MS8: DISCUS End to End Architecture Review

Following on from deliverable D2.1 and the architecture update in deliverable D2.3 the DISCUS architecture remains fundamentally as originally proposed at the beginning of the project: consisting of LR-PON for access and backhaul to a relatively small number of metro-core nodes, interconnected with a flat optical core network forming an optical island mesh of optical light paths.

Although the original architectural concepts have remained largely intact, there have been significant developments improving the design concepts and verification of the design objectives from work carried out over the first two years of the project.

We see finding rural solutions, that minimise the level of government subsidies required, as a critical DISCUS objective which removes the digital divide between customers in dense urban areas and those living in remote and sparse rural areas. The importance of the rural solution has led to improved designs for sparse rural areas using the idea of open ring or cable chain structures and more efficient final splitter layouts to minimise drop costs.

The open ring /cable chain designs allow re-use of today's legacy ring topologies deployed during the SDH/SONET era and also enables resilience and optical fibre monitoring techniques to be employed economically for at least the backhaul portion of the LR-PON.

An important part of the LR-PON design for both rural and urban solutions is the design and choice of technology for the amplifier node. It is still envisioned that the early systems would use established EDFA amplifier technology operating in the C-band. However we have also studied the options of using SOA amplifiers that would enable expansion of future capacity outside the C-band and exploitation of all other optical windows. The SOA solutions require more amplifiers and a more complex amplifier node design. However this increased complexity can be offset by the greater level of integration offered by SOA technology.

Upgrading the LR-PON to higher speeds and delivering core transmission speeds as point to point links across the LR-PON fibre infrastructures have also been pursued over this review period. Developments of the 40Gb/s upgrade of the downstream direction of the rural design of the LR-PON show that by using an SOA pre-amplifier at the ONU, a 512 way total split can be supported making it compatible with the infrastructure of the 10Gb/s TDM OOK LR-PON channels. 100GB/s point to point transmission over the LR-PON infrastructure using DP-QPSK modulation scheme has been simulated. The analysis shows that with appropriate FIR filter designs 100GB/s transmission can be achieved with at least 512 way split and up to 160km total distance. This is sufficient for many practical application situations for point to point links from one LR-PON to another LR-PON through the optical switch at the metro nodes and across a core light path through the core network without regeneration.

DISCUS has continued to keep a watching brief on coherent access technologies as a future upgrade strategy for the WDM /TDM hybrid LR-PON. There are no special requirements of the LR-PON design foreseen as these systems should work over the same infrastructure and be coupled into the LR-PON in defined wavebands via the access and optical switching layer within the DISCUS Metro-core nodes.

The metro-core node and core network design is now envisage as a two-layer architecture with a packet processing layer and an optical "light path" layer which provides high capacity transparent interconnect between the metro-core nodes. The use of the packet layer enables coexistence with the OEO design used today where traffic demand does not justify full light path interconnect. Sub wavelength grooming using add drop multiplexers is thus a sensible intermediate option until evolution of greater numbers of transparent light paths justifies full "optical island" interconnect. The concept of the optical island has also been more rigorously

defined without becoming religiously dogmatic about the definition. An optical island is now defined as the set of metro-core nodes interconnected via optical light paths where an optical light path is an optical path between two metro nodes without any packet processing at intermediate nodes that it might traverse along its physical route. To facilitate the reach and capacity of the light path routes and to minimise or eliminate the use of regenerators the use of sparse Raman amplification has been introduced. If some long distance links are still required then the optical island definition now includes the idea of a "translucent" network, which allows a sparse population of possible light paths through the core network which use regenerators when the more extreme link distances are encountered. We believe occasional use of regenerators is better than sticking to a rigorous definition of the optical island having only transparent light paths (with no regeneration). This could require the core to be unnecessarily split into smaller less optimal optical islands.

Overall the architectural review concludes that the basic architectural concept of the DISCUS project is still correct and viable and will be the most cost effective and scalable solution to meet the potential huge demands for network capacity in the future.