

# Monitoring Voice over IP Service Quality

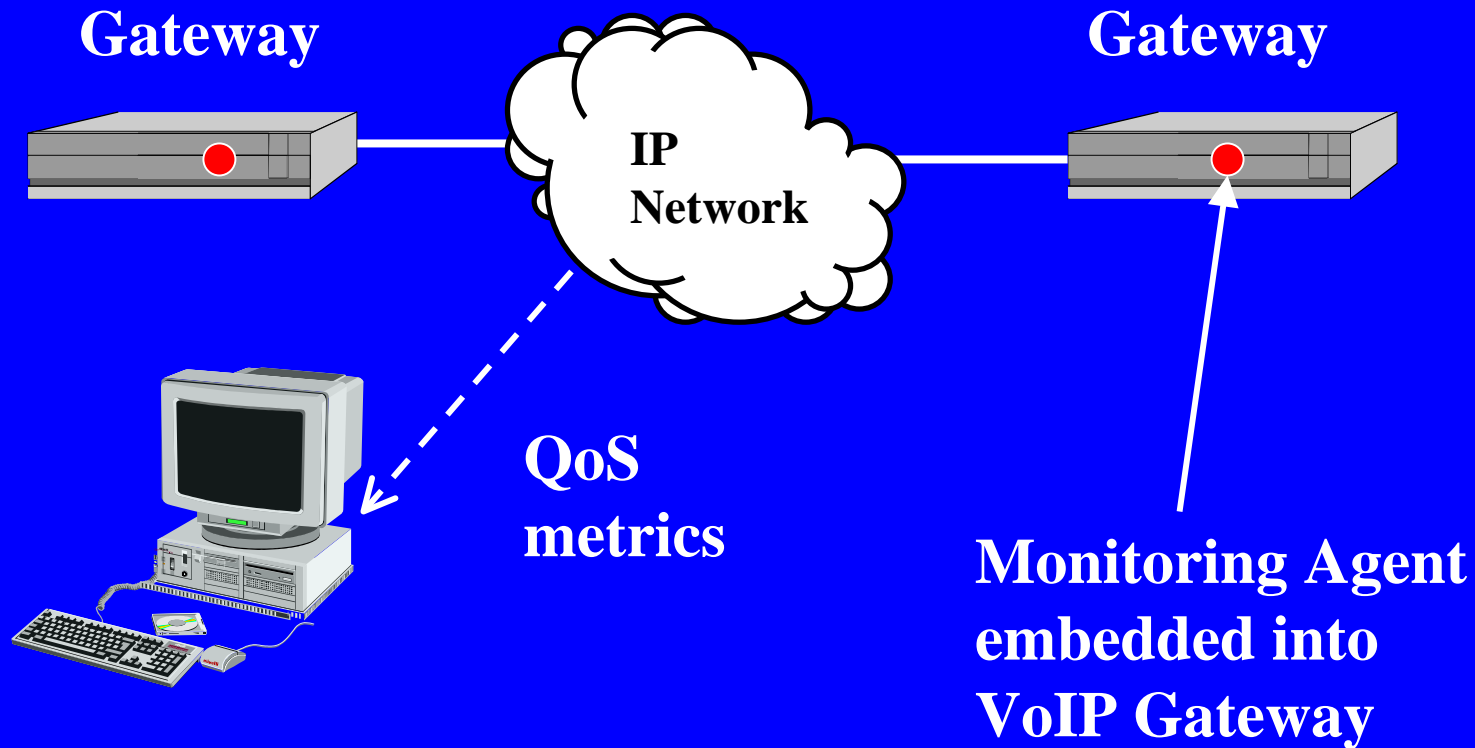
*Dr Alan Clark*

*Telchemy, Inc*

*Suwanee, GA*

*alan@telchemy.com*

# Embedded Passive Monitoring



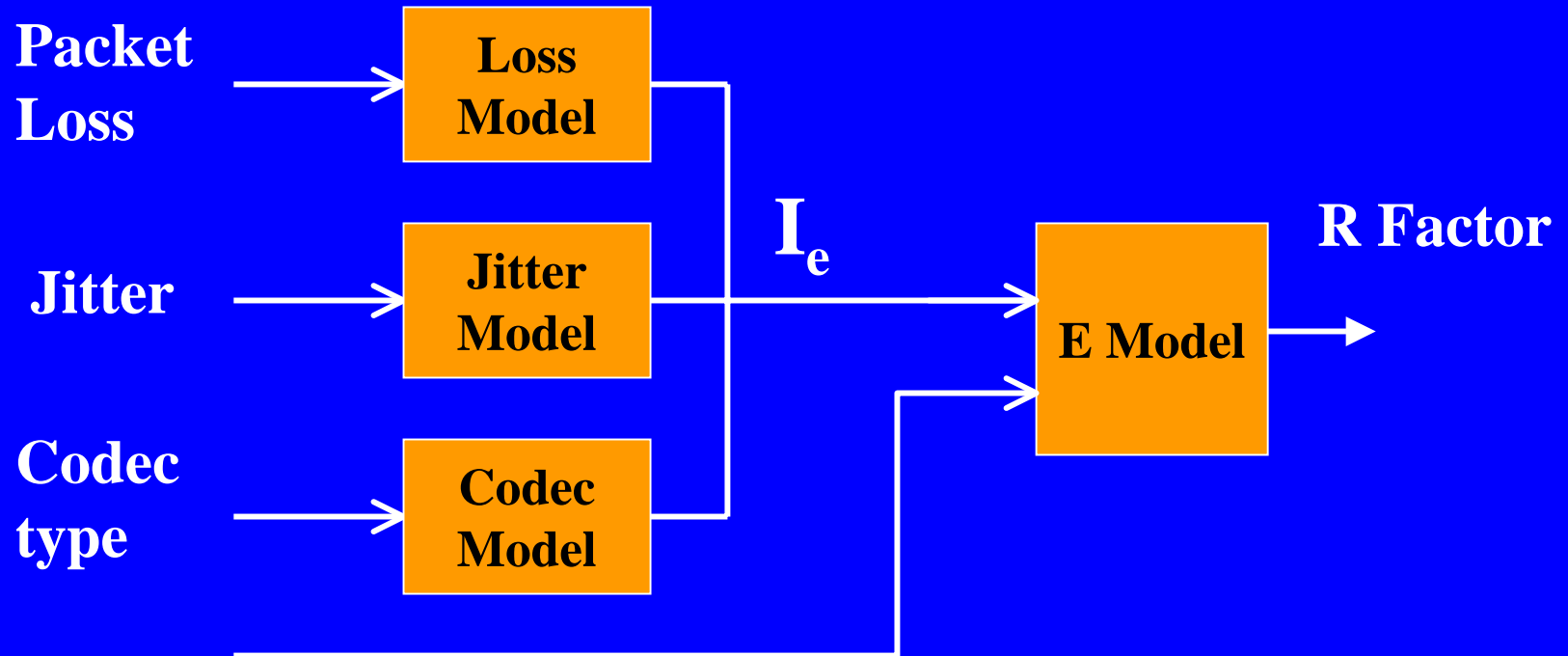
# Active vs Passive Testing

- **Active Measurement**
  - Establish looped back test call
  - Send recorded speech file
  - Compare sent and received files (PSQM/PESQ)
- **Passive Monitoring**
  - Measure characteristics of live calls
  - Determine Transmission Quality metric
  - Estimate Speech Quality metrics

# Embedded Passive Monitoring

- Provides per-call voice quality metric for all calls
- Does not generate additional network traffic
- Easy to add to existing IP Gateways
- Easy to integrate with existing SMS and CDR systems

# E Model

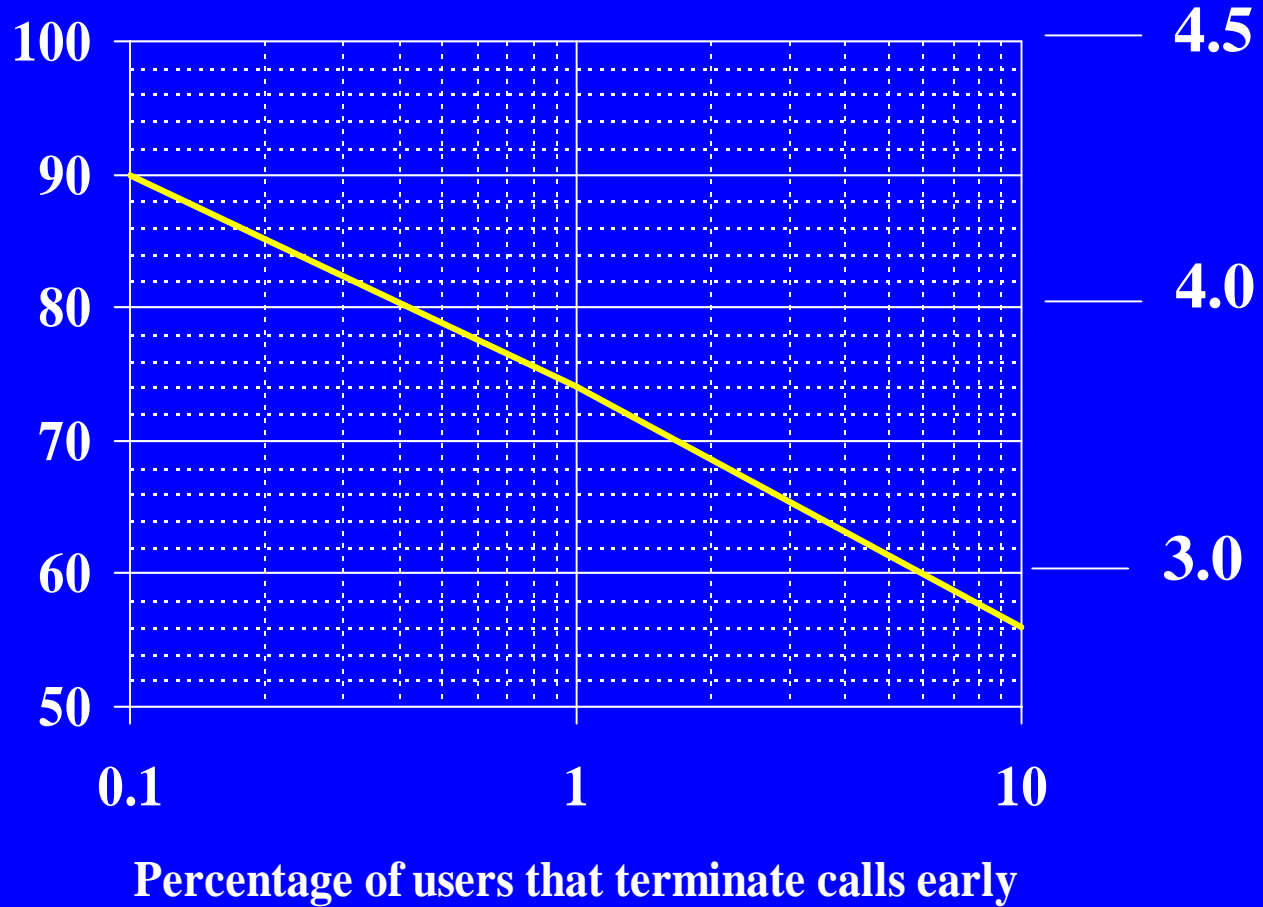


**Delay, measured  
using RTCP**

# R Factor vs MOS

R Factor

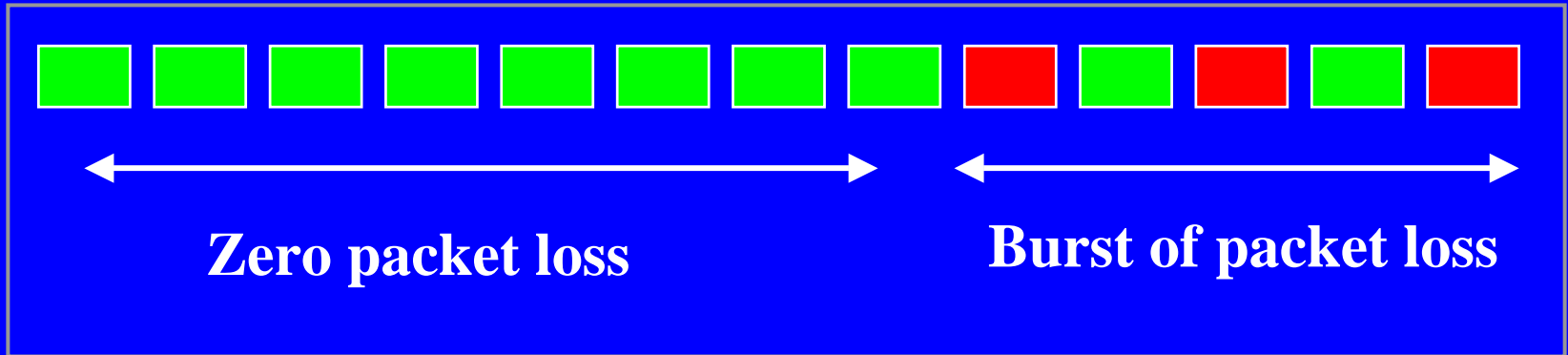
MOS



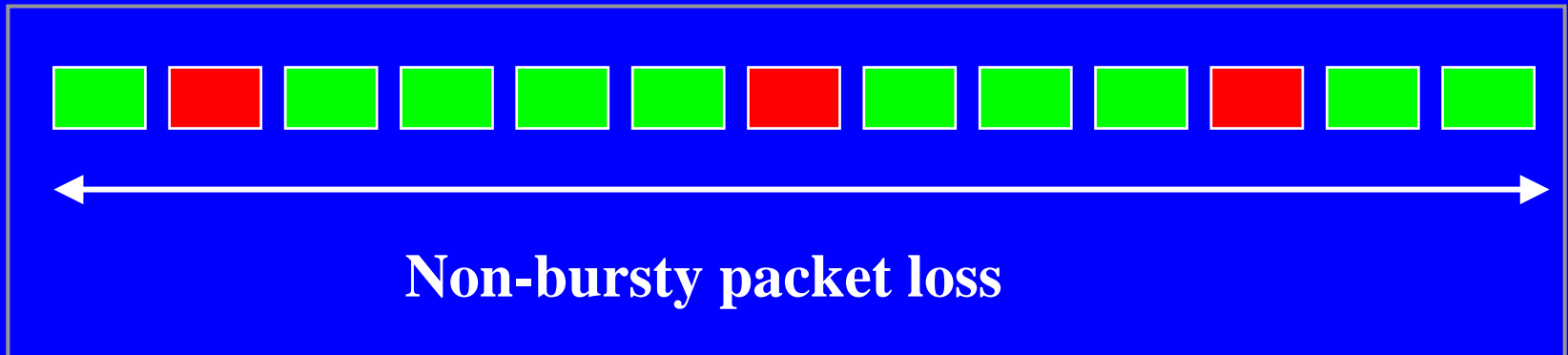
# Impairments can vary with time

- Interaction of streams in IP network causes many impairments to vary with time
- Adaptive jitter buffer
- Call re-routing
- CODEC type changed during call

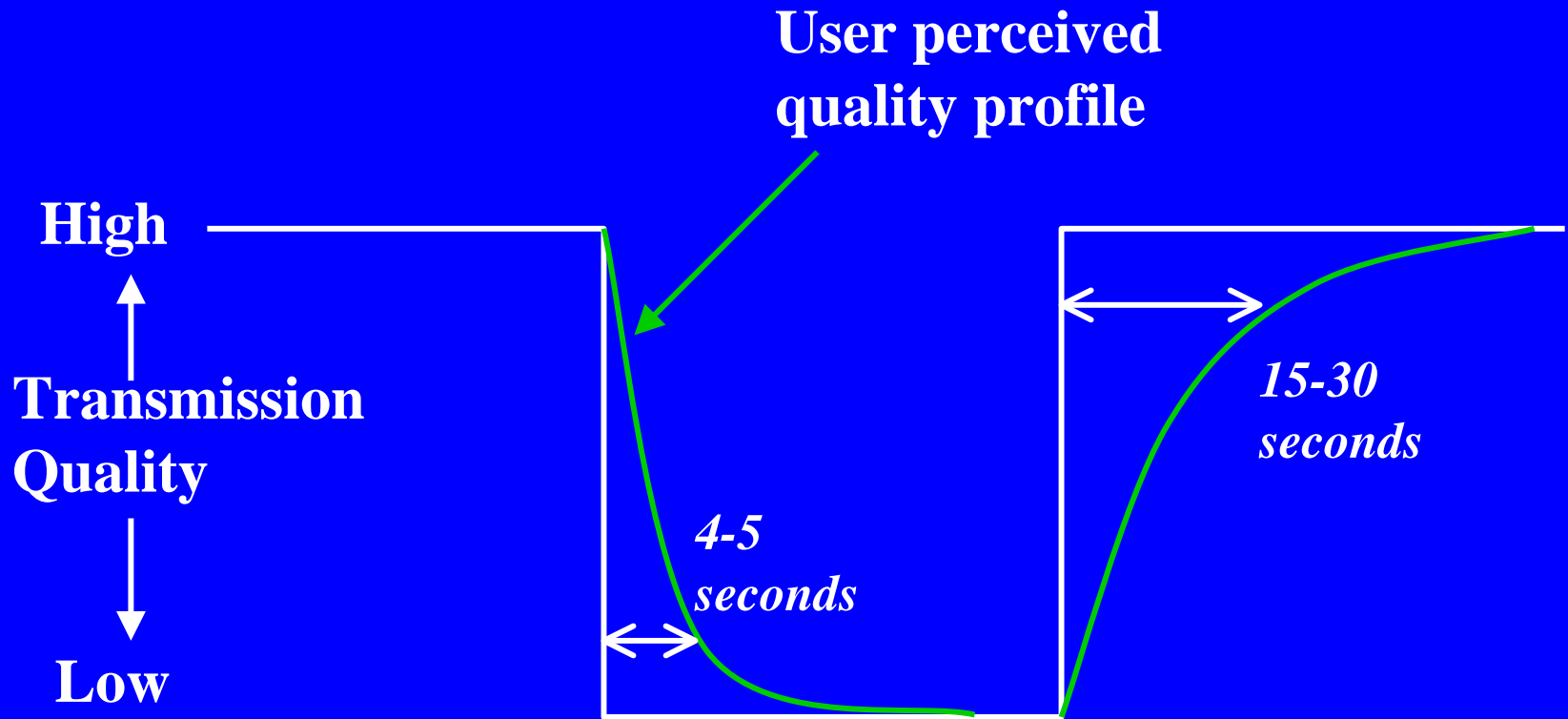
# Burst vs average loss



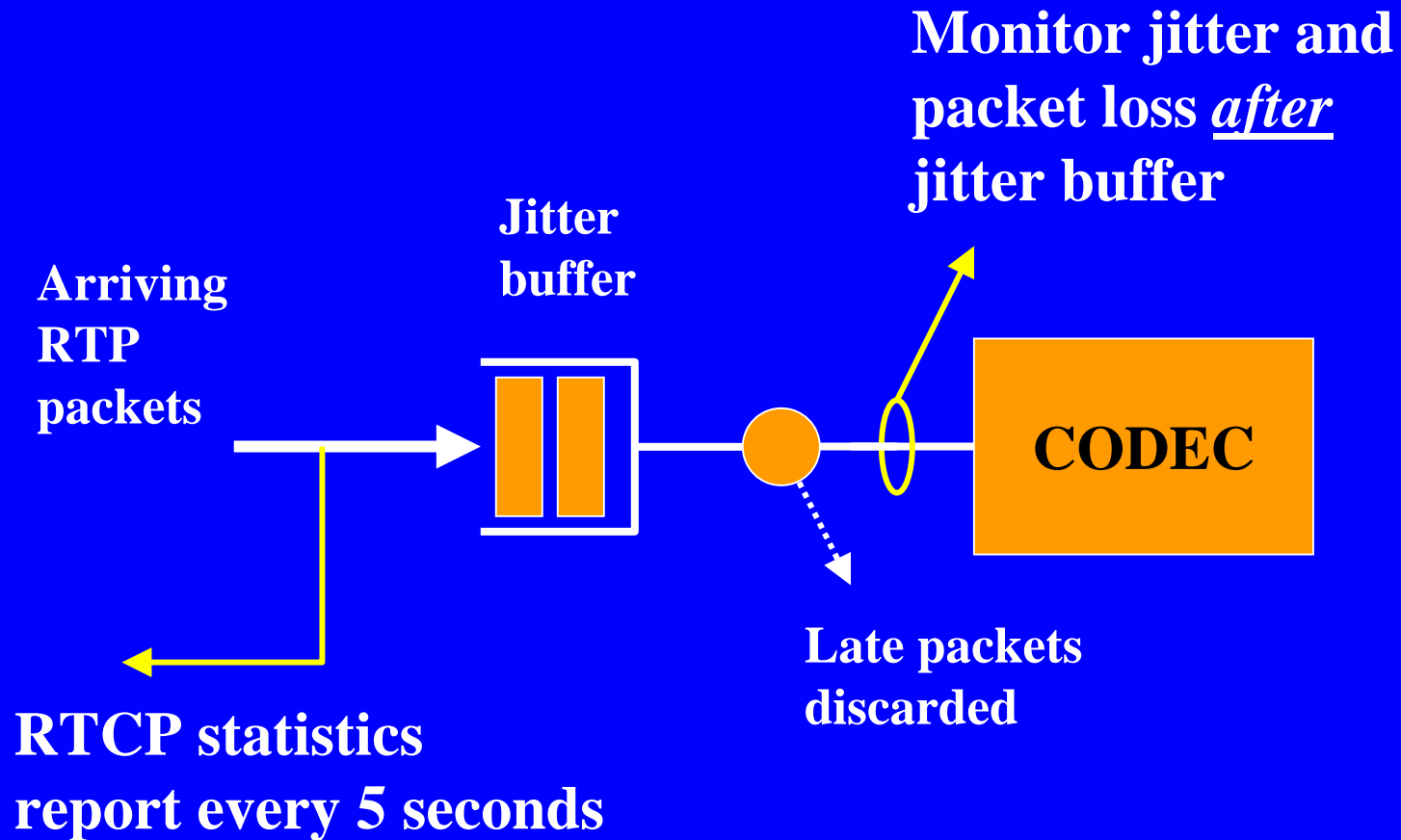
*Is not the same as*



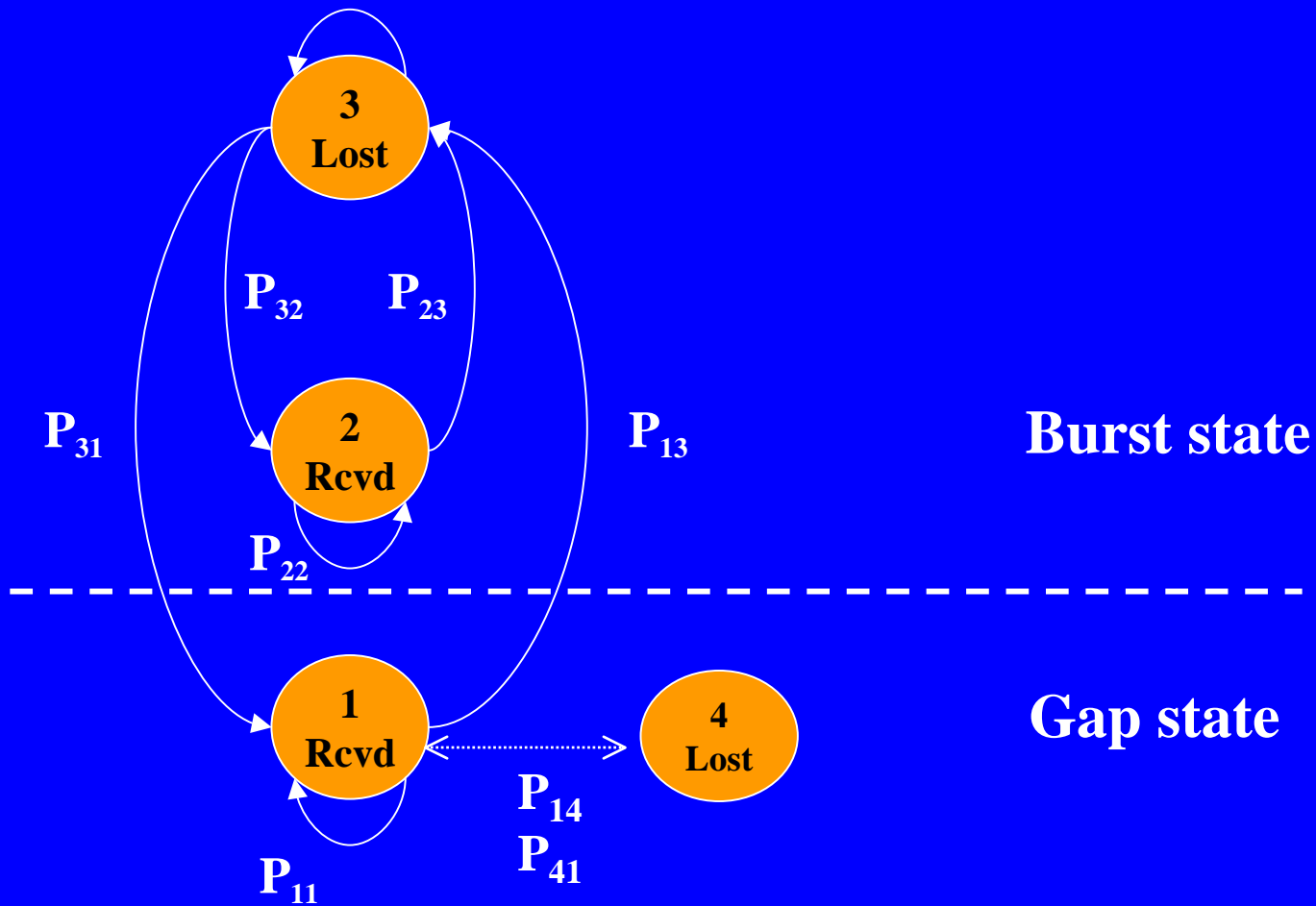
# Effects of packet loss burst



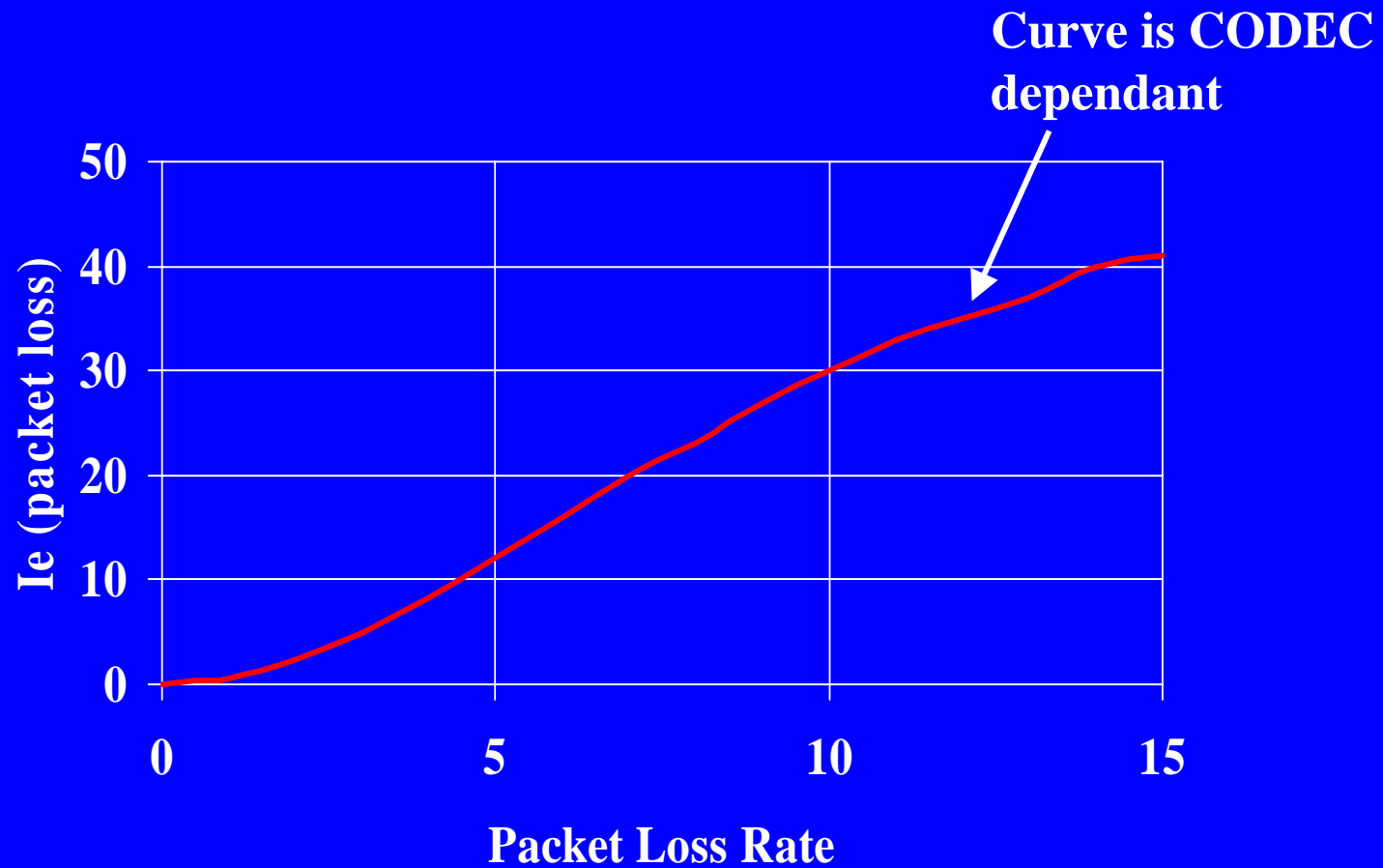
# Measuring Packet Loss



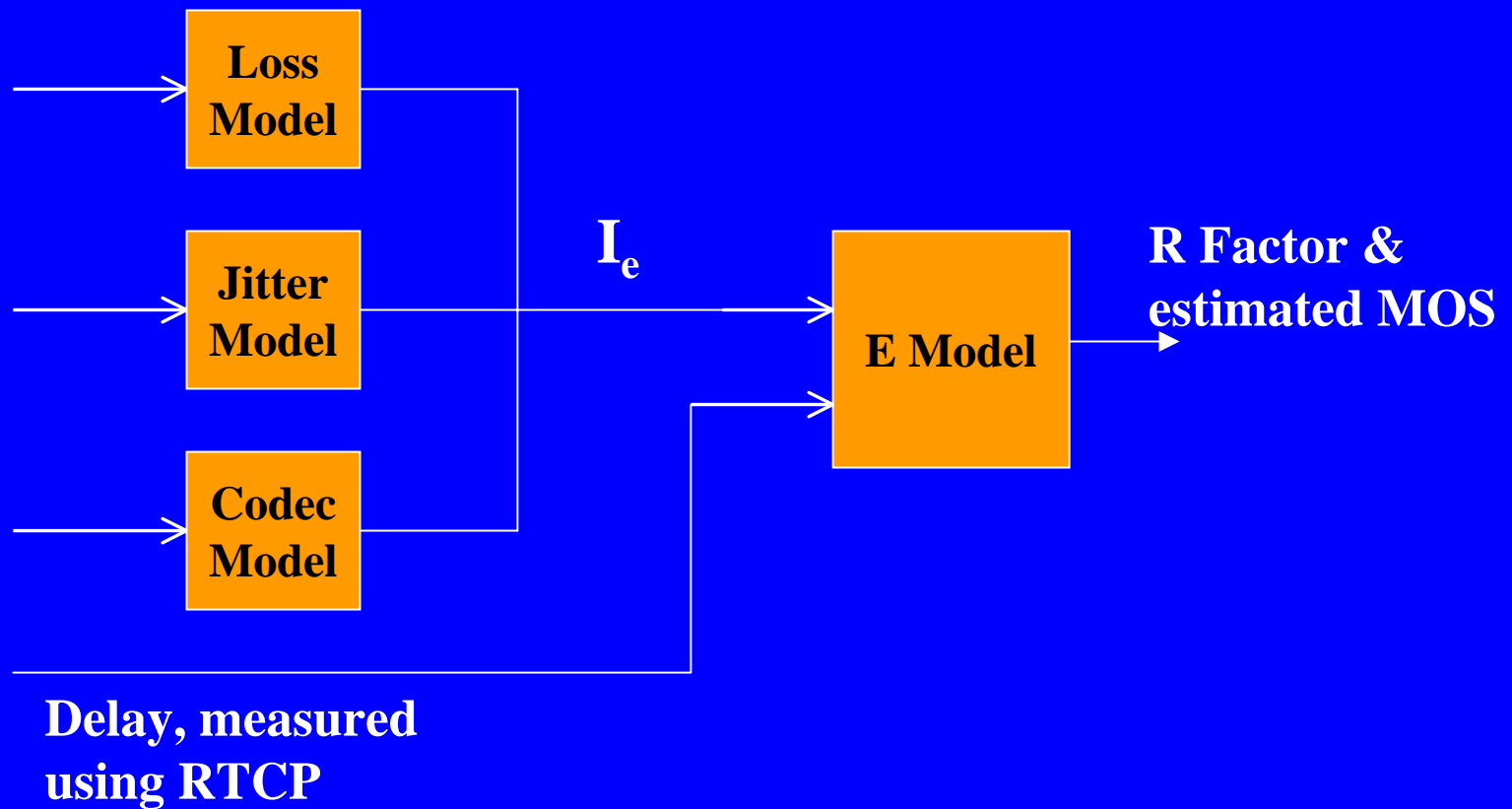
# Loss Model - Markov model



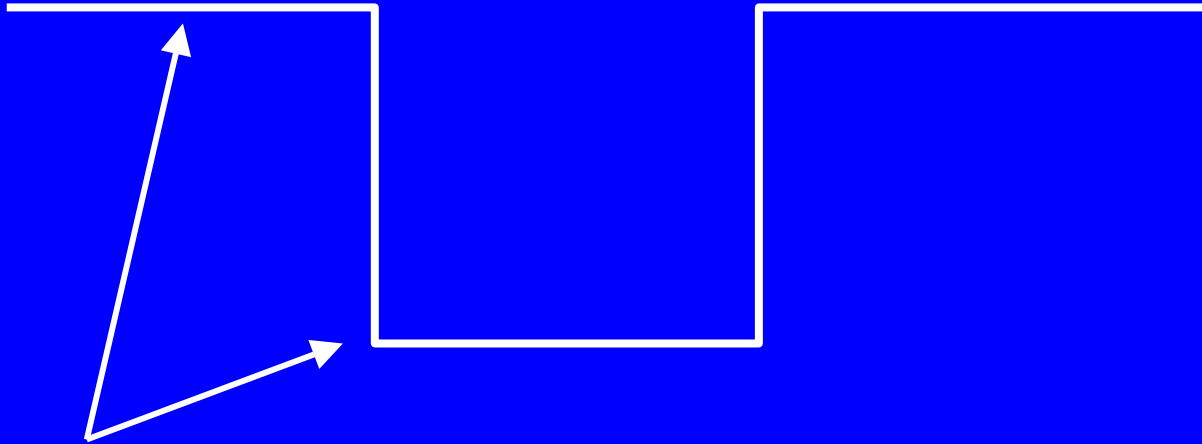
# Loss Model - mapping loss to $I_e$



# Passive monitoring

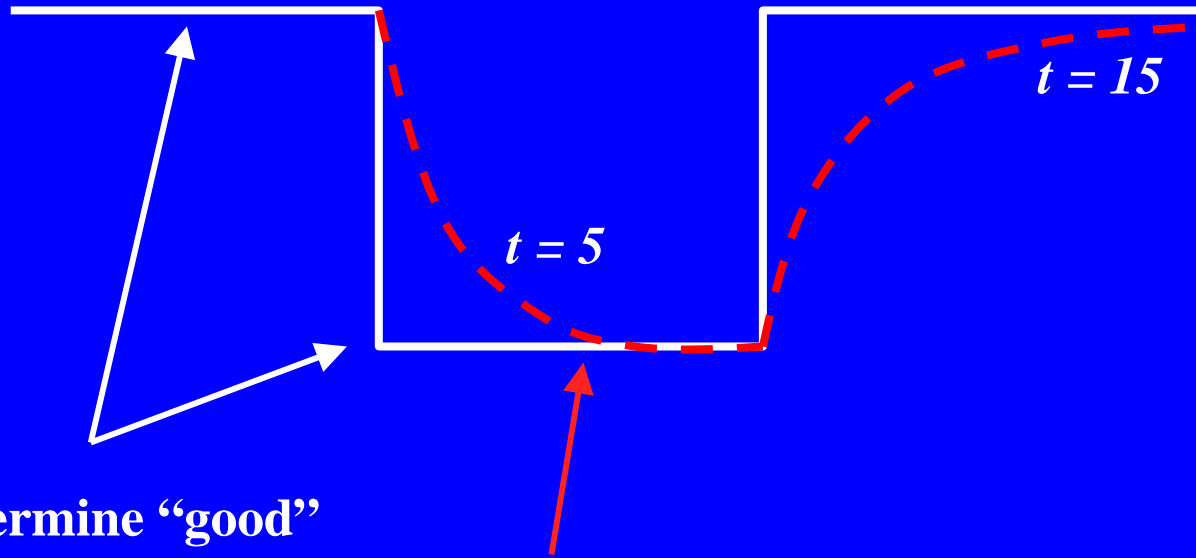


# Determining QoS metrics



**1. Determine “good”  
and “bad” state  
Ie Factor**

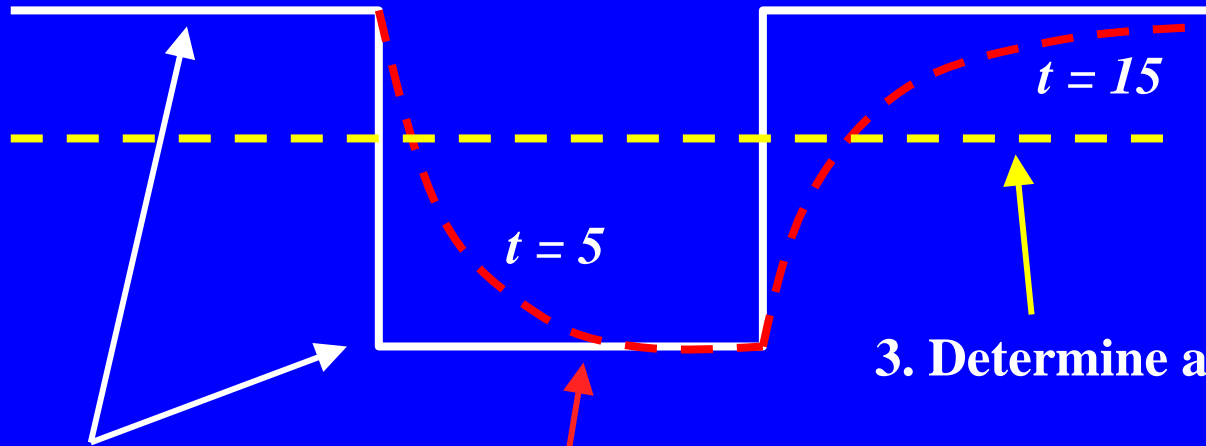
# Determining QoS metrics



**1. Determine “good”  
and “bad” state  
Ie Factor**

**2. Estimate  
Instantaneous  
R Factor for  
each state**

# Determining QoS metrics



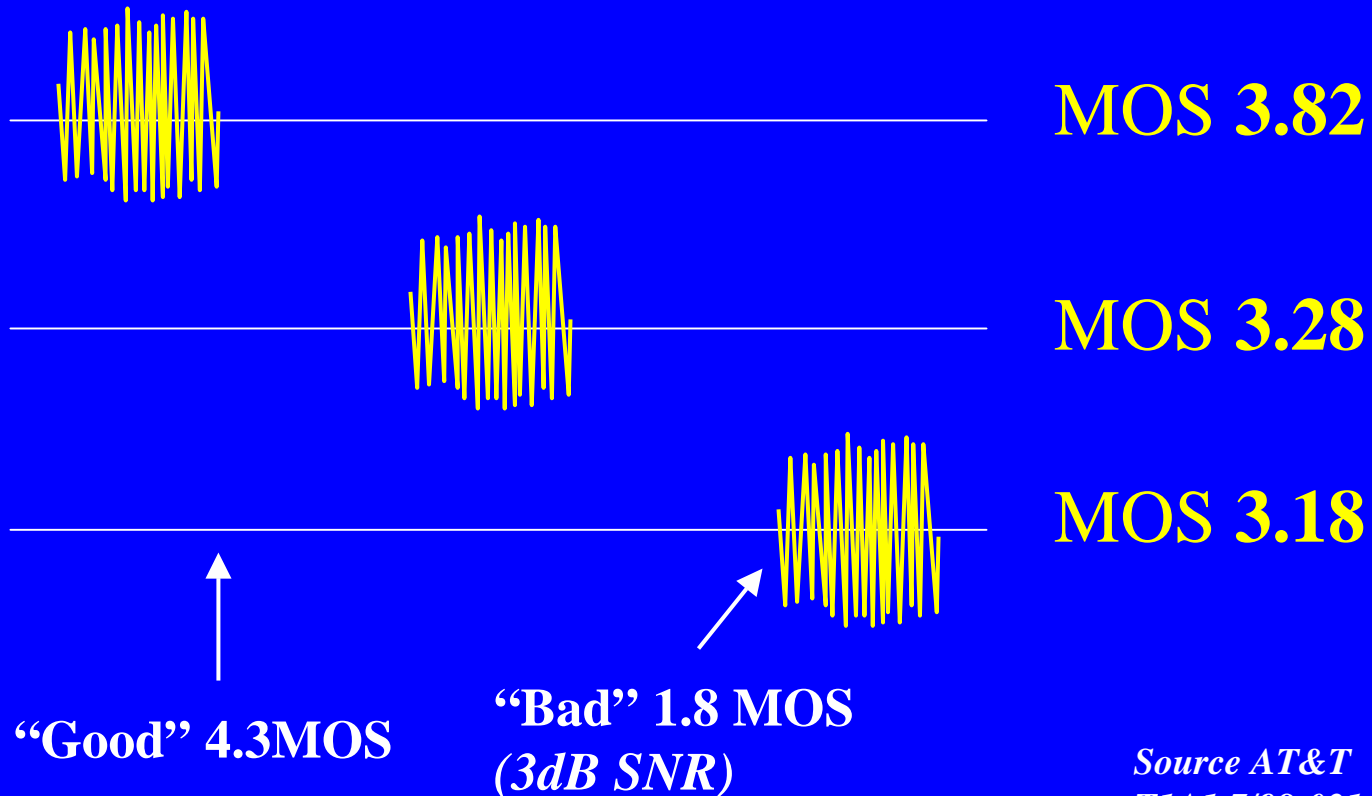
**1. Determine “good”  
and “bad” state  
Ie Factor**

**2. Estimate  
Instantaneous  
R Factor for  
each state**

**3. Determine average Ie**

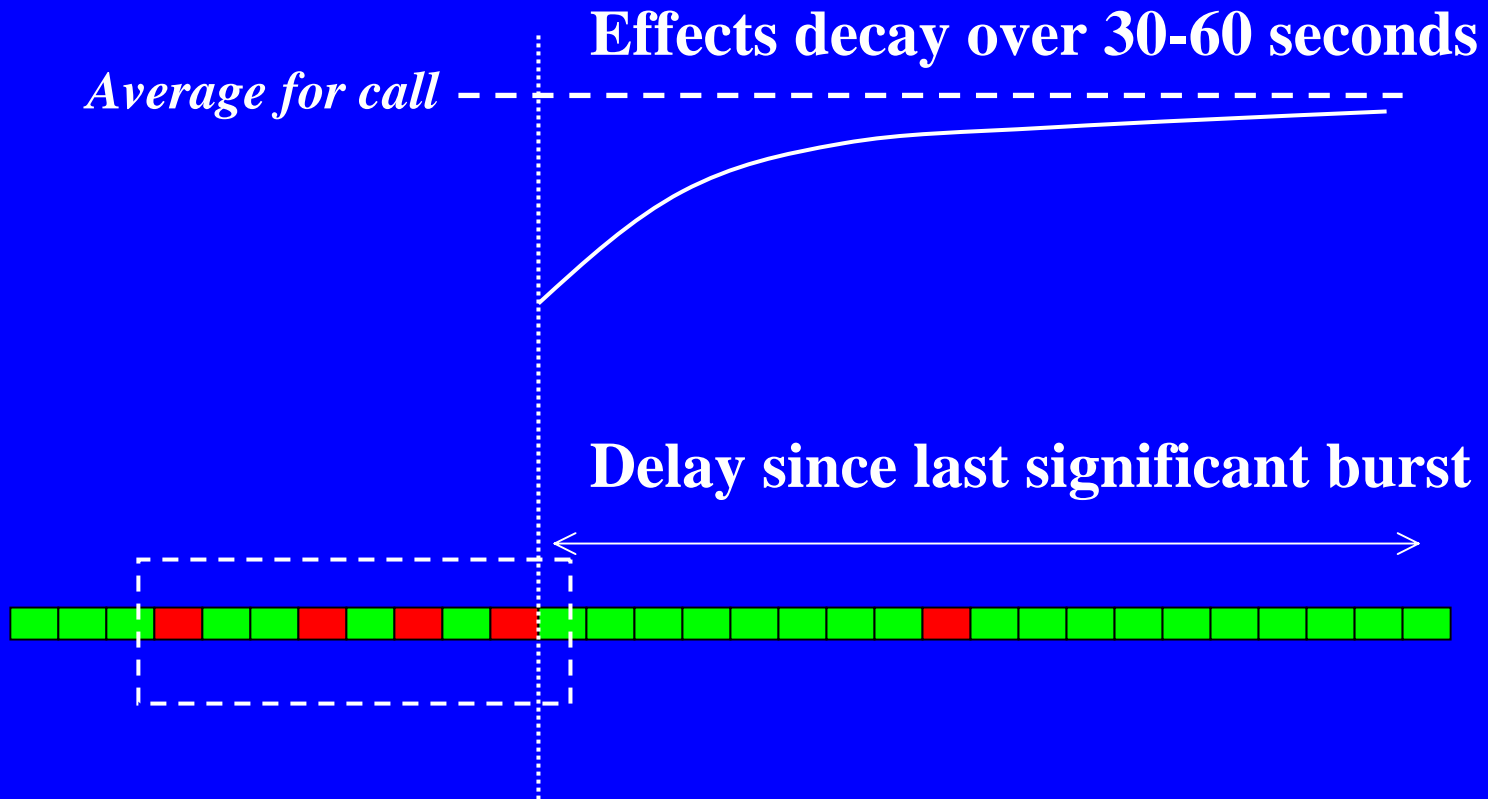
# “Recency” effect

60 second call

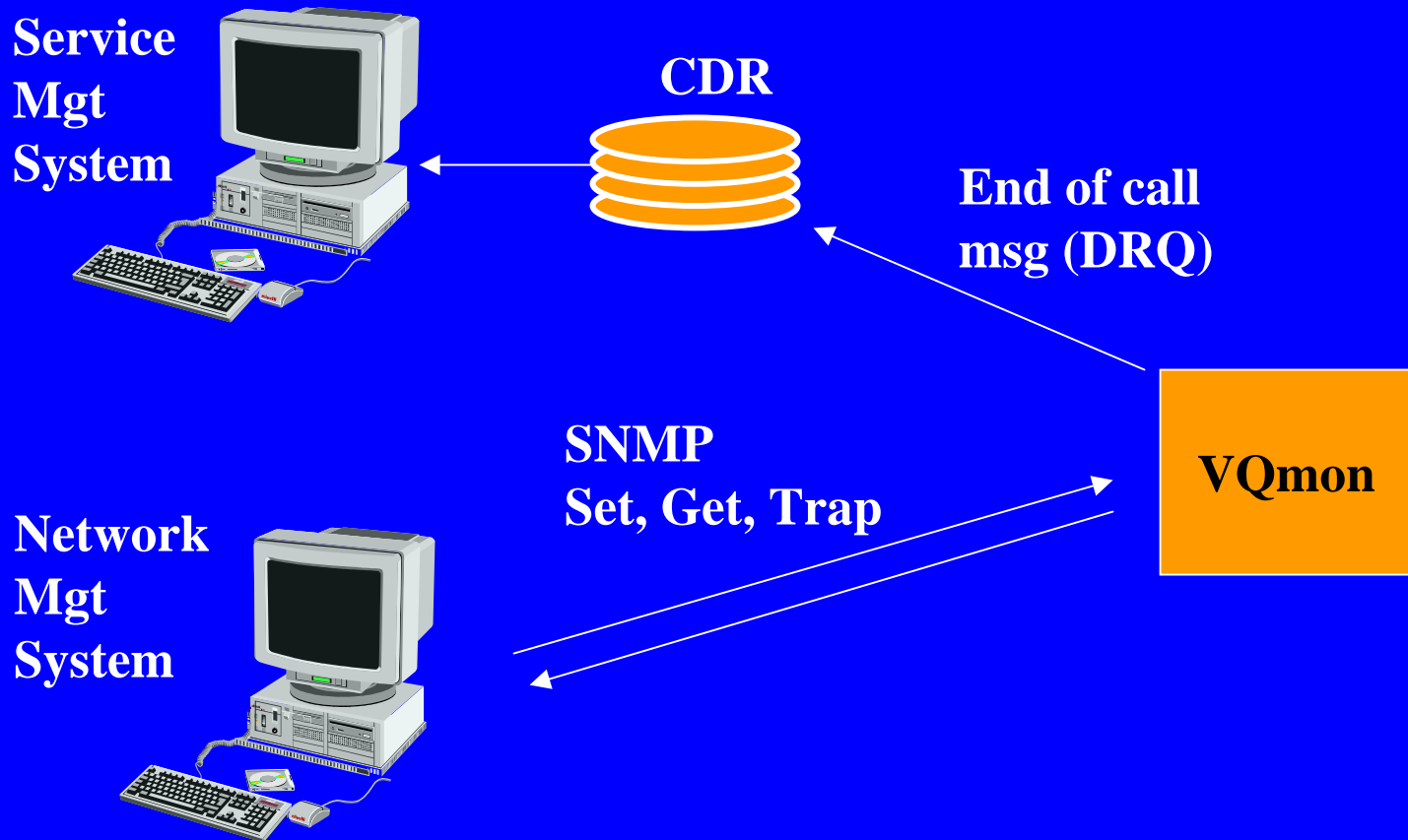


Source AT&T  
TIA1.7/98-031

# Estimation of recency effect



# Integration with VoIP SMS



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