The Past, Present and Future of Academic Networking

Bob Day  Network Development Director
Tim Kidd  Production Services Director
UKERNA
Topics

- What is JANET?
- The Past
- The Present
- The Future – Challenges
- The Future – SuperJANET5
UKERNA: basic facts

- UK Education & Research Networking Association
  - not-for-profit company limited by guarantee
  - operated as a public-sector organisation

- headquarters: CCLRC, Chilton
  - administration, management, customer service, development ...
  - complement ca. 90 staff
  - other network operations via ULCC
UKERNA objectives

Advancing and supporting the UK’s education and research network

“To take responsibility for the networking programme of the education, learning and research communities in the United Kingdom; and to research, develop and provide advanced electronic communication facilities for use within these communities, and to facilitate the electronic connectivity of these communities to external third parties.”
What is JANET?

- 19 regional networks.
- 10Gb core across UK.
- >20Gb external connectivity.
- ≈1,000 sites.
Who Uses JANET?

- Higher Education Institutions
- Further Education Colleges
- Research Council Establishments
- Schools (collectively or individually)
- Other organisations where there is clear benefit to HE, FE or RC community.
Who funds JANET?

Joint Information Systems Committee

Services  RSCs  MU  UKERNA

Suppliers  Regional Networks

Universities and Colleges

HEFCE  HEFCW  SHEFC  DEL  ELWA  LSC  SFEFC  SuperJANET
Topics

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The Dawn of JANET

- **Late 1970s**: SRCnet, regional research networks
- **1984**: JANET born, X.25 network, serving 50 sites @9.6kbit/s
- **Late 1980s**: X.25 network, 2Mbit/s backbone, 64kbit/s access, 200 sites
- **Early 1990s**: X.25 network, 8Mbit/s backbone, 2Mbit/s access
- **Early 1991**: JANET IP Pilot (over X.25)
JANET protocols

- Coloured Books
- ISO OSI vs TCP/IP
- Protocol wars ...
- Gateways
- Killer application
- 10 months later ...

LI NX
JANET comes of age

1992
SuperJANET
34Mbit/s PDH
SMDS network
first regional networks

1995
SuperJANET II
IP over ATM
155Mbit/s backbone

Late 1990s
SuperJANET III
general bandwidth upgrade

2001
SuperJANET4
10Gbit/s core
155Mbit/s - 2.5Gbit/s links to regional networks

2006
SuperJANET5
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Acceptance testing – a fairly noisy business!
Current market position

<table>
<thead>
<tr>
<th>Service</th>
<th>Provider</th>
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<tbody>
<tr>
<td>value-added services</td>
<td>UKERNA</td>
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<tr>
<td>IP routing service</td>
<td>UKERNA</td>
</tr>
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<td>transmission service</td>
<td>Telco.</td>
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<td>fibre infrastructure</td>
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Other Services

Training

Workshops & conferences

Customer Service

Documentation
Developments

Content delivery infrastructures

Network Access

Multicast

Video Conferencing

IPv6

UKLight

IP QoS
Classes of IP forwarding service

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
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<tbody>
<tr>
<td>Less than Best Efforts</td>
<td>for non-critical traffic - protecting other service classes</td>
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<tr>
<td>Best Efforts</td>
<td>current class of service on JANET</td>
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<tr>
<td>IP +</td>
<td>for streaming video, interactive applications – Assured Forwarding</td>
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<tr>
<td>IP Premium</td>
<td>for videoconferencing, voice over IP – Expedited Forwarding</td>
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Implementation

will be needed

it’s pretty easy

it’s pretty hard

will never need it
Implementing IP service class

- policy decisions and router implementation
  - relative proportions of different classes
  - service agreements and packet marking
  - policing on ingress: queue, drop or remark?
  - queuing and shaping on egress ...

Some implementation statistics for JANET ...

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<td>70</td>
<td>SuperJANET backbone routers</td>
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<td>18</td>
<td>HE/FE regional networks</td>
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<td>10</td>
<td>RBC networks</td>
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Progress to date

• It does what it says on the can
• The benefit is for sites with low bandwidth
• Next phase is to examine support issues
Network Access

- peering with ISPs
- investigating emerging technologies
- local-loop unbundling
- support for mobile IP
- high-quality gateways for remote access?

reaching the whole of UK education

reaching the individual student

- adult and community learning
- interconnecting schools networks
- workplace-based learning?
- applications interworking
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Challenges...

• Widening the community.
  • Schools
  • Adult Community Learning
Education networks

10 regional networks
144 local education authority networks

Scottish Schools Digital Network
– built over SuperJANET in Scotland
– 32 local authority networks

Lifelong Learning Network Wales
– attached to SuperJANET in Cardiff
– 22 unitary authority networks
Challenges...

• Widening the community.
  • Schools
  • Adult Community Learning
• Supporting e-research.
Jodrell Bank

NNW

Glasgow, Edinburgh

Manchester, Leeds

Reading, London

Bristol, Portsmouth

Dwingeloo, Netherlands

SurfNet

GÉANT

Joint Institute for Very Long Baseline Interferometry in Europe
It doesn’t always work out as it should...
Ingenuity Award 2004
Ingenuity Award 2004
Ingenuity Award 2004
Global Internet Connectivity
February 2002

London C-PoP
Tele House
Tele City

New York
Abiline
ESnet

Flag Atlantic (south & north)
2.5Gb
2.5Gb

USA Internet Transit
KPNQwest
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<td>KPNQwest (UK) really is in administration. Agree &amp; install WorldCom transit.</td>
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# SuperJ ANET5 Requirements

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<td>Reliability</td>
<td>improve by building in more resilience</td>
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<td>Scalability</td>
<td>ability to increase bandwidth at controllable cost</td>
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<td>Separability</td>
<td>protection of interests of teaching &amp; learning and research sectors</td>
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<td>Flexibility</td>
<td>responsiveness to additional network service requirements</td>
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An overall architecture

requirements to be served

commodity use  e-research  network R&D  service development

IP production network  test-bed(s)  test-bed(s)

special purpose bandwidth

flexible transmission platform
Key objective ...

- visibility to UKERNA in day-to-day operation
- capacity planning and cost control by UKERNA
- early adoption of new optical technologies, as and when these arrive
The market challenge...

- value-added services
- IP routing service
- transmission service
- fibre infrastructure

UKERNA

Telco.
Summary

• Academic networking as a driver of technology
• Academic networking as a driver of university and college core missions
• From DIY to mainstream
• Looking forward to the next twenty years...