



# **QoS SIG Presentation**

## ***QoS Issues for Rural Communication***

Dr. Parag Pruthi *NIKSUN*

Dr. Ashutosh Dutta *NIKSUN*

Soma Bandyopadhyay TCS

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# SIG Contributors



- Parag Pruthi (NIKSUN)
- Ashutosh Dutta (NIKSUN)
- Soma Bandyopadhyay (TCS)
- .....

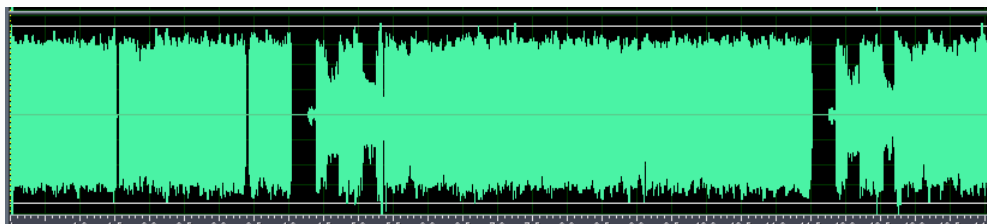
- QoE => Perceived Quality of Service
- Network Metrics
  - ⊕ Bit rate, delay, jitter, packet loss rate
  - ⊕ Power consumption
- Application Metrics
  - ⊕ Call setup delay
  - ⊕ Failed calls, dropped calls, retransmission
  - ⊕ MOS (Mean Opinion Score)
- Several standards groups ...
  - ⊕ ITU-T SG12
  - ⊕ ITU X.902 (IP Telephony)
  - ⊕ IETF – IPPM, DIFFSERV
  - ⊕ 3GPP – 3GPP TS 32.409 (IMS performance)

# What affects QoE for Rural Users

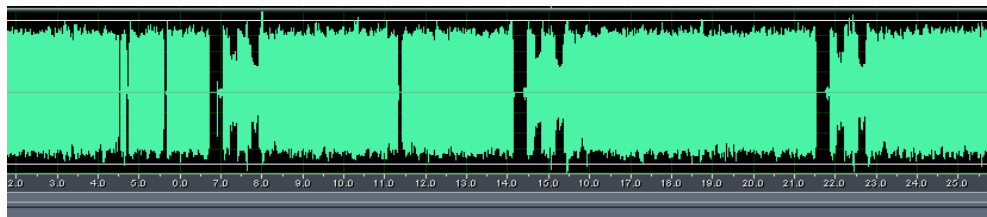


- Network Characteristics
  - ⊕ Ad hoc type networks – scattered group of users
  - ⊕ Lossy links, Fluctuating Traffic demand
  - ⊕ Delay tolerant networks (DTN) - not suitable for interactive traffic
  - ⊕ Low bandwidth → Network congestion
  - ⊕ Network heterogeneity (e.g., WiMAX and WiFi)
- Frequent user mobility (e.g., cell mobility, subnet mobility)
- Application characteristics
  - ⊕ Current Types of Application
    - ⊕ Cellular voice, File transfer (e.g., non-real-time), SMS
  - ⊕ Future NGN Application requires QoS support from lower layers
    - ⊕ Real-time streaming (e.g., IPTV)
    - ⊕ Interactive (e.g., VoIP) – Delay sensitive
    - ⊕ Distance learning, Mobile banking
    - ⊕ Group-based conferencing (e.g., Multicast)
- (Priority) Services need QoS reservation

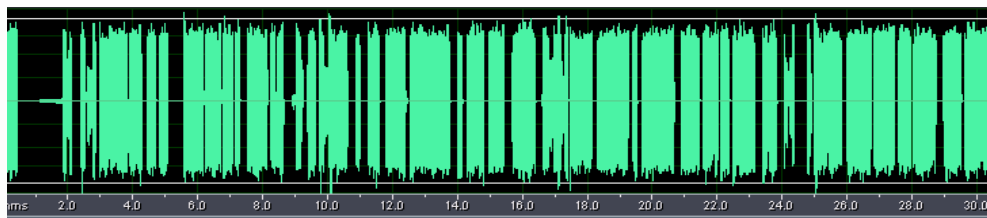
## Audio Quality



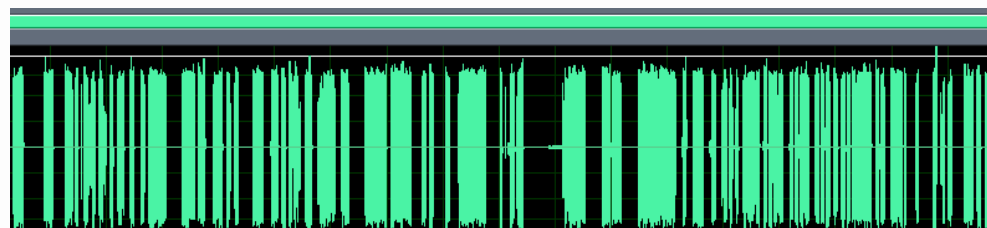
7 Mbps Cross Traffic



8 Mbps Cross Traffic



9 Mbps Cross Traffic



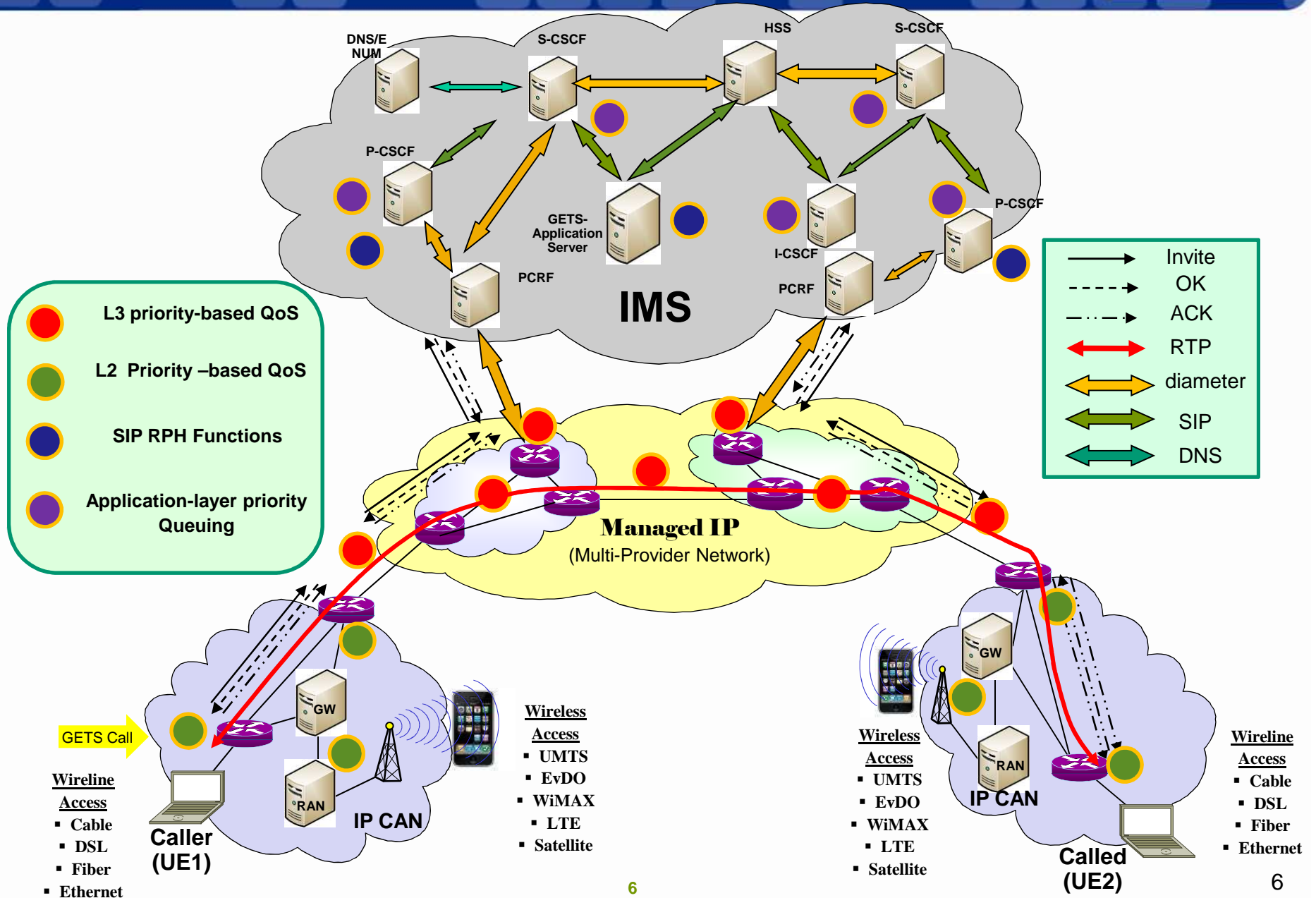
9.5 Mbps Cross Traffic

## Video Quality




Increase Traffic Congestion

# QoS is needed at multiple layers



# Priority QoS Treatment (Diffserv approach) in the Core IP Transport



QoS Traffic Class				
	Priority Level	1) No QoS	2) QoS – EF Only	3) QoS –(EF & AF4)
EF- Expedited Forwarding	Highest  Lowest		SIP REGISTER Priority SIP  Priority Voice , Video (RTP)	SIP REGISTER Priority SIP  Priority Voice and Video (RTP)
AF- Assured Forwarding				
BE – Best Effort			Priority/Non-priority SIP  Priority/Non-priority RTP traffic	Non- Priority SIP  Non-Priority Voice , Video (RTP)

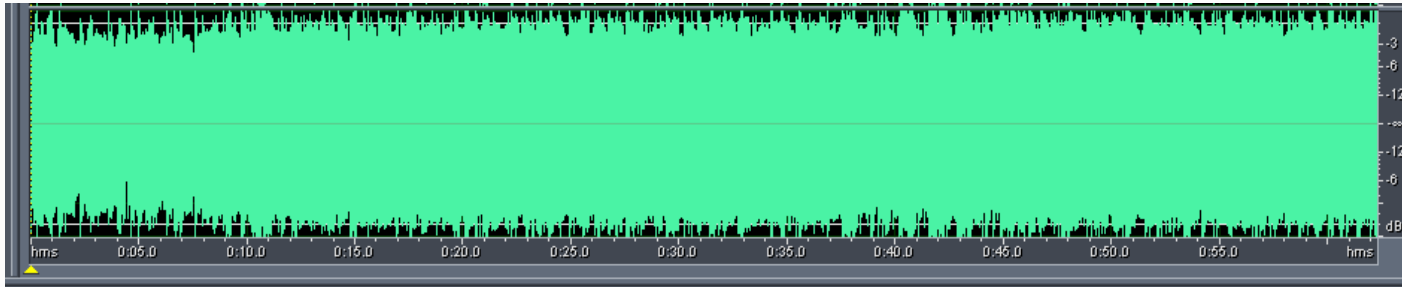
DSCP classification and marking at the edge, and class-based priority queuing and assured bandwidth scheduling at the edge and core routers

- **EF Treatment:** For Emergency SIP signaling and SIP Register transport (Strict-priority forwarding for bounded bandwidth)
- **AF Treatment:** For Emergency VoIP and Video/IP RTP media (Weighted shared bandwidth scheduling of remaining bandwidth among AF classes)
- **BE Treatment:** Best-effort traffic forwarding only when bandwidth not in use by higher priority traffic; Drop otherwise

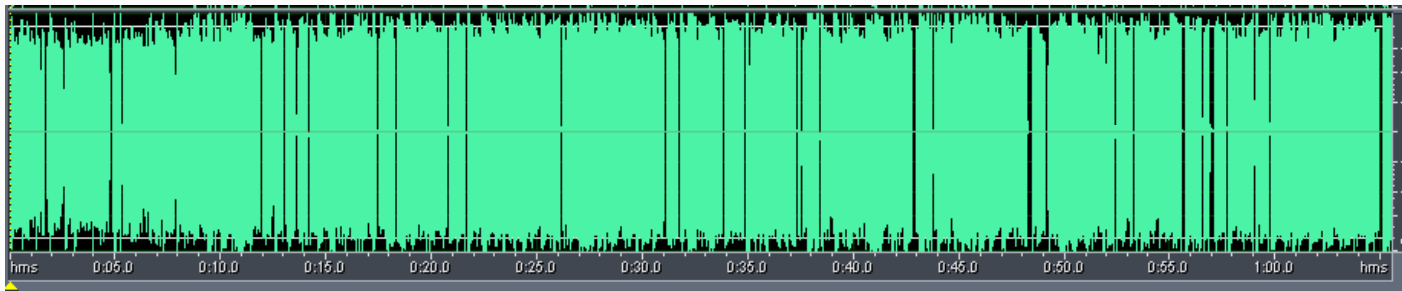
# Applying Diffserv-based QoS to VoIP



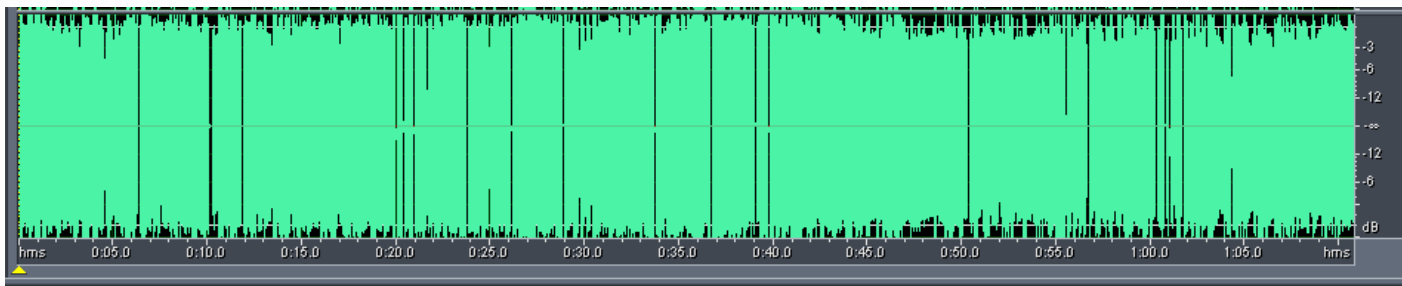
## VoIP Call (10 Mb/s One-way Cross Traffic)



**Priority VoIP** – 10 Mb/s cross traffic (packet size 1440 bytes)



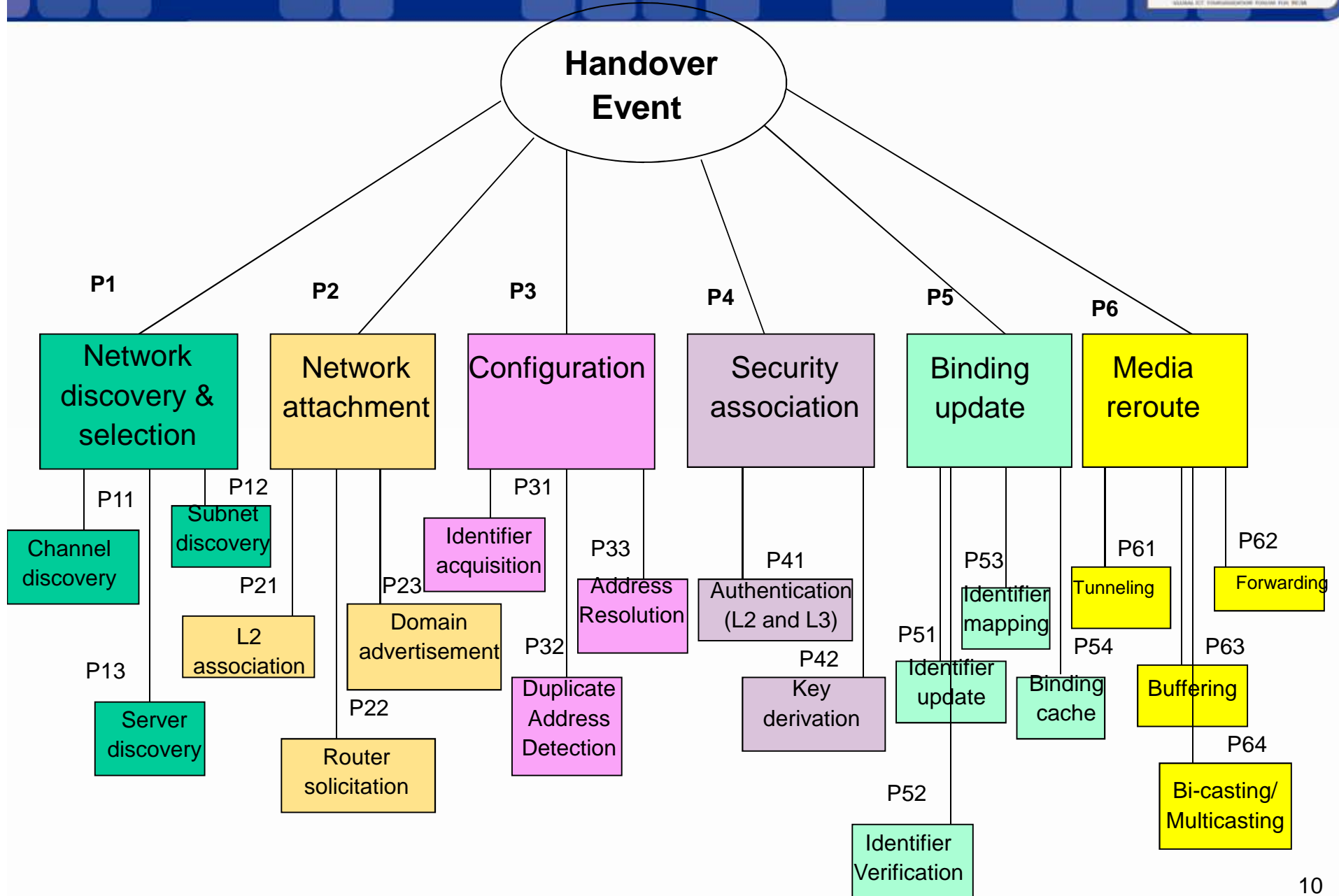
**Non Priority VoIP** – 10 Mb/s cross traffic (packet size 1440 bytes)



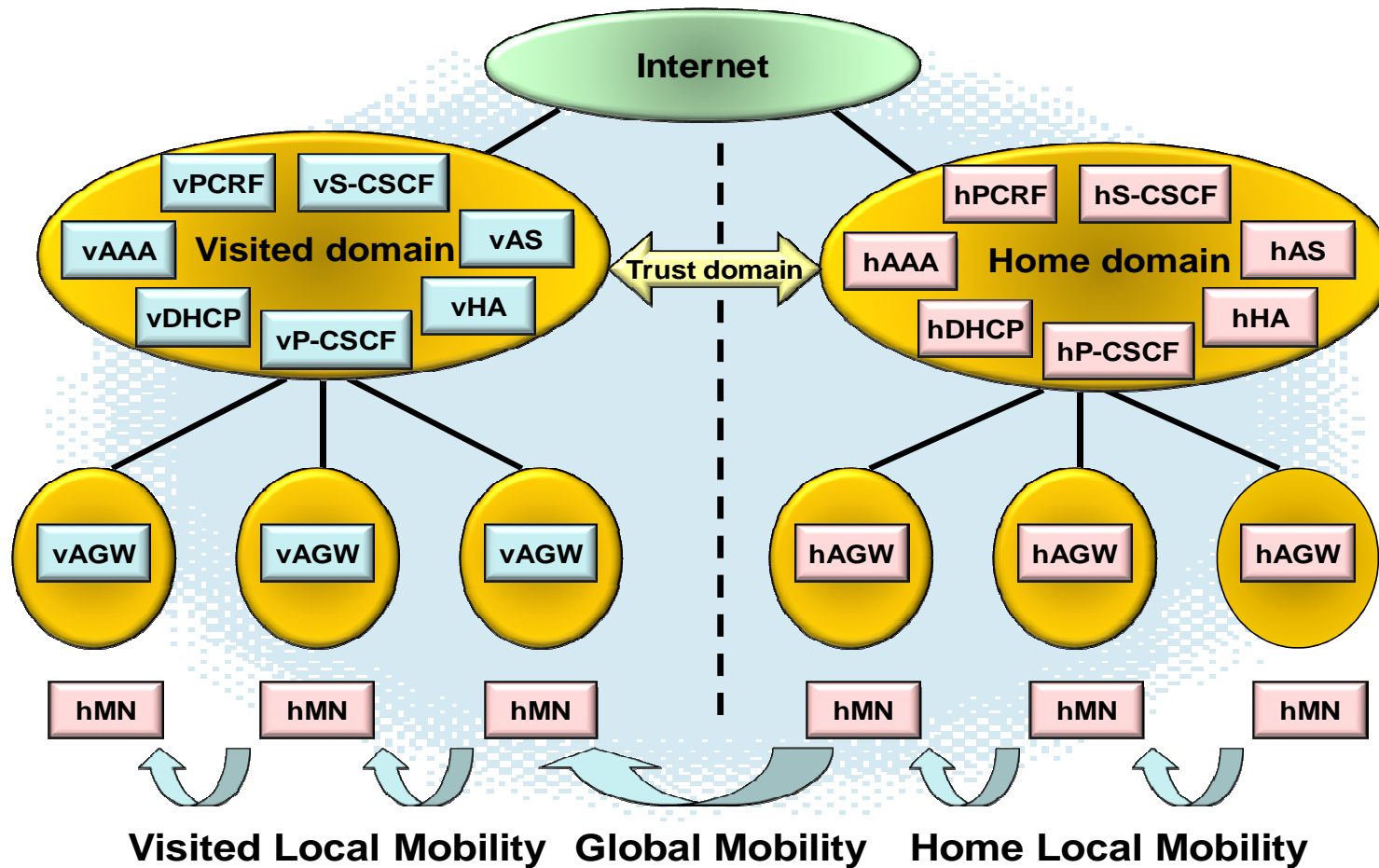
**Non Priority VoIP** – 10 Mb/s cross traffic (packet size 400 bytes)



# Where is the delay during handover process?



# A typical roaming scenario in 4G network



# Effect of handoff on QoS – IMS Network

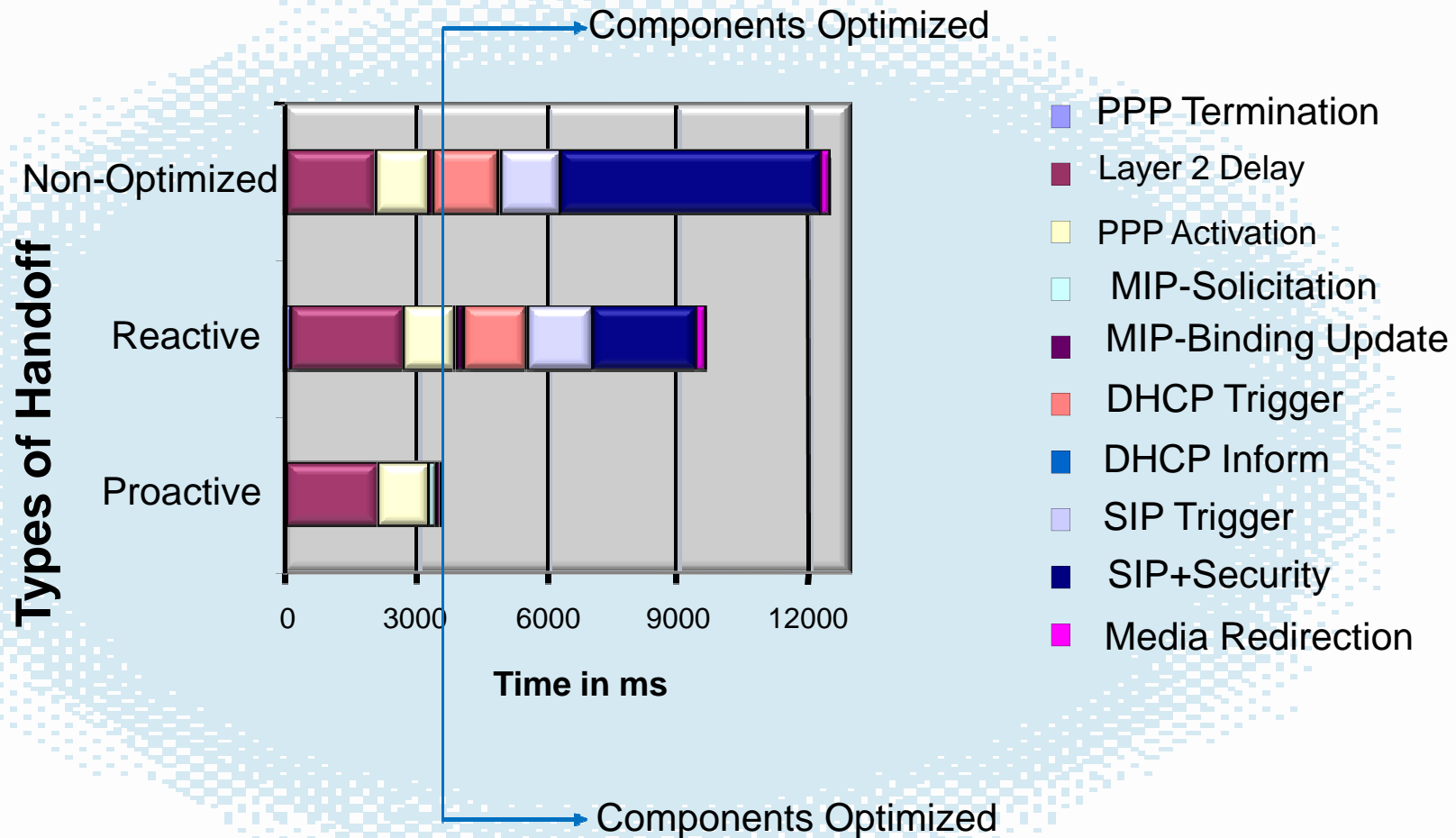
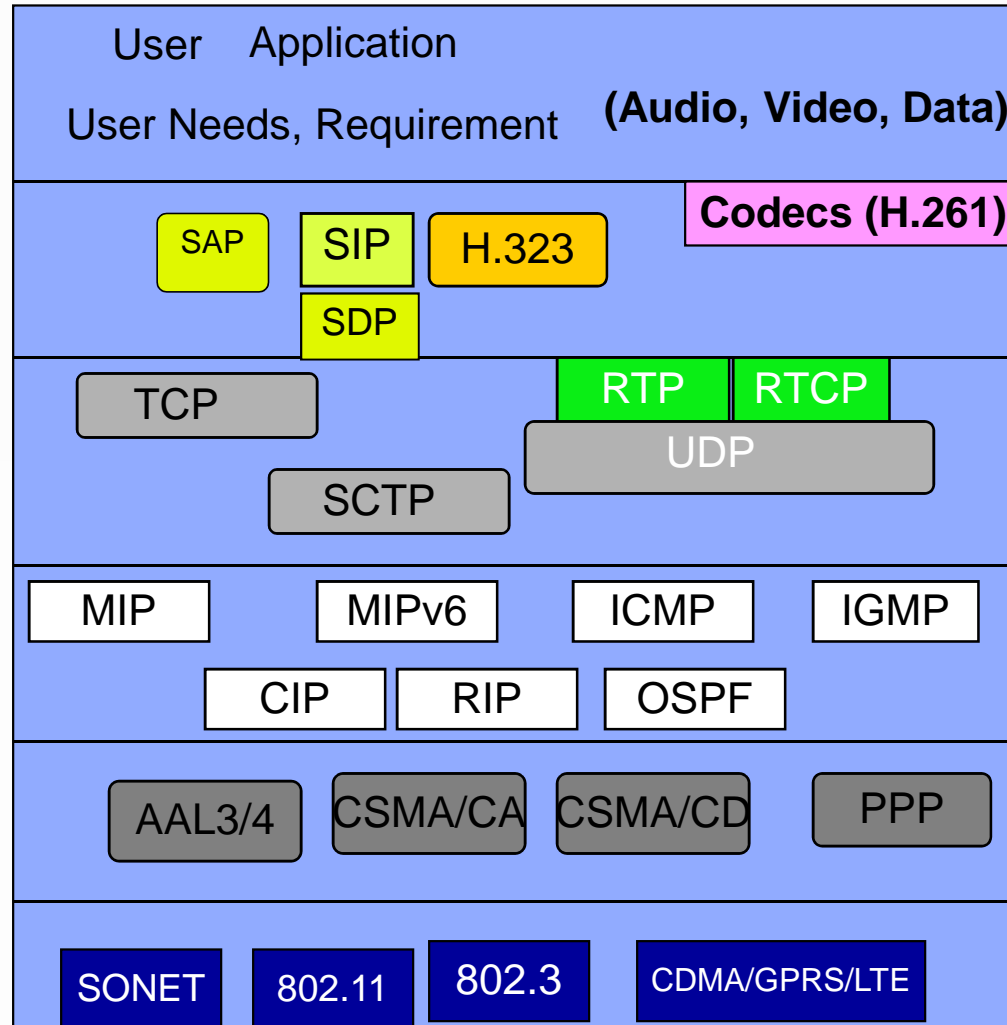
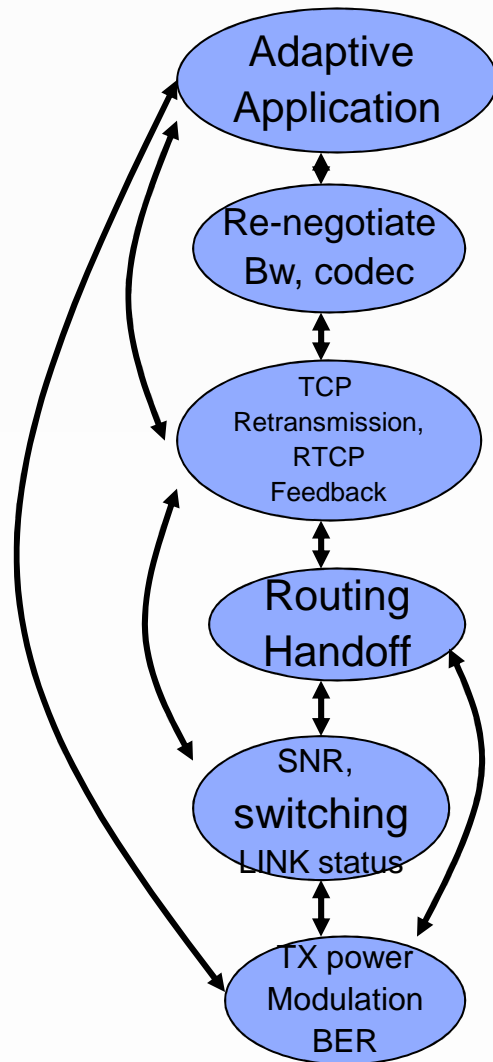


Figure 1: Levels of MMD Optimization

# Cross-layer feedback helps to achieve QoS

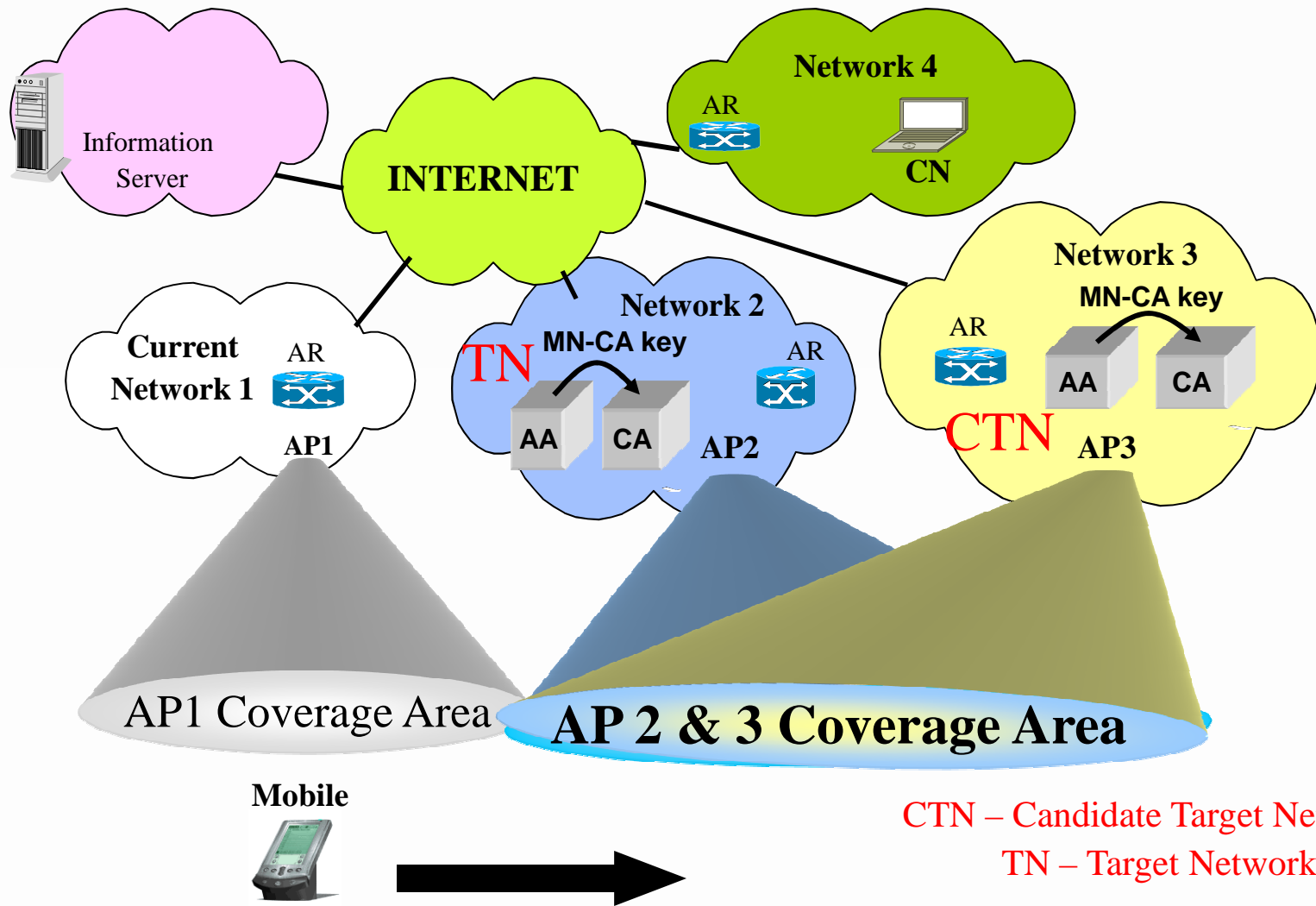


# QoS – Open Issues



- Deriving QoS based on a generic cross layer framework
- Adaptive in nature
  - Analyzing network condition /application characteristics dynamically (Using of context, using of semantics )
- Applicable to rural as well as urban context

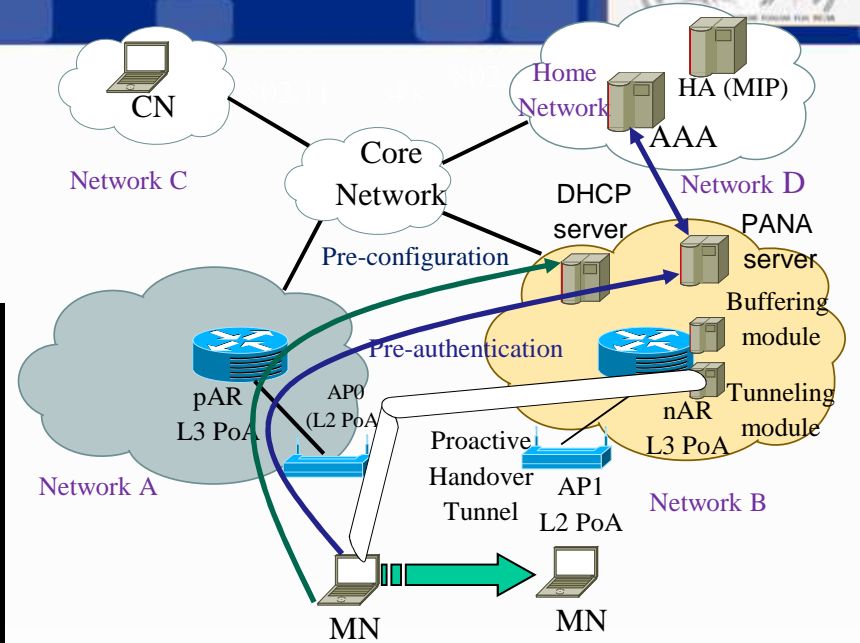
# Use case: Media Independent Pre-authentication and proactive discovery



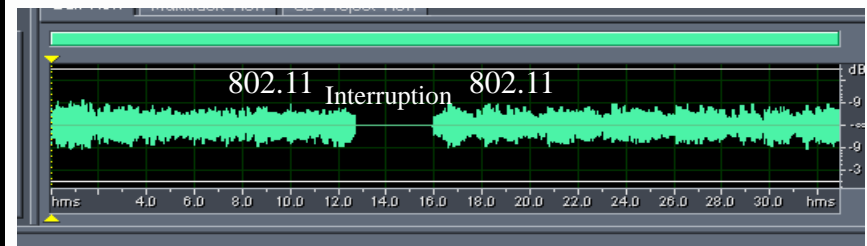
# IEEE 802.21 assisted proactive handover



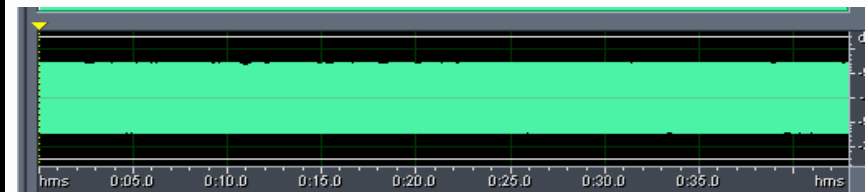
## Results: Media independent proactive handoff



Mobility Type	Mobile IPv6				SIP mobility	
	Buffering Disabled + RO Disabled	Buffering Enabled + RO Disabled	Buffering Disabled + RO Enabled	Buffering Enabled + RO Enabled	Buffering Disabled	Buffering Enabled
Handoff Parameters	Buffering Disabled + RO Disabled	Buffering Enabled + RO Disabled	Buffering Disabled + RO Enabled	Buffering Enabled + RO Enabled	Buffering Disabled	Buffering Enabled
L2 handoff (ms)	4.00	4.0	4.00	4.00	4.00	4.00
L3 handoff (ms)	1.00	1.00	1.00	1.00	1.00	1.00
Avg. packet loss	1.3	0	0.7	0	1.50	0
Avg. inter-packet interval (ms)	16.00	16.00	16.00	16.00	16.00	16.00
Avg. inter-packet arrival time during handover (ms)	21	45	21	67	21	29.00
Avg. packet jitter (ms)	n/a	29.00	n/a	51.00	n/a	13.00
Buffering period (ms)	n/a	50.00	n/a	50.00	n/a	20.00
Avg. Buffered Packets	n/a	2.00	n/a	3.00	n/a	3.00

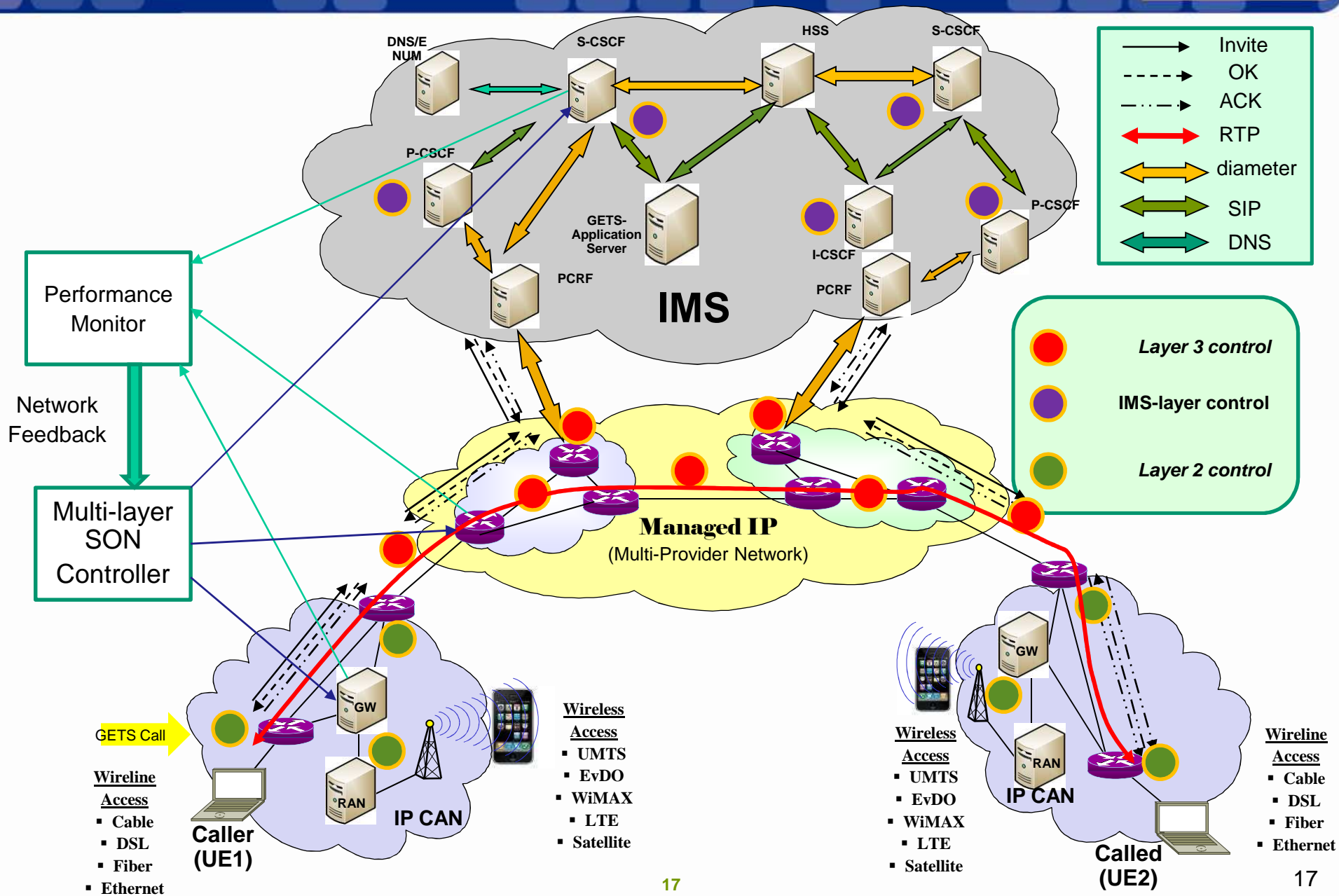


Non-optimized handoff  
(200 packets loss, ~ 4 s handover delay)



Media Independent Pre-auth handoff  
(No packet loss – 5 ms handoff delay)

# Feedback-based service oriented architecture



- Define several use case scenarios for communication in rural India
  - ⊕ Focus QoS metrics for a specific set of applications
- Survey available techniques and framework being discussed in different SDOs
- Map the appropriate techniques and protocols to those use case scenarios
- Draft Best Current Practices for QoS Requirement for Rural India

# Task Force



- NIKSUN, TCS, IITA, (NEC), (VNL), I4CT, MPHASIS
- Gaurav Srivastav (MNNIT)