Synchronization in Telecommunication Networks

By

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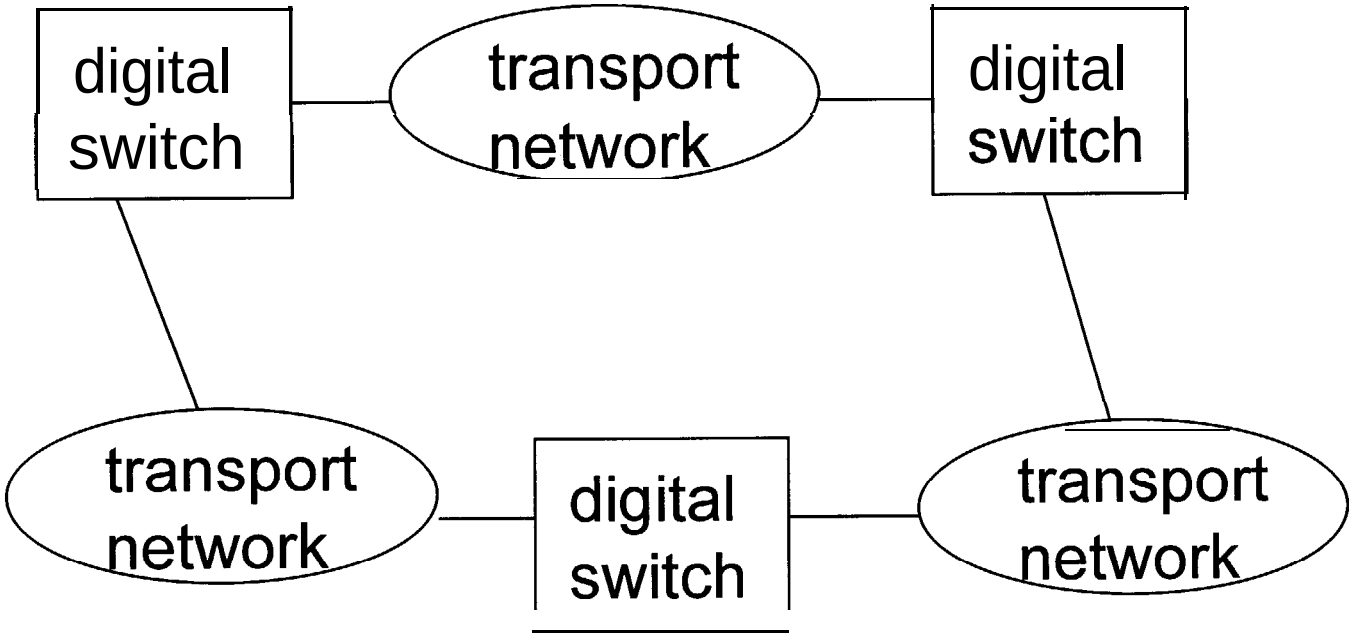
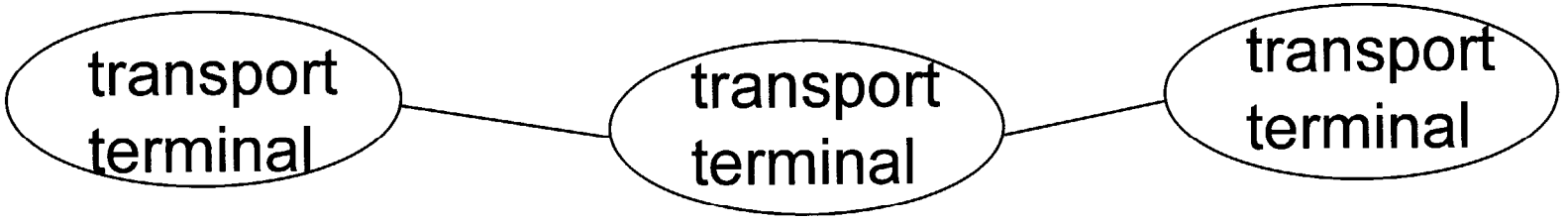
Outline

- Components of a telecommunication network
- Need for synchronization in a telecommunication network
- AT&T's synchronization network architecture

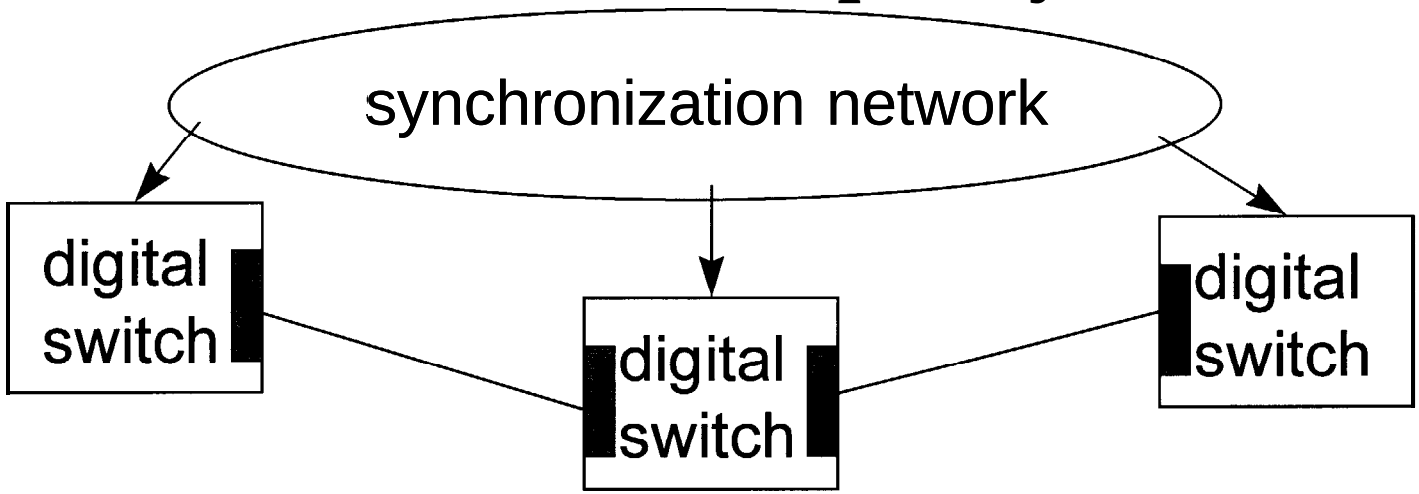
Some Major Components of a Telecommunication Network



transport network



Digital switches require synchronization, i.e. they need to operate at the same nominal frequency.



- This is achieved by synchronizing the switches to the same nominal frequency and having buffers at the interfaces to absorb short term fluctuations in frequency.
- When a buffer cannot absorb fluctuations data is lost (or duplicated). This is called a “slip”.

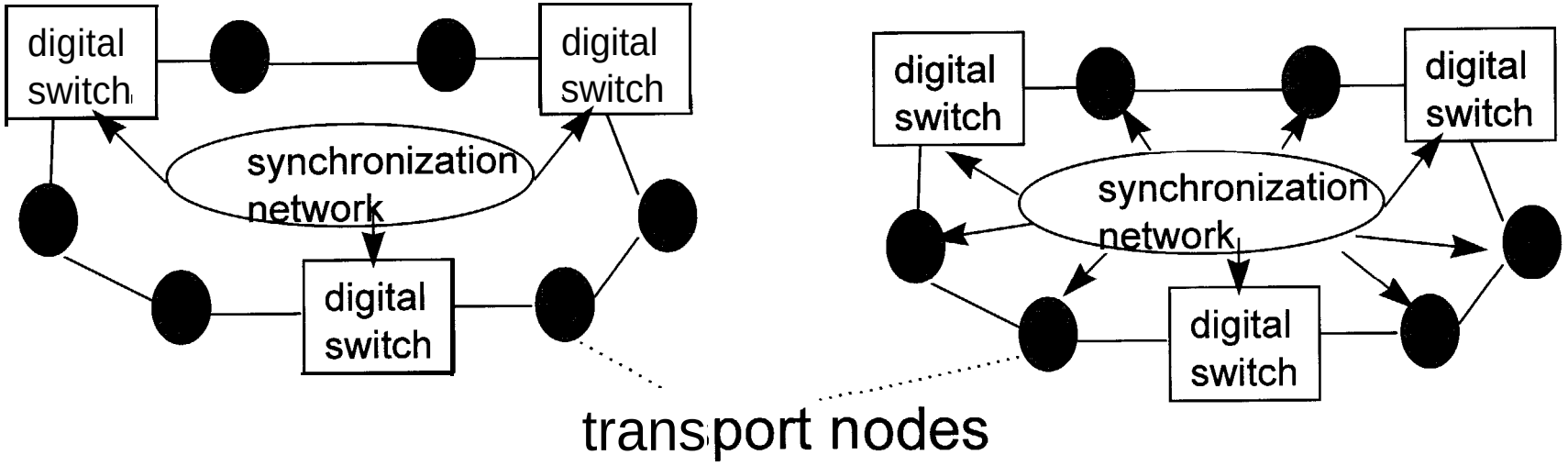
The Impact of a slip depends on the type of data being carried.

Service	Impact
voice	no noticeable impact
voice band data	bit errors, call may be dropped
facsimile	partial obliteration of text/image
digital data	retransmission of lost data
video	frozen picture lasting several seconds
encrypted voice	audible click; possible retransmission of encryption key

The new transport technology, i.e. SONET (SDH), requires synchronization

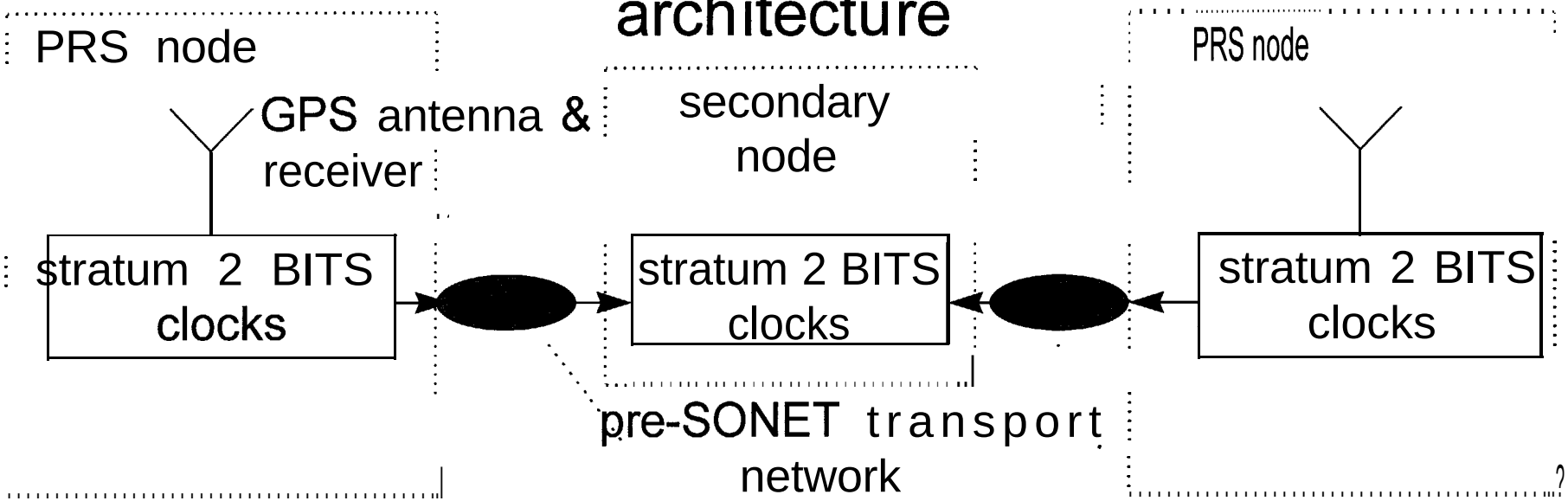
Pre-SONET synchronization

Post-SONET synchronization



Synchronization degradation in SONET transport network will not cause data loss, but will degrade frequency stability of signal carried in SONET payload. This can result in slips in the switching network.

AT&T's pre-SONET synchronization network architecture

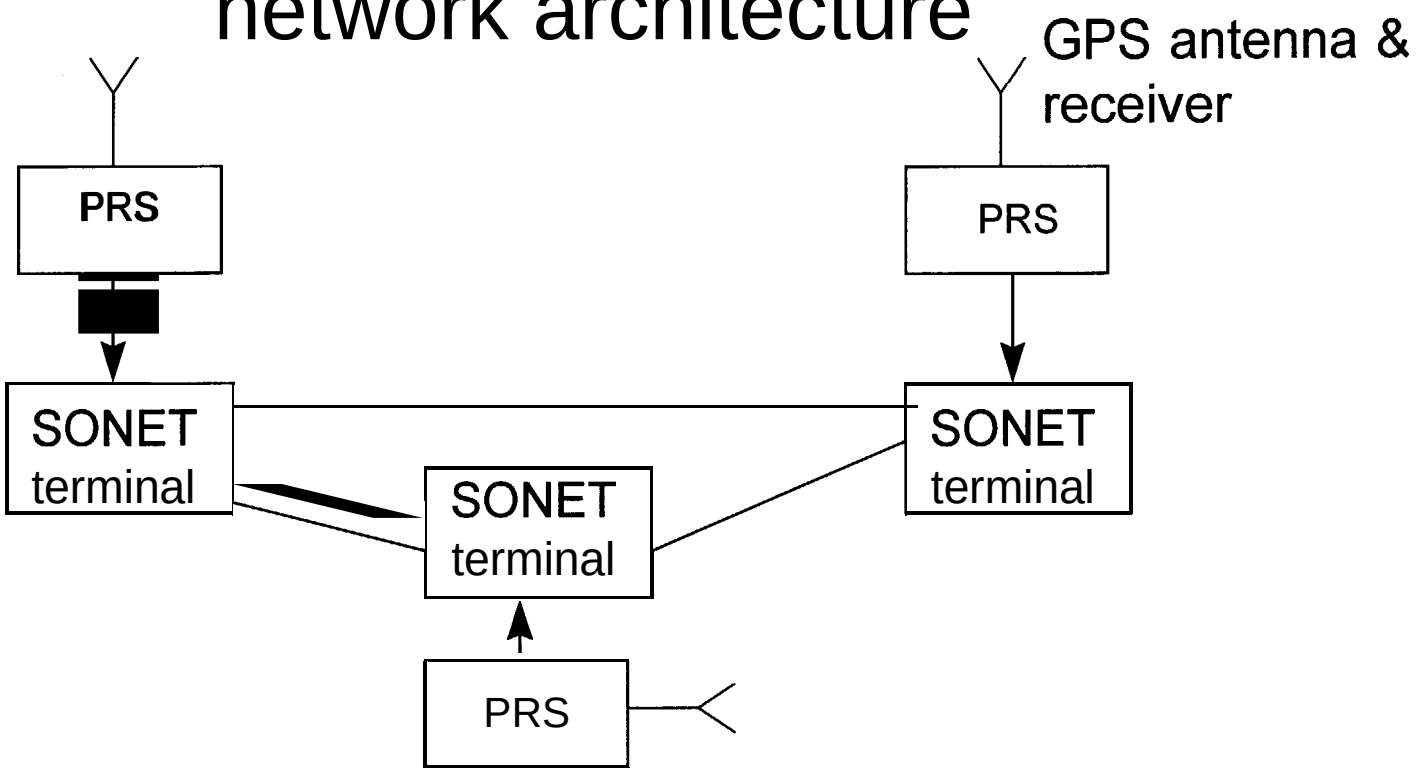


- A Primary Reference Source (PRS) provides a frequency with a long term accuracy of 1×10^{-11} or better with verification to UTC. A PRS can be implemented with a Cesium beam, GPS or LORAN. GPS based implementation is cost-effective. AT&T was a pioneer in using GPS.

- Pre-SONET transport technology allows synchronization signals to be transmitted without significant frequency degradation.

Synchronization network is hierarchical: A few PRS nodes and many secondary nodes to which synchronization is transmitted

AT&T's post-SONET synchronization network architecture



•No hierarchy in the synchronization network: Every node in the network has a PRS based on GPS.

- NO transport of synchronization signals over SONET

Summary

- The purpose of synchronization in a telecommunication network is to minimize the number of slips. Slips are deletion (or duplication) of data.
- The impact of slips depends on the type of data carried by the signal.
- SONET (SDH) transport technology needs synchronization. SONET transport can degrade frequency stability of carried signal; therefore, signals carried in the SONET payload may not be suitable for synchronization distribution.
- GPS is a cost-effective method to implement Primary Reference Sources in a telecommunication network.
- AT&T's pre-SONET sync network had PRS nodes and secondary nodes. AT&T's post-SONET sync network has a PRS based on GPS in every node.