Module Name

Signaling

Sub-Modules:

- *Signaling Complexity*
- *Signaling Channels and Techniques*
- *Signaling Issues*
- *Signaling Models*

Definition of Signaling

- Signaling is used between user and the network, or between two network elements to exchange various control information like:
  - Traffic Descriptors
  - Service Descriptors
  - Channel Identifiers
- In other words, Signaling is used to dynamically establish, monitor, and release *connections* (including physical, virtual and logical connections).

Definition of Signaling (2)

- Signaling is used only for establishment and release of *dynamic* connections
- *Static* connections are configured, manually or otherwise, and may or may not require signaling.
- Signaling provides the means for resource reservation.
- In essence, Signaling provides the means to exchange connection-related information prior to and/or after information transfer.

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Signaling Complexity: Telecom Network

- Traditionally, use of signaling in Telecom Networks was bare minimum.
- It was restricted to establish/release a voice channel in order to allow telephonic conversation.
- Now, with advent of supplementary services (e.g., CLIP, Call Forwarding, etc.), signaling is becoming more complex.
- For e.g., SS7 which has an advanced network architecture provides feature-rich signaling.

Signaling Complexity: Virtual-Circuit-Based Network

- If Permanent Virtual Circuits (PVCs) are established, generally, no signaling is required.
- For Switched Virtual Circuits (SVCs), signaling takes place using well-defined signaling protocol.
- The signaling complexity is dependent upon the underlying technology.
- For e.g., Q.2931/Q.2971 (signaling protocol for ATM) is much more complicted vis-a-vis Q.933 (signaling protocol for frame relay).

Signaling Complexity: Datacom Network

- Datagram networks, generally, do not require signaling. This is because by very definition, a connectionless network does not entail connection setup.
- To provide QoS, some of resource reservation and hence some form of signaling is required.
- For e.g., newer protocols like MPLS and RSVP require some form of signaling message exchange and resource reservation.

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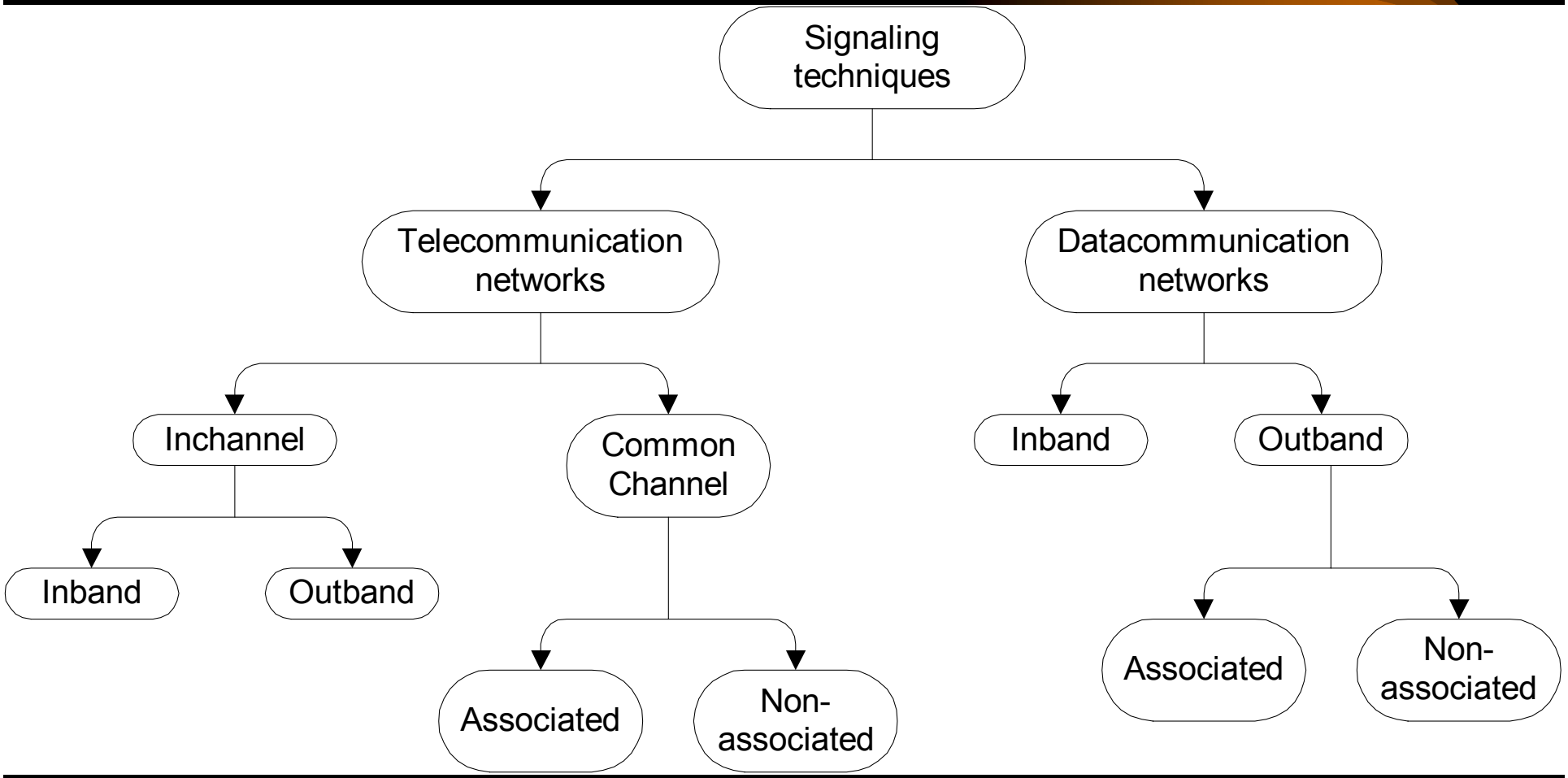
Signaling Channels and Techniques



Inband versus Outband Signaling

- Telecom Network:
  - *Inband signaling* refers to using the same voice frequency band to carry signaling information as that used to carry voice (i.e., 300-3400Hz).
  - In contrast, *outband signaling* refers to using frequencies above the voice band (but below the upper threshold of 4000Hz) to carry signaling information.

Inband versus Outband Signaling (2)

- Datacom Network:
  - *Inband signaling* refers to using the same virtual channel to carry signaling information as that used to carry data.
  - In contrast, in *Outband Signaling* the signaling information and data are carried on different virtual channels.

Inchannel Signaling versus Common Channel Signaling

- Telecom Network:
  - In *Inchannel signaling*, the same physical channel carries signaling information as well as voice and data.
  - In contrast, *Common Channel Signaling* uses a separate channel for solely carrying signaling information for a number of connections.

Inchannel Signaling versus Common Channel Signaling (2)

- Datacom Network:
  - To some extent, inchannel signaling and common channel signaling in telecommunication networks is analogous to inband signaling and outband signaling of datacommunication networks respectively.

Associated Signaling versus Non-Associated Signaling

- Telecom Network:
  - Both these techniques are variants of Common Channel Signaling
  - In *Associated signaling*, the signaling channels and the data paths pass through the same network elements.
  - In *Non-associated signaling*, there is no correspondence between signaling channels and data paths.

Associated Signaling versus Non-Associated Signaling (2)

- Datacom Network (for ATM):
  - In *Channel associated signaling*, all the signaling messages for each VP is exchanged on VCI=5 of that virtual path.
  - In *Channel non-associated signaling,* all the signaling messages of all the virtual paths are exchanged on VPI=0 and VCI=5.

MetaSignaling

- Another technique *metasignaling* finds mention in various signaling standards.
- Metasignaling refers to the process of establishing signaling channels using signaling procedures.
- The signaling channel so established is then used to establish channels for data transfer.

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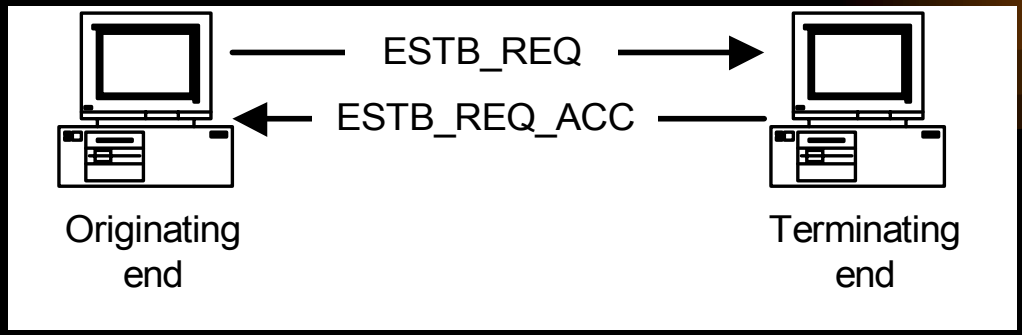
Signaling Issues

- Acknowledgements
- Timer protection
- Parameter negotiation
- Call/Connection identification
- Finite state machine modelling
- Message encoding and decoding (TLV format)

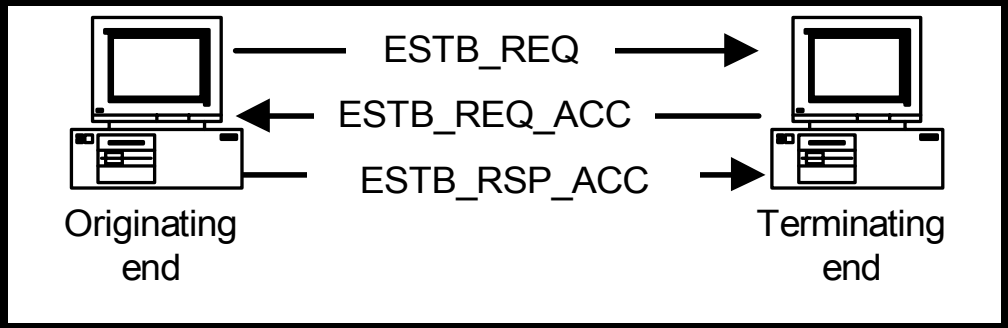
Acknowledgements

- Required due to unreliable nature of transmission media.
- The classical two-army problem suggests that no scheme can provide full-proof acknowlegement for an unreliable media.
- However, 2 or 3 handshakes is typically sufficient for a normal case.

Acknowledgements (2)



Two Way Handshake



Three Way Handshake

Timer Protection

- Timers are used to avoid inordinate delays in case the signaling messages get lost or corrupted.
- Timer is started after message transmission.
- In case message is lost or discarded, the timer expires and message is retransmitted.

Timer Protection (2)

- If the message reaches safely and is acknowledged, the timer is stopped.
- Choosing the correct timeout value is important.
  - If this value is too small, then timers will timeout very frequently.
  - If a very large value is chosen, it may defeat the purpose of keeping timers.
  - Typical value is twice the round-trip propagation time.

Parameter negotiation

- This entails arriving at a common set of parameters.
- The nature and scope of parameter negotiation depends on the number of handshakes.
- In a two way handshake, negotiation is bare minimal.
- A three way handshake provides more scope for negotiation.

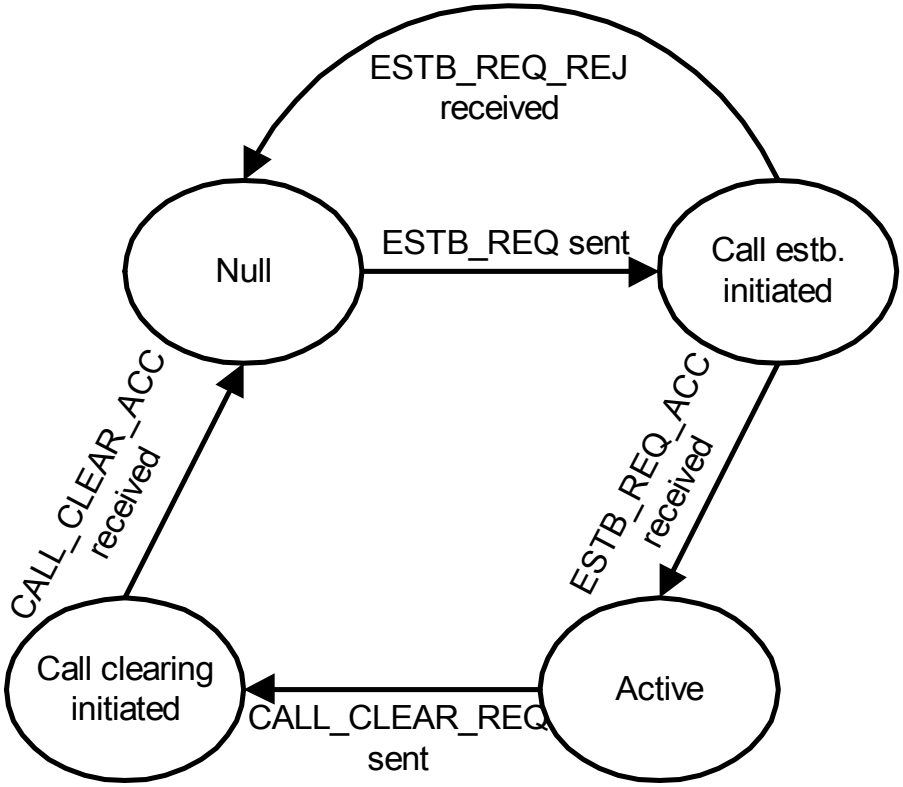
Call/Connection identification

- Consider the following steps:
  - An end-system ‘A’ sends a connection establishment request to ‘B’
  - ‘A’ sends another request to end-system ‘B’ for connection establishment
  - ‘A’ then receives a reply from ‘B’. How does ‘A’ identify to which request has ‘B’ replied to?
- The solution is to generate a uniq_num and accompany it with every message.

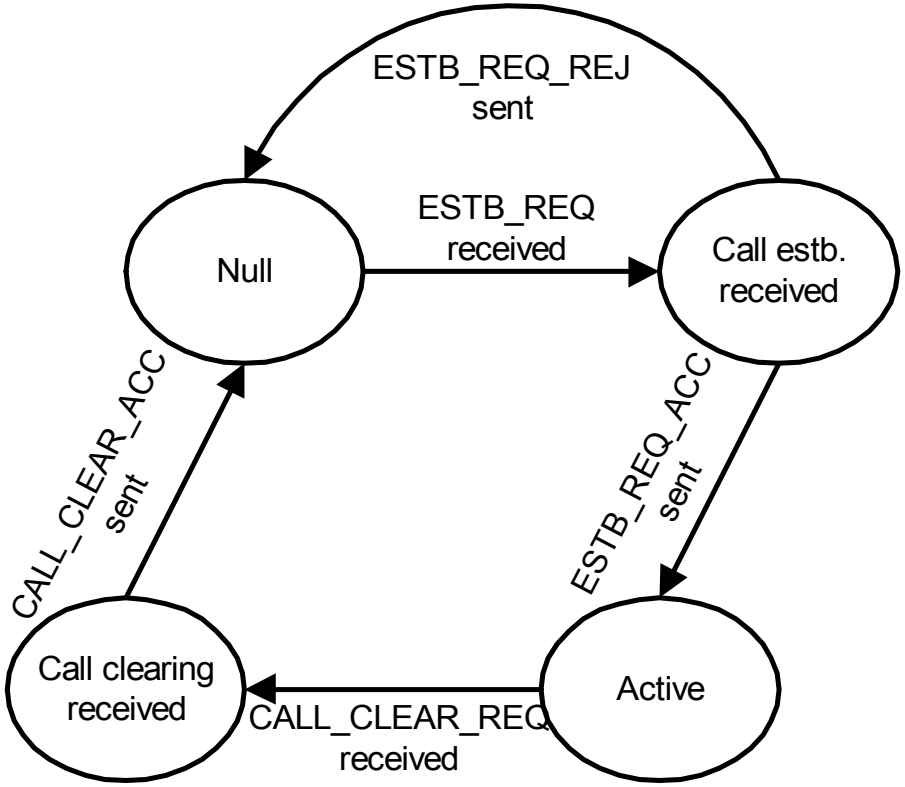
Finite State Machine (FSM)

- A Call goes through three phases
  - Call establishment
  - Data transfer
  - Call releasing
- The FSM accepts messages only if the message is permitted in that state.
- The state change happens when 1) a message is received from peer, 2)Timer expires and 3) User Request. received from User.

Finite State Machine (FSM) (2)



(a)



(b)

Encoding/Decoding

- Generally, messages are encoded in Type-Length-Value (TLV) format.
  - Type: Identifies the type
  - Length: Length of message (total length or length excluding the header)
  - Value: The actual contents
- Information blocks within the message may also be encoded in TLV format.

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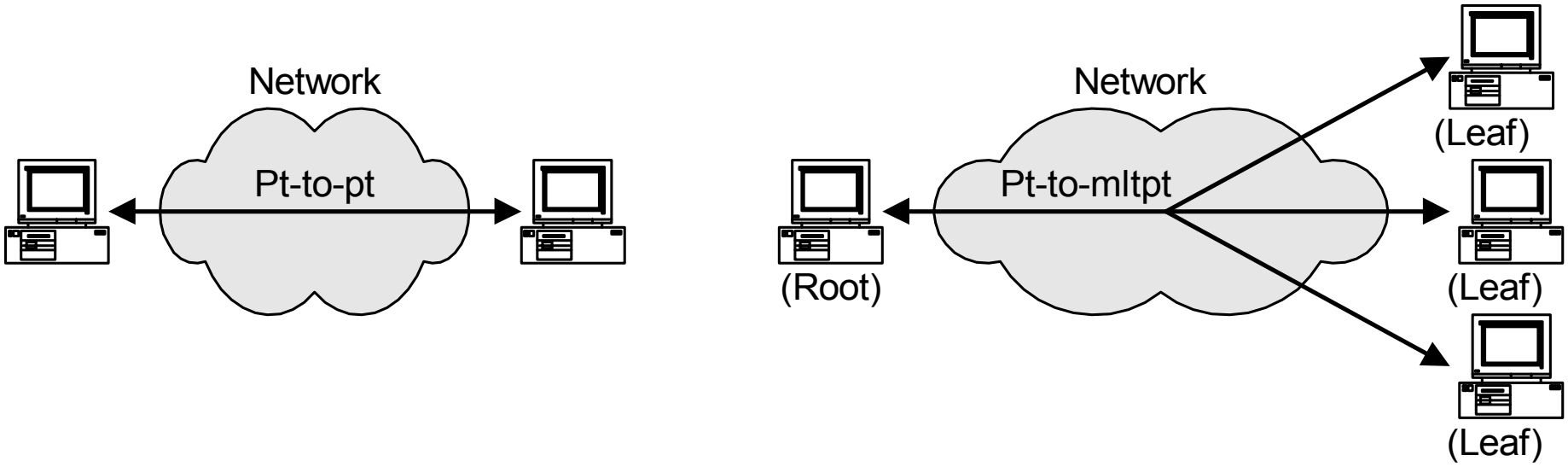
Signaling Models

Pt-to-pt: Point-to-point signaling
Pt-to-mltpt: Point-to-multipoint signaling
Signaling message exchange



Point-to-Point Signaling

- Point-to-Point signaling model is used to establish and release connections between two end-points.
- The is the most common model of signaling.
- Not only is this model popular, it is also very simple to implement.

Point-to-MultiPoint (PMP) Signaling

- Point-to-MultiPoint signaling model is used to establish and release connections between a root and multiple end-points.
- This form of signaling is mainly used for multicasting or broadcasting applications (e.g., distant learning).

Starting a PMP call

- A PMP call is generally started by the root.
  - The root may take this step voluntarily,
  - Or, it may do the same after receiving an explicit request from a leaf.
  - The leaf can send the connection establishment request to the root through signaling channel or through other means.
- The first connection is established following point-to-point procedures.

Adding parties to a PMP call

- After a PMP call is established, parties are added by the root.
- The root is informed either through a signaling message, or through some ‘other means’.
- Subsequent parties have no say in determining the parameters of the connection, as it has already been fixed

Dropping parties and releasing a PMP call

- A leaf of a point-to-multipoint call can drop itself out of the connection by sending a message to the root.
- It is mandatory for the root to entertain this request, and drop that particular party.
- If the root drops itself out of the connection, the whole connection is cleared.

Nature of a PMP call

- By definition, a PMP call is one in which the data flows from the root to the leaves (i.e. unidirectional in nature).
- Theoretically, nothing precludes bi-directional data-flows in PMP calls.
- However, if leaves are allowed to send data to the root, there is a multipoint-to-point connection along with the point-to-multipoint call.

Adv/Disadv of a PMP call

- Advantages
  + Saving of network resources like bandwidth. The % saving depends upon the breadth and the depth of the PMP tree.
- Dis-advantages
  - PMP connections are difficult to establish, manage, and release.
  - It is not easy for the leaves to indicate the root to start a connection.
  - The unidirectional nature

The following module

Signaling

ends here