

Agregando Calidad de Servicio a las Redes de Educación e Investigación

CUDI Reunión de Primavera 2003 Ensenada

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Juniper Networks

Agenda

- DiffServ QoS Architecture
- Edge CoS/QoS Strategies
- Core CoS/QoS Strategies (IP/MPLS)

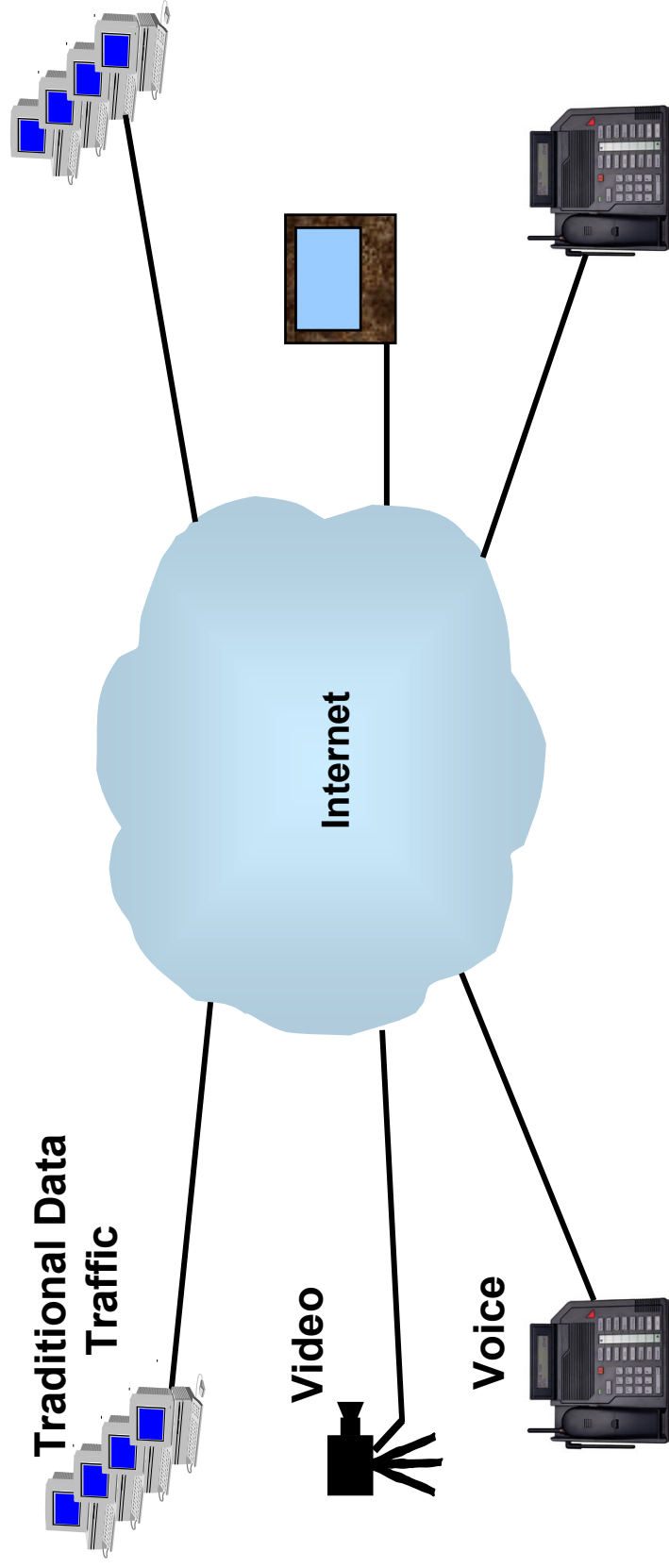


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The Need for QoS

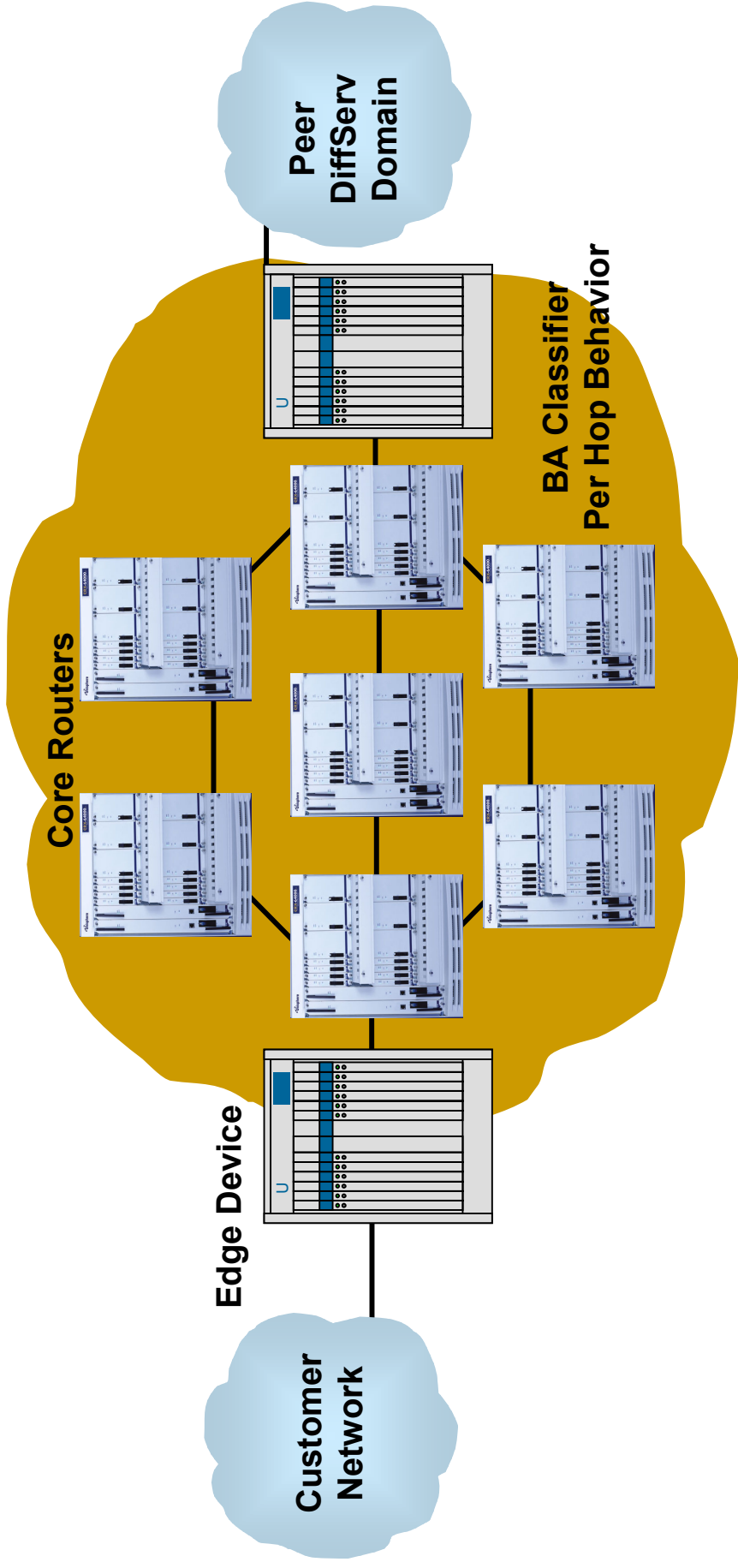


- Applications in use on the Internet are changing:
 - Voice
 - Video
 - Traditional Data
- New service levels required:
 - Better than best effort
 - Assured Experience



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Differentiated Services Network Components

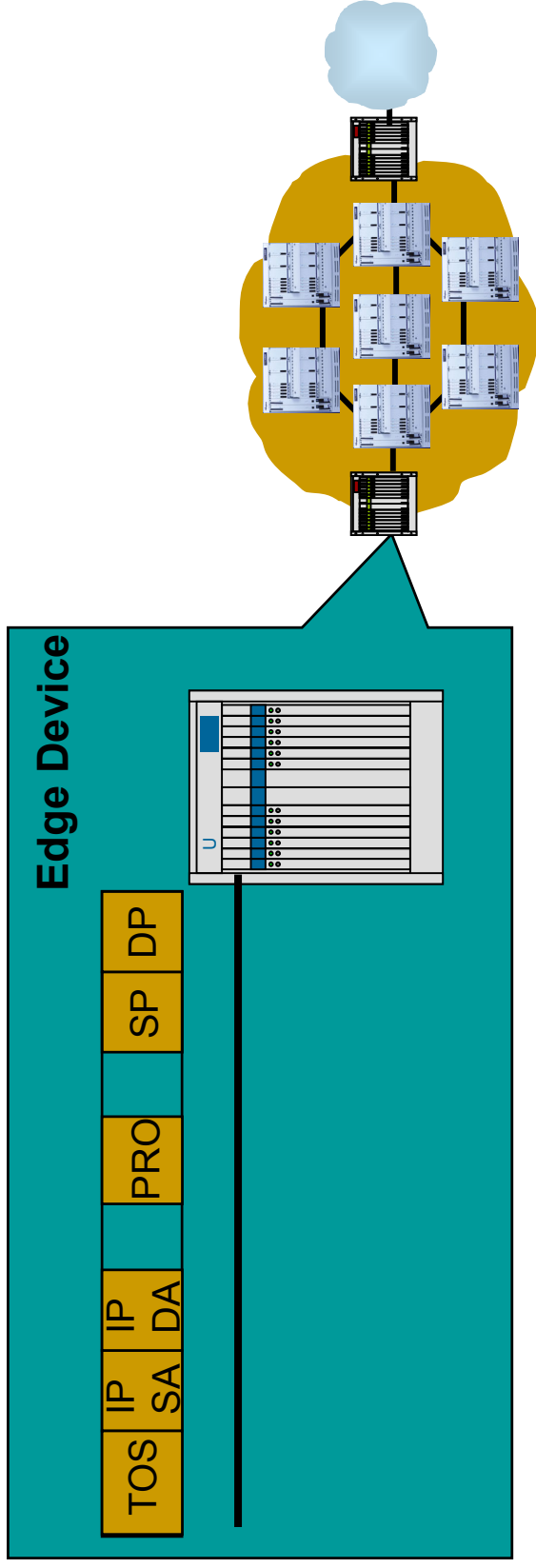


DiffServ Router Requirements

- Multiple Traffic Classes
 - IETF DiffServ PHBs : Traffic Classes
 - Assured Forwarding (AF: RFC 2597)
 - Expedited Forwarding (EF: RFC 2598)
- Configurable Buffer Management for each traffic class
 - Best Effort
 - Low Loss : more buffers and/or bandwidth
 - Low Latency: strict priority with rate limiting
 - Low Latency & Low Jitter: strict priority with traffic shaping



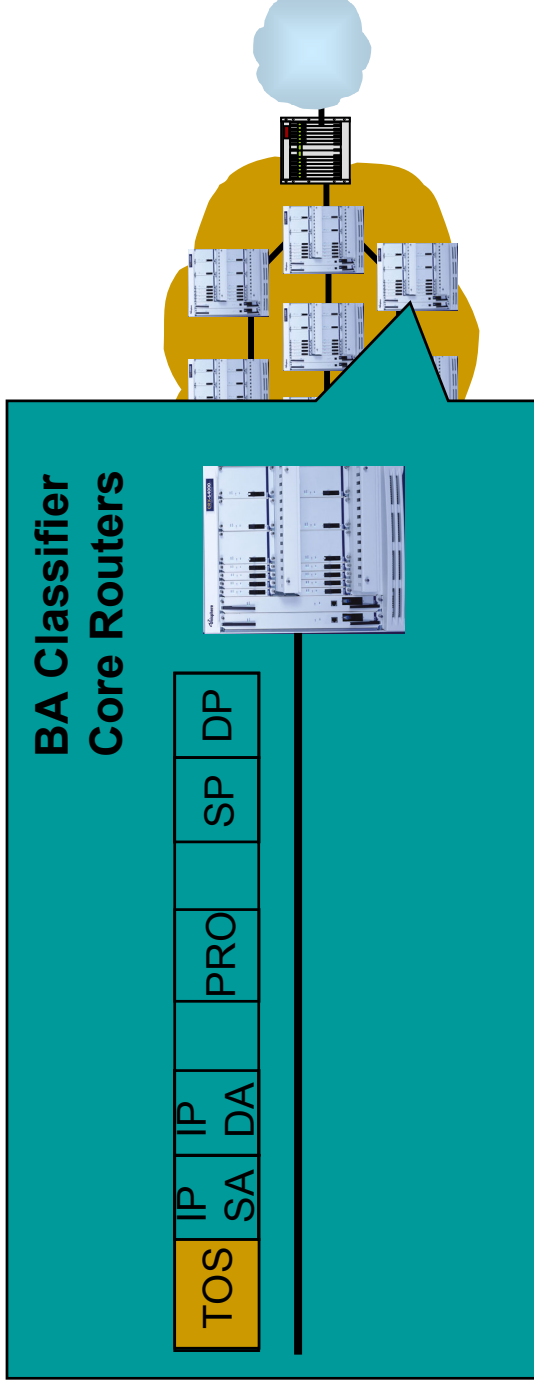
Edge Device



- Multifield Classification
- DSCP Marking
- Flow Policing
- Traffic Shaping



BA Classifier Per Hop Behavior



- **Expedited Forwarding (EF)**
 - Minimizes Delay and Jitter
 - Provide Highest Level QoS
 - Out of Profile Traffic is Dropped
- **Assured Forwarding (AF)**
 - Better than Best Effort routing
 - Different drop precedence per class
 - Out of Profile Traffic may be demoted in class or drop precedence



Generic QoS Management Tasks

- Divide Traffic into Multiple Classes
 - Premium
 - Assured
 - Best Effort
- Class-Based Queueing and Scheduling
 - Weight-Round Robin
 - Strict Priority
- Traffic Management
 - Policing and Shaping
 - RED/WRED
- MPLS-Based Quality of Service
 - Traffic Engineering
 - Traffic Protection



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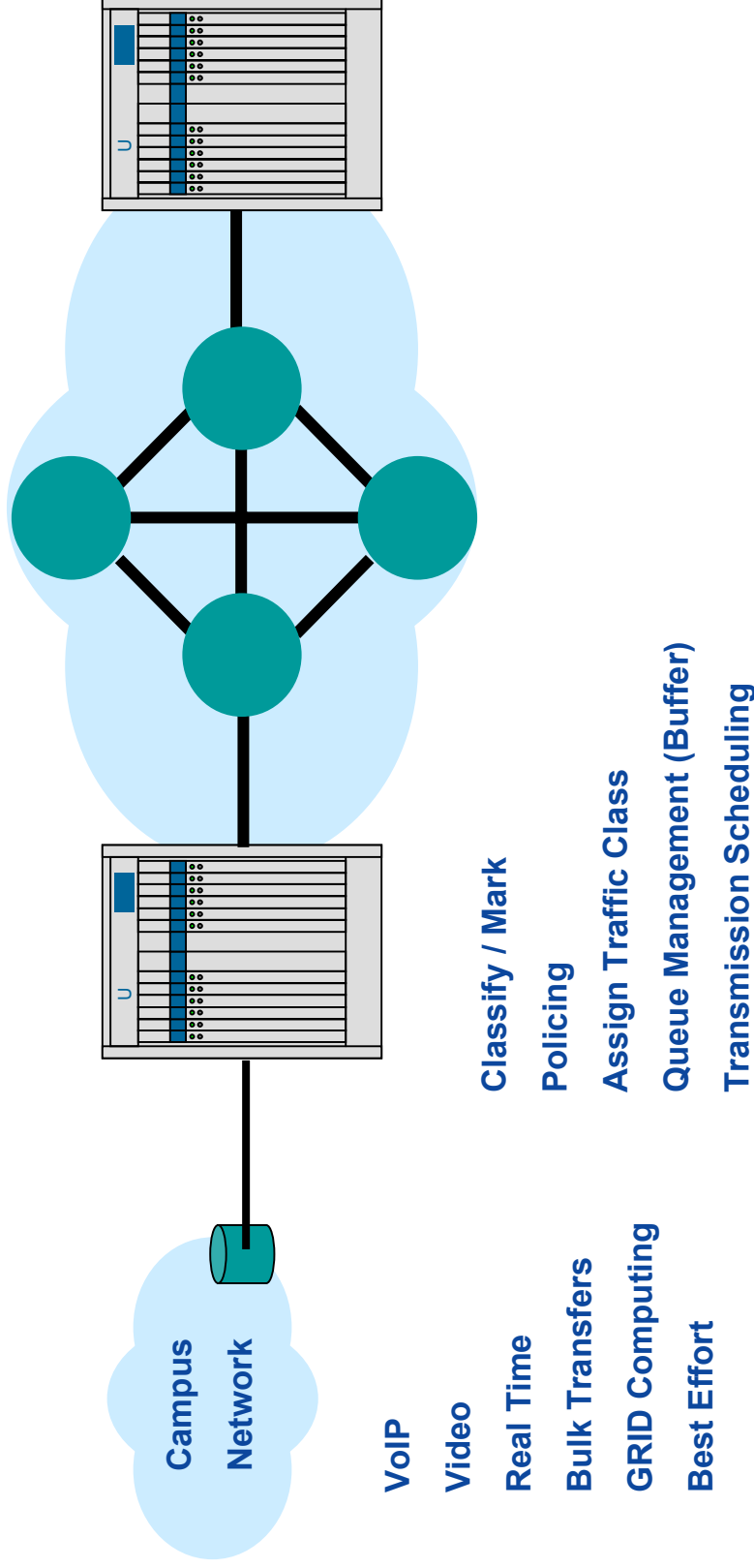


Edge QoS Management Tasks

- **Packet Classification**
 - Identify flows based on L2/L3/L4 information
 - Each flow is associated with a traffic class
- **Token-bucket-based policing**
 - Configurable parameters:
 - Sustained Rate
 - Maximum Burst Size
 - Exceeding traffic is either marked or dropped
- **Egress Buffer Management**
 - Buffer size and characteristics are determined according to delay budget for traffic class
- **Transmission Scheduling (Queueing Discipline)**
 - According to traffic class
 - Strict Priority or Weighted Round-Robin



Edge Router Requirements



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Wire Speed Performance QoS Requirement

- Only as good as the weakest link
- Each hop must:
 - Route at Wire Speed, even under load
 - Route at Wire Speed while classifying packets
 - Continue to route at wire speed while also queuing packets for different services



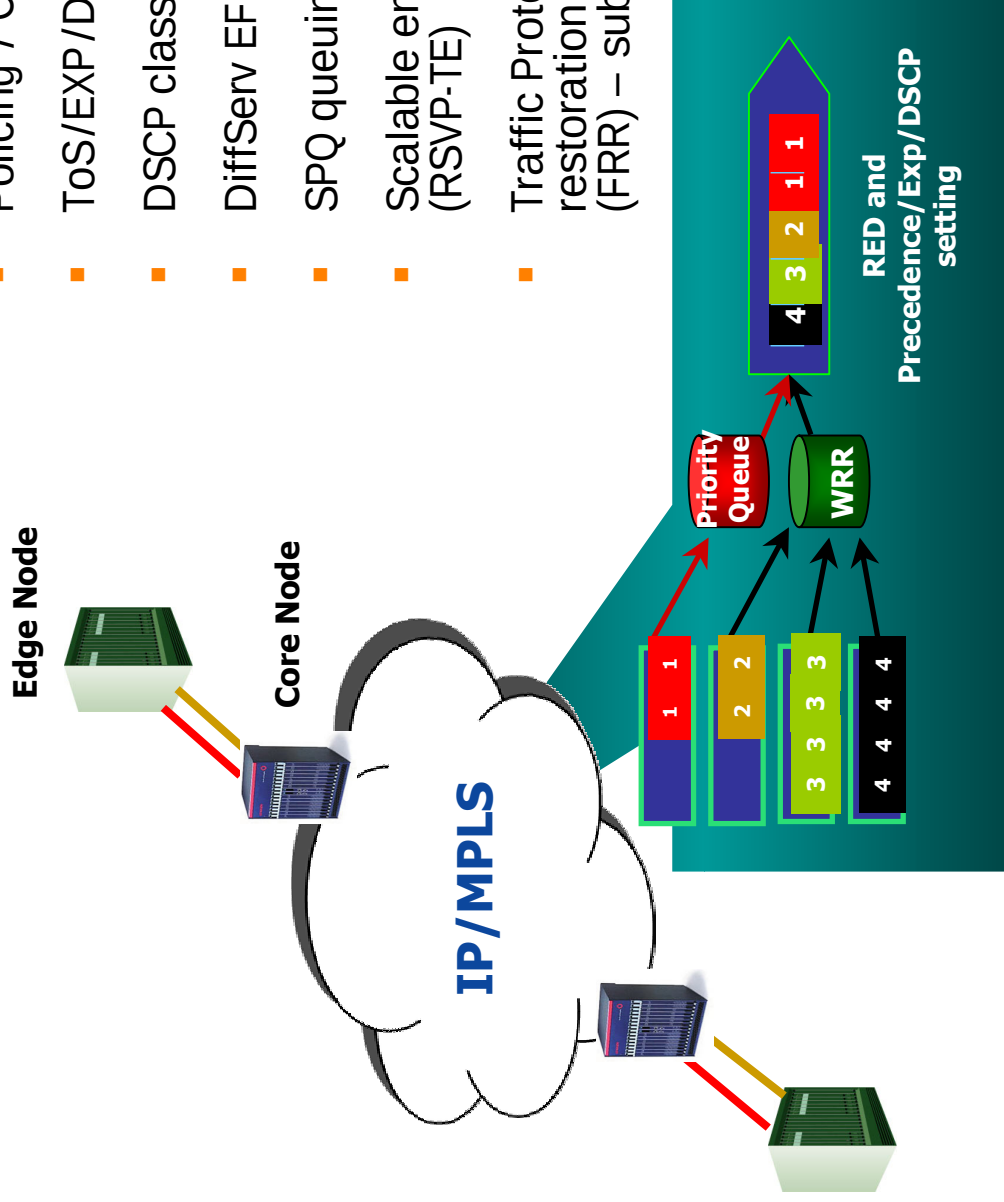
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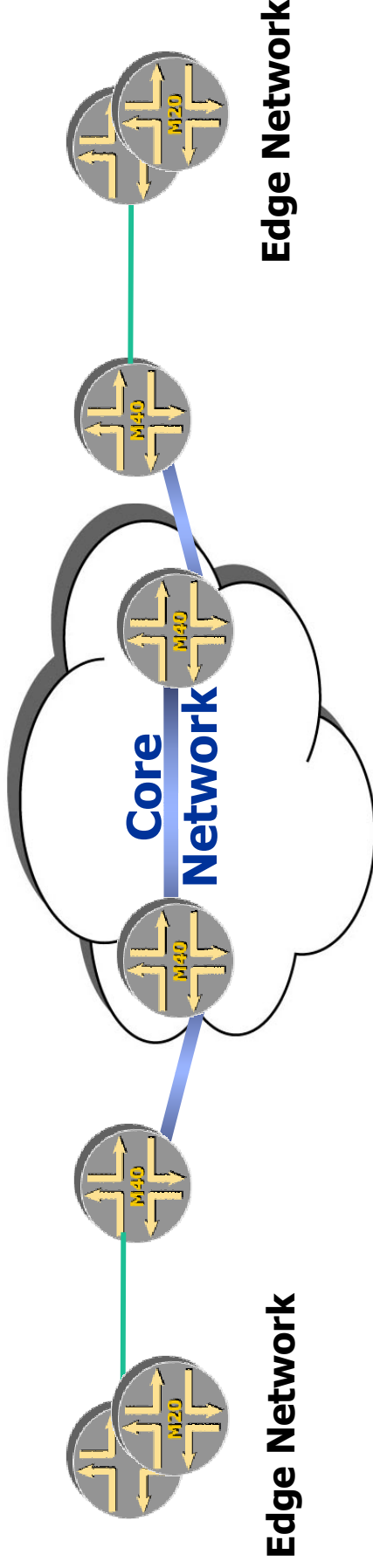


Core QoS Architecture

- Policing / CAC
- ToS/EXP/DSCP marking
- DSCP classification
- DiffServ EF /AF PHBs
- SPQ queuing
- Scalable end-to-end QoS signaling (RSVP-TE)
- Traffic Protection with Fast restoration via MPLS Fast Reroute (FRR) – sub-50ms LSP protection



End-to-End Requirements for Delay



$$D_{total} = T_f + T_{sf} + \sum_{i \in path} (S_i + P_i) + Q_{max}$$

- Application processing delay (packet formation), T_f = low ms to sub-ms
- Packet switching delay, $T_{sf} \sim 10 \mu s$ per hop
- Serialization delay, S_i = bits/link rate * number of hops
- Propagation delay, P_i = 1 ms/100 mile
- Queuing delay, Q_{max} variable



CoS – Class of Service

- CoS is the preferential treatment of packets with certain characteristics
 - Define which packets get treated preferentially
- IPv4 packets
 - ToS/DCSP field can be used for CoS
 - ToS/DCSP values can be mapped to CoS mechanisms
- MPLS packets
 - EXP bits can be used for CoS
 - Mapping to ToS/DSCP bits
- All routers in a network must support CoS setting for applications to fully benefit

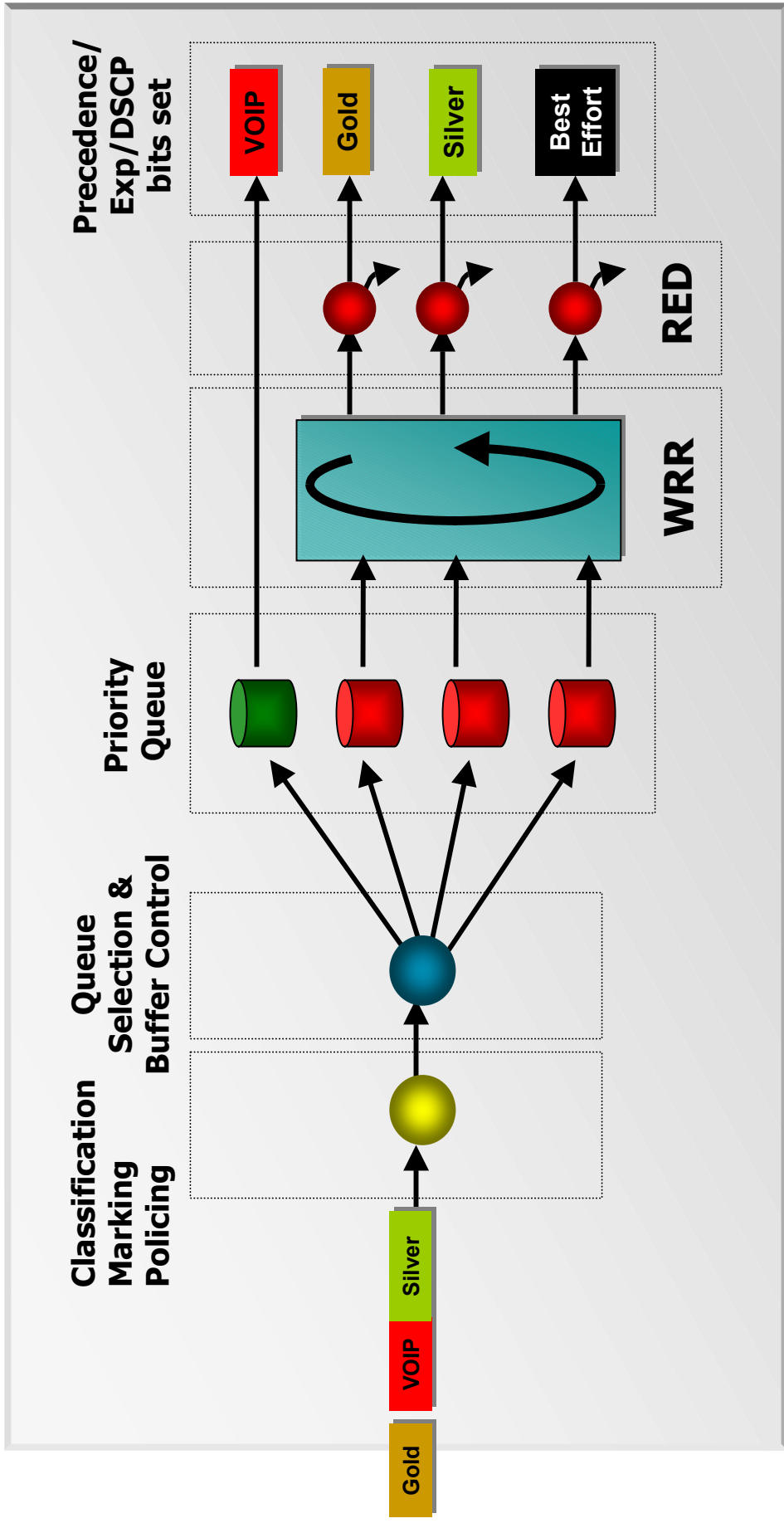


Classification/Marking

- DSCP
 - For IP packets, the entire 6-bit DSCP field is used to map into queuing and drop priority
- Flexible MPLS mapping
 - For MPLS packets, there is a mapping function between the EXP/COS field and queuing and drop priority



Generic QoS – Packet Processing



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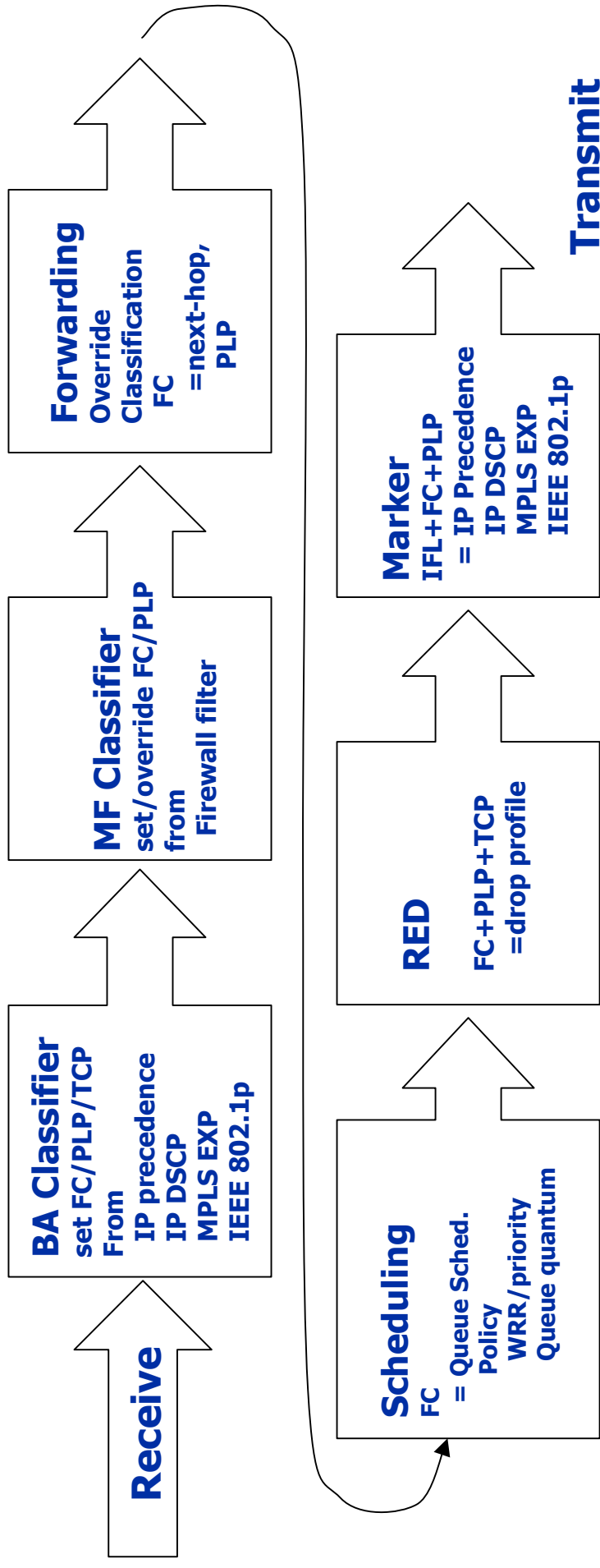
- Time averaging
 - When indexing into the drop profiles queue length, a time-averaged queue length is used

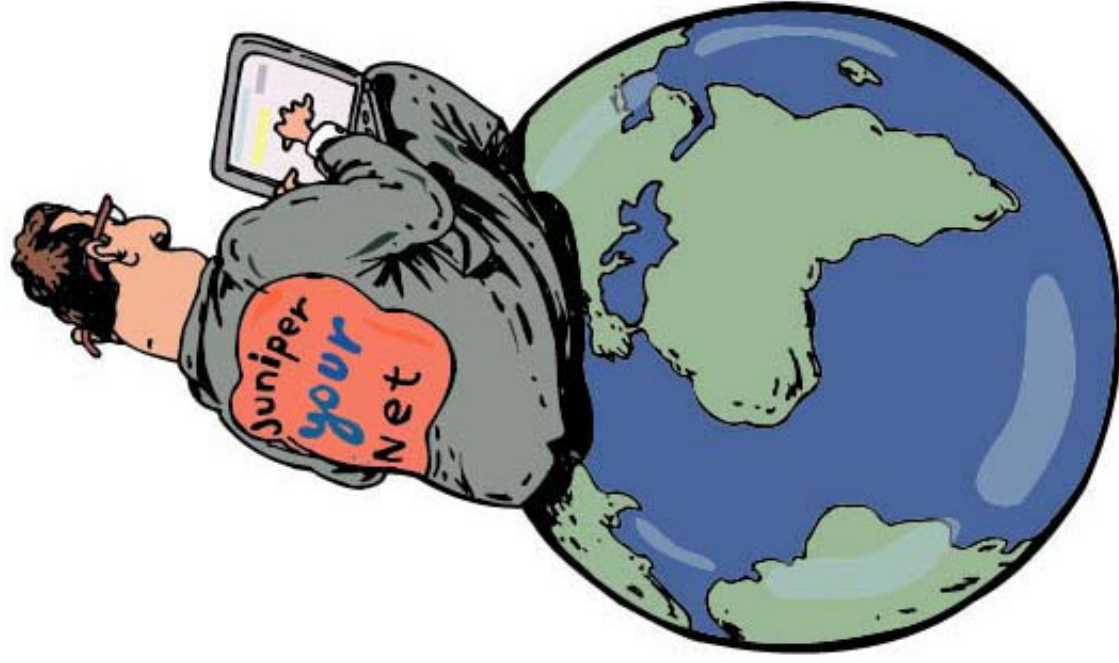


- How it Works
 - RSVP establishes dedicated LSP for VoIP
 - Signalling includes Bandwidth Requirements and Protection Options
- Protection
 - Primary LSP
 - Secondary LSP
 - LSP Fast-Reroute
- Network Topology
 - Possibility of assigning links dedicated to specific traffic classes (Premium)
 - Premium LSPs have higher priority for LSP establishment and re-route in the event of link failure

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CoS/QoS Configurable Components





Thank You!

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