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Initial Report on Proposals for Standards Activities and Priorities

Dissemination Level: Public

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  PU = Public,
  RE = Restricted to a group specified by the consortium (including the Commission Services),
  PP = Restricted to other programme participants (including the Commission Services),
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Abstract:

This deliverable reports on proposals for standards activities and priorities.

First a high level overview of the DISCUS network and a comparison with current networks is described. Then an overview on the standards involvement of DISCUS partners is given. The standards groups' area of technical work as well as the processes to submit and retrieve information is described. Finally areas of potential interaction with standards groups are given.

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Other Beneficiaries			
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3	Coriant	COR	Germany
4	Telefonica Investigacion Y Desarrollo SA	TID	Spain
5	Telecom Italia S.p.A	TI	Italy
6	Aston University	ASTON	United Kingdom
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TABLE OF CONTENTS

1 Introduction

For the project DISCUS it is important to be informed on standards related to the existing core, metro and access networks and to inform standards bodies on the results of the project towards a new network structure as researched in DISCUS.

The work in DISCUS will for sure go in many aspects beyond what is defined in current standards. But as a new network structure requires a huge investment, it makes sense to carefully look what parts can undergo a smooth evolution of the current network based on existing standards and what part would need a disruptive approach.

This deliverable reports on DISCUS's strategies and planned interactions with standards.

2 High level overview of the DISCUS architecture and concepts

The DISCUS project aims to produce a cost-effective architecture for ubiquitous broadband services, building on optical-centric solutions such as Long-reach passive optical access and flat optical core, in order to reduce the total amount of electronic processing carried out in the network. The proposed architecture is shown in Figure 1.

Long reach passive optical network (LR-PON) is an evolution of well-known PON technologies (e.g., Ethernet passive optical network (EPON) and Gigabit passive optical network (GPON)), developed to minimise equipment and infrastructure by multiplexing traffic from customers onto a single fibre as close to the customer premises as possible.

By introducing a longer fibre reach from the user to the network node (which we will refer to as DISCUS Metro-Core node), and a larger split in the distribution network, LR-PON can serve a much larger number of customers using similar infrastructure.

In addition the longer optical reach (over 100 km has been experimentally demonstrated), allows concentrating fibre terminations from many PONs in a smaller number of "DISCUS" Metro-Core nodes, each covering large areas. Thus, a substantial number of nodes deployed in current telecoms networks, which carry out electronic packet switching and processing, can be consolidated as long reach access systems can by-pass local exchanges and terminate directly on a core node.
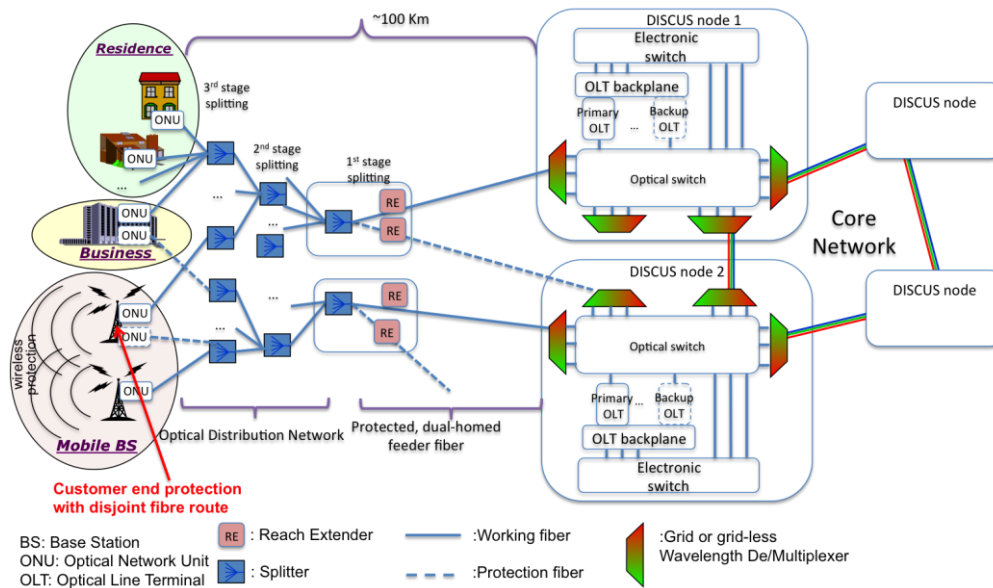
Figure 1 DISCUS initial architecture, based on Long-Reach Passive Optical Network access and flat optical core.

The DISCUS node is a core edge node providing the only electronic packet processing interface between PONs and core transmission network. It is placed in a similar architectural position in the network as what are often called metro-core (MC) nodes in today's architectures. Each node has an access side, facing the LR-PON and a core side, facing the wavelength-switched optical core. The core is a flat optical network interconnecting DISCUS nodes through a full mesh of wavelength channels. These wavelengths traverse intermediate core nodes without entering the electronic sub-layers. All nodes belonging to the same flat core form a transparent island. Interconnection among transparent islands can be achieved through signal regeneration, or traffic grooming and processing where required.

The main guiding principles of the DISCUS architecture design are as follows:

- Propose a highly simplified network architecture, which is composed of a long reach access and a flat optical core, connected by a number of Metro-Core nodes.
- Reduce cost and power consumption by consolidating the large amount of network nodes and reducing or eliminating electronic grooming in the core.
- Increase the split of the PON to allow sharing infrastructure cost among a larger number of users. The architecture will be flexible enough to allow sharing a PON network between both residential and business users.
- Produce a network architecture with a combined wireless edge with ubiquitous optical access and demonstrate the benefits to customers that the combined architecture produces. So, for example the PON could be used as a backhaul for mobile services.
- Produce a solution that can gracefully grow sustained bandwidth over the installed network infrastructure without service disruption or major infrastructure modification/upgrades. Ensure the solution is able to adopt new technologies as they arise while co-existing with previous generation technologies (i.e., graceful evolution).
- Propose the 'Principle of Equivalence' for connections, i.e., that any user connected to the PON fibre can in principle access any type of service, from residential broadband service, to dedicated point-to-point high speed (100Gb/s today and higher in the future), independently of its location.

- Ensure the solution provides service resiliency mechanisms in case of faults in the physical infrastructure including total metro-node failure (i.e. disaster recovery will be considered as an inherent part of the design).

3 Involvement of DISCUS partners in standardization

Standards Organizations	Involved DISCUS partner	Type of involvement
FSAN	ALUD	Monitoring and contributions to NG-PON2, specifically TWDM-PON, and to OE (Operations and Engineering) Task Groups
	TID	Monitoring NGPON and OE (Operations and Engineering) Task Groups. Participation in FSAN Operators meetings.
	COR	Monitoring and contributions to NG-PON2 specifically point-to-point WDM
ITU-T SG15 Q2	ALUD	Monitoring and contributions to NG-PON2 specifically TWDM-PON
	COR	Monitoring and contributions to NG-PON2 specifically point-to-point WDM
BBF	ALUD	Monitoring and contributing to Fiber Access Network (FAN) Working Group activities, specifically on PON Optical-Layer Management (WT-287, WT-311)
	TID	Monitoring Fiber Access Network (FAN) Working Group activities
ITU-T SG15 Q12	TI	Monitoring and contributions to the evolution of transport network architecture

DISCUS partners for instance contribute to the Full Service Access Network (FSAN) Group. FSAN is a forum for the world's leading telecommunications services providers, independent test labs, and equipment and component suppliers to work towards a common goal of truly broadband fiber access networks. In FSAN, PON evolution is being analyzed in two main Task Groups (TG): Next Generation PON (NGPON) and Operations and Engineering (OE), with involvement of the major operators and vendors worldwide. For DISCUS, it is very important to align to the technical and operators requirements for NG-PON2 technologies and beyond, so that coexistence and smooth migration from NG-PON2 to DISCUS LR-PON technologies is assured. On the other hand, FSAN studies can be reported as material to Broadband Forum (BBF) and ITU-T standards.

The international leading global organization for information and communication is the International Telecommunication Union (ITU). A standards branch of ITU is the ITU-T. The work in ITU-T is divided in so-called Study Groups (SG). For the DISCUS project the SG 15 "Networks, Technologies and Infrastructures for Transport, Access and Home" is relevant. SG 15 is sub-divided in so-called Questions (Q). DISCUS partners contribute to Q2 "Optical systems for fiber access networks" and to Q12 "Transport network architectures".

Within the Broadband Forum (BBF) the optical access network related topics are dealt with in the Fixed Access Networks group (FAN). Topics under discussion are launched as Study Documents (SD), are then – if of sustained interest - promoted into Working Texts (WT) which after approval acquire the status of Technical Recommendations (TR). ALUD is presently involved in BBF discussions about WT-287 (PON Optical Layer Management) and is monitoring WT-311 (Intelligent Optical distribution network (ODN) Systems Architecture and Requirements).

4 Technical fields of interaction with standardization bodies

The DISCUS **core network** is a photonic backbone based on flexgrid re-configurable optical add drop multiplexer (ROADM) technology, whose number of nodes must scale up to 100-150 according to preliminary estimations. Some aspects of such kind of networks have been already standardized (e.g. the flexgrid in ITU-T G.694.1), while other aspects peculiar of the DISCUS architecture may require additional standardization effort. The most important technical issues specific of the DISCUS core network that may deserve contributions to standards can be summarized as follows:

- scalability of photonic backbones up to the number of nodes foreseen in DISCUS for large European networks;
- transmission impairment assessment and mitigation in flexgrid photonic backbones;
- flexgrid ROADM architectures and performance.

For DISCUS it is important to design the section of the **access network** heading towards the metro-core nodes such that current access and metro network fiber infrastructures including ODN (Optical Distribution Network) elements like splitters can be reused. In this way the cost of a migration from the existing network to a DISCUS network can be minimized.

Based on current standards, the access ODN as well as the metro fiber sections consists of one Single Mode Fiber (SMF) of typically up to 40 km and power splitters (in case of PON) with a split factors of 16, 32 or 64. The ODN is transparent; this means that it does not block or selectively route any wavelength within the transmission band of the SMF.

Point-to-point wavelength division multiplexing (WDM) relies on assigning individual wavelengths to optical network units (ONUs), without resorting to time division multiplexed (TDM). Also these channels are to be provided over the transparent ODN. The channel selection is accomplished only in the end nodes using wavelength selected or tuneable optics.

The DISCUS approach is intended to establish more versatile optical networks across the metro and access segments. In some respects the new network design will go well beyond what is presently accepted in that space as pointed out above. E.g. inline optical amplifiers are being considered as a potentially important new element in LR-PONs. Also the approach of virtualizing the ODN by establishing bespoke networks (e.g. for backhauling) on an existing PON-ODN is a new concept that has not yet been addressed in standards. These are fields in which DISCUS can contribute to related discussions at standards about new systems and network generations beyond next generation – passive optical network 2 (NG-PON2).

Optical monitoring in access networks (metro-access networks in future) is gaining more and more interest also in standards. Presently both FSAN and BBF have activities going on in that space. At FSAN theses aspects are addressed by the Operations and Engineering Task Group, in BBF by the FAN group. Up to now FSAN was mainly focusing on just monitoring optical powers at transmitters and receivers as well as some minor studies related to embedded optical time domain reflectometer (OTDR). At BBF the document WT-287 has been launched to address generic monitoring architectures with primary focus on OTDR variants suitable for access. It will soon be closed and approved. The newly launched WT-311 will deal with making ODNs more intelligent, the details are still to be defined. These are relatively new activities in standards, so there are a lot of open questions, both technically and process-wise. There will likely be opportunities to bring in new ideas into the discussion based on the work done in this respect in DISCUS.

5   Potential actions for standardization

Standards groups tend to be relatively slow moving organizations with an emphasis on technologies close to product readiness. Therefore, it is important to concentrate on dissemination activities at relevant standards bodies first, aiming to gain support for DISCUS concepts as a future perspective. At a later stage of the project, concrete standards contributions should be submitted.

The processes for bringing information in a standards group are described for the example of the FSAN group.

Members can only be a company. Membership categories are operators, vendors and test labs. There is no membership foreseen for any other stakeholders like academia. The operators form a management committee, which defines the technical goals to be achieved for a meeting. Based on this the management committee releases a Call for Contributions (CfC) about one month before the meeting. Based on the questions of this CfC, contributions can be submitted by FSAN members. Free style contributions related to other subjects are usually not accepted for presentation. All presentations are considered to be internal to the FSAN group and not public.

If FSAN has a need for information beyond this, workshops are organized, where also external experts can be invited.

The monitoring of the discussions in FSAN, that are relevant for DISCUS can be done by any member company.

The partners ALUD and TID are monitoring the Calls for Contributions (CFC) of these two main FSAN TGs and have potential to support a joint contribution with other DISCUS partners including DISCUS results when aligned with the CFCs. TID can also participate in the FSAN Operators meetings in Europe in representation of Telefonica bring the DISCUS concepts and results to discussion.

Possible fields for interaction with standards are described below.

Partner Tyndall is working on a new concept for burst-mode receivers with electronic dispersion compensation (EDC) circuits, which are interesting for standardization of access networks. It could solve the challenge to operate with low cost direct modulated lasers (DML) in the ONU. This could be reported to FSAN by partner ALUD when a CFC asks for similar input.

Future networks need to have higher flexibility and capacity than current networks. DISCUS is addressing this e.g. by introduction of an active remote node (RN) and in general by optical amplification in the ODN. As this is different from existing networks, it needs to be presented and discussed in standards fora. This could be in the form of a contribution on long reach access architecture to a FSAN workshop "beyond NG-PON2" (tentative agreement by FSAN Chair M. Caroll on San Jose meeting Feb 2014)

In ITU-T, SG15, Q12 "Transport network architectures", Partner Telecom Italia will introduce the DISCUS architectural vision emphasizing the specific technical issues of the core network and proposing technical solutions to be standardized. The primary aim of this activity is to make ITU-T aware of the benefits of a flat network architecture and secondly to pave the way for including in ITU-T Recommendations the specific technical solutions required by the DISCUS core network.

Regarding the NGPON and Operations and Engineering FSAN Task Groups, TID can support a contribution including DISCUS results when contributions on some of the following topics are asked by FSAN: Pay as you Grow concept, 1:1/N PON protection, FTTH customer self-installation approaches, power consumption studies, PONs reliability. TID is also analyzing new concepts for PON monitoring in LR-PONs with amplifiers and could also contribute to FSAN if aligned with the Europe meetings CFCs.

6 Summary and conclusions

In these document standards activities for FSAN, ITU-T and BBF are described. Partners ALUD, TI and TID will participate and contribute to the relevant standards meetings. Besides a standards monitoring, presentations and workshop contributions are planned, provided the CfC allows for these activities.

Abbreviations

BBF	Broadband Forum
CfC	Calls for contributions
DISCUS	DIStributed core for Unlimited bandwidth supply for all Users and Services
DML	Direct modulated lasers
EDC	Electronic dispersion compensation
EPON	Ethernet passive optical network
FAN	Fibre access network
FSAN	Full service access network
FTTH	Fibre to the home
GPON	Gigabit passive optical network
ITU	International telecommunication union
ITU-T	ITU's telecommunication standardization sector
LR-PON	Long reach – passive optical network
MC	Metro core
NGPON	Next generation passive optical network
ODN	Optical distribution network
OE	Operations & engineering
ONU	Optical network unit
OTDR	Optical time domain reflectometer
PON	Passive optical network
Q	Questions
RN	Remote node
ROADM	Re-configurable optical add drop multiplexer
SD	Study documents
SG	Study groups
SMF	Single mode fibre
TDM	Time division multiplexed
TG	Task groups
TR	Technical recommendations
TWDM-PON	Time & wavelength division multiplexed passive optical network

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WDM	Wavelength division mulitplexing
WT	Working texts