CREATE-NET

Optical networks research: Decline or Resurgence?

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First of all:

- Decline and Resurgence in the industry does not necessarily mean the same for us
  - The bubble (and its burst) had technical and political reasons
- Some decline in optical research took place after 1996 (there was the JSAC/JLT joint issue, “final document”)
  - Researchers moved to the field of wireless, ad-hoc, sensor networks and so on
  - To find that these networks are extremely “analog”
- Getting back some of those researchers and the experience of analog networks gives a different approach to optics.

Topics in Decline

- Optical protection/restoration based on MPLS concepts
  - OK, OK, it is important, but…
  - Aren't they repeating SONET protection basically?
- Optical burst/packet switching
  - Fundamental considerations do not let me believe in this
    - lack of optical random access buffers and all-optical 3R
  - Over-provisioning of optical networks for the burst/packet with lowest OSNR – too expensive
  - Different situation for *light trail* derivatives (Add and/or Drop w/ electrical buffering)
- QoS
- SONET/SDH incl. NG, VCAT, LCAS…
  - Sportive edition of an old car model

Resurging (or even new) topics

One of the oldest questions is still unsolved:

- How to do network planning with traffic uncertainties
  - For dynamic setup/tear down of lighpaths
  - Normally, a network is designed for a given traffic matrix
  - To accommodate traffic that is not in the matrix we have to over-provision ***optically***
  - Just how much, and where?
- Impairment constrained based routing (ICBR)
  - How to extend either routing (OSPF-TE) or signalling (RSVP)
  - If OSPF-TE would be extended, we would see a link update from each node along the path for each LSP – does not scale, probably
- Optical boarder gateway protocols
  - Optical multi-homing

Resurging topics (or new) – cont.

- Ethernet and Optics
  - The new layer 2 will be the old one – Ethernet
  - With PBT (provider backbone transport), T-MPLS, VLAN-XCs Ethernet PHY replaces GFP+SONET
  - But: Ethernet can do more than connections!
    - Could we benefit from MAC learning and spanning trees?
      - Fast restoration?
      - Load balancing?
      - Network coding???
    - How can an Ethernet switch modify the underlying wavelength topology
      - Should it?

Resurging topics (or new) – cont.

- Still, and again: Radio over Fiber (RoF) or:
  - Fiber backbones for multi-gigabit wireless base stations
  - UWB pulses in fiber and radio, IR(?)
  - MIMO or DAS (distributed antenna systems) with centralized processing behind the fiber backbone
  - Use of (E)PON and wireless to better feed and manage WLANs

Conclusion:

- A lot of the new research topics has to do with optics as an analog transmission medium
- Switching packets might be better done electronically – for a long time
- Ethernet is (still) the next big thing
  - 100G, PBT, GMPLS controlled Ethernet, etc…
- Optical networks conquer the access
  - New technologies will come up – PoF, RoF, IR
  - Networks will be different for that