a world-wide standard. Thus, end users are able to use their mobile device all over the world by means of roaming. In the Netherlands, the frequency bands used for GSM are the 900 MHz band and the 1800 MHz band (1710-1785 and 1805-1880 MHz). To enable a telephone call, the mobile device should be able to connect to the base station (uplink) and vice versa (downlink). These communications take place in different bands, the 900 MHz band makes for example the frequency of 890-915 MHz for the uplink and 935-960 MHz for the downlink. The GSM bands are divided between five telecom operators; KPN, Libertel (Vodafone), Telfort (O2), Dutchtone (Orange) and Ben (T-mobile). This means, that only these five firms have licenses to exploit the GSM network.

UMTS is also an ITU standard that is part of the IMT 2000 family. IMT 2000 standards are all called third generation technologies (3G). According to TNO (2007) the IMT 2000 family consists of:

- UMTS FDD with HSPA
- UMTS TDD
- UMTS LTE (future technology)
- CDMA2000 1xEV-DO, Revisions A and B

The special thing about UMTS technology regarding to GSM, is that UMTS makes it possible to send and receive data with higher speed, theoretically up to 2Mbit/s, which is comparable to a fixed internet connection at home.

UMTS networks work slightly different compared with GSM networks. The mobile device communicates with the fixed telecommunication network via an antenna. UMTS works moreover in both TDD and FDD, while GSM is only suitable for FDD. FDD makes used of two bands, the first is responsible for communication between the mobile device and the base station and the other for vica versa. (two-way traffic) TDD, on the other hand separates the two-way traffic by time instead of allocating a specific band.

The network, moreover, is build of macro-cells to cover the larger distances and smaller ones for the cities.
To prevent jamming with other networks, the device and the base station communicate on a certain frequency band. Like radio communications.

Different technologies use different bands. The radio and TV communicate on a different level on the spectrum than mobile phone or "mobile internet".

Telecom operators of the 3G technologies need paired linked

**Antennas and frequencies**

The antenna sends and receives signals to and from the mobile device. The antenna is moreover connected to the fixed network through the antenna-site equipment. Depending on the frequency that is used and the distance that it should cover, certain transmitting power is needed. This power is bundled and is transmitted horizontally from and to the antenna. It is comparable to light bundles, the further you want to shine, the more powerful the light source should be. (VROM)

The height of an antenna depends on the frequency it must work with. Ideally, an antenna should be a fourth part (quarter) to half of the wavelength. So the height of an antenna for the 900 MHz (GSM) is 9x shorter than that of the 100MHz (Radio)

Two things are important in the roll out of a mobile communication network, which are the **range** and the **capacity**. Range means how far a signal can be reached, which is circle diameter around the transmitting equipment. The higher the frequency, the lower the range. Capacity stands for the number of calls that the frequency band can handle per time unit. Traffic

Radio planning goes beyond mobile telephones for consumers, radio and TV stations, national alarm, communication between trains, ships and airplanes and space communications. This research focuses on the mobile communications for the consumer and business market.

**The antenna**

The antenna sends and receives signals to and from the mobile device. The antenna is moreover connected to the fixed network through the antenna-site equipment. Depending on the frequency that is used and the distance that it should cover, certain transmitting power is needed. This power is bundled and is transmitted horizontally from and to the antenna. It is comparable to light bundles, the further you want to shine, the more powerful the light source should be.

Antennas come in different forms and shapes; however, first of all, it is important to define the difference between an antenna and an antenna-site.

According to TDL (2006) report, an antenna-site could be a mast, a location on a roof or a location on a church tower. On each antenna-site, one or more antennas could be situated and each antenna is made of one or more components, or panels. There are generally two kinds of antennas; the first consists of one component that is able to beam radio signals at 360 degrees, which is also called the “round beamer”. The second kind is made of three components, each of is able to beam radio signals at 120 degrees. The three panels could be placed near each other, but it is also possible that the panels are placed hundreds of meters of each other in order to have the perfect composition sending and receiving. In all situations, the composition of the panels is mostly counted as one antenna. This is the case for antennas that are used for GSM and UMTS, which is mostly the focus of this research.

The WiMAX antenna shows a high resemblance with the UMTS antenna, according to TDL. The antenna is however a bit smaller and therefore more discreet. It is possible that the resistance against antennas will be less with WiMAX antennas; however, no research in this area has been done yet.
Is it necessary to separate antenna-sites from the mobile network operators?
Glossary

Antitrust Laws in US = Competition law in EU: Laws designed to promote or maintain competition

Asset Specificity: Assets here include either capital goods or workers’ skills. Specificity refers to a situation in which the capital goods or the workers’ skills are useful for only a small number of tasks and cannot be transferred easily to other tasks.

Barriers to entry: Porter’s definition of entry barriers: The cost of entry will also depend importantly on barriers to entry into the industry. Entry barriers are features of an industry that give incumbents inherent advantages over potential entrants.

Beauty contest: A beauty contest is a comparative selection procedures which is used to distribute spectrum licenses. A number of candidates is invited to apply for a license and only one is chosen on the basis of criteria set by the institution organizing the spectrum distribution.

Collocation: Ability for other operators to install equipment in the incumbent’s local switches in order to supply services over the incumbent’s local loop (Bijl, P. d., Peitz, M., & CPB. (2000).

Copper line: Main transmission medium to connect a telephone to a local switch. Copper lines are “slow,” that is, have narrow bandwidth unless combined with an enabling technology such as ADSL (Bijl, P. d., Peitz, M., & CPB. (2000).

Customer access network: Network connecting end-users’ telephones and local switches (sometimes also referred to as local network, local access network, local loop) (Bijl, P. d., Peitz, M., & CPB. (2000).

Digital dividend: Part of the spectrum from 174 to 230 MHz (VHF) and 470 to 862 MHz (UHF).

Dynamic Economic Efficiency: rate of entry and exit over time in a market.

Economies of Scale: As the quantity of the product produced increases, the amount of capital can increase. With a greater amount of capital, the cost per unit of producing the product falls. In simpler terms, larger companies can produce a product at a lower cost per unit than smaller companies Scale economies are “the degree of scale economies at y is S = C(y)/yC’(y) =AC (y)/C’(y) =(average cost) / (marginal cost). Return to scale are increasing, constant, or decreasing as S is greater than, equal to, less than unity”. Baumol et al. (1982) p. 21 Economies of scale is defined as “unit costs decline as outputs increases. Oster (1999) p. 413.

Economies of scope: Costs of production of two lines of business run together are less than the sum of each run separately. Oster (1999) p. 413

Economies of Scope: The costs of production are likely to be lower if a company produces several different products but these products use a common technology or common marketing channels.

Facilities-based competition (FBC): Competition between operators such that entrants build their own facilities, in particular customer access networks (Bijl, P. d., Peitz, M., & CPB. (2000).

Fixed telephony: Telephony over a network with fixed connections to end-users, in the sense that the locations of endpoints are geographically fixed. Usually, the connections consist of wires (“wireless local loop” is an exception) (Bijl, P. d., Peitz, M., & CPB. (2000).

Frequency: Number of electromagnetic waves which pass a certain point over a given period of time (generally 1 second). It is equivalent to the speed of light divided into wavelengths and expressed in Hz - Hertz (cycles per second) or multiples - KHz (KiloHz), MHz (MegaHz), etc.

Interconnection: Linking of telecommunications networks in order to allow the subscribers of one operator to communicate with subscribers of another operator, or to access services provided by another firm (e.g. an operator or an internet service provider) (Bijl, P. d., Peitz, M., & CPB. (2000).
Long-run Average Total Cost: The cost per unit of producing every possible quantity of the product, allowing the company to produce with the amount of capital that can produce that given quantity as cheaply as possible.

Long-run Equilibrium: A condition in which the economic profits are equal to zero. There is no incentive for new sellers to enter the industry nor for existing sellers to exit the industry.

Long-run: A period of time in which all factors of production are variable.


Marginal Revenue: The addition to total revenue from producing and selling one more unit of the product.


Mobile telephony: Telephony over a network with mobile connections to end-users, in the sense that the locations of endpoints are not fixed geographically. End-users use mobile handsets to connect to the network (Bijl, P. d., Peitz, M., & CPB. (2000).

Monopolistic Competition: An industry with one seller but a very elastic demand for the product. There are many sellers. The buyers and sellers have perfect information. And there are no barriers to entry. The difference is the fourth characteristic: in perfect competition, the products are identical whereas in monopolistic competition, the products are differentiated.

MVNO Een mobiele virtuele netwerk operator (mobile virtual network operator of MVNO) is een aanbieder van mobiele diensten die netwerkcapaciteit huurt van een MNO.


Oligopoly: An industry in which there are few sellers --- few enough that each seller has an ability to affect the price.

Perfect Competition: An industry in which there are so many sellers that no one can affect the price individually, in which there is perfect information, in which there is easy entry into and exit from the industry, and in which the products of the sellers in the industry are identical.

Radio spectrum: the radio spectrum is only a relatively small part of the electromagnetic spectrum, from 3 Hz to 300 GHz. In line with the range of frequencies, the radio spectrum is divided into frequency bands and sub-bands. These waves enable, for instance, the transmission of mobile communications and fixed wireless communications.

Short-Run: A period of time in which at least one factor of production (usually capital or land) is fixed. This means that we have our business in its present form and plan to continue in this manner.

Telecommunications network Transmission: systems, switching equipment, and signaling systems, permitting the conveyance of signals by wire, radio, optical or other electromagnetic means (Bijl, P. d., Peitz, M., & CPB. (2000).

Telecommunications: Conveyance of data (e.g., voice and other sounds, visual images) by wire, radio, optical or other electromagnetic means (Bijl, P. d., Peitz, M., & CPB. (2000).

The Ministry of Transport, Public Works and Water Management (VenW) is one of the thirteen ministries which make up the national government. The ministry consists of the policy departments and executive departments, as well as the Directorate-General for Public Works and Water Management (Rijkswaterstaat), the Transport, Public Works and Water Management Inspectorate (Inspectie Verkeer en Waterstaat) and the Royal Netherlands Meteorological Institute (KNMI).
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