The Global Internet: A different perspective on Broadband Access to the Internet

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- Different transport networks
- Different administrative entities
- Different protocol stacks in each network
- Encapsulation/Emulation schemes to go from one network to another
- Multiple hot spots and bottleneck points
- Multiple Operation Support Systems and NMS’s
- Multiple hops through the same physical network (Internet is currently made up of leased lines from the IXCs and LECs.)
GI Concept: Consolidate and Differentiate

Consolidate
- Common Physical Transport Network (Cell-based)
- Consolidation of OSSs and NMSs and Services

Differentiate
- Multiple Administrative Entities (IXCs, LECs, ISPs etc.)
- Multiple Protocol Stacks
- Multiple Service Entities

Uses Advances in Software Engineering as enabling technology
Scalable Architecture to prevent hot-spots and allow for growth
Global Internet: Key Concepts

- ATM Backbone is a reality
- IP applications at the desktop is a reality
- The distinction between ISPs, LEC, IXCs etc. disappearing
- Two address formats are dominant: IP and E.164
- The boundary between the Public Switched Telephone Network and the Internet is a blur

What should this be? (ATM? IP? Both? Neither?)
Pros and Cons: Single vs Multiple Control Planes

Single Plane:
- Simplifies the protocol inside the network.
  - One Addressing Scheme
  - One Routing Scheme
  - One Signaling Scheme
- Complicates the protocol stack at the edges
  - Encapsulation/Emulation techniques
  - Force-fit all applications to work over a set predefined network protocol style- example connection-oriented ATM with end to end signaling for QoS support.
  - Natural dichotomies of differing protocol styles get highlighted
    - IP over ATM is one such example.
Pros and Cons Continued

Multiple Control Planes
- The network takes on the burden of supporting multiple stacks
- The CPE stack is simplified as each protocol is supported naturally
- Allows applications to run in a style and form that is most suitable for it-connectionless, connection-oriented, hop-by-hop, end-to-end, best-effort, QoS-guaranteed etc.
- Administrative nightmare if we have too many stacks.

Fortunately in the Late Nineties the choice is down to two:
- IP
- ATM

Key Point: In the Global Internet both should be supported

Immediate Benefits of the dual stack:
- IP provides natural support for multicast applications (ATM does not)
- Browsing applications benefit from the IP setup (hop by hop etc.)
- Rich history of QoS-based support on the ATM stack can be reused- i.e., RSVP== Rely on SVCs for your QoS Packets
Current Approach To Broadband Internet

- End to End ATM from ATU-R to ISP
- PPP over ATM between ATU-R and ISP
- SVC and PVC services
- PPP to provide
  - Authentication
  - Security
  - Autoconfiguration
- QoS support (map each ppp session to a SVC)
Some Observations

• Entire ATM Cloud viewed as a point to point link
• IP addresses hidden from PSTN (only E.164)
• All accesses to the Internet (data + control) through the ISP
• ISP data bottleneck + latency issues for web accesses (number of PPP sessions that can be demuxed at the ISP is an issue)
• Broadband replacement for the narrowband dial up link
• No inherent support for IP multicast as well as mobile IP!!!

ADSL = A Dialup Service for web Lookups == A Definite Sureshot Losing Proposition !!!
MPOA: Multi-Protocols Obsoletes ATM Access
-Some thoughts on simplifying Access Protocols

- One overriding principle behind the standard
  - One Control Plane (ATM) for all network layer protocols
  - Encapsulation and/or Emulation techniques to map from other layer 3 protocols to ATM
Resulting ATU-R Stack for handling "connectionless" IP Traffic

Data Transfer Plane
- FTP
- HTTP
- DHCP
- L2TP
- PPTP
- TCP
- UDP
- ARP
- RIP
- IP
- ICMP
- PPP
- LANE
- IPoA 1483, 1577

Signaling Plane
- RSVP
- QoS Mgr
- Call Control/Config Module
- Q.2931
- SSCF
- SSCOP
- PVC/PVP Mgt

Network Mgt Plane
- SNMP
- UDP
- IME
- IP
- ILMI
- Sig/CC Mgt
- SNMP/AAL 5
- ATM Mgt
- TC Mgt
- PMD Mgt

Ethernet PHY
- MAC
- ATM
- ATM-ADSL TC
- ADSL -PMD

PHY
- AAL 5
Alternative View- Ipsofacto bindings

- ATM is a scalable link level multiplexing technology
- Multiple Level Three Protocols can use the same VP/VC space
- No attempt to force fit one networking paradigm for everything
- The binding from layer 3 address to layer 2 address is a function of the layer 3 protocol

- IP-> ATM VP/VC uncoordinated hop by hop (IPSOFACTO)
- FR-> ATM VP/VC co-ordinated setup using signaling
- ATM -> ATM VP/VC co-ordinated setup using signaling
ISP

Residential Lan

PC

Global Internet

web server

ATU-R

AdSL Network

ATU-C

RMI

Ipsofacto SVC

corba/java based messaging system pvc

- ISPs retain control of “access” to the internet
- Data path however goes directly through the global internet using IP (Ipsofacto is the most natural way but IP Switching, MPLS and other IP based solutions also preferable than PPP).
- security, authentication and billing agents provided by ISPs using CORBA or JAVA and can be remoted to ATU-C or ATU-R
- Separation of data and control paths critical for scalability
- Minimizes latency for web and IP multicast traffic
**Simplified Protocol Stack at the ATU-R**

<table>
<thead>
<tr>
<th>Local Resources</th>
<th>TCP, UDP etc.</th>
<th>Other Networks</th>
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<tbody>
<tr>
<td><strong>IPSOFACTO</strong></td>
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<tr>
<td><strong>AAL5</strong></td>
<td></td>
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<td><strong>ATM</strong></td>
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<td><strong>PHY</strong></td>
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</table>

- **API**
- **OBJECT-BASED VIRTUAL SERVICE MIDDLEWARE**

- Clean partitioning to allow multiple protocols to live together
- No encapsulation or emulation protocols
- Add as many network stacks as is needed by the client
- Ability to remote agents from the ISP and the service operators
**GI Concept**

- Common Transport Network (ATM) for all services
  - Multiple protocols on the transport network (IP+ATM)
  - Network supports both E.164 and IP addresses
  - Multiple administrative entities share common transport network
  - Each entity retain control of access to its logical network but data path is directly through the global internet (separation of control and data)
  - Security, authentication and billing agents can be remoted to various network elements by ISPs or IXCs or VoD suppliers using CORBA/JAVA technology
  - Completely distributed peer to peer network without any hotspots
  - Distributed Object Technology to move functions/agents inside the network
  - One Operation Support System and NMS inside the transport network
Distributed object based peer-to-peer architecture framework

- No centralized hot spots or bottlenecks
- Allows for redistribution of resources based on traffic
  - Link bandwidth is not the only resource to be contended for-
    memory and processing requirements factored in
- Customization of protocols stacks and services on a per-user basis possible
- Flexible service creation by multiple entities on the same transport network
- Allows for optimizing data paths as well as control paths in the network
- Cost savings on Operations Support System due to single transport network

Main Challenges:

- Performance issues with distributed object-based architectures
  - Lightweight agents needed for line cards and embedded processors
  - Latency
  - Concurrency
  - Security - agent <-> agent, agent <-> server etc.
- Getting the mindshare of various parties on the common architecture
Summary

• New Architectural Ideas for Broadband Access
• Unique opportunity to guide the architecture of the Global Internet
• Existing narrowband protocol stack not suitable for future broadband applications
• PPP over ATM bandwagon in the ADSL Forum needs to be examined and ramifications quantified.

“Hardware is soft- easier to change, Software stacks once in place are almost immutable- Software is hard”