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

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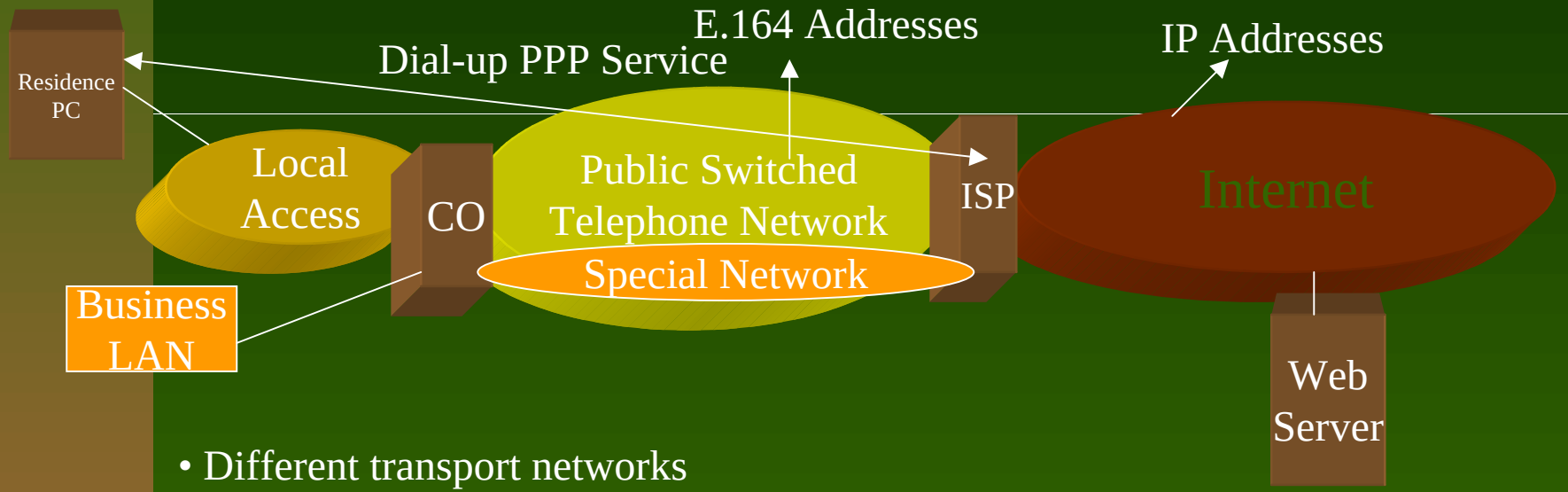
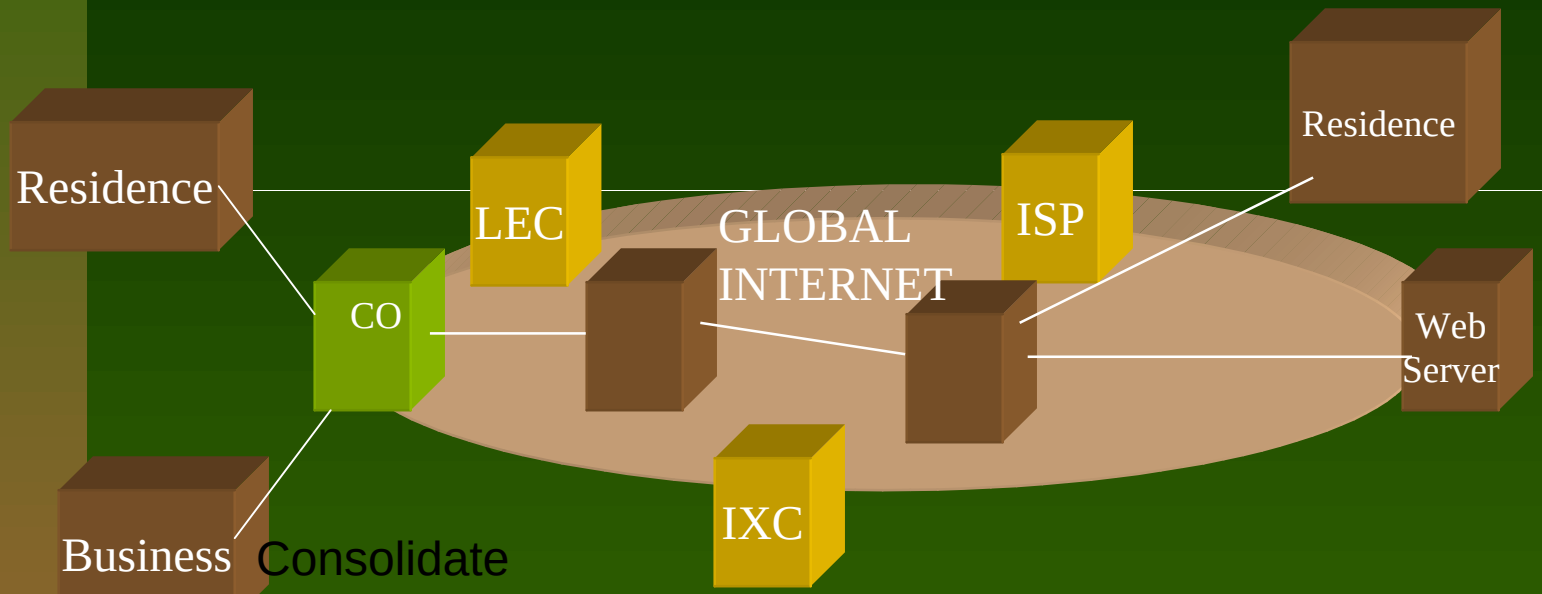
Present Network



- 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

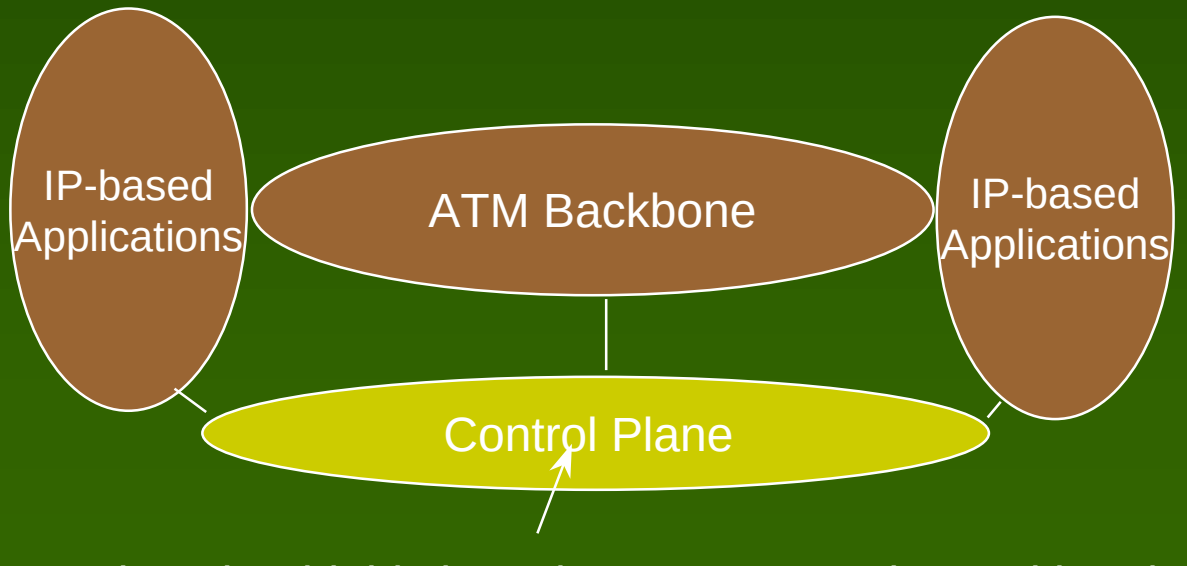
- Multiple Administrative Entities (IXCs, LECs, ISPs etc.)
- Multiple Protocol Stacks
- Multiple Service Entities

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



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:

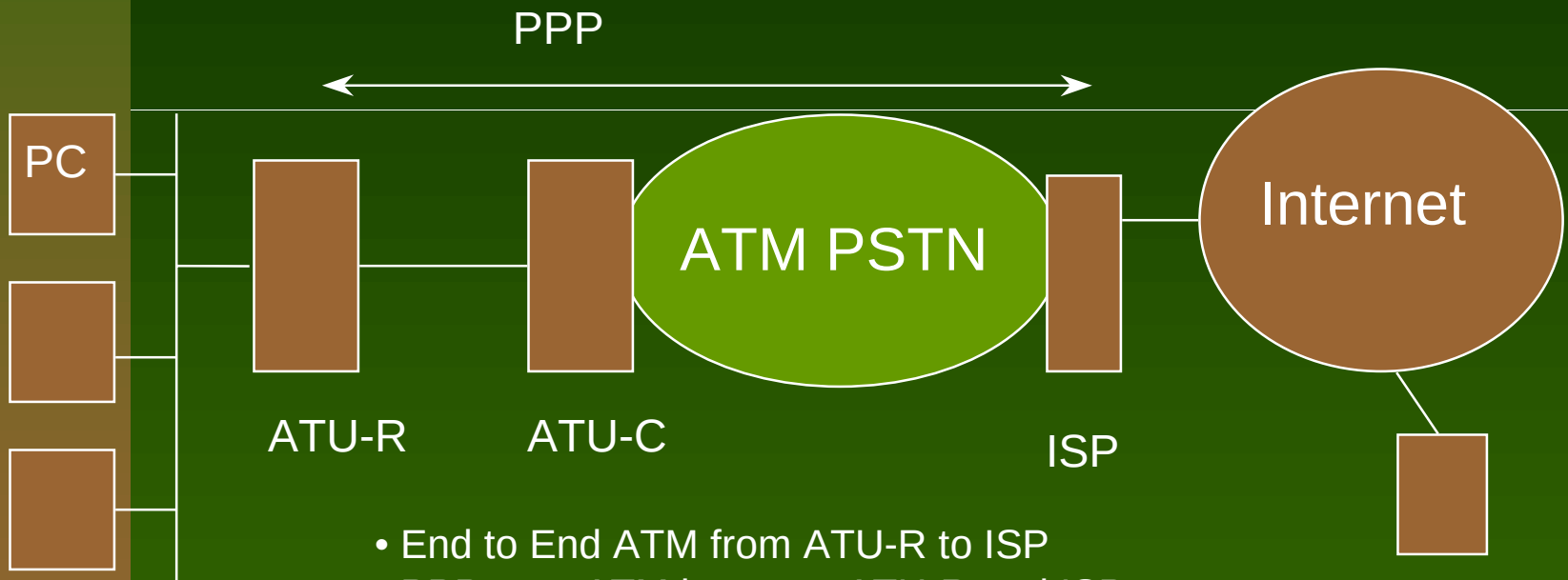
- IP
- ATM

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

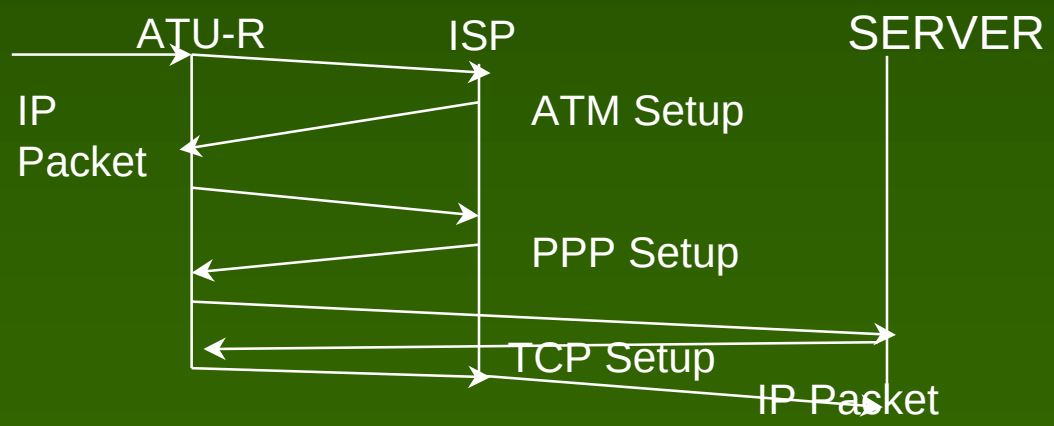
Current Approach To Broadband Internet



- 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

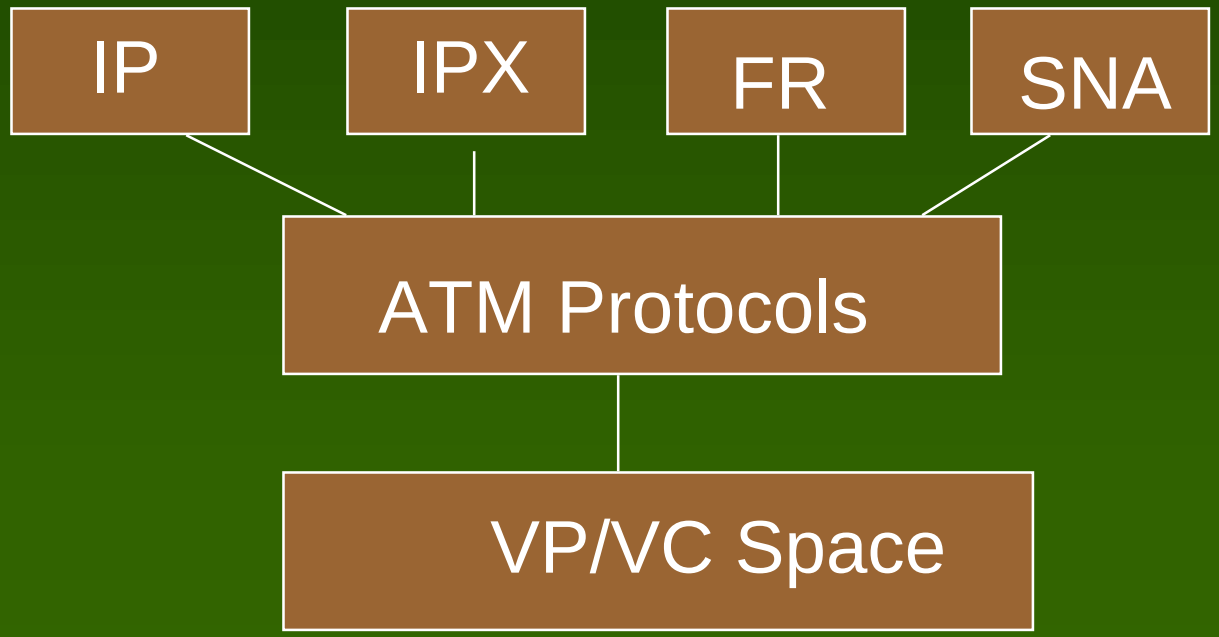
- Entire ATM Cloud viewed as a point to point link
- IP addresses hidden from PSTN (only E.164)
- All accesses to the Internet (data + control) through the ISP
- ISP data bottleneck + latency issues for web accesses (number of PPP sessions that can be demuxed at the ISP is an issue)
- Broadband replacement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



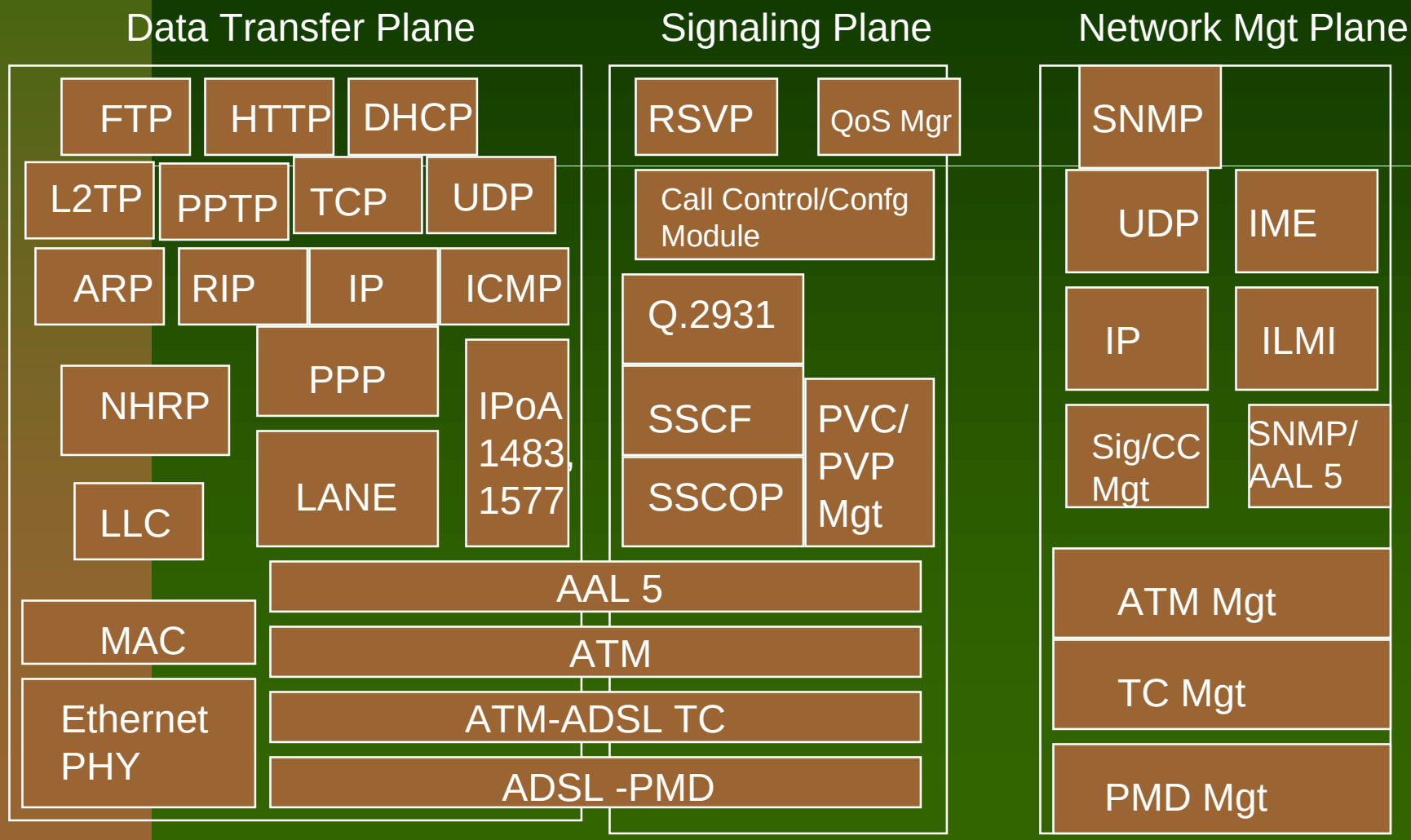
ADSL= A Dialup Service for web Lookups== A Definite Sureshot Losing Proposition !!!

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

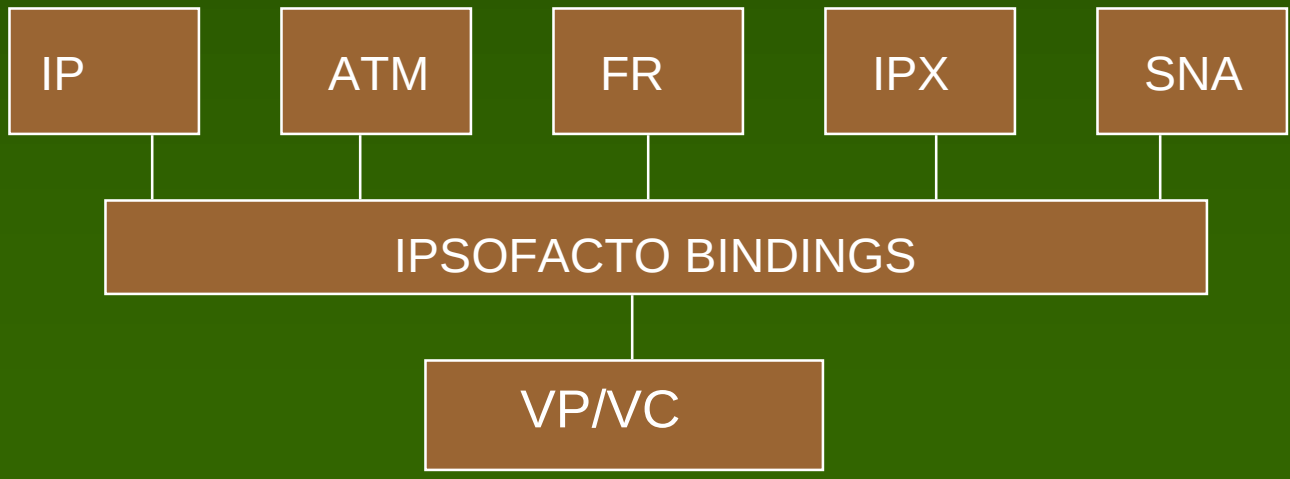


Resulting ATU-R Stack for handling "*connectionless*" IP Traffic

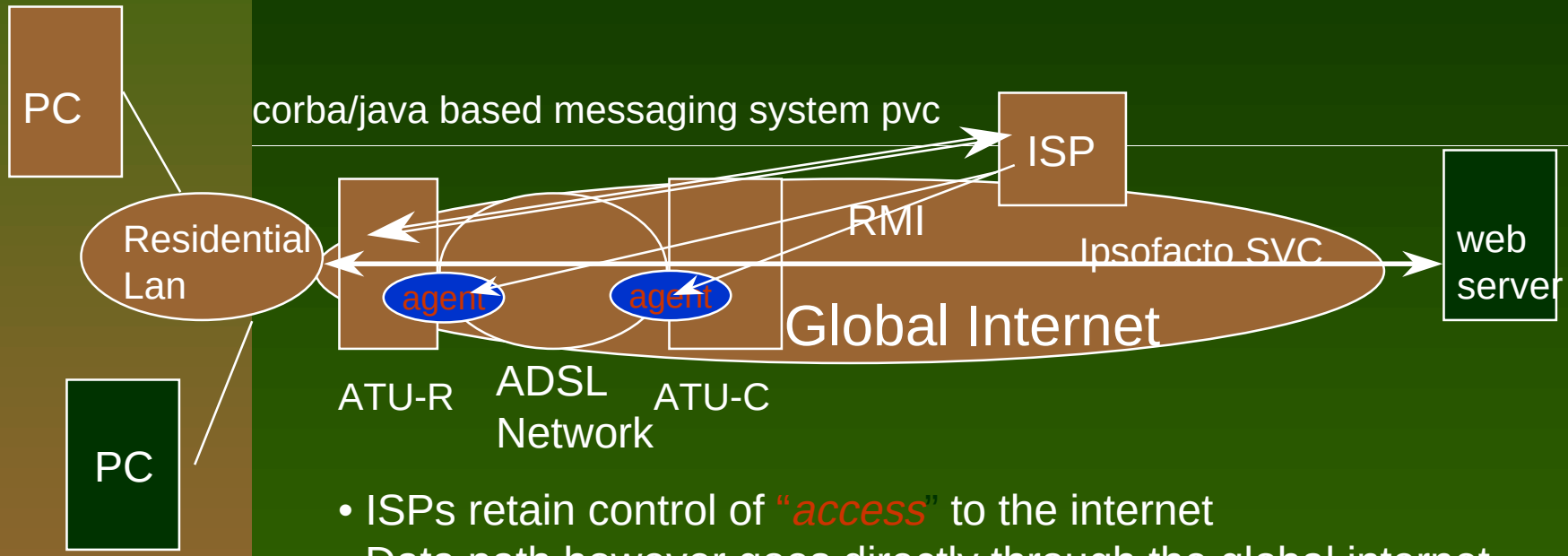


Alternative View- Ipsofacto bindings

- 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

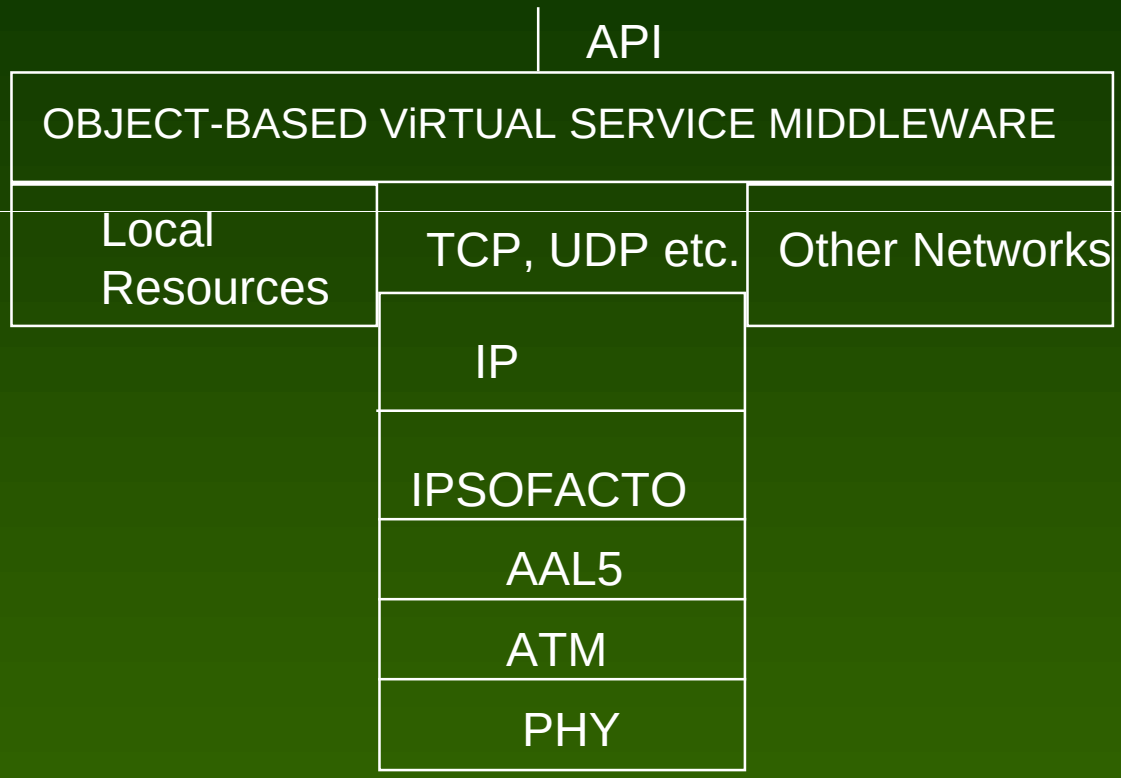


Alternative Architecture: Global Internet= IP + E.164 Addressing



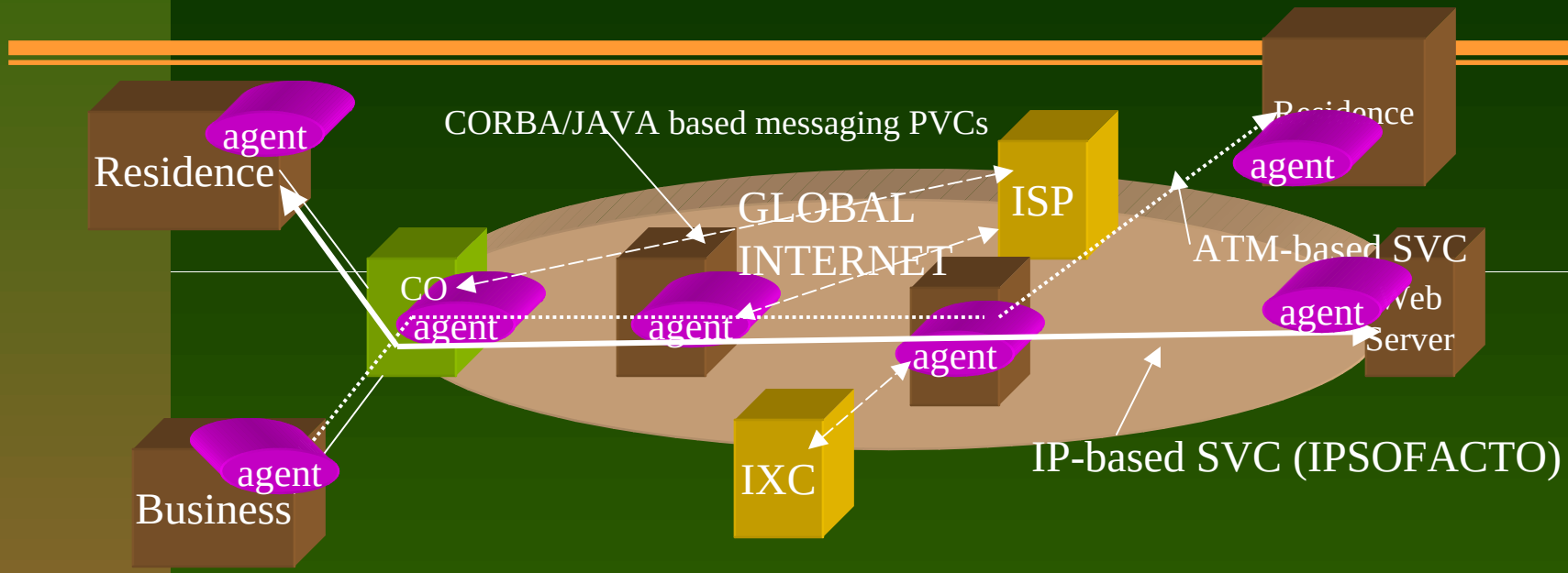
- ISPs retain control of "*access*" to the internet
- Data path however goes directly through the global internet using IP (Ipsofacto is the most natural way but IP Switching, MPLS and other IP based solutions also preferable than PPP).
- security, authentication and billing agents provided by ISPs using 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



- 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

GI Advantages and Challenges

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”