



Computer Networks

An Engineering Design Approach

Bridges

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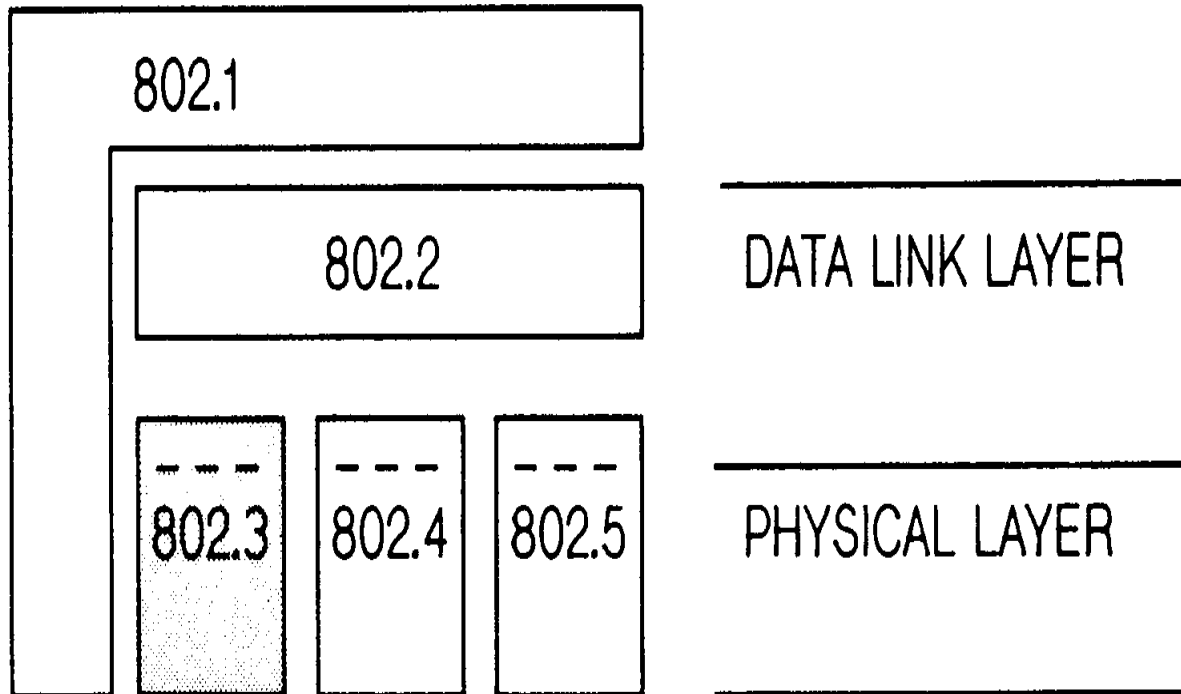
Based on: "Lecture Notes in Computer Networks"



Interaction Points

- A quick recap of the concepts learnt so far
- Internetworking basics
- Some definitions
- Mathematical limits to the rate of data transfer
- Evolution of Protocols: Generic Concepts
- Evolution of Aloha Protocol and its Variants
- More on Physical Layer basics
- A little more on WANs and the Internet
- Evolution of simple Layer-2 protocol frameworks
- The IEEE 802.x family
- What shall we cover during the next set of lectures?
- Questions and Answers

The IEEE 802.x Architecture and Specifications revisited



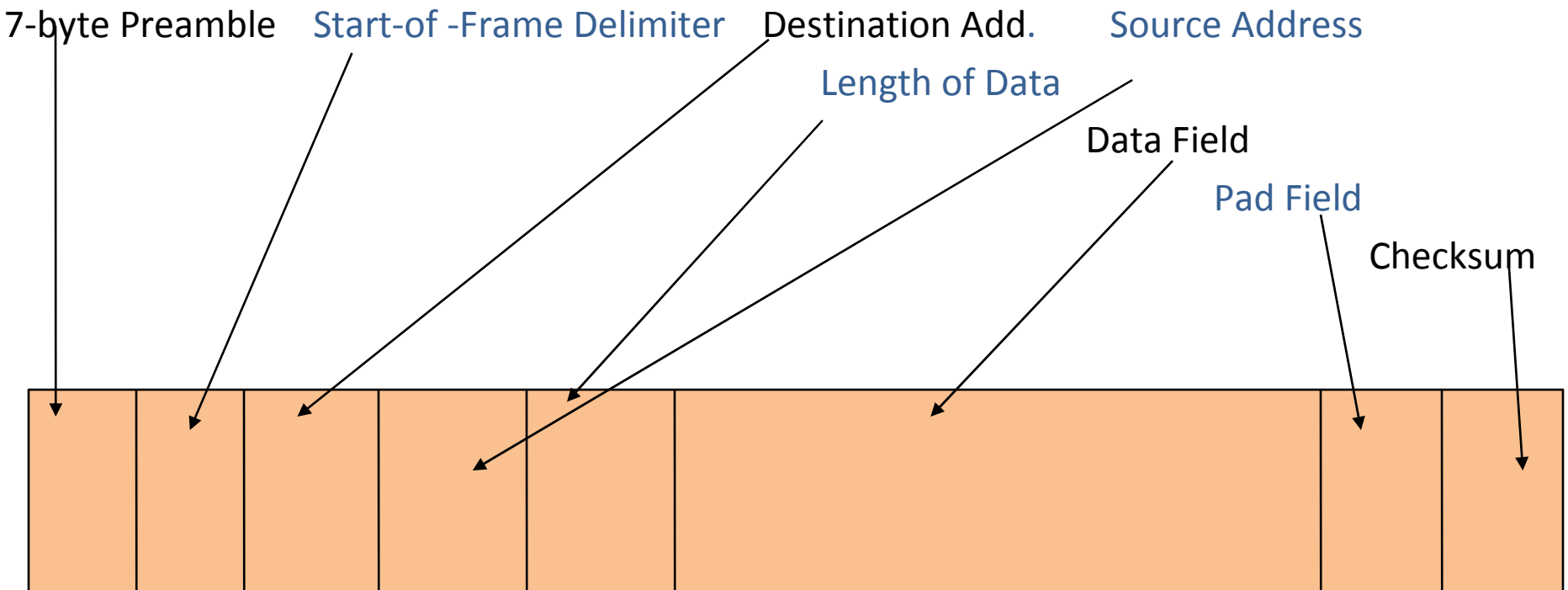
Based on IEEE documents with instructional modifications

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Data Link Layer (IEEE 802 included)

- **Data Link Layer consists of two sub-layers:**
 - Media Access Control (MAC) sub-layer &
 - Logical Link Control (LLC) sub-layer.
- **Major Issues involved in the design of the Data Link Layer include:**
 - Which services are to be provided to each of the adjacent layers?
 - Exactly when to provide these services?
 - How to provide them?
 - To whom should they be provided?_

A Sample Frame Format (IEEE 802.3)



Routing / Forwarding / Switching of Frames

- Frame Routing and / or Forwarding: <Size: Fixed / Variable> *Bridge style*
 - Store-in-entirety first and forward later
 - All nodes on each side form their respective collision domains
- Frame Routing and / or Switching: <Size: Fixed / Variable> *Switch style*
 - Store header first and begin switching without waiting for payload's arrival
 - Uses no or smaller collision domains, where applicable

Switching Fabric, Network Processors and the Semantic Gap

- **Switching Fabric**
 - High-speed Physical mechanism that allows the backplanes to execute low-latency switching
- **Channels**
 - Process-to-Process abstraction / view
 - Request-Response abstraction / view
 - Message-Stream abstraction / view
- **Network Processors**
 - Specialized network nodes optimized for functions like switching / routing / forwarding / provisioning etc.
- **Semantic Gap**
 - Gap between services / functionalities / features expected by applications and the capabilities of the networking technology

The IEEE 802 Bridges

- As discussed earlier, in case two networks differ at the DLL and lower levels, they can be connected by using a Bridge.
- Thus, theoretically, a *Bridge* is an *interconnection device* that has two layers (DLL and PL) and that can map two different DLL Frame formats onto each other (thereby providing support for *frame translation* on demand).
- Many of today's Switches also incorporate required elements of Bridging capabilities.

The IEEE 802 Bridges ...

- The IEEE 802 Bridges offer the basic functionality of the Bridges defined above; and, also extend it in some specific ways.
- Two basic types of Bridges are:
 - Half Bridges
 - Full Bridges
- Another classification of Bridges may look like:
 - Transparent Bridges
 - Source Routing Bridges

Transparent Bridges

- A Transparent Bridge is also known as a Spanning Tree Bridge or a Plug-and-Play Bridge.
- Design Goals of a Transparent Bridge:
 - No manual configuration should be required for using the bridge.
 - No hardware / software changes should be necessary for operation.
 - There should be automatic detection, address-location and periodic review of the internetwork status.
 - Promiscuous Mode operation should be supported by default.

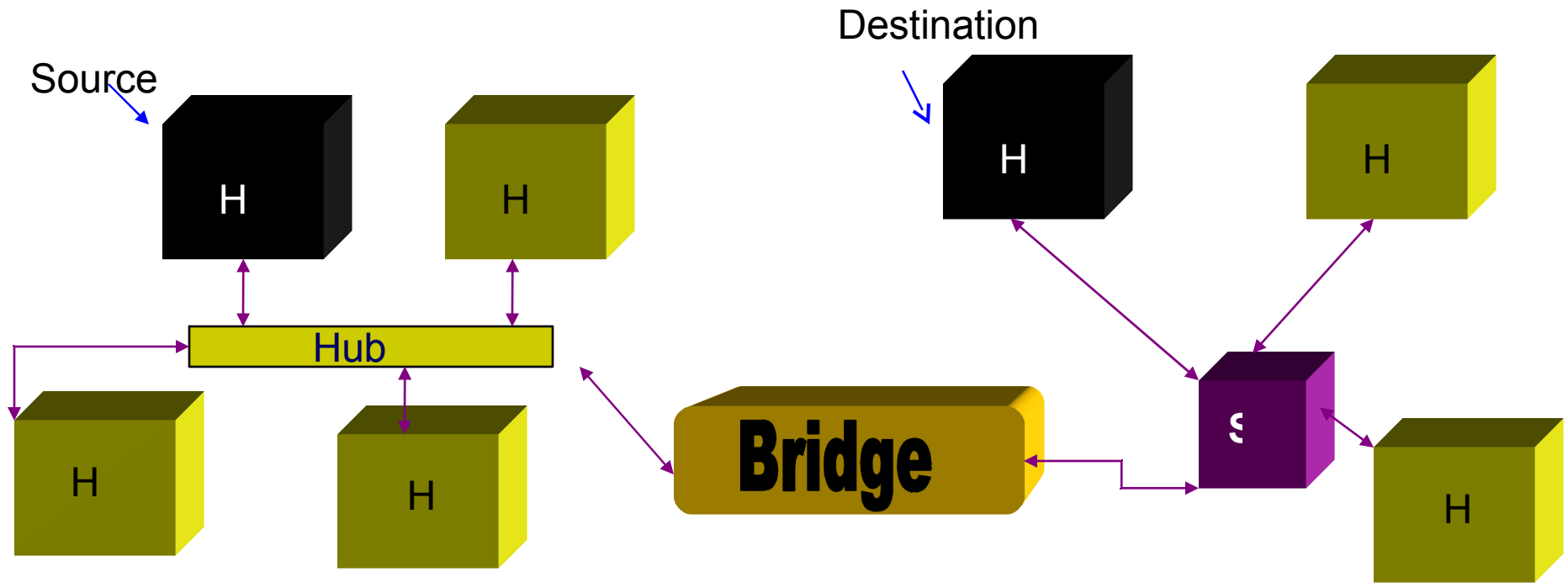
Operation of the Transparent Bridges

- A Transparent Bridge accepts all Frames that it receives from the attached networks.
- Frames destined for a station on same LAN from which they originate are immediately discarded by the bridge.
- Only those Frames which are destined to reach other LAN(s) are processed further for the purpose of Forwarding.
- The forwarding decision is based on the current status of the local hash table maintained by the bridge in question.
- This hash table is periodically refreshed by the bridge at preset regular intervals (in order to take into account any network node / switch etc. that might have come up or gone down in the mean time).

Operation of the Transparent Bridges ...

- When the network first comes up, this table is empty. It is gradually filled in by means of exploration.
- The basic schemes that helps in building up this table at the start up and later update at said intervals are:
 - Flooding and
 - Backward Learning Algorithm
- Periodic flushing of the table contents may be 'selective purge' or 'purge-all' type.

Operation of a Bridge with Two LANs



Source Routing Bridges

- **What is Source Routing?**
 - It may be defined as a scheme of bridging two or more LANs in such a way that the bridge may perform the traditional job of format translation etc. while the onus of deciding a route between two nodes (Source and Destination nodes) and failure handling remains on the Hosts themselves.
 - Here, each Host is supposed to be aware of the fact that it is sending a message to another host on the same LAN or a different LAN.
 - In the latter case, the high order bit of the address is set to 1.
 - Also, routing details are provided in this case within the header itself.

Source Routing Bridges ...

- **What is Source Routing ...**

- Each bridge has a 4-bit Identification Number whereas each LAN has a 12-bit Identification Number.
- Although, like the Transparent Bridges, even the Source Routing Bridges operate in promiscuous mode (by default), they simply discard any frame meant for a destination on the originating LAN.
- This scheme requires the Hosts to discover location of Destination Hosts and routes leading to them. This is accomplished by broadcasting Discovery Frames.

- **Such bridges can be implemented in terms of:**

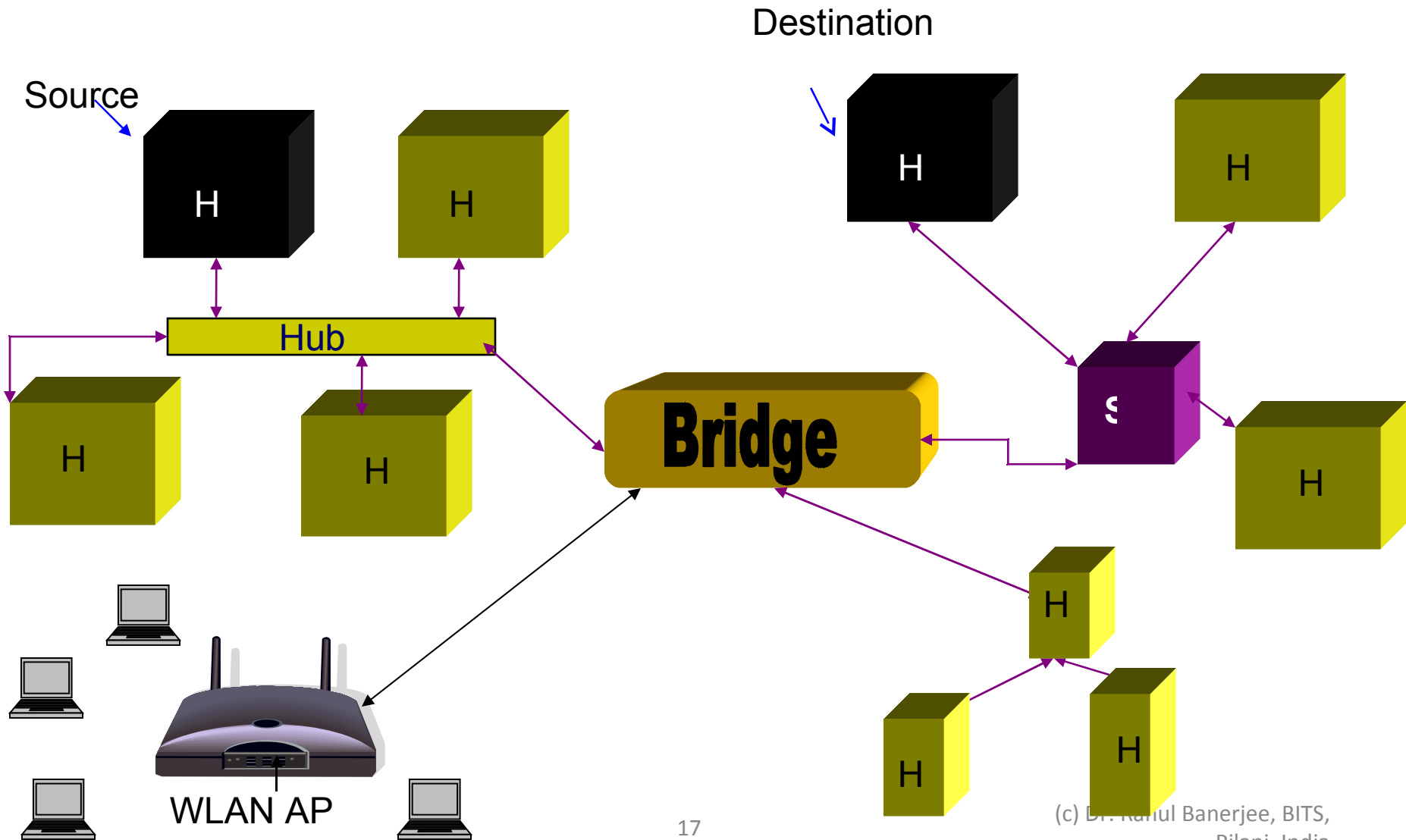
- Hardware
- Software
- Partly in Hardware and partly in software

How do the Source Routing Bridges compare to the Transparent Bridges?

Bridges may be compared with respect to:

- » Transparency
- » Location of Complexity
- » Configurability
- » Connection-orientation
- » Routing
- » Location Discovery
- » Failure Handling
- » Optimality

Operation of a Bridge with Four LANs



Unit Summary

- Bridges provide connectivity and where required protocol translation at Layer-2.
- Packet Switching is more cost effective than Circuit Switching primarily since the latter allows resource monopolization and therefore charges users time-wise and distance-wise instead of charging them according to actual traffic and its quality.
- Networks, like many others, need to scale to be cost-effective.

Any question please?

Thank you for your kind attention!

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- IEEE 802 standards issued so far PLUS amendments like:
 - 802.3ap-2007: IEEE Standard for LAN/MAN — Specific Requirements Part 3: CSMA/CD Access Method and Physical Layer Specifications — Amendment 4: Ethernet Operation over Electrical Backplanes
 - 802.11-2007 IEEE Standard for LAN/MAN — Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
 - 802.15.4a-2007 IEEE Standard for Telecommunications and Information Exchange Between Systems; PART 15.4: Wireless MAC and PHY Specifications for Low-Rate Wireless PANs (LR-WPANs) — Amendment 1: Add Alternate PHY
 - 802.1ag-2007 IEEE Standard for LAN/MAN — Virtual Bridged LANs — Amendment 5: Connectivity Fault Management

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