

30 Years of International Networks

Lessons of the past, visions of the future

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The Cross Roads

- **Are at cross-roads of the Internet**
- **Several new Services are starting to use the Internet**
 - **Mobile 3G – as it develops**
 - **WiFi – growing rapidly**
 - **Several huge new countries – like China**
- **Many current services realise new needs**
 - **Security, mobility, multicast, re-configuration**
 - **With backwards compatibility**
- **Internet Governance key issue - Geneva**

Corollary of the the Choice

- The new services should find present Internet problems resolved
- Can be done by many small fixes to keep present system going
- Better to move over to system that has tried to resolve most of the problems
- **Think next generation IPv6 the way to go**
- What can the past tell us, what does the future hold in the move to IPv6?
- I am using this partly to illustrate how the past can guide us on the future

6net Analogue->Digital Telephone Switch

- **The UK BT tried to go over in mid '60s**
 - Technology buggy
 - Costs too high
 - Abandoned for a decade
- **A decade later technology was right**
 - Transition would be too disruptive on manufacturing
 - Used old arguments to delay change a decade
- **Decade later agreed to move over in 5 years**
 - Moved in 18 months for economics and difficulty of running two systems simultaneously

Prestel vs Minitel

- Both tried to provide uniform information services
- Both tried to provide the only such services nationally in the 70s
- Prestel failed, Minitel succeeded for over a decade, but then the Web took over
- **Why**

Minitel vs Prestel/Videotext

~75 - 85

ITEM	Prestel/ Vidotext	Minitel
Terminal Cost & Spec	Medium	Low
Data Provider	Central	Any
Terminal Provision	Full Cost	Subsidised
Provider Network	PSS	Special -> Transpac
Access Network	PSTN	PSTN & Packet
Database Provision	Any	Any

6net The One Slide Comparison

- **Prestel wanted to own the data, Minitel let anyone own it**
- **Minitel provided free universal terminals**
 - On the back of the Directory System
 - Meant cheap terminals
 - Anyone could add data
 - **Thus Minitel successful, Prestel very limited**
- **Minitel provided and required special terminals, net and specific data types**
 - **Thus eventually Web won over Minitel**



6net The Teletex Service ~ 80-84

- Based on Telex plus features
- Attempted to license terminals
- Attempted to restrict directory
- Mandated many features
- Specialised Data Network
- **Failed. Needed special terminals – could have used normal ones, far too regulated, did not allow people to become part of service without central control**

WAP Repeat of Mistakes

- **Only recently Mobile Providers repeated the early mistakes with WAP**
 - Again they tried to keep all data on their systems
 - Again the data had to be specially formatted for WAP
- **Again the system failed to catch on, the customers wants the services accessed together, the Data Provider wants to offer it once.**

6net Move to IPv6 versus Arpanet

- Clearly we should all go to Next Generation Internet
- In 1971-73, UK Government had zero interest in Arpanet
 - Unless Industry wanted it.
- In 1971/72, British Government was interested only in European dimension
 - Europe Good, US Bad, unless industry wanted it
- ICL said two weeks visit to US was worth more
 - Only British Post office funded it 5000
 - Whole story in www.England.isoc.org
- No other government had interest or were asked
- Now UK government again waiting for industry call, other Europeans governments more open

IPv6 Advantages

- **Reviewed IPv4 and made many changes**
 - **Changed address length 32 -> 128 bits**
 - **Removing any future address range need**
 - **Removed need for Network Address Translation**
 - **Allows sophisticated address management**
 - **Made end-end encryption mandatory**
 - **If implemented would improve security greatly**
 - **Provided efficient support for mobility**
 - **Clear WiFi likes it, not so clear on UMTS**
 - **Provided good hooks for automatic config**
 - **Made provision for signalling QoS**

Concerns at Transition

- **IPv6 not needed, have enough address space, it will not run out soon**
 - Not clear on address space. China growing fast, others also, UMTS would need lots, embedded devices many more
- **The software for transition not available**
 - The stacks are improving fast
 - Most major computer suppliers have stacks
 - Great attention paid to transition aids
- **Applications show little improvement**
 - Most applications can change only the API to the underlying stack – but then do not use new features.
 - Only when done and deployed can you use features

More Concerns

- **Costs prohibitively high**
 - Detailed costing refutes this – but there are costs, of course
- **There is no proof it would work**
 - There are many medium-scale pilots now – like 6NET
- **It will be years before we need bother**
 - Some countries will make the transition within five years – Japan, Korea, China
 - Many others have transition policy – e.g. France, **US Defence**, UMTS
- **We have heard it all before with OSI in '80s**
 - True, but this is different and much better prepared

6net What about OSI in the 1980s?

- **IP started as a two-man effort**
 - Grew dynamically by peer design, implementation and pragmatic experience
 - Added protocols came from systems needs
- **OSI Protocols designed by international committee without implementation**
 - Change control very bureaucratic
 - Tried to design a complete system
- **OSI adoption attempt by fiat, IP by natural selection**
- **IP provided free on Unix by DARPA support and tested in numerous projects**
 - **OSI not really part of such a wide experimental action**

Barriers to IPv6 Transition

- Have answered many of the objections, nevertheless there are problems
- The few vital, short-term drivers are
 - Probably Games and Mobile
 - Manageability of NATs and problems of end-end security through time
 - **Reducing Urgency of introduction**
- Investment will be needed ISPs etc
- The consistency of many applications with IPv6 must be verified
- The management of change needed
- The availability of all components needed by a particular organisation must be demonstrated

NCP-IP Transition

- **TCP time scale**
 - Started 1973,
 - Standardised 1978
 - Pilot Service started 1980
 - Transition 1983 – completed very fast
- **TCP/IP Advantages over NCP**
 - Addresses 256 -> 4,000,000, 000
 - Multiple Networks
 - Transport separated from Network

6net Comparison with NCP ->TCP in 1983

- **Very different situation, 200 Hosts vs 200M**
 - Now impacts all aspects of our live
 - Can no longer take disruptive risks
- **Most manufacturers had no interest**
 - IBM, DEC, UNIVAC supported proprietary nets
 - Now most have IPv6 suites – e.g. Microsoft, IBM, Sun, Cisco, Juniper and can support IPv6
- **Switch was sudden, no gradual transition**
 - Though UCL service transitioned early
 - This time co-existence will last many years
 - Dual-stack working is expected
 - Gateways will be there from the beginning



Some Similar Results

- **Some older machine will not change**
 - There will be transition services for a while
 - Newer machines will be put in IPv6 only
 - The cost of running two sets of systems at the same time will encourage faster transition
- **Whole systems like UMTS and some large-scale deployment of WiFi may be IPv6 only**
 - But IPv6 features used may be very limited
- **After initial burst of getting applications moved as before, will use new features**

Disruptive Tendencies

- **Security will remain serious problem**
 - Many Government agencies do not want too much end-end encryption
 - Fought against uniform systems in the past, after September 11 may do so again
 - Some strong industry pressures against IPSec and MIP. Mobile companies want to use SIM-based security under their control
- **Users likely to press for similar facilities irrespective of mode or place of access**

Some Unresolved Issues

- **Now many large legacy applications**
 - If well designed, little problem in moving
 - Some 6NET cookbooks addressing this problem
 - Sometimes have poor network-code separation; can give problems
- **When to adopt and when adapt**
 - Much can be done by adaptation gateways
 - Eventually adoption is more efficient and requires much less maintenance
- **Which higher-level standards must migrate**
 - A key debate in the IETF, 3GPP and elsewhere

6net Naming, addressing and directories

- Obviously the 128 bit address space of IPv6 will have major impact in Internet
- IP telephony is clearly happening
- What will be the impact on an integration of IPv6 addresses, telephone numbers, web addresses, e-mail address, security certificates and documents
 - Currently DNS is simple, but deals only with 1st
 - Enum deals partially with the second
 - An integration of these and document stores would have immense impact



The Information Network

- **The Internet has metamorphosed from a data network to a vital information and transaction network**
 - **Most other communications-based services are moving onto .the Internet**
 - **E.g. Telephone moving onto it, Telex has disappeared**
- **My main thesis on the move from IPv4 to IPv6 impacts only the basic network**
- **Far greater changes can be expected in the mechanisms for information provision – and their control**
 - **Of course these changes will have major impacts also on protocols and components**

6net Needs in Information Dissemination

- **Some countries and organisations wish to limit access to the information**
 - Pornography, SPAM and Viruses acceptable reason for limiting Internet content
 - Some countries' more concerned with limiting access to potential opposition
 - Currently some limit access to sites – but not usually to search engines
- **There is major concern on SPAM, Data Privacy, Caches and use of Cookies**
 - The approach to these have national scope, but the Internet does not
 - There may have to be support in the protocols and regulatory framework

6net Finance, Taxation and Governance

- **Until recently taxation and duties could be decided and applied nationally**
 - It is no longer possible with the present Internet
 - Even if certain transactions look at the source of the transaction, dummy accounts could easily be set up
- **Legal sanctions are normally applied where the offence took place**
 - With Internet Fraud, SPAM, Privacy violation, this may not be adequate
- **Governance – Efficiency versus International**

Summary

- **One set of changes which must occur is the transition to IPv6**
 - **We should all understand its impact.**
- **Far more fundamental changes will occur as the Internet is recognised as the Information and Communications network**
 - **Here there will be immense technical impact – but also on the legal & regulatory environment**
 - **Even new sanctions may have to be devised**