

Converged and Optical Networks Cluster

Brussels, 17th February 2009

AGENDA

- EC perspective 2009 (Andy Houghton, Pierre Chastanet)
- Major outcomes of projects after 1 year (Cluster projects)
 - 1-2 slides for project
- Key technology trends and promising research path (Cluster projects)
 - e-Photon/One roadmap discussion
 - Project inputs (one slide per project)
- Contribution to FIA in Prague (Cluster projects)
 - Network development and Future Internet
- Contribution to ICT Mobile Summit (Cluster projects)
 - Sustainability, others
- Any other business

PARTICIPANTS

- All key projects of the cluster present, representing both FP6 and FP7: SARDANA, FUTON / TRIUMPH, LASAGNE / GANDALF / UCELLS, DICONET, OMEGA, ReDeSign, e-Photon/ONE / BONE, ALPHA

LAST NAME	First name	Organisation	Project
BRUSSE	Bart	ConTeSt consultancy	ReDeSign
JAEGER	Dirk	TU Braunschweig	ReDeSign
JAVAUDIN	Jean-Philippe	France Telecom	OMEGA
MARTI	Javier	Universidad Politec Valencia	GANDALF, LASAGNE, UCELLS
POINT	Jean-Charles	JCP-Consult	DICONET
POPOV	Mikhail	Acreo AB	ALPHA
VAN DAELE	Peter	IBBT - Ghent University	BONE
MONTEIRO	Paulo	Nokia Siemens Networks	FUTON, TRIUMPH
PRAT	Josep	UPC	SARDANA

PROJECTS – ONE-YEAR RESULTS

ALPHA

- Specification of services, driver of bandwidth. Highest requirements would be 24 Gb/s (Ultra-high Definition TV or 4k or 8k) to the end-user.
 - Uncompressed video for point-to-point. True user requirement could be lower.
 - But could consider 1Gb/s network inside the home (need to take into consideration advances in picture and motion picture compression). 1Gb/s corresponds to real throughput needed to deliver super high-definition TV.
 - But problem of power consumption on the screens: if this becomes the driver for bandwidth growth, this will oppose to energy issues. Consumer application is the driver, but pricing will be a bottleneck (see BREAD analysis on killer application).
 - Adoption issue to be taken into consideration for the timings of the roadmap (as well as technology maturity: 8k TV set might only become available from 2020)
 - 2 aspects: total traffic (rapid increase because of new customers) and individual max traffic (high/peak users) -> basically differentiate core and access requirements
 - Connectivity will depend on migration path (new homes installed de-facto in optical; old homes to be upgraded) and usage (does everybody need 1Gb/s symmetrical?) and operational constraints (e.g. operate concurrently a FTTx network and a cable network + manage the transition -> challenge of cable operators).
- Passive and Active Optical Network, but active Ethernet is not point-to-point (so named AON). WDM 10Gbps GPON are explored.
- Green field (new buildings) vs. upgrade strategies for in-building/home networks. This requires research and operators are very interested (determines their economic models).
- Transmission for access/in-building (SMF, MMF, POF)
- Demonstrators

OMEGA

- Typical familial home scenarios, involving 4-5 people, with different data flows with various QoS (need to guarantee minimum bandwidth for each user)
- Consider mixture of WiFi, PLC... and compatibility of future access networks (most of current access technology do not support future data rate requirements)
- Need of compatibility with future middleware (UPnP/DLNA...)
- Definition of a full architecture reference model (legacy device / Omega device / Omega gateway) which enables transition and working from/with legacy devices.
- Inter-MAC layer concept: acts as an intelligent bridge between PLC, radio, HWO Hybrid Wireless-Optic (i.e. with the MAC layer of these technologies), guarantees QoS to the end-user, performs interface with network protocol layer and does path selection (equivalent of low-intelligent routing locally). This enables to abstract from the physical access technology. This is similar to adaptation layer in ATM.
 - E.g. If data rate of Wifi link drops, new path using access technology with the appropriate performance to provide the required QoS.
- Standardisation of this inter-MAC layer: problem that there is no real body suitable for such standardisation (802.lavb could be an option or start a new group in ETSI).
- **Candidate for FUTURIS?**

FUTON

- Joint processing of all the radio systems (2G, 3G, WiMAX, LTE, IMT-Advanced) from multi-antenna sites
- Could be used for multi-operators model
- Facilitate the implementation of cooperative MIMO
- Model of all the channels including impairments and discussion with the optical links
- Distributed broadband wireless system (DBWS)
- Common radio interface management defined
- Looking at very low cost components to do radio over fibre
- Maximum distance between the antenna and the joint-processing: 20km considered.
- Consider to use some channels that are not used any more (e.g. CATV), but no conversion – digital all along.

BONE

- 49 partners, 17 countries, 519 researchers
- Presentation of integration activities, cross-country exchange, organization of ECOC'2008, number of joint publications, acknowledgement of EC contribution in joint publications, record paper acceptance at OFC'2009...
- Summer school, technical roadmap (key to define the future of research in optical network, long track record in developing this since ePhoton)
- BONE very important window between academic and industry: "one-stop shop" for industry to see state of the art in optical network, although the industry is not heavily involved directly in the project (but very present in the governing board).
 - Intention to organize specific workshops for the industry
 - Problem of short term orientation of research in most companies
- NoE is really a unique mechanism globally – nothing similar in the US or in Japan (but in Japan, more industrially-led program, in which some academic participate)
 - Could be a good way to showcase how Europe is doing things more efficiently
 - But NoE not sufficient to finance all necessary activities: need of national/regional funding to carry out complementary activities (especially the research itself).
 - Because of limited funding, need to line-up with all programs (EC, national...) -> no room for blue sky research (very focused toward what program fund).

ReDESIGN

- Architecture challenge, analyzed through survey with cable operators
- Various architecture with larger and smaller fibre nodes
 - Transmission capacity lower than what most analyst expected when using smaller fibre nodes
- Convergence between markets across Europe with respect to development of digital services (including TV package) for broadband requirements
 - By 2014-2018, the available bandwidth on coax will run out of capacity vs. bandwidth requirement to deliver symmetrical services
 - Average network capacity for cable networks will become insufficient in 5-10 years if nothing is done.
- Improvement of hybrid fibre-coax (HFC) channel, objective to improve the capacities of current network, without large infrastructure upgrade
- Considering possible upgrade and green-field solutions for future
- NB: No retail market of set top boxes for cable. Analog package still present but huge discrepancies across countries (from 20 to 60 analog channels).

- Incentives in Scandinavia to move to digital: they provide customers with 2nd set top box for very attractive price -> equivalent TV distribution for a household with multiple TV sets, and enables cable operators to decommission their analog package.
- But probably 30% of operators will never move out of analog
- Market issues, but this is really driving cable research (e.g. limit in upstream bandwidth)
- Analysis is done on the basis of symmetrical services, but most of the considered services in the cluster are mostly downstream.
- Sticking to DVB-C2: broadcast is still the most efficient way to deliver the service (i.e. selection of service on the termination, i.o. using upstream channel to choose service).

DICONET

- Development of impairment aware routing wavelength assignment algorithms
- Development of modelling tools to make a modelisation of network failures and realize dynamic planning
- Definition of extension of protocol to enable an impairment-aware control plan
- Idea is to monitor the network in the optical domain by looking at the BER, without having to monitor in the electronic domain
- IETF working group in this domain, impact of failure and impairment monitoring recognized as a problem in internet routing
- Input provided through paper to the FIA; input rejected by Alcatel for the Future Internet JTI Vision document, but was eventually included in the SRA.

GANDALF/LASAGNE/UCELLS

- GANDALF: integration of optical wire-line and wireless.
- LASAGNE: fully all optical packet routing (logical gates, clock recovery, flip-flop...) using all-optical label swapping. It was tested at 40Gbps.
- UCELLS: UWB over fibre (analog, and both impulse radio and OFDM) – high-speed optical sampler to be able to extract the low-power signal of UWB. Can identify the wireless transmitter and adapt the power of transmission (also adaptation in the frequency domain -> spectrum management).

SARDANA

- Research spin-off of ePhoton/ONe+
- Long reach PON, hybrid WDM metro ring with TDM access trees, colourless ONU... (architecture based on GPON, but transparent), Remotely-pumped optical amplifiers in the metro.
- Architecture scenarios comparing available technologies and targeted SARDANA performance. Scenarios define the maximum distance and max number of ONU (when distance increases, need to reduce the number of ONU: can't serve 1024 customers at 100 km.
- Taking into consideration of all possible impairments in the new WDM
- Development and testing in Finland of remote nodes, both fixed or reconfigurable
- 1st prototype and testing of colourless ONU

Contribution to Future Internet Assembly

- FI not going below the IP layer and assume too much that the network is present (see email from Misha on feedback from Madrid)
- "FIA is building a Ferrari, but they assume too much that the highway to drive it will be available. They don't consider that there will be different type of roads, and that there will be a lot of traffic lights on the road".

Optical Network Roadmap Discussion and Contribution to FIA

- High-speed transmission, needed for ultra-long link (e.g. trans-ocean): be as spectral efficient as possible, QPSK modulation... But can also be used for smaller topologies.
- 100 G Ethernet: ETNA developing carrier-grade Ethernet
- Beyond 100GbE: problem of backward compatibility if going beyond 100Gb; on a network point of view, Ethernet people just need that the frames are respected. Then they expect lower layer to develop the interface for single-mode fibre, for multi-mode fibre...
 - Cheapest technology available (produced in millions of parts)
 - 100GbE mainly produced initially to connect back plane points to points (e.g. routers), then extended to do networking
- Who is the user of optical networks? Layer 2? GMPLS? Gigabit Ethernet? IP Packets? Future Internet?
 - But never refitting of upper layers into the optical requirements
 - Core/metro/access networks? Cable networks (but we have seen that 1/3 of operators will stay analog), mobile network operators (but they have not fully adopted IP yet), NREN's are well using optical networks but their requirements are rarely retransmitted to optical community, then home/LAN networks
- IP-Ethernet-Optical Core network still a black cloud
- Future Internet defined many design goals (security, QoS, heterogeneity, resources management, virtualization...). But how many can be done at optical level?
- Internet architecture issues: list is perceived as independent of layer 1 and 2, but in practice, this is largely untrue.
- Incentive for new energy efficient design, which can make major power savings (e.g. optical routing vs. electrical routing)
- Assumption of the FI community is that layer 1 and 2 are just point-to-point and a given; they work primarily at upper layers. If a network is something taking from layer 1 to 7 in ISO model, then there network functionalities in the FI that can be moved to layer 1 and 2.
- When you stay within one domain, things are still simple, but problem appear with doing cross-domain (especially if the domain belong to different operators). Progress made in this area by MUPBED project.
 - E.g. A VoIP application developed a protocol (RTP) on top of TCP to enable real-time capabilities in a protocol which was not designed for this purpose.
- The "network-agnostic" claim in future internet is not realistic: the lower layers have to operate with the IP. When people start developing an application, they will consider sending flow from one IP address to the other. Developers will learn TCP, IP, RTP... but they don't really care about Ethernet.
 - Need of more tools to connect the network and the application.
 - Also the capacities provided by lower layers are key enablers for upper layers (P2P wouldn't be possible without the prior evolution in optical networks).
- Move from best-effort based internet to smart networks (satisfying defined application requirements)
- Energy efficiency: key incentive to move from electronic routing to full-optical routing

- Future Internet clean-slate: bottleneck between upper layers and lower layers (see TRILOGY) is IP. But the redefinition of new protocol and convergence of layers requires dialog between researchers from upper and lower layers communities.

Optical Switching

- Problem of OPS is that there is no memory, thus the move to OBS
- How to make everything optical?
- Important is to be able to reconfigure the network, based on traffic models, to be able to adapt the switching capacity to the application usage
- Take into account the protection (in case there is a fibre broken, to be able to keep provisioning the service to users)
- Promising area: optical flow switching (OFS), which is like OBS, but with a longer range
 - Key roadblocks: scalability and memory, whatever the switching technology is
 - Optical packet switching will likely not be deployed by operators before 15 years, because of these 2 key constraints
 - Research identified under Photonics21 to work on optical memory, but big uncertainty with regards to the possible outcome
 - Alternative to optical switching for operators: routing, but obviously need to come back in the electrical domain. But then huge power consumption -> need energy efficiency.
 - E.g. Facebook: \$1 million energy bill per month for their servers

ICT Mobile Summit

- Cluster meeting in Santander
- Call for papers and contribution driven through BONE, but people prefer to submit papers to ECOC which is 3 months after.
 - Need to change the name to reflect the constituency if the intent is to cover all aspects (mobile, optical, converged...)
 - Need to decide if we keep it a scientific conference or a high-level conference
 - Papers published there considered as category 2 (vs. IEEE category 1)
 - But opportunity to have projects to interact, cooperate...
 - Could replace/merge with concertation?