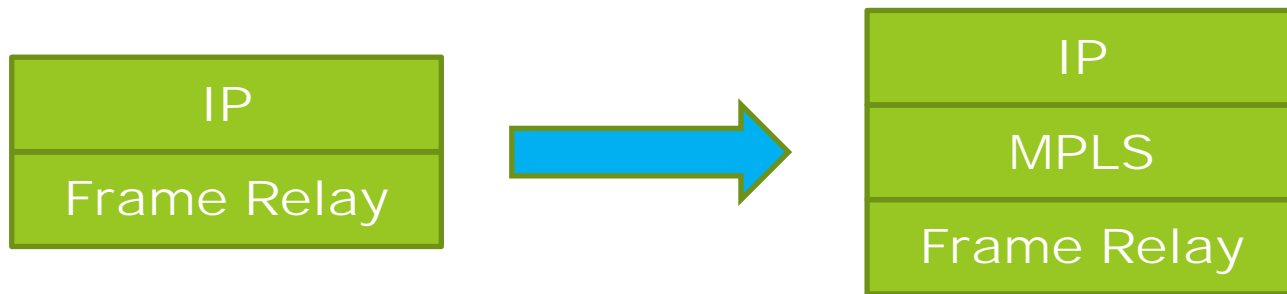


Converged Networks

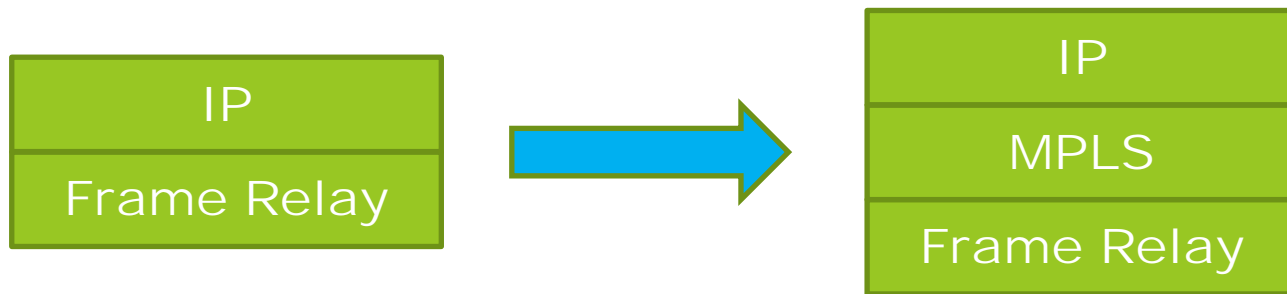
- Networks
 - From Telecom to Datacom, Asynchronous Transfer Mode (ATM)
 - From Datacom to Telecom, Multiprotocol Label Switching (MPLS)
 - Further Convergence
 - Evolving Networks

Data Communication to Telecommunication – Multiprotocol Label Switching



- MPLS standardization began in 1997 by the IETF
- MPLS uses a small, 20 byte label inserted between the Layer 3 (IP) packet header and the Layer 2 frame header
- MPLS provides
 - A fast forwarding mechanism
 - Support for connection-oriented switching
 - Quality of service assurance for voice, video, and time critical data

Data Communication to Telecommunication – Multiprotocol Label Switching

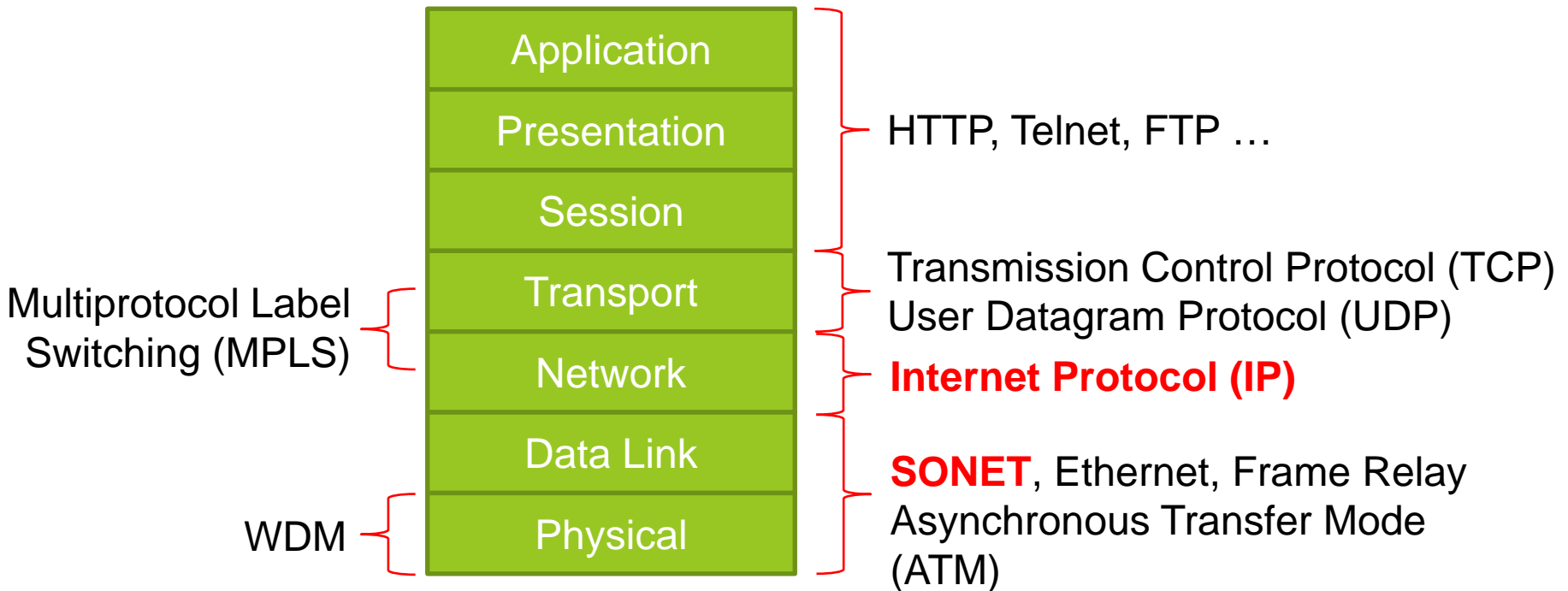


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Network Convergence

- Network convergence refers to the use of both datacom and telecom protocols and hardware in the same network.
- The motivation is to share resources and to combine the flexibility of datacom networks with the high capacity and **Quality of Service assurance** of telecom networks

Protocol Stacks



By the 1990's

- Internet Protocol had become the most important data network protocol
- SONET had become the most important telecommunication protocol

Standards Bodies

- International Telecommunications Union (ITU)
 - Wavelength Division Multiplexing (WDM)
 - Asynchronous Transfer Mode (ATM)
- Internet Engineering Task Force (IETF)
 - TCP/IP
 - Multiprotocol Label Switching (MPLS)

Telecommunication to Data Communication – Asynchronous Transfer Mode (ATM) over SONET



- ATM was standardized in the 1990's by the ITU
- It is an ambitious approach to carrying a very wide range of services
- ATM provides Quality of Service (QOS) guarantees, for voice, video, and critical data services, that IP does not
- ATM networks are now widely deployed

An ATM "Cell"

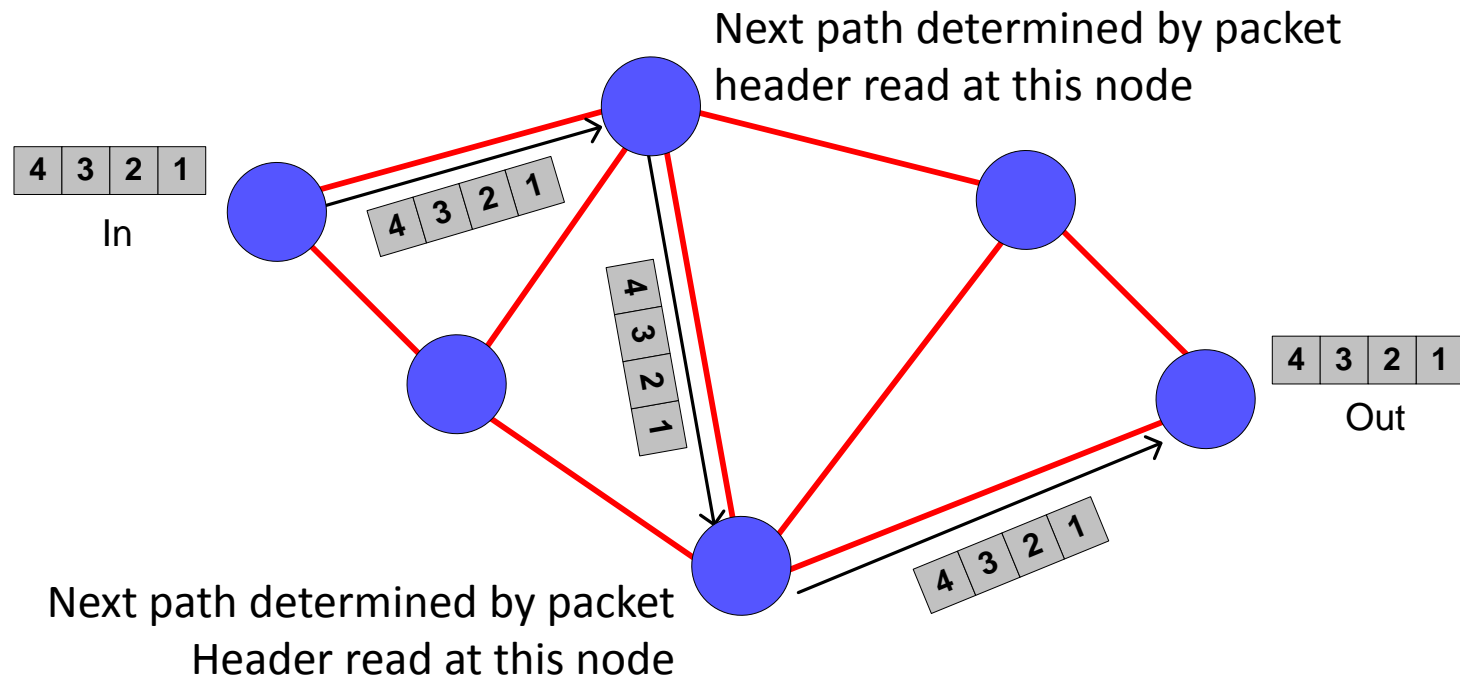
Includes a
"Virtual Channel Identifier"
for Virtual Circuit Switching



The relatively small 48 byte payload represents a compromise between requirements for:

- Fast switching to ensure quality of service
- Low overhead for more efficient use of bandwidth

Virtual Circuit Switching (Connection Oriented Networks)



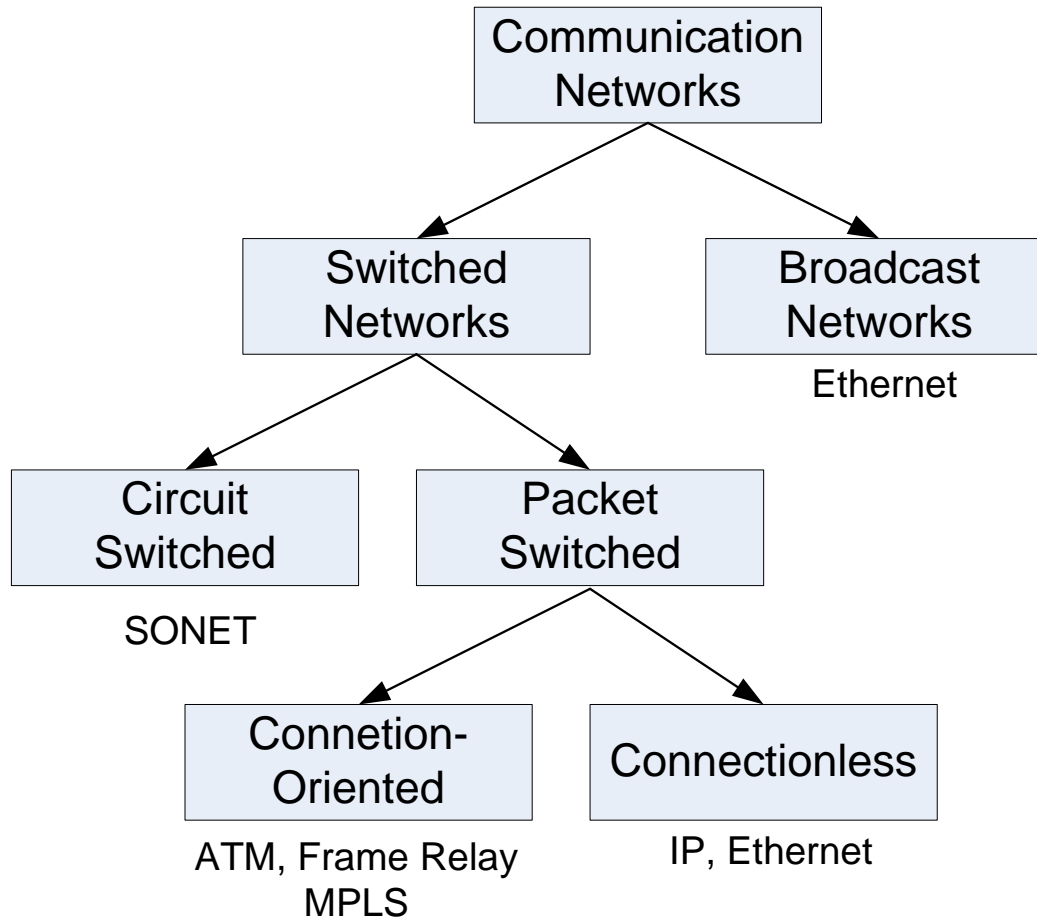
- Networks with virtual circuit switching look like circuit switched networks, but the circuits are not “hard wired”

Virtual Circuit Switching

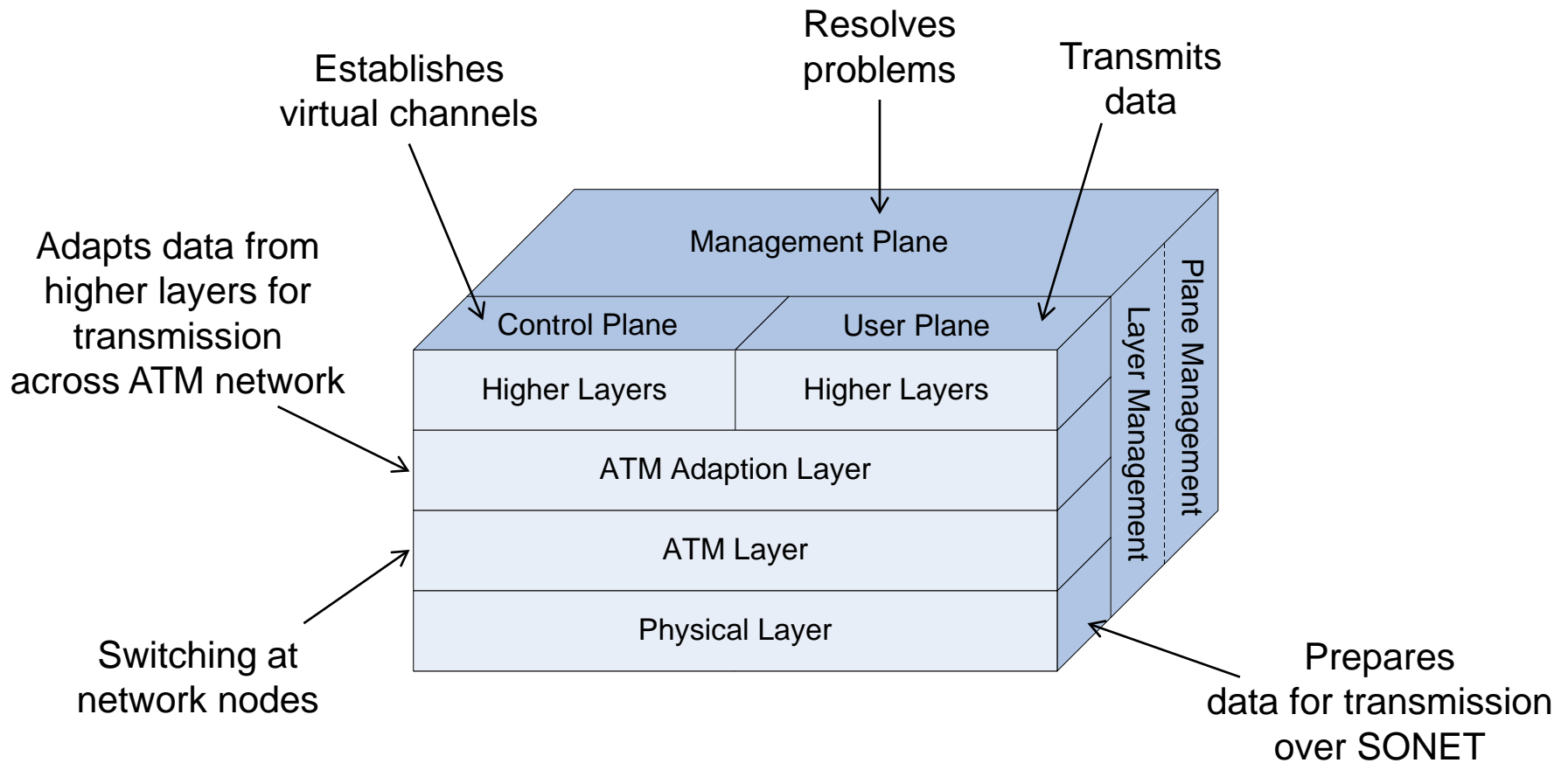


- Virtual circuit switching mimics old-fashion circuit switching

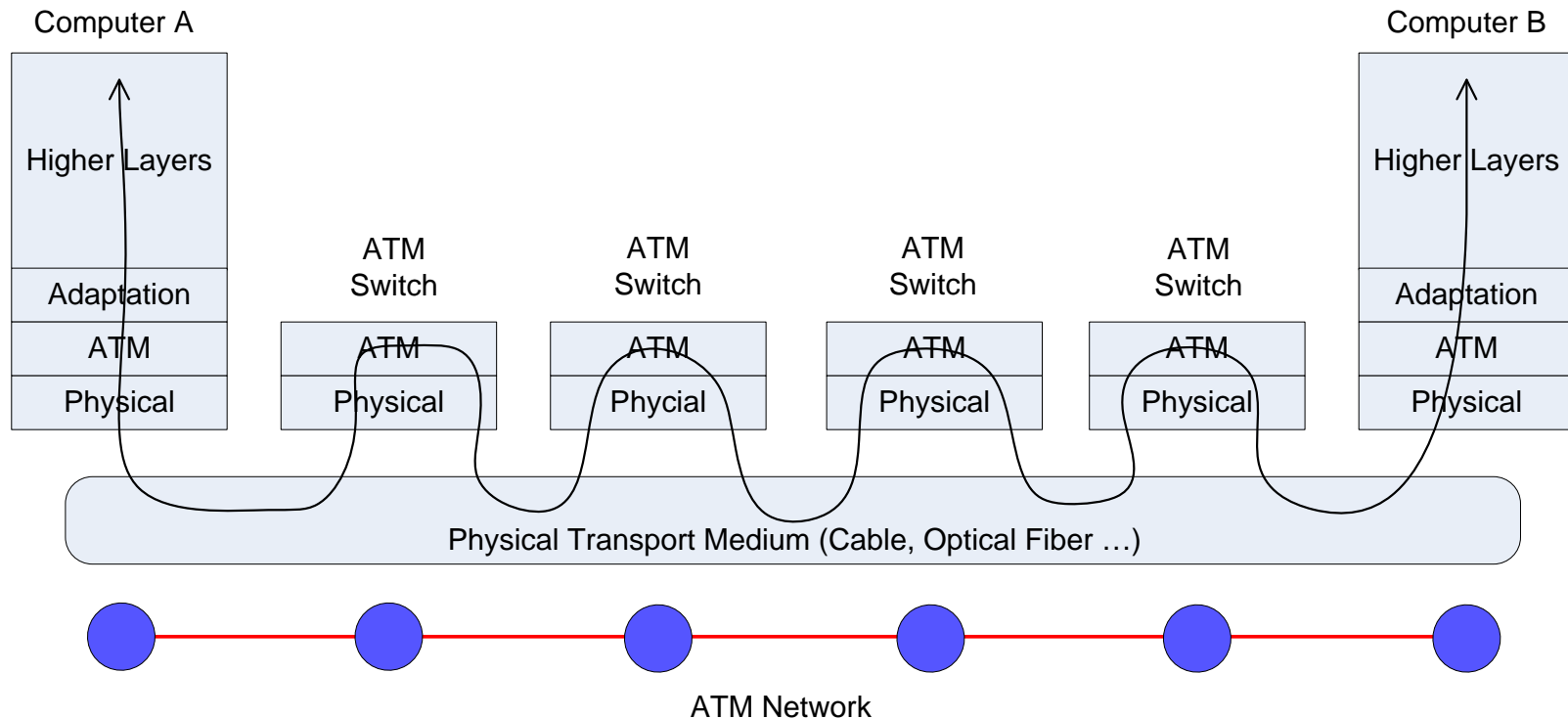
Network Classification by Switching Type



Asynchronous Transfer Mode – “Reference Model”

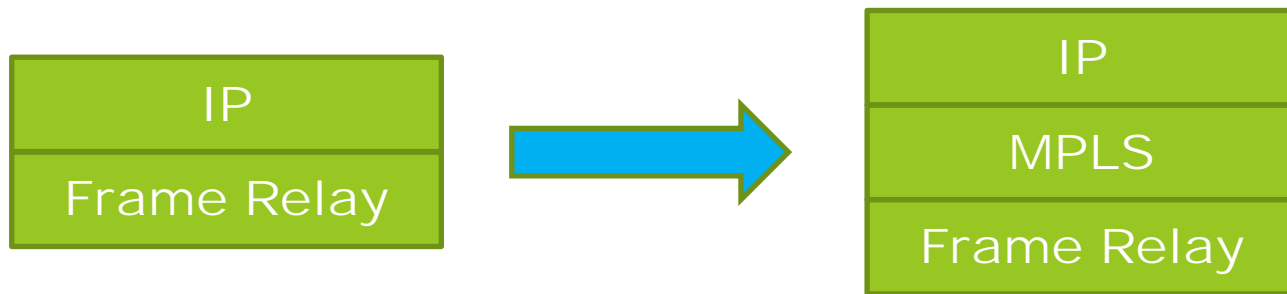


Stack Traversal Across an ATM Network



- Node switching takes place at the ATM layer

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Motivation for Further Convergence

- Internet protocol dominates data transfer and ATM was not able to displace it.
- IP over Frame Relay with MPLS does not provide the capacity of SONET and WDM

A More Fully Converged Network



- The communication infrastructure has evolved so that complicated convergence schemes like this are widely used today
- People agree that simplification would be a good thing

“IP over WDM”



- IP is here to stay
- So is WDM
- The question is how to most efficiently build networks that use both
- Real world solutions must take into account the current network infrastructure