Photonic Services and their Applications

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Photonic Service

- **End-to-end connection** between two or more places in network
- Described by *photonic-path* and *allocated bandwidth*

**Features**
- Transparency to modulation formats
- Low transmission delay, the shortest photonic path is formed
- Future-proof design due grid-less bandwidth allocation (in fine step of e.g. 1GHz)
- Constant delay (i.e. negligible jitter), because none or only specially tailored electrical processing is present
- Stable service availability due to allocated bandwidth

**Issues**
- Limited reach - universal all-optical regeneration is missing, but it can be extended by specialized OOO and/or OEO regenerators (suitable just for limited number of applications)
- Absence of global management and operation system or communication between separate management systems
- Multi-vendor network interoperability, although first tests were already successful, ITU-T also produced recommendation G.698.2 - “Black link”
- All-optical nodes should be grid-less and direction-less

**Applications**
- Interactive human collaboration
- High definition video and Cave-to-cave
- Remote instrument control
- Remote control of vehicles
- Comparison of atomic clocks
- Ultra-stable frequency transfer

Implementation

- **Dark fiber - unlit fiber**
  - Fiber full bandwidth available
  - Freedom on deploy any equipment, no limit in directionality or amplification
  - Renter must pay all rental cost, acquire equipment and deal with its maintenance
  - Difficult troubleshooting and putting into service

- **Dark channel - dedicated bandwidth or one channel within traditional transmission system**
  - The bandwidth is branch off before traditional equipment and branch in after the equipment placed in “huts”
  - Reduced cost - channel typically consumes 1/40th or 1/80th of available spectrum
  - Freedom on equipment deployment
  - Amplification must respect other channels
  - Easier putting into service and troubleshooting

- **All-optical Lambda - lambda passing through regular transmission system**
  - Low cost, no special inline devices
  - Unidirectional channels only
  - Amplification is done together with other channels - suffers from noise
  - Simple maintenance and putting into operation

Remote collaboration – 3D HD+ video

Collaboration on architectural model: Prague (CZ) - San Diego (CA,US) (Cinegrid 2011)


Atomic clock comparison - Precise Time Transfer

- Comparison national time scales UTC(TP) and UTC(BEV)
- Long-term measurement since August 2011
- Comparison with Common View GPS, PPP and BIPM Circular-T
- Optical path length 560 km, combination of: transmission systems, 652 and 655 fiber, different DCUs (fiber and FBG)

Time Stability

Optical time transfer short-term comparison with GPS Common-view and PPP time transfer

Optical time transfer long-term comparison with GPS Common-view time transfer and Circular-T

* Pictures may appear blurry because of stereoscopy projection

The research leading to these results has received funding from the European Community’s Seventh Framework Program (FP7/2007-2013) under grant agreement nº 238875 (GÉANT). This work was supported by the Ministry of Education, Youth and Sport of the Czech Republic as part of the CESNET Large Infrastructure project LM2010005 and by Technology Agency of the Czech Republic grant TA01011105