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Preliminary Findings of the EARNEST Technical study

Acknowledgements and Disclaimer

› Acknowledgements
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› Disclaimer
  › Words beyond those written on the slides are personal opinions of the presenter and are not endorsed by the coordinators nor the contributors to the EARNEST Technical Issues study

Outline

› What is EARNEST ?

› Topics covered by the Technical Study

    › Fibre optics

    › Transmission technologies

    › Data Plane

    › Control Plane

    › Operational Aspects

    › Middleware

What is EARNEST ?

› Foresight Study into Research and Education Networking in Europe
  › from 1 March 2006 until 31 October 2007, and as part of the EU Funded GN2 (GÉANT2) project
› Seven parallel sub-studies
  › Researchers' Requirements
  › **Technical Issues**
  › Campus Issues
  › Economic Issues
  › Geographic Issues
  › Organisation and Governance Issues
  › Needs of Users in Schools, Healthcare, and the Arts, Humanities and Social Sciences

Transcription Findings (1)

› New low loss fibre and improved modulation techniques promise longer transmission distances (up to 150 km without amplification)

› New G.656 fibre standard supports CWDM and additional DWDM channels.

› Newer fibre may be obtainable, but most routes will likely be mix of older fibre types. May therefore be difficult to take advantage of recent advances in transmission capabilities.

Transmission Findings (2)

› Most manufacturers focusing on 50 GHz spacing for DWDM channels (i.e. ~80 channels per fibre). This has been found to provide good performance trade-off with respect to faster line rates and longer reaches.

› Tunable lasers, VOAs, EDCMs, multi-degree ROADM technology, and PIC-based OEOs promise easier-to-facilitate (and potentially cheaper) WDM systems. Also make meshed optical networks possible.

› True all-optical PXCs under development.

› Passive Optical Networks (PONs) being trialled.

› No obvious path for SONET/SDH beyond OC-768 (40 Gbps), and likely to become legacy technology in coming years

Ethernet evolution

› All manufacturers developing 40 and/or 100 Gigabit Ethernet

› 40 GE - interim solution; implementations expected by 2009
  › for data centre applications at first
  › some vendors talking about WAN capabilities (80 km before amplification/2000 km before regeneration).

› 100 GE implementations expected by 2010, although may be later.
  › initially likely to be 4 x 25 Gbps; restricted to short-haul applications.
  › full serial implementations not expected until 2012.

› Carrier-grade OAM&P and virtual circuit functionality is currently being added (e.g. PBBTE, CFM)
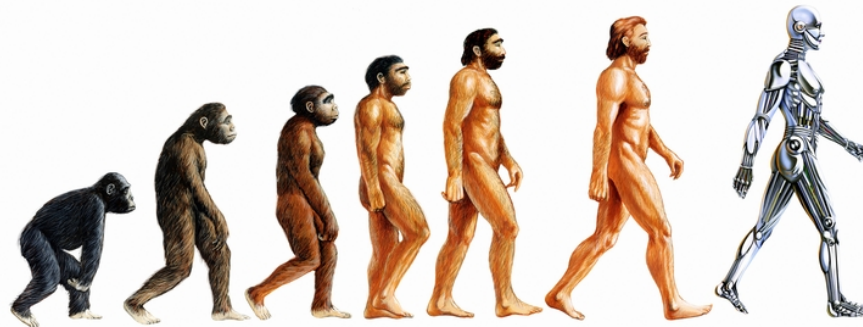
Control Plane and Routing Findings (1)

› Routing scalability becoming problematic (again).

- › Huge rise in number of hosts, fragmentation of service provider hierarchy, increase in multihoming, and amount of traffic.

- › Global routing table now >230,000 entries, which generates around 400,000 BGP updates per day.

- › Concern that growth is starting to outstrip router chipset and memory developments, but more specifically the cost of provisioning these.

- › Not immediate cause for concern, but IAB/IETF looking for efficiencies. Proposed to split IP addresses into identifiers and locators. [Possible implications for AAA as well]

Control Plane and Routing Findings (2)

› IPv6 growth has been slow, but new predictions now suggest IPv4 address space could be exhausted in 3-5 years.

› IPTV may (finally) provide impetus for IP multicast.

› MPLS widely adopted, but GMPLS less popular.

Network Virtualisation Findings

› Virtualisation concepts starting to be used on all networking layers.

› Basic virtualisation already implemented in certain modern routers

› NRENs (e.g. CANARIE, CESNET) pioneered customer-empowered network concept

  › Deployment of UCLP and similar technologies are first steps towards full network virtualisation.

› Initiatives such as GENI (US) and FEDERICA (EU FP7) aim to go further in virtualising networks

  › disruptive technologies to be tested over production infrastructure.

Virtualization is only one step away....

Operations and Performance Findings (1)

› Increasing availability of dark fibre allows R&E networks to operate hybrid networks, enabling dedicated links to be provisioned for demanding customers using C/DWDM.

› Limited tools for managing Network Layers 0-2, and very expensive.
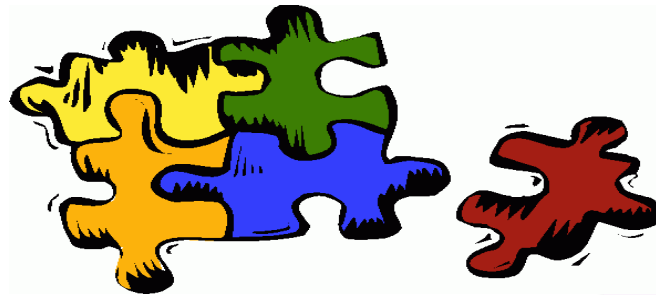
› Management of Layers 0-2 currently labour intensive and relies heavily on documentation.

Spot the differences !

› Most end-to-end performance issues are due to problems at customer sites.

› Recommend extending scope of PERT (possibly integrating with NOCs).

› Core networks likely to continue to be overprovisioned as bandwidth is cheap, although should support QoS information so QoS can be applied on edge networks if necessary.

Operations and Performance Findings (3)

› Middleboxes such firewalls, NATs, rate shapers and other 'black box' solutions are responsible for many network problems.

  › encourage workarounds that circumvent what the box is trying to achieve in the first place.

  › more careful use and management needed.

› 10 Gbps+ network monitoring is currently expensive, but cost should reduce with specialist multi-core appliances.

Middleware Findings - Federations

World domination is out !

› Identity federations are *the* solution for supporting user access to remote services.

› Most NRENs have identity federation or are establishing one. Others should plan to do so within next couple of years.

› NRENs are natural candidates for supporting technical organisation within their countries, as well as representing national federations.

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Middleware Findings - Identity

› User-centric identity management also growing, and abstract identity framework also being worked on. NRENs should monitor developments.

› It is recommended that NRENs support multiple trust infrastructures in order to be able to handle different AAIs, although should try to minimise number necessary (e.g. by reusing existing PKIs).

› SAML 2.0 likely to be used for exchanging identity data for web-based applications. X.509 certificates still used for other applications. Schemas such as eduPerson or SCHAC becoming more important for interoperability.

› No well established standard for communicating identity data to applications. NRENs should be proactive about this

More details

› Workshop in La Hulpe (by invitation only). Sep 25-26, 2007.

› The EARNEST website
http://www.terena.org/activities/earnest/index.html