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Bellcore Passive Monitors and Their Use in Packet Traffic Management

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Introduction
Motivation and Background

- Traffic management methods are needed to support desired level of network performance or quality-of-service (QOS) across a wide range of services, and reduce network capacity costs
  - Good methods can cut costs by factors of 2 to 4 yet still support the performance required by various services
- Rapid evolution of telecommunications technologies & services has outpaced teletraffic theory development
  - The challenge for teletraffic theory is to address the complexity of emerging networks and services in ways that can be applied in practice

Network Traffic Management
Objectives

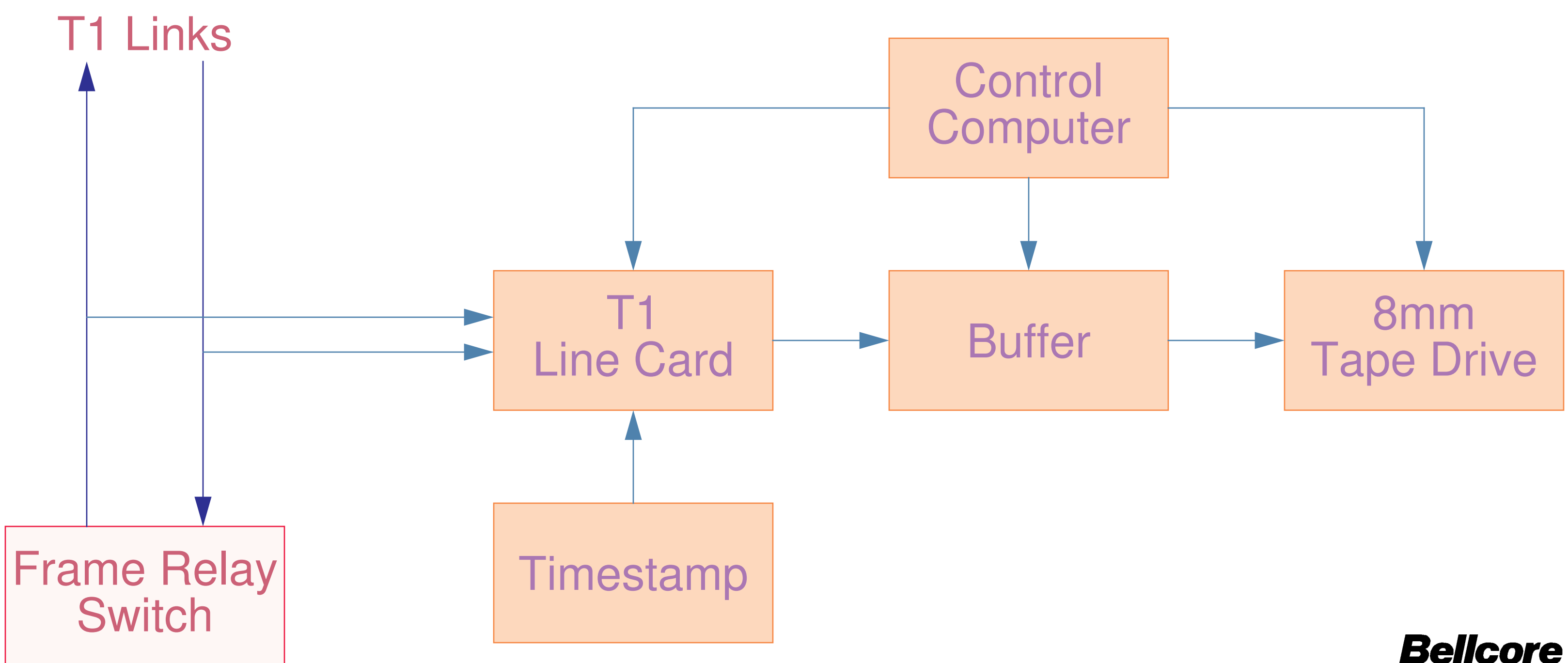
- Design broadband networks for realistic traffic loads generated by real applications
- Ensure cost-effective and competitive network design/performance
- Meet end-user needs for adequate Quality-of-Service (QoS)
- Maintain network integrity

Network Traffic Management
Approach

- Traffic data collection: monitor and store measurements from working networks supporting real services and applications
- Traffic data analysis: provide unique understanding of actual broadband traffic
- Traffic modeling: determine accurate traffic models
- Traffic management: develop practical methodologies for managing broadband networks

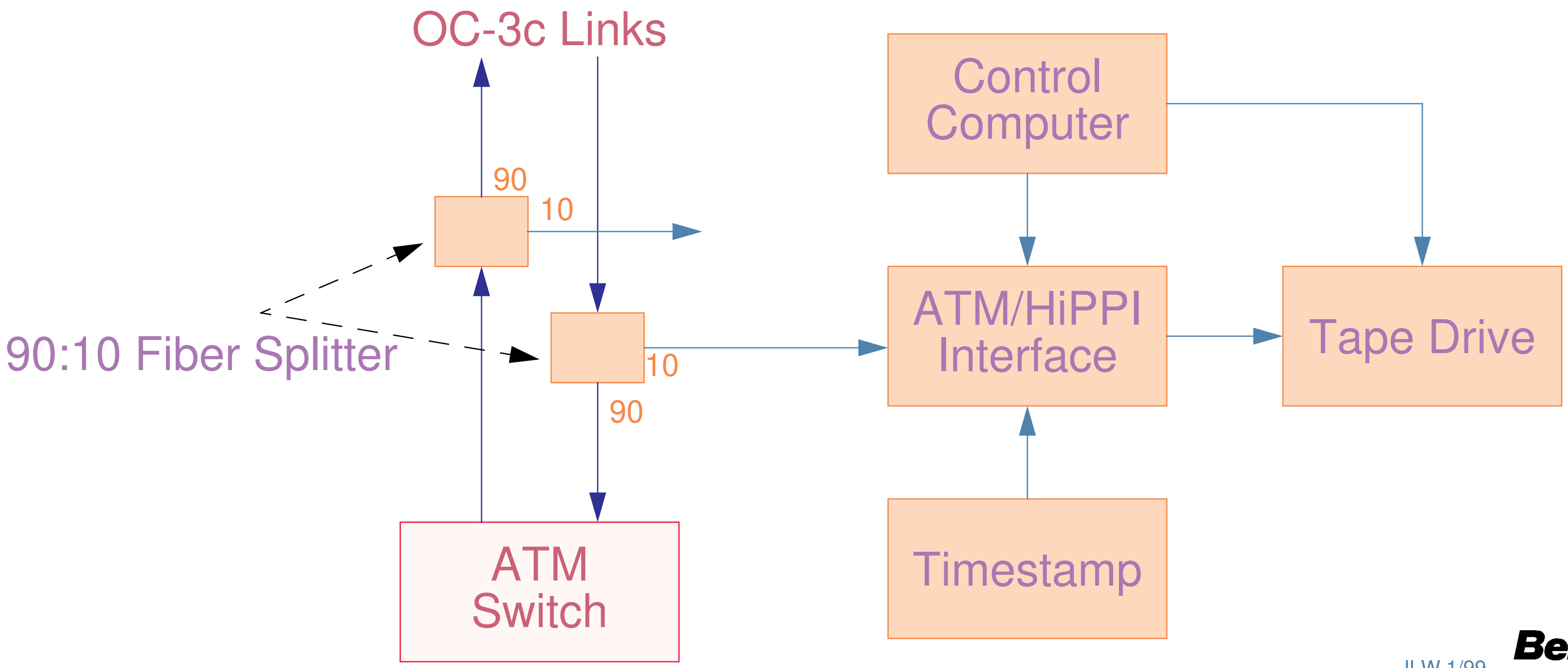
Frame Relay Traffic Data Collector

- Custom-built Frame Relay traffic data recorder
  - *Nonintrusive, lossless* collection of every frame (header + payload)
  - Extended collection period (days)
  - Timestamp accurate to 1 millisecond



ATM Traffic Data Collector

- Custom-built ATM traffic data recorder
  - *Nonintrusive, lossless* collection of every cell (header + payload)
  - Extended collection period (hours)
  - Timestamp accurate to 50 nanoseconds

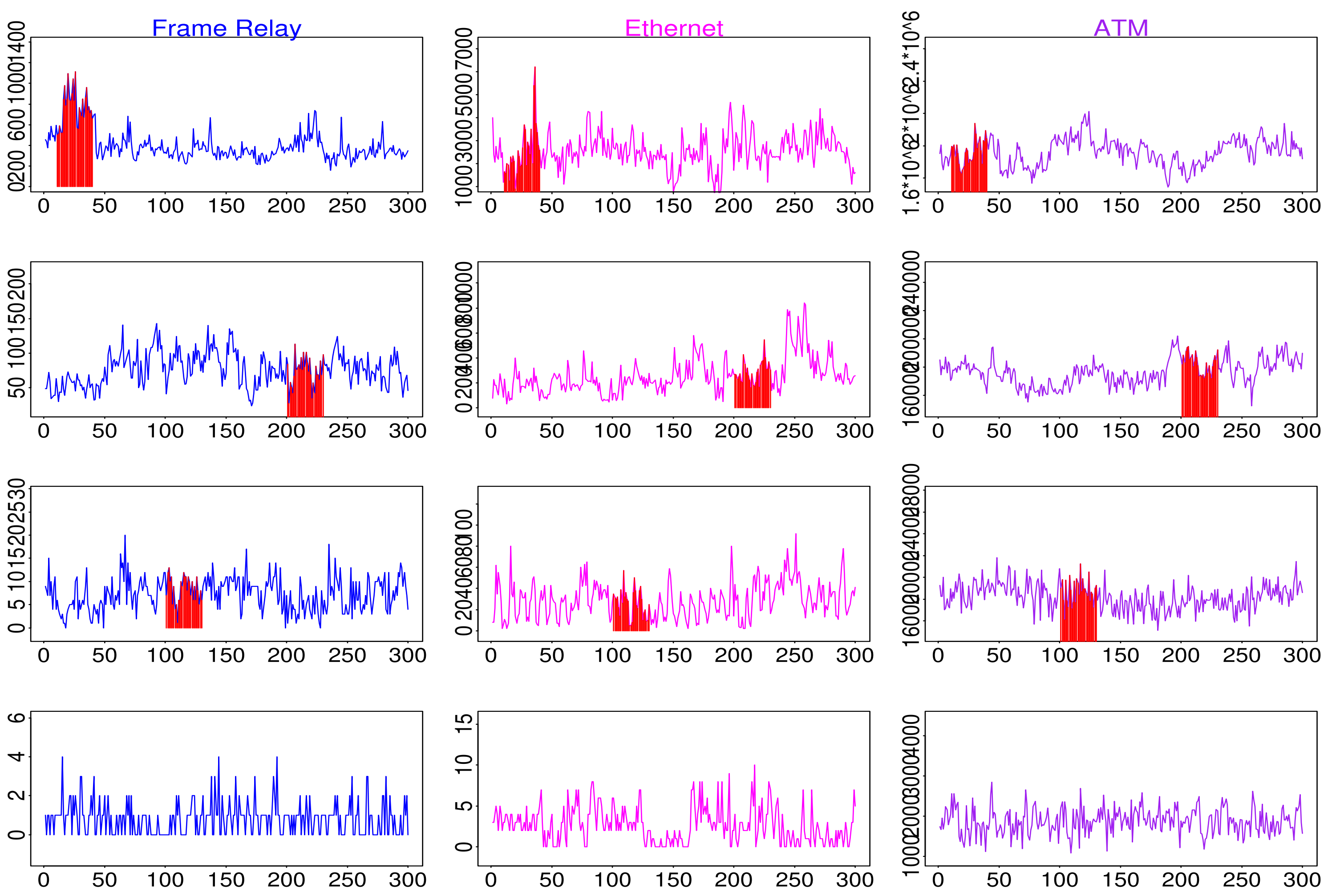


Recent Bellcore studies
Large volumes of traffic traces

- Nonintrusive, lossless, high-resolution, & extended
- Range of technologies and services
  - ISDN D-channel
  - CCS/800/AIN
  - Ethernet
  - VBR video
  - Frame Relay (2 in 1996, 4 in 1997, 1 in 1998)
  - Internet over Frame Relay (2 in 1997)
  - ATM (1996,1998)

Actual Packet Traffic

Variations over many time scales



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Traffic Management Considerations
Practical concerns

- How big should the switch/router buffer size be?
- What load level should links be allowed to reach without performance degradation?
- What is the overselling factor for the links?
- What measurements should the switch/router be collecting on a regular basis?
- When should the switch/router start to reject connection requests?
- Will the shaping and policing functions help to improve network efficiency or fairness?
- How should the links be dimensioned so that the blocking objectives are met?
- What is the usable capacity of a switch/router?

Traffic Management Issues
Impact of actual packet traffic characteristics

- Buffer management
- Safe operating points
- Statistical multiplexing gains
- Operational measurements
- Admission control algorithms
- Shaping and policing
- Connection level engineering
- QoS testing