

Flexible multi-wavelength hybrid fibre access networks supporting quality of service

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Flexible Multi-Wavelength Hybrid Fibre Access Networks supporting Quality of Service

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Presentation outline



- **Convergence of access networks**
- **Flexible WDM in hybrid fibre access networks:
the *HARMONICS* concept**
- **Access network protection**
- **Field trial**
- **Conclusions**

Upgrading access networks



Trends in access networks

- large and increasing variety in signal formats and last-mile media, a.o.
 - POTS, N-ISDN, xDSL over TP
 - CATV, FM radio, telephony, datacom over coax
 - GSM, DECT, LMDS, MMDS, UMTS over wireless
 - in-house POF
 - fast growing capacity demand (second phone lines, internet data, mobile users, ...)
 - new operators seeking transport capacity (e.g., by hiring network capacity)
 - IP becoming the universal customer gateway, evolving to QoS differentiation
- ⇒ upgrade capacity and strive for convergence of access networks
- + bring fibre closer to the customers → **hybrid fibre access networks**, with fibre feeding various last-mile networks
 - + upgrading capacity while protecting investments in fibre plant → **WDM**
 - + forecast-tolerant and flexible capacity provisioning → **dynamic wavelength routing, with QoS awareness**

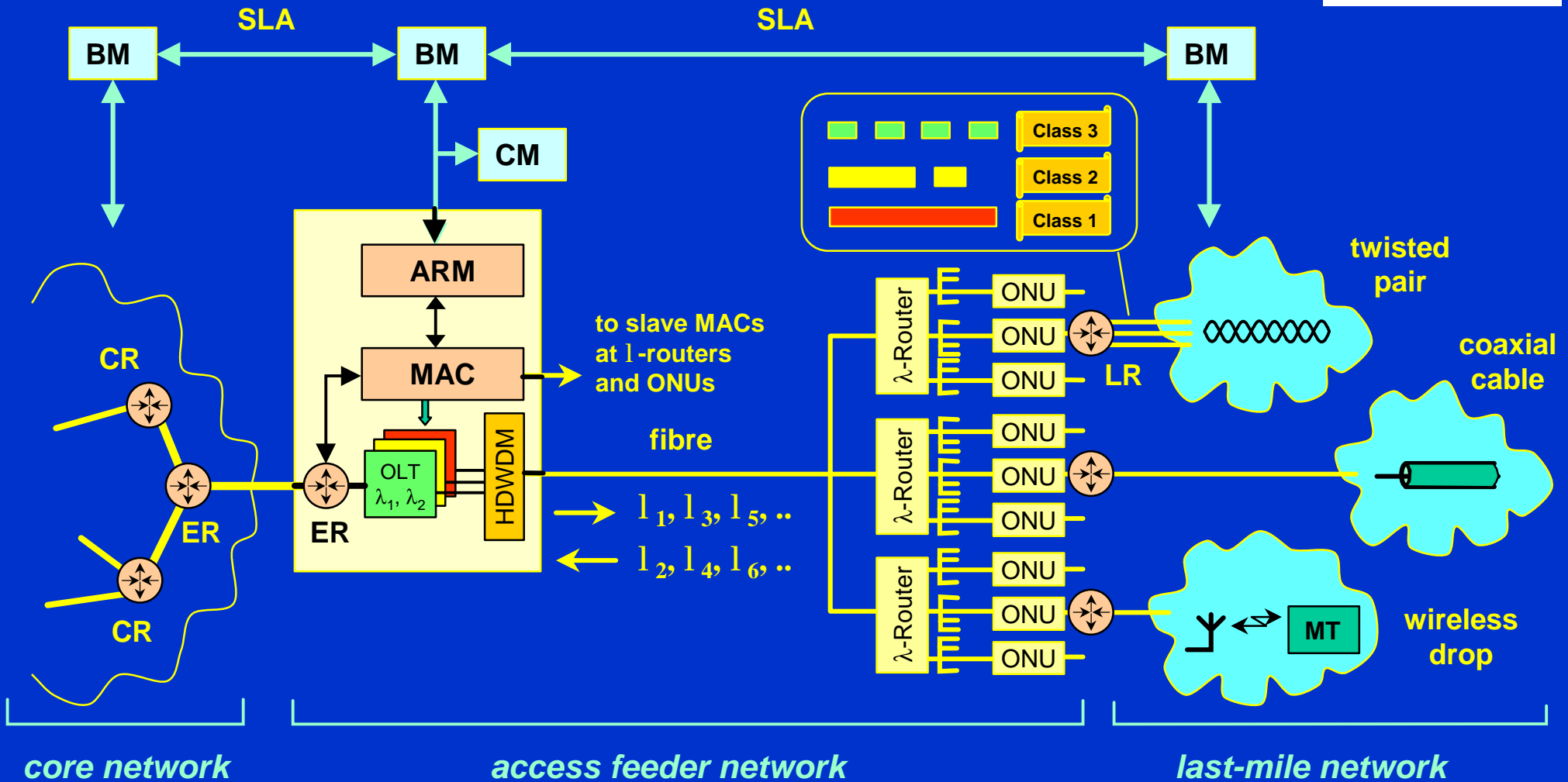
The HARMONICS project*



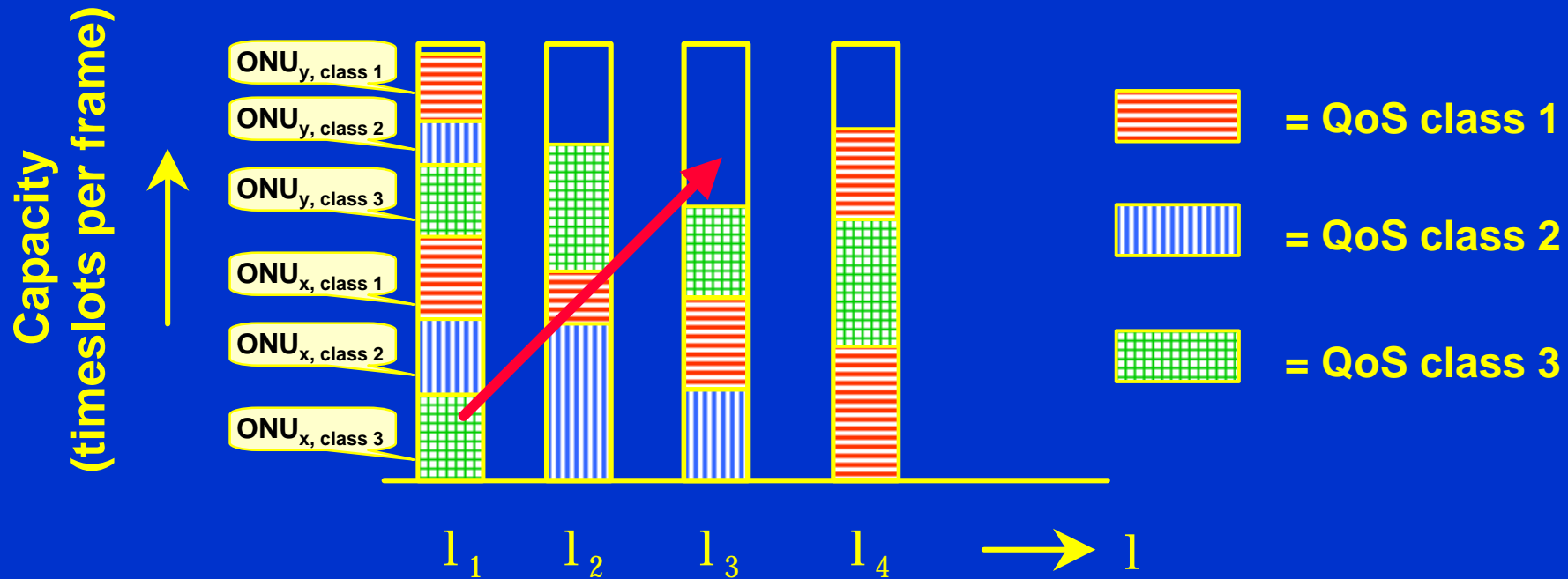
*Promote the convergence of access networks,
by devising*

- **dynamically reconfigurable fibre network, feeding wide variety of last-mile customer access networks + wide variety of services**
- **packet-based WDMA/TDMA MAC protocol offering capacity-on-demand**
- **control plane protocols supporting QoS classes of IP-based services**
- **network protection switching**
- **field trial with real IP-based services and real users**
- * Hybrid Access Reconfigurable Multi-wavelength Optical Network for IP-based Communication Services

Handling different service classes in Hybrid Access Networks

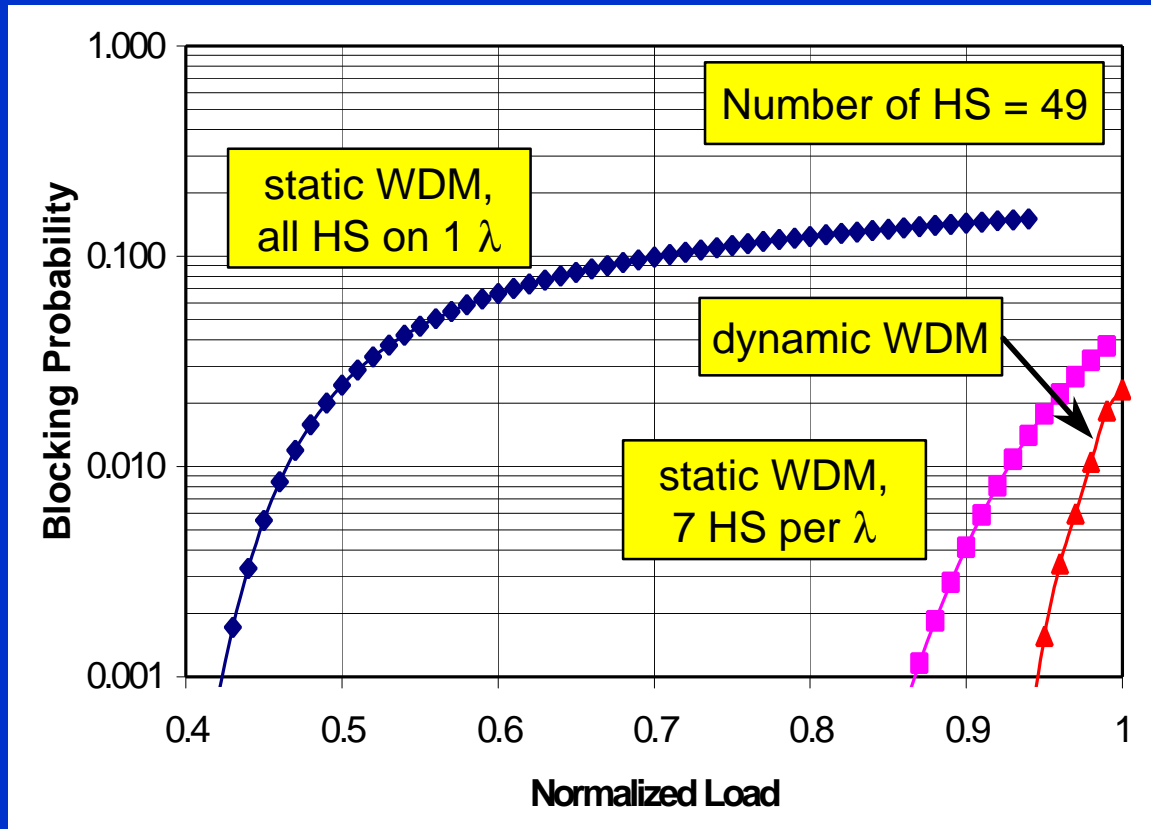


Dynamic wavelength routing taking QoS levels into account



- good support for traffic hot spots
- good support for mobility
- efficient use of traffic handling capacity
- fast WDMA/TDMA MAC protocol needed

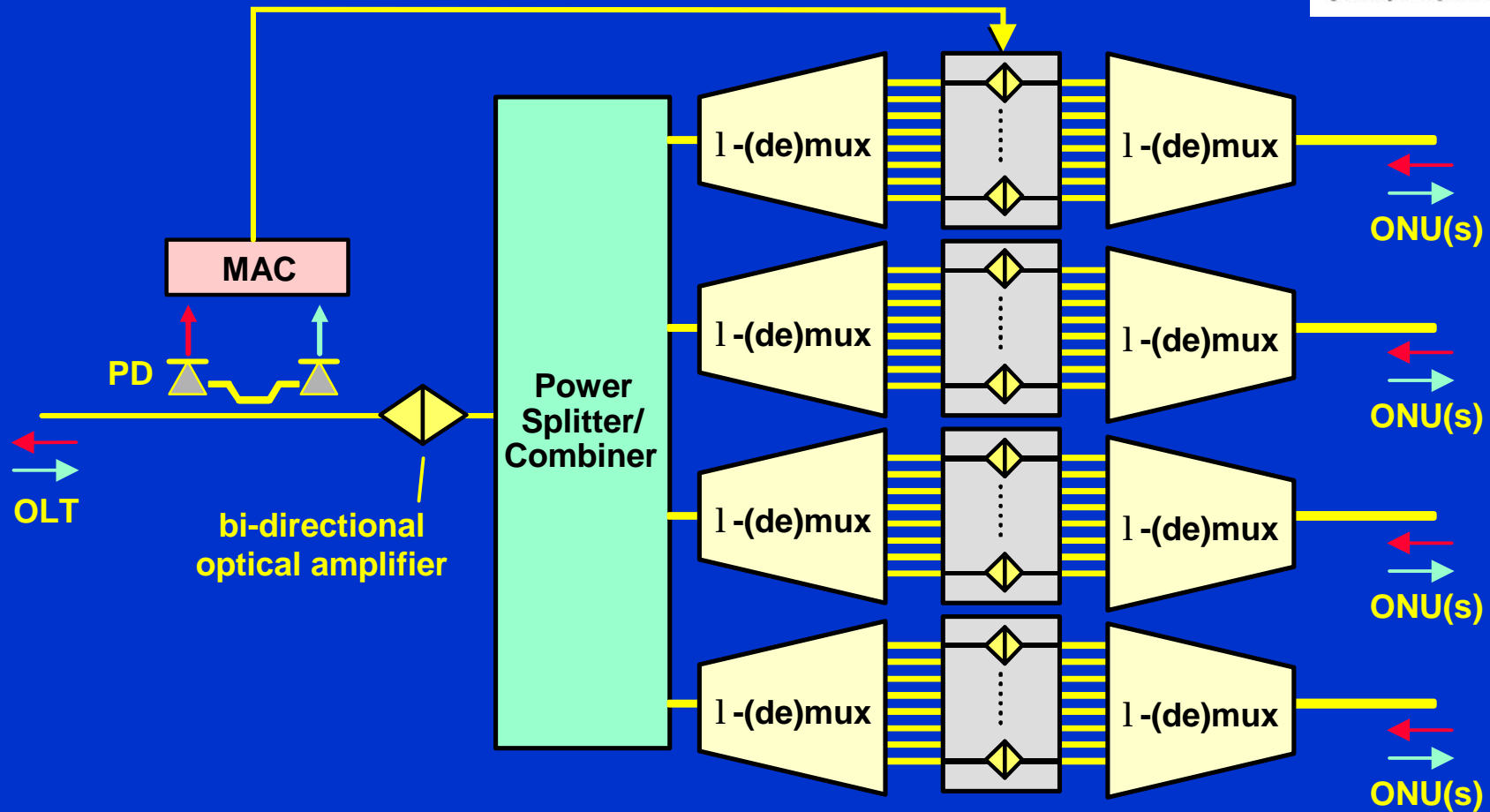
Impact of λ -reallocation



- HS : number of cells which are “hot spots”
- assumptions :
 - 7³=343 cells,
 - 7 wavelengths,
 - Poisson call arrivals, uniformly distr. call duration and BW,
 - traffic load of “hot spot” is 4 times that of regular cell

dynamic λ -reallocation reduces blocking probability, in particular for unknown “hot spots” distributions

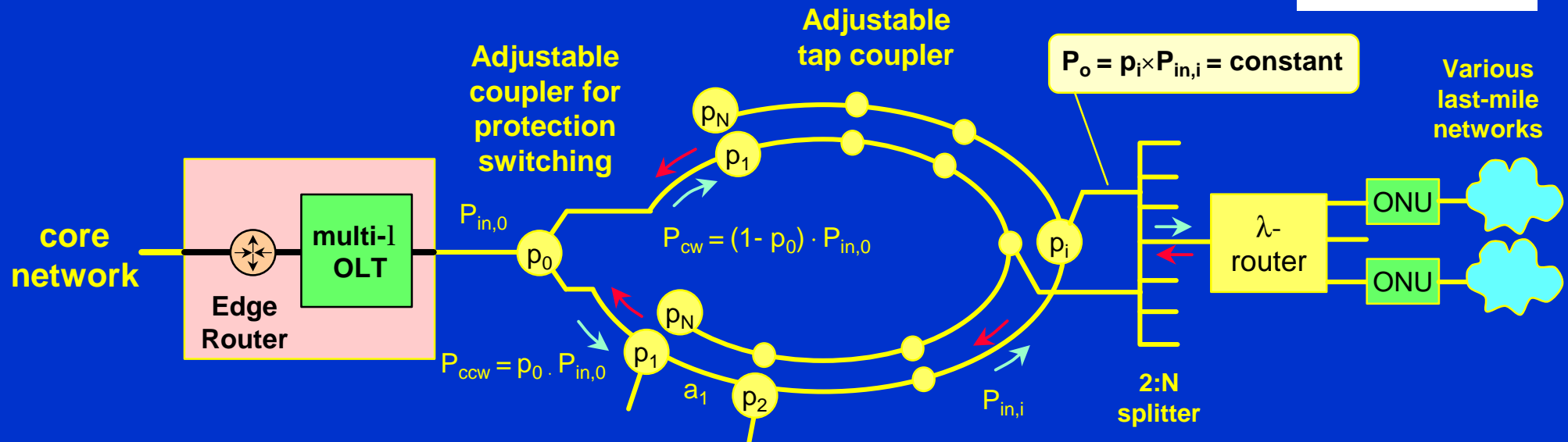
Fast Flexible Wavelength Router



- using fast SOA gate arrays
- provides also wavelength multi-casting

SOA gate
arrays

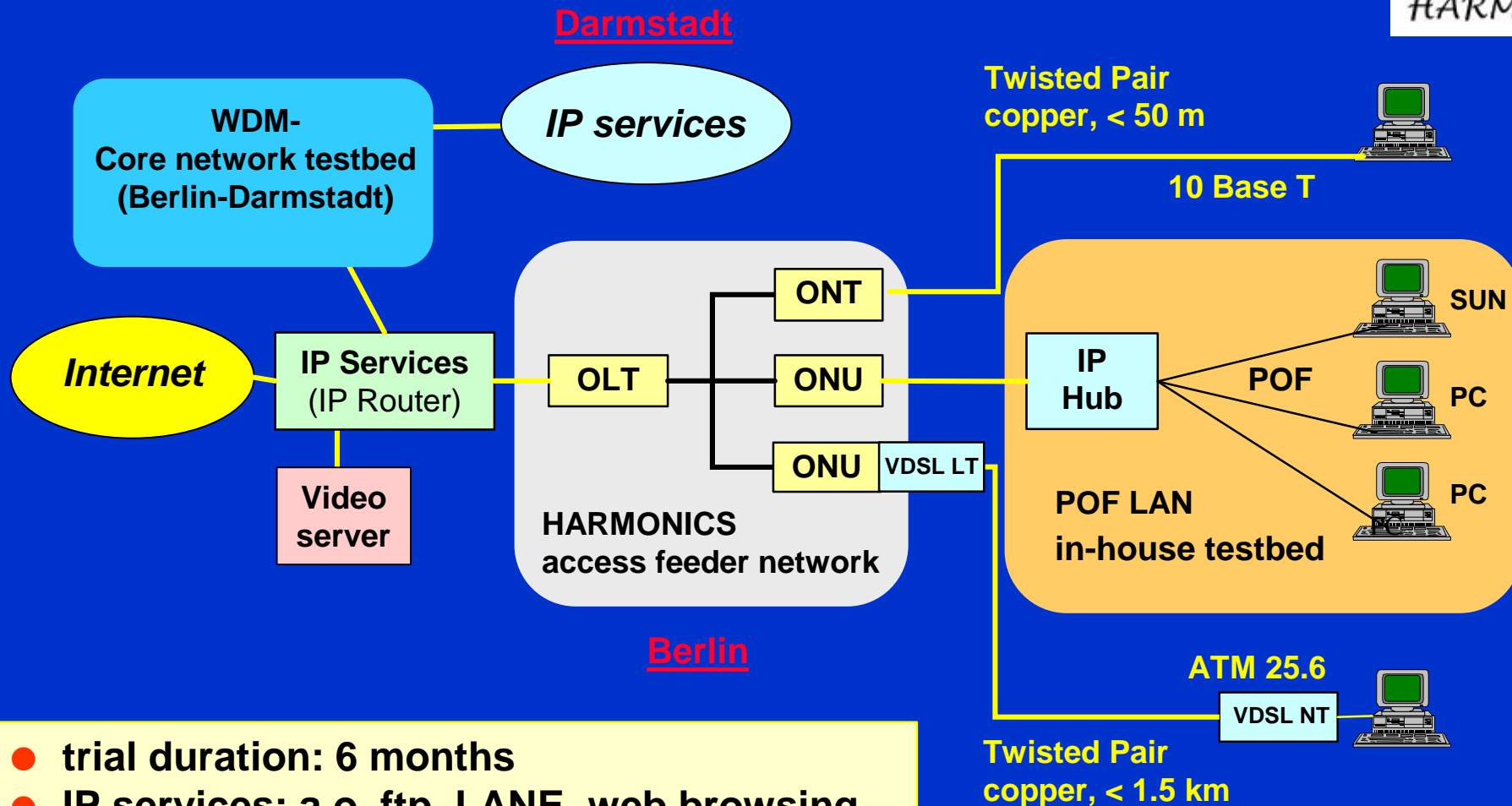
Network protection



tap coupler drop factors:
$$p_{i-1} = 1 - \frac{1}{1 + a_{i-1} \cdot p_i} \quad \text{with } i = 2, 3, \dots, N \quad \text{and } p_N = 1$$

- Double fibre ring protection
- Easy scaling and network maintenance

Field Trial



- trial duration: 6 months
- IP services: a.o. ftp, LANE, web browsing, VoIP, video/audio on demand, video conf.

Conclusions



- **By deploying multiple wavelengths in the fibre feeder of hybrid access networks, a wide variety of independent services and/or operators can be hosted**
- **Flexible wavelength routing enables dynamic reconfiguration of these networks, thus supporting QoS differentiation and improving the operation efficiency (e.g., for handling ‘hot spots’)**
- **Network protection by a double fibre ring and adjustable power taps yields an easily scalable and maintainable network**
- **The viability of the system architecture will be shown in a field trial, with IP-based QoS-aware services**

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more info: <http://www.ist-harmonics.net/>