



Participants

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Recommendations

The aims of the session were to develop recommendations for the four main areas previously identified as being important in the technical study area. These were transmission technologies, control planes, operations and performance, and middleware. Future networking initiatives such as GENI also needed to be considered.

Unfortunately, most of the expertise in this breakout session was mostly concerned with the lower networking layers, with few participants actively involved in operation or middleware issues. With this in mind, the following recommendations were formulated:

- 1) It was agreed that dark fibre was becoming more ubiquitous, but there was still a requirement to investigate if and where it exists in some places. In addition, the possible sharing of dark fibre in possession of one NREN, by other NRENs needed to be considered.
- 2) It was felt that there was a lot of scope for improvement in Layer 1 transmission equipment in the coming years. Ways of reducing costs through port integration, and minimising the re-generation and/or amplification requirements should be investigated. In addition, the use of SDH or Ethernet as a transmission protocol needed careful evaluation. A move towards using fewer devices in core network was another consideration.

- 3) It was agreed that multi-vendor hybrid networks were the future, but that inter-optical domain models still needed to be developed. There were still interoperability problems with different implementations of standards, and NRENs needed to work more closely with vendors and standards bodies on such issues. There were also a number of management and policy issues to resolve, but that was not necessarily a technical issue.
- 4) One important question was whether networks should stick with IP and solve the lack of guaranteed service by continuing to overprovision, or should separate networks be built (e.g. using lightpaths) for demanding users? Alternatively should bandwidth reservation techniques continue to be developed, and if so, should bandwidth allocation be undertaken at the control plane or middleware levels? Another important question was whether bandwidth reservation across multiple domains would ever be feasible until bandwidth becomes so cheap and abundant that no-one cares about recouping the cost of provision.
- 5) There was general support for continued provision of separate testbed networks that would enable disruptive testing of new protocols to be undertaken. However, these should be long-distance and vendor independent.
- 6) A number of points were raised with respect to how networks should be managed in future. Should everyone move to IPv6, or was a completely new protocol likely to emerge? Furthermore, should the use of public IP addresses for all hosts be encouraged, and were NATs and firewalls appropriate as they encouraged the use of protocols for unsuitable tasks? There were also concerns about the complexity of managing separate optical and IP layers, as well as multiple VLANs on top.
- 7) There appeared to be little knowledge of how well large AAI federations might scale in future, so this was an area for investigation. In addition, concerns were expressed as to whether there should be as much focus on Grid activities when the general trend was to support more, but smaller customers with less specific requirements (particularly in the school and healthcare sectors).
- 8) The research and education community needed to work more closely with vendors as to specifying its requirements. Most developments were currently carrier-driven, but NRENs had still special characteristics and potentially offered an extensive test environment for new technologies.