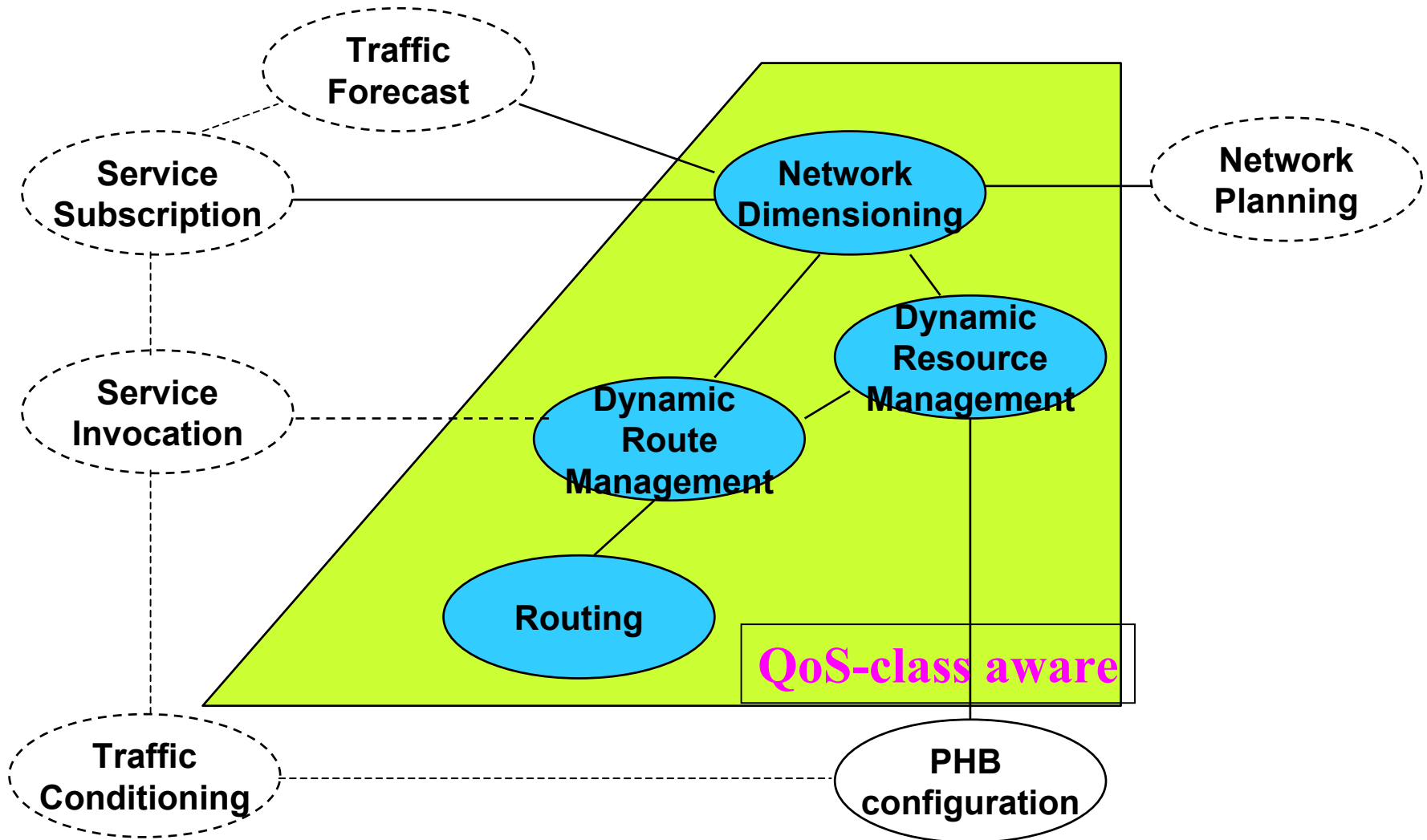




Resource Management





Traffic Engineering (TE)

Dimensioning



Traffic Engineering (TE)

Dimensioning

- Centralized component
- Objective: Guidelines for overall network operation
- Operation: Long-term (days-weeks) or due to special network conditions



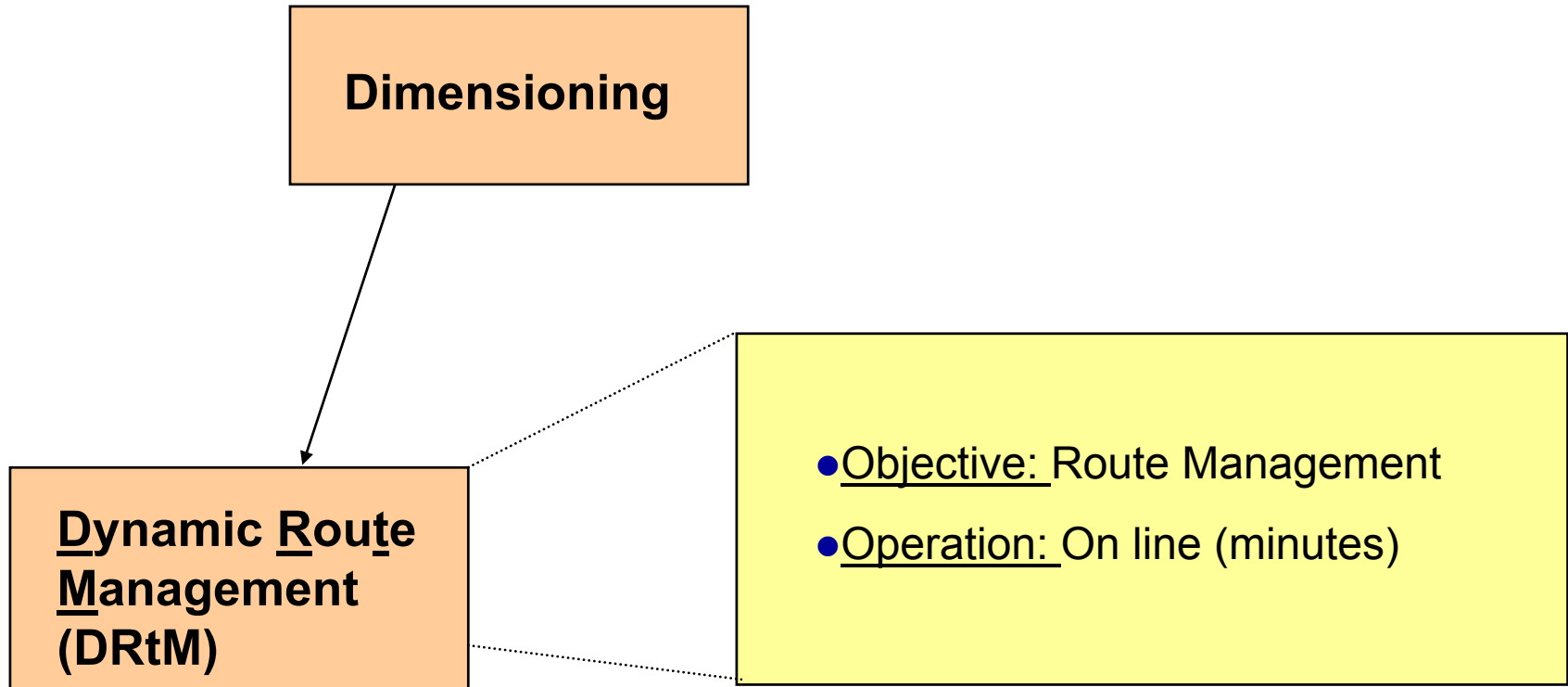
Traffic Engineering (TE)

Dimensioning

**Dynamic Route
Management
(DRtM)**

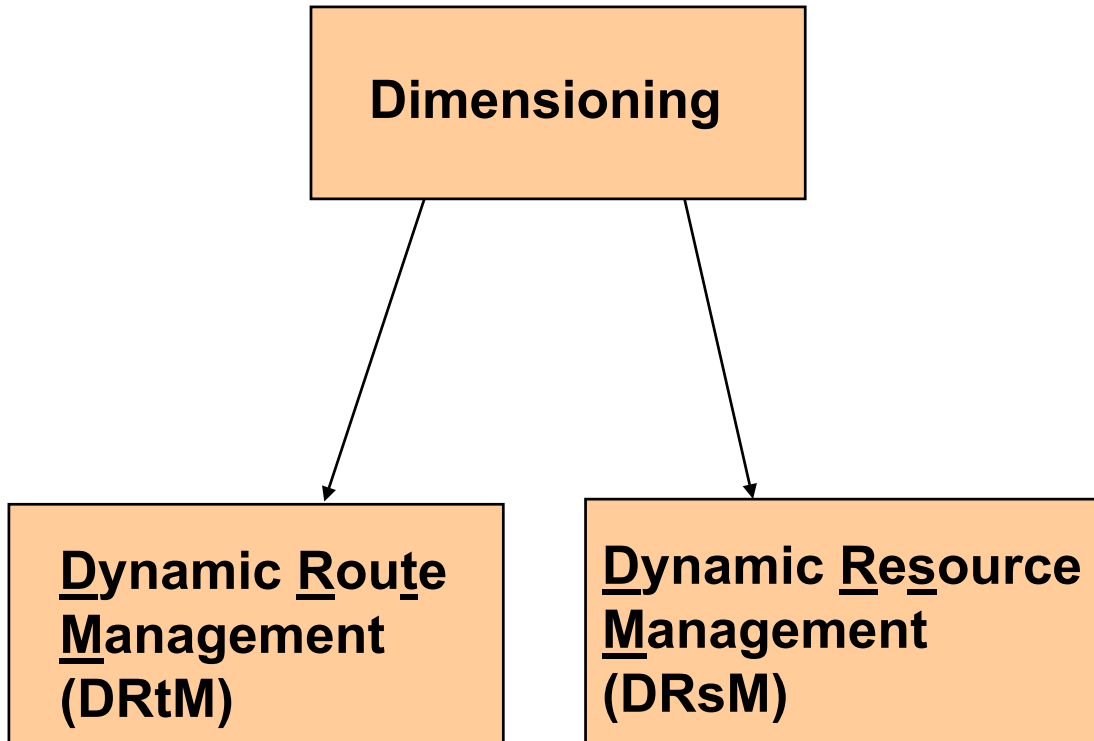


Traffic Engineering (TE)



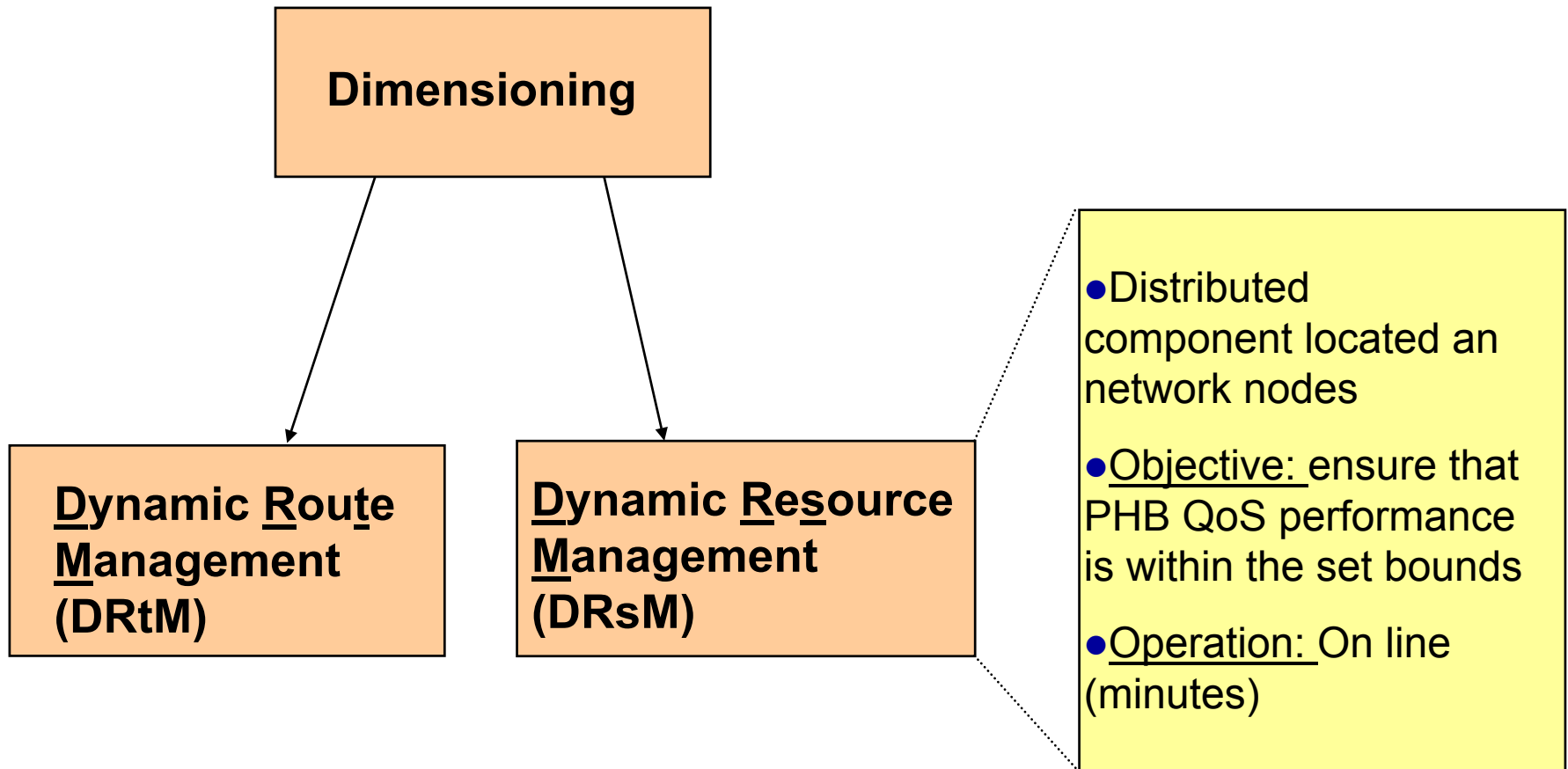


Traffic Engineering (TE)



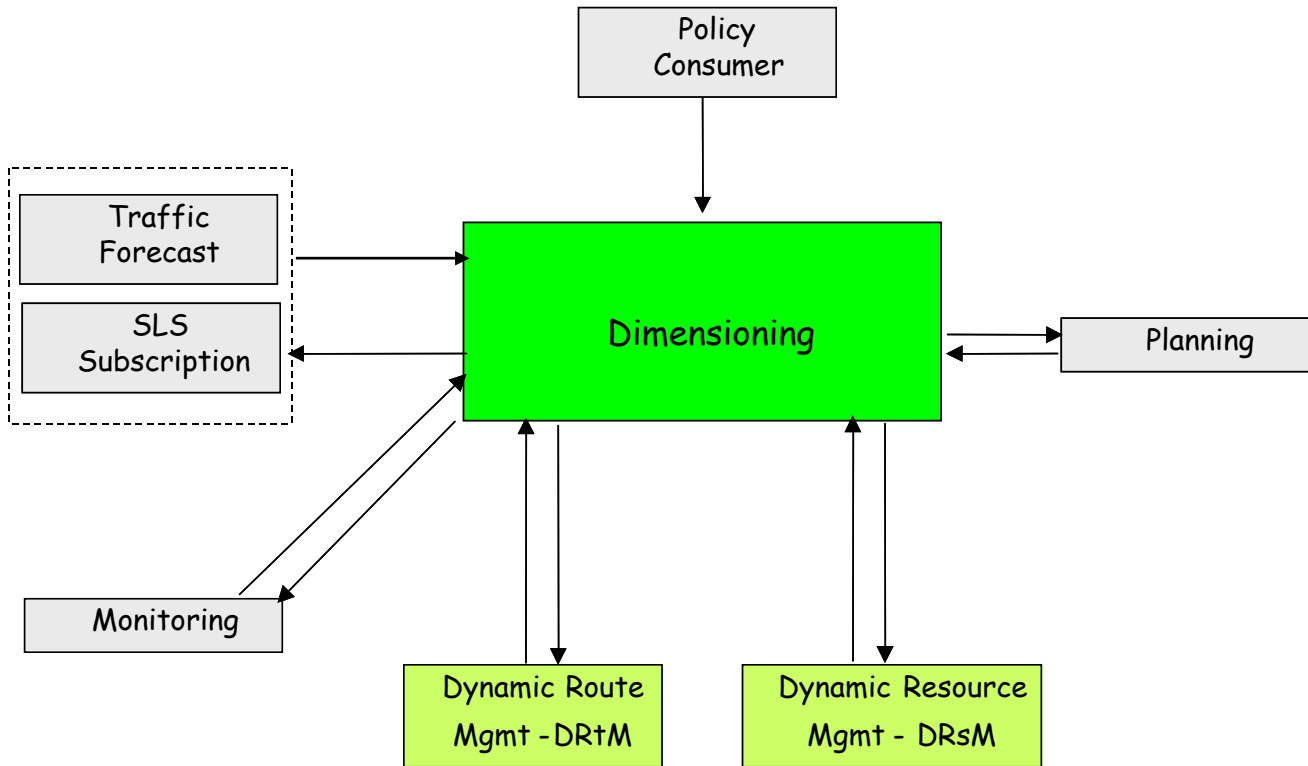


Traffic Engineering (TE)



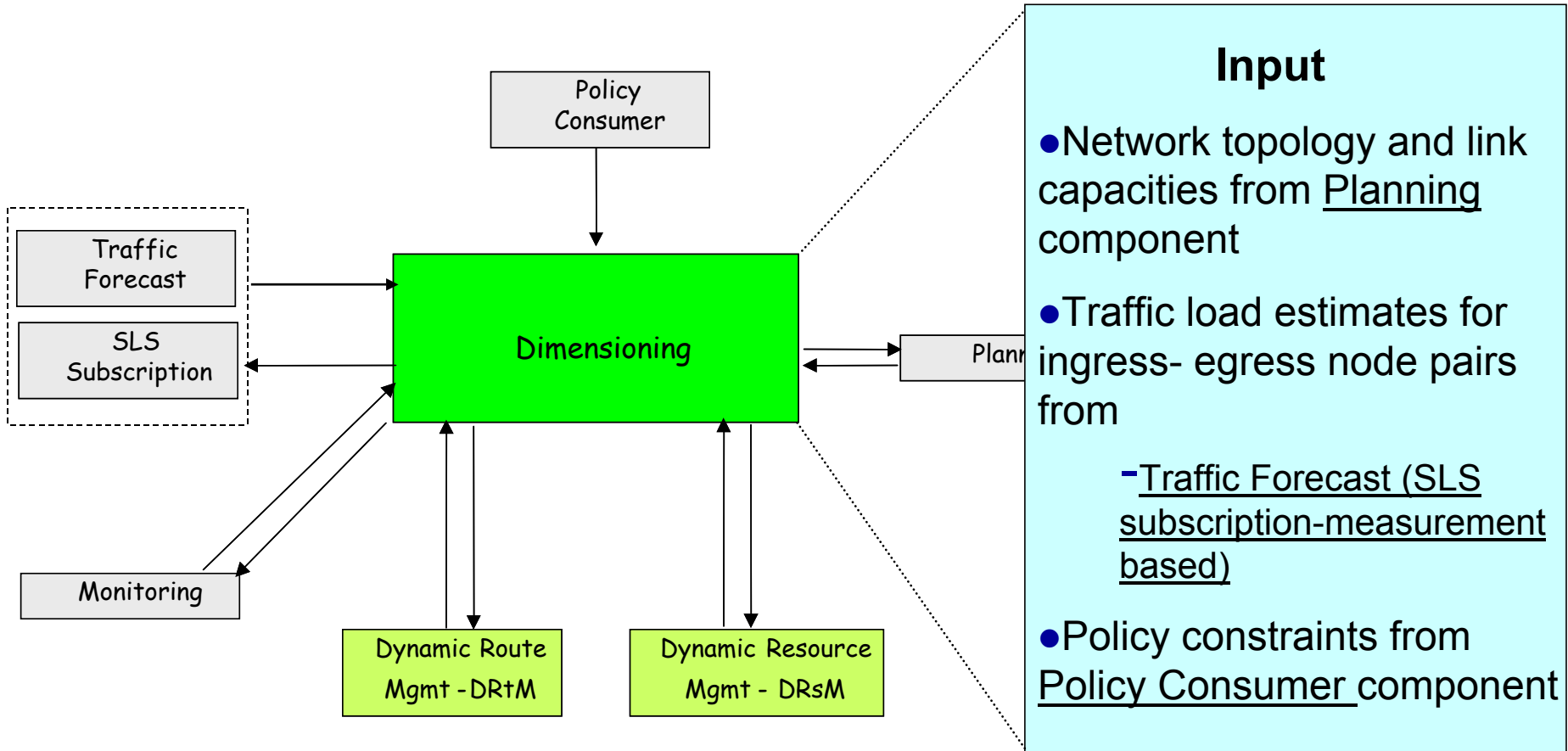


MPLS TE - Dimensioning



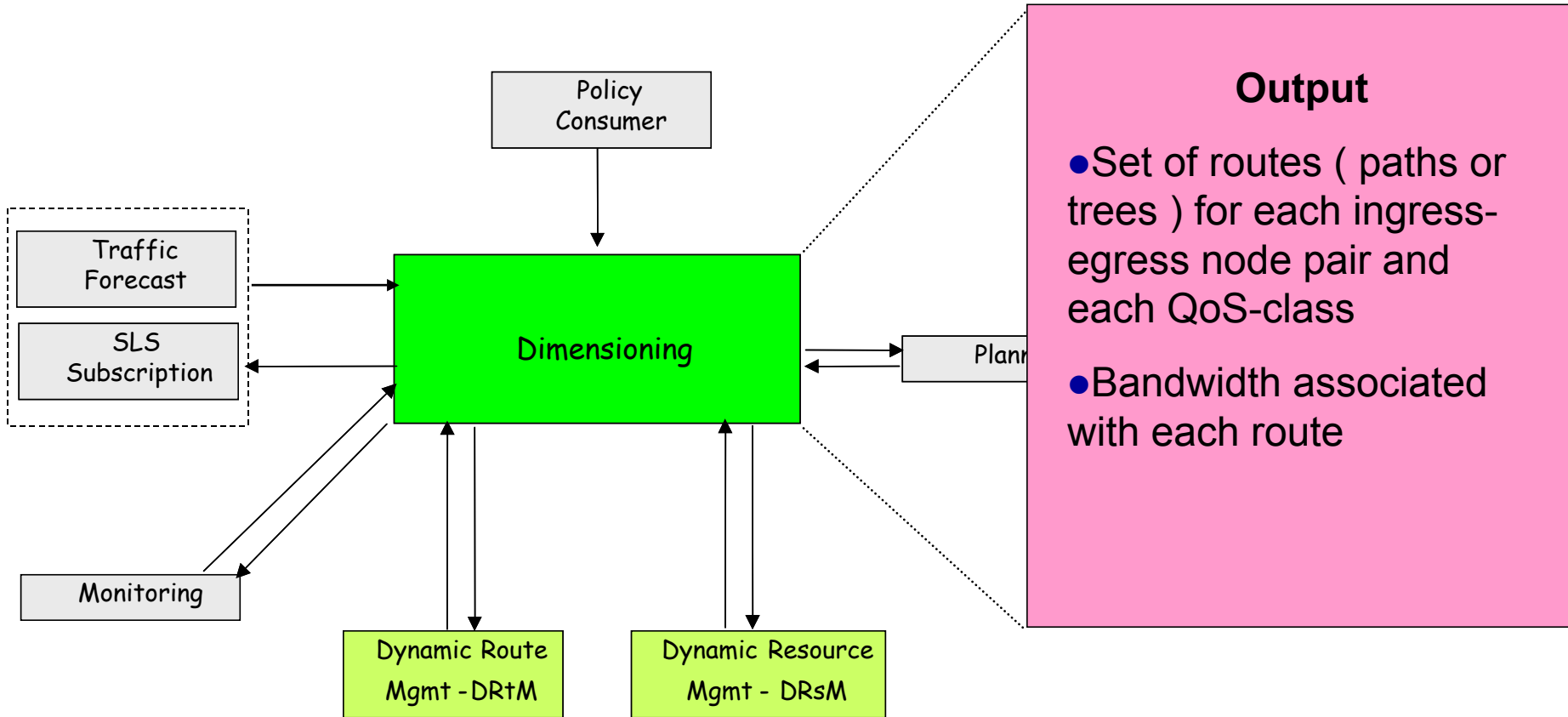


MPLS TE - Dimensioning





MPLS TE - Dimensioning





MPLS TE - Dimensioning

◆ Redimensioning

- Periodically (days - weeks)
 - Time-of-day updates can be taken care of during the initial dimensioning
- Network topology-capacity changes (Planning)
- Alarms from DRtM
- Alarms from DRsM
- Inability to satisfy SLs (SLS Monitoring and/or subscription)



MPLS TE - Dimensioning

◆ Traffic model

- **QoS-Class.** May include
 - Blocking probability
 - Loss probability
 - End-to-end delay
- **QoS-Class traffic is mapped to one PHB**
- **Bandwidth of each QoS-Class determined by**
 - Specifications in SLS negotiation
 - Calculations based on SLS-specified blocking probability and bandwidth requirements of each invocation (Erlang Loss)
 - Estimated



MPLS TE - Dimensioning

◆ Network node model

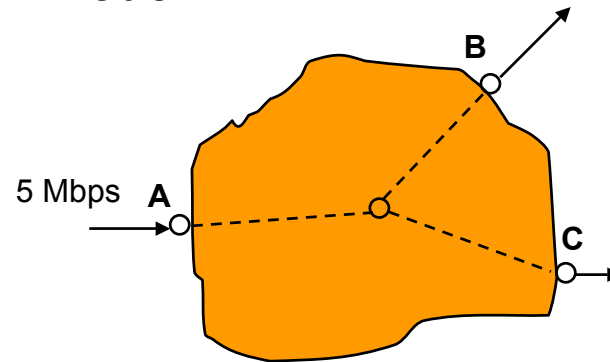
- Each node supports a number of PHBs
- A PHB may be associated with a
 - Loss probability
 - Delay (upper bound, percentile)



MPLS TE - Dimensioning

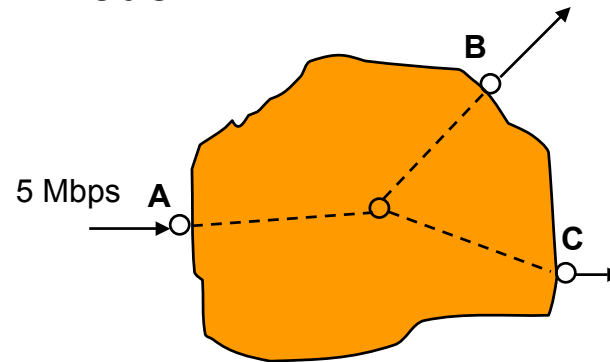
◆ Hose traffic trunk model

- 5 Mbps bandwidth entering A
- May be directed to either B or C
- **But** not at the same time

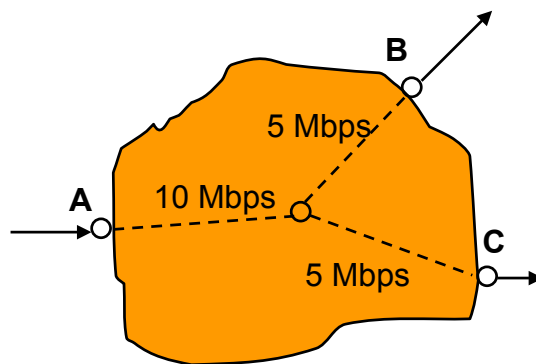


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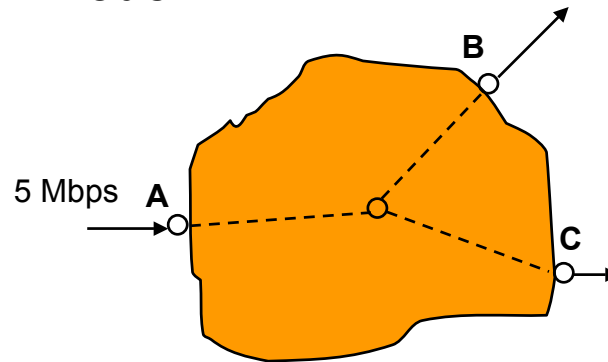
Treating each destination separately



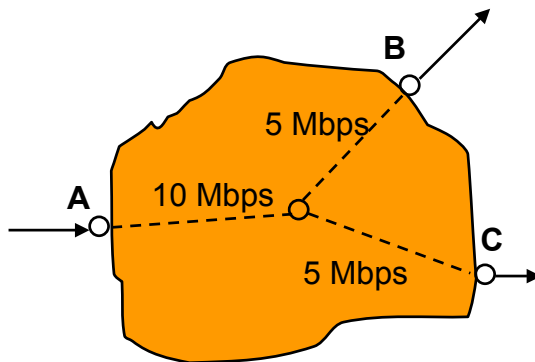
MPLS TE - Dimensioning

◆ Hose traffic trunk model

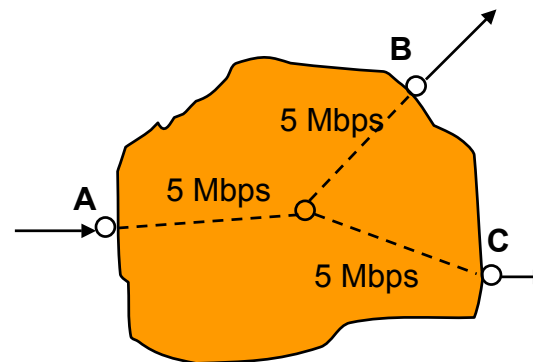
- 5 Mbps bandwidth entering A
- May be directed to either B or C
- **But** not at the same time



Treating each destination separately



Actual bandwidth needs





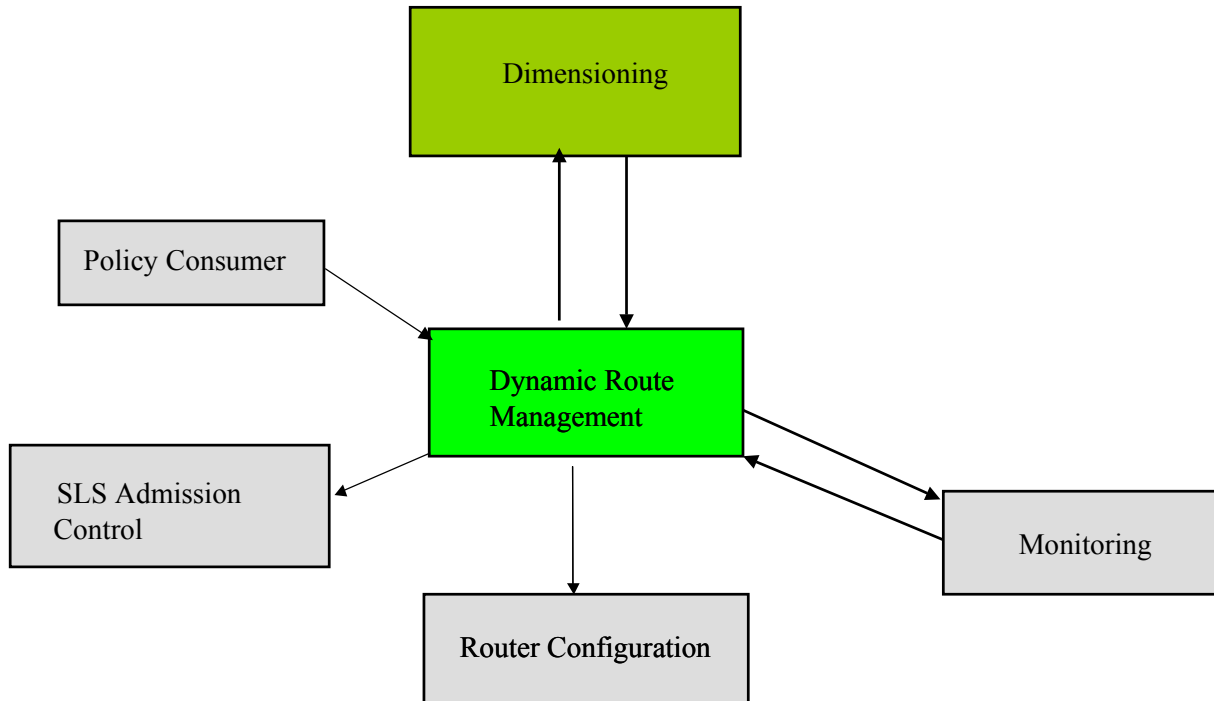
MPLS TE - Dimensioning

- ◆ **Optimization objective**
 - Link cost as function of link load
 - Maintain low link costs while
 - Satisfying traffic bandwidth requirements
 - Satisfying traffic QoS requirements

- ◆ **QoS requirements as optimization constraints**
 - Blocking Probability: Taken into account through bandwidth requirements (by traffic forecast)
 - Loss and Delay : Translated into hop-count constraints

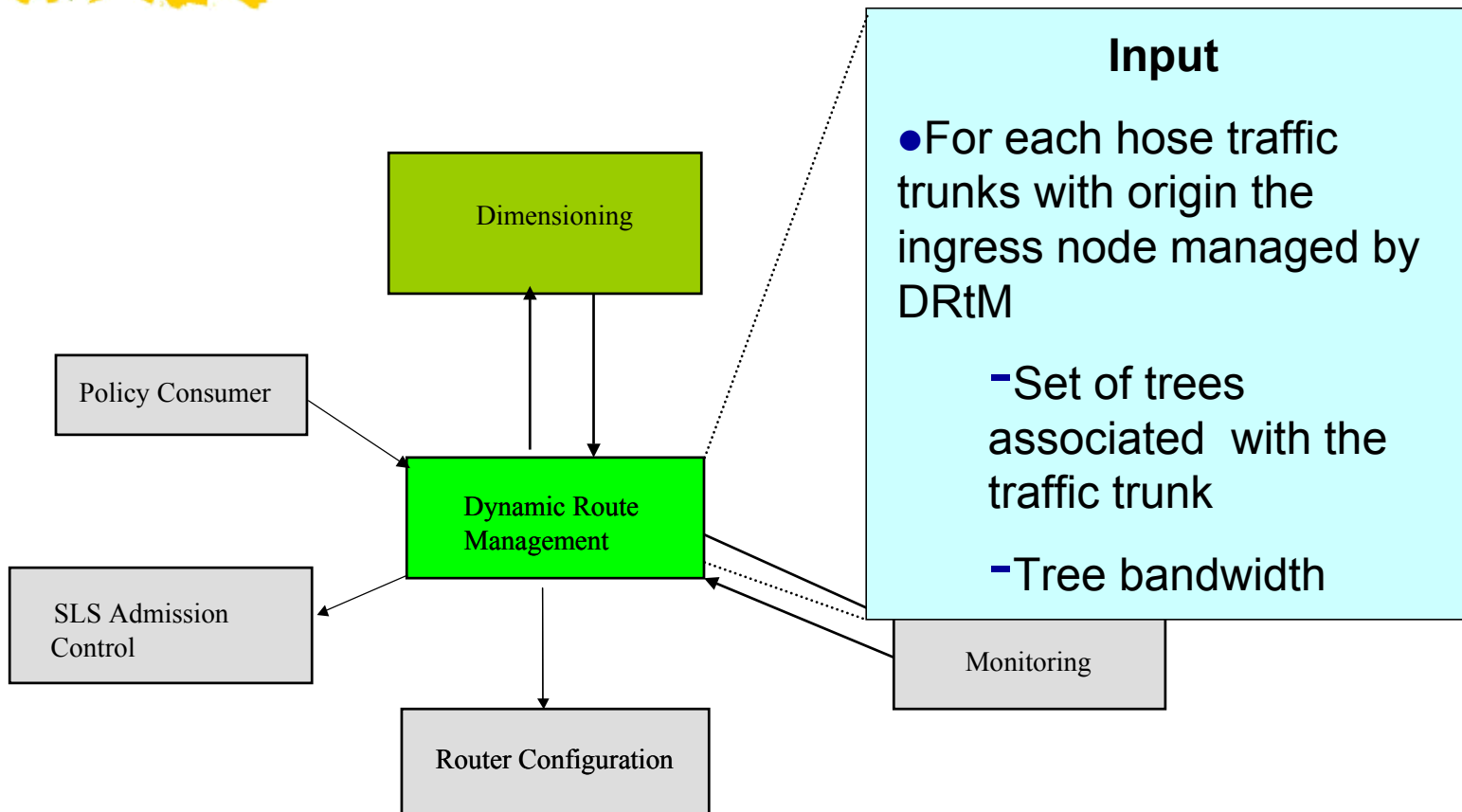


MPLS TE - DRtM



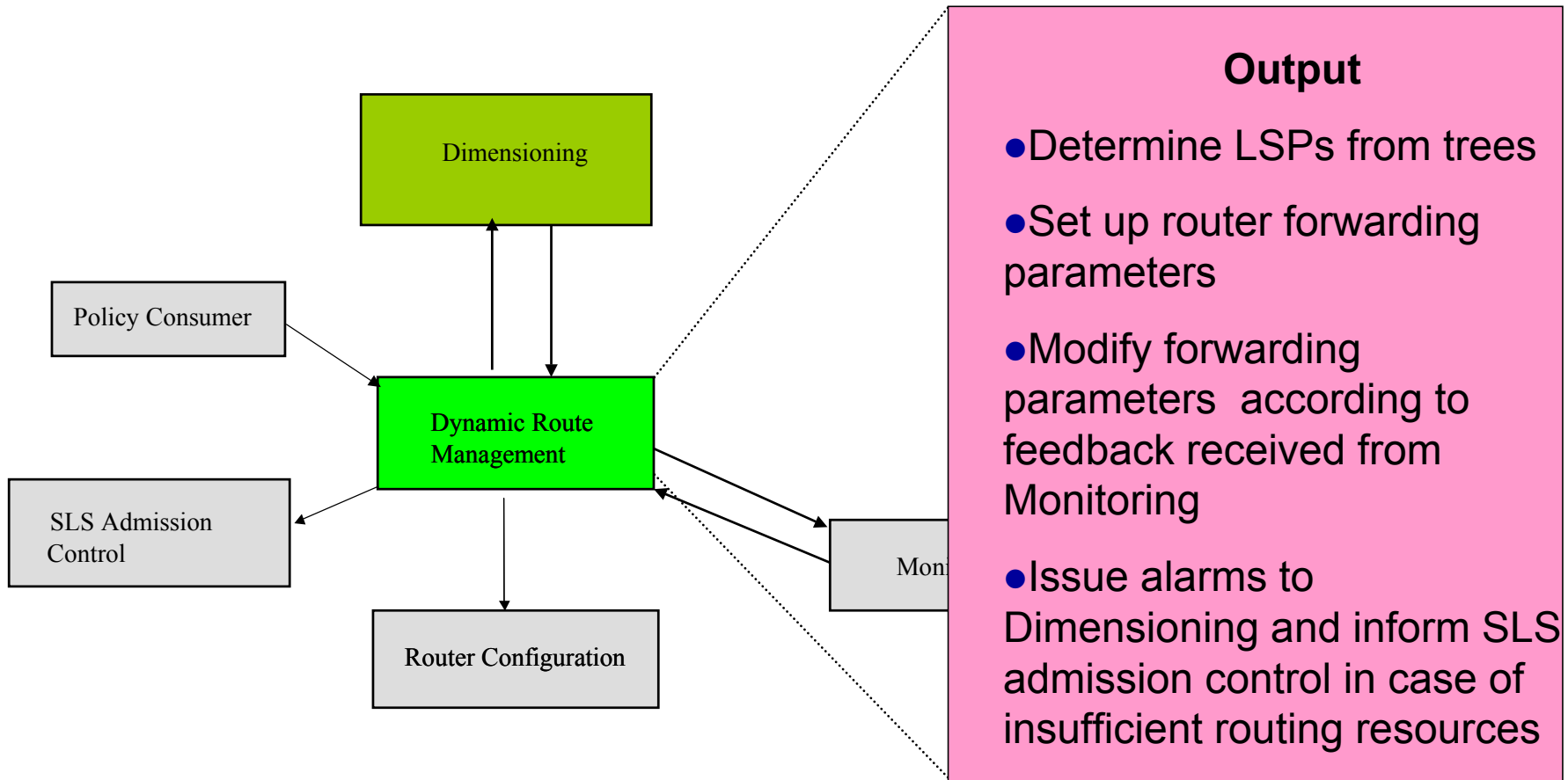


MPLS TE - DRtM





MPLS TE - DRtM





MPLS TE - DRtM

◆ Initialization actions

- For each hose traffic trunk
 - Create LSPs to accommodate trunk traffic trees
 - Map “address spaces” to LSPs according to tree bandwidth, based on prior statistics
 - Configure Router LSP forwarding table according to the mapping in previous step
- Metrics to be monitored by Monitoring component
 - End-to-end QoS performance of LSP traffic (reactive measures)
 - PHB QoS performance at network nodes (proactive measures)



MPLS TE - DRtM

◆ On-line operation

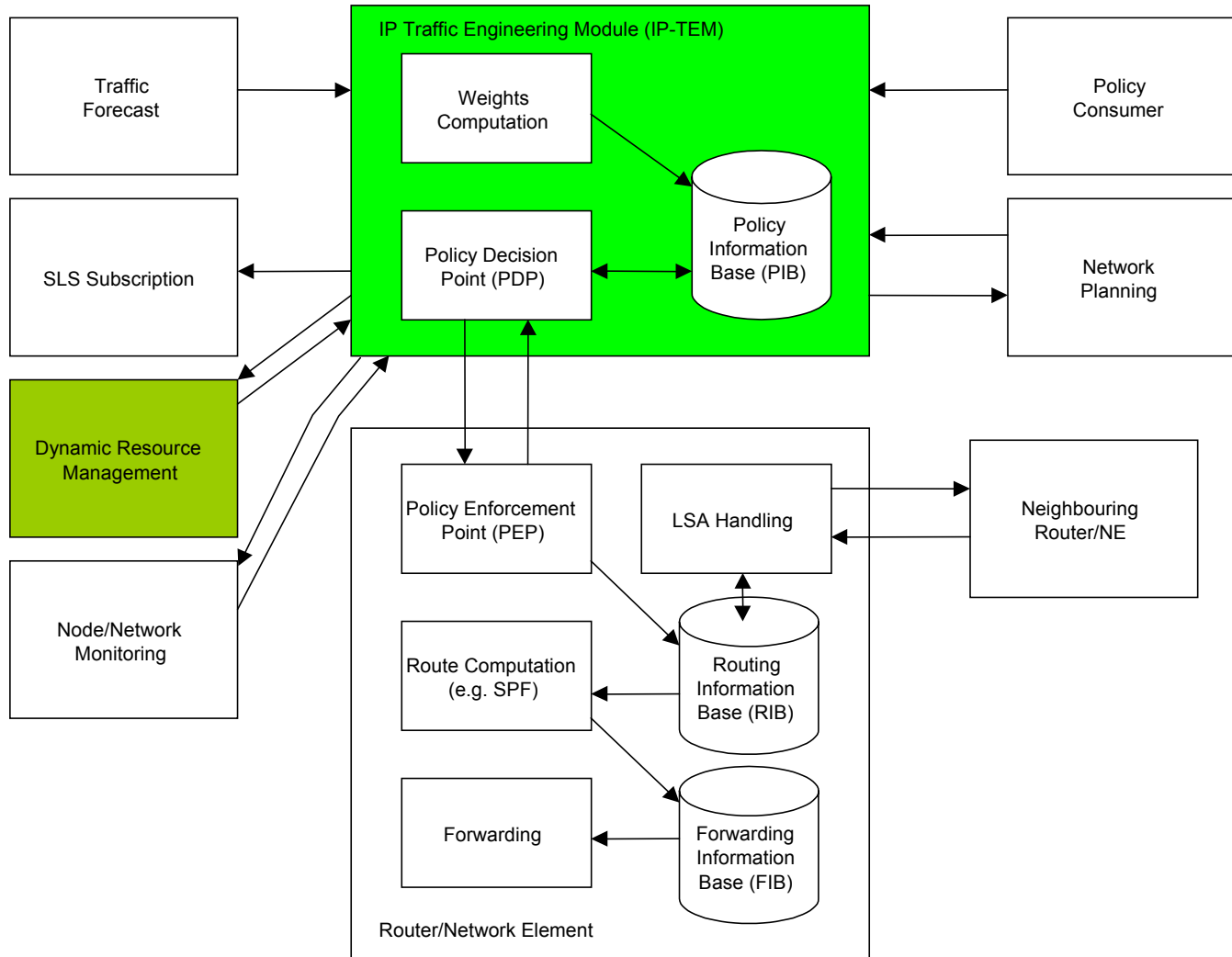
- LSP traffic QoS performance critical
 - Remapping of address spaces to alternative LSPs
 - Warnings to Dimensioning
- PHB QoS performance critical
 - Partial remapping of related LSP traffic
- Unavailability of (properly performing) LSP bandwidth
 - Alarms to Dimensioning
 - Warnings to SLS Admission Control



- ◆ **Basic Assumptions :**
 - Routing Protocol: OSPF
 - Dynamically assigned cost metrics per DSCP
- ◆ **Dimensioning:**
 - Objective: Guidelines for overall network operation
 - Output: Cost metrics per DSCP
- ◆ **Dynamic Route Management (DRtM)**
 - Objective: Management of link weights
- ◆ Dimensioning + DRtM = IP-Traffic Engineering Module (IP-TEM)
- ◆ **Dynamic Resource Management (DRsM)**
 - Same functionality as in MPLS

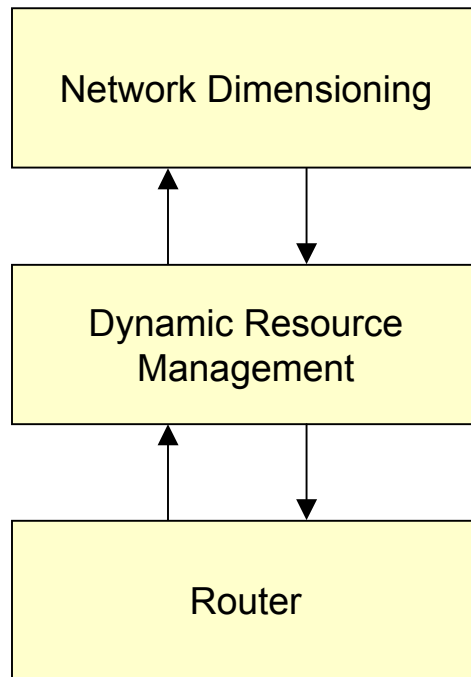


IP TE



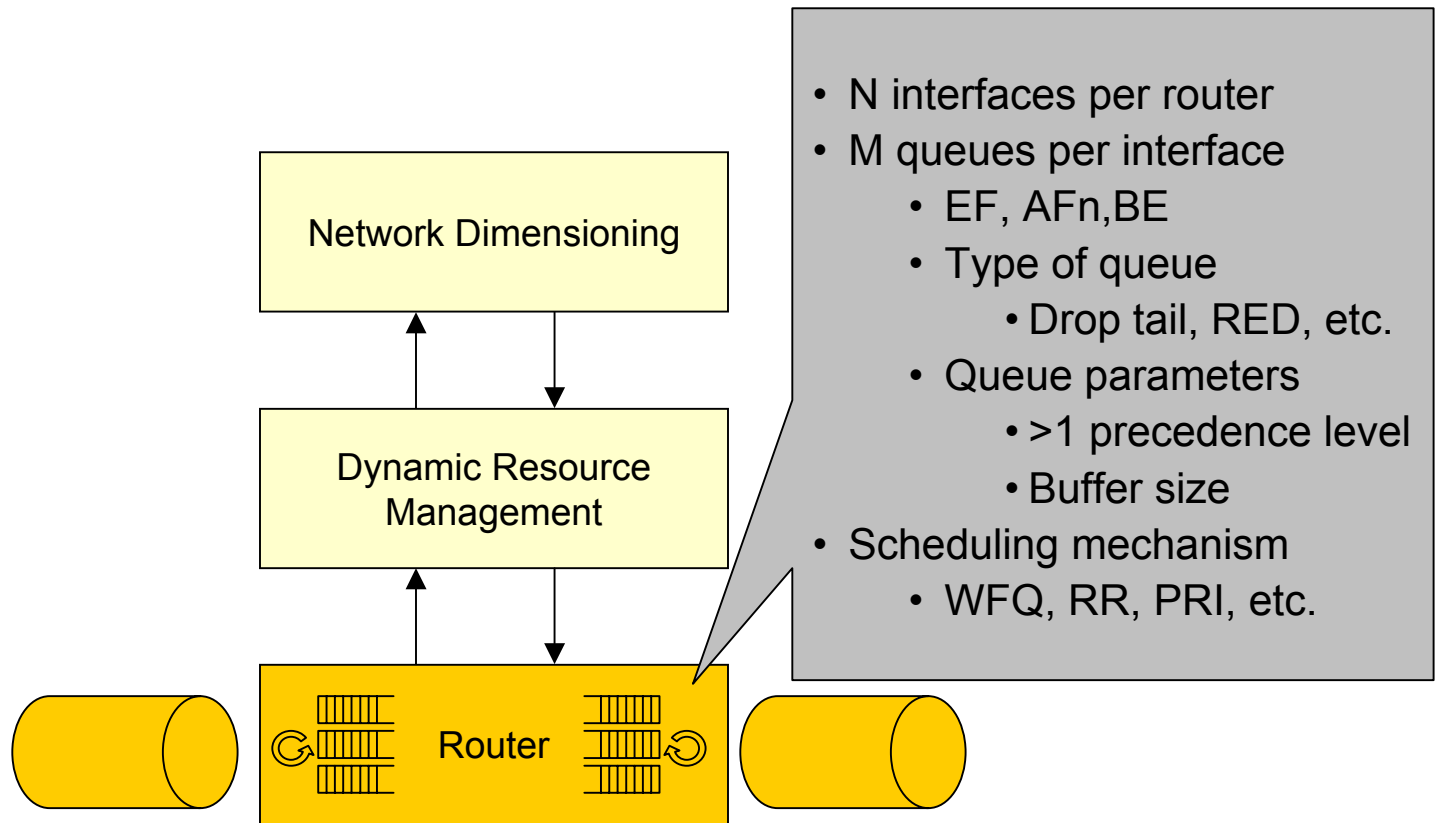


MPLS TE - DRsM



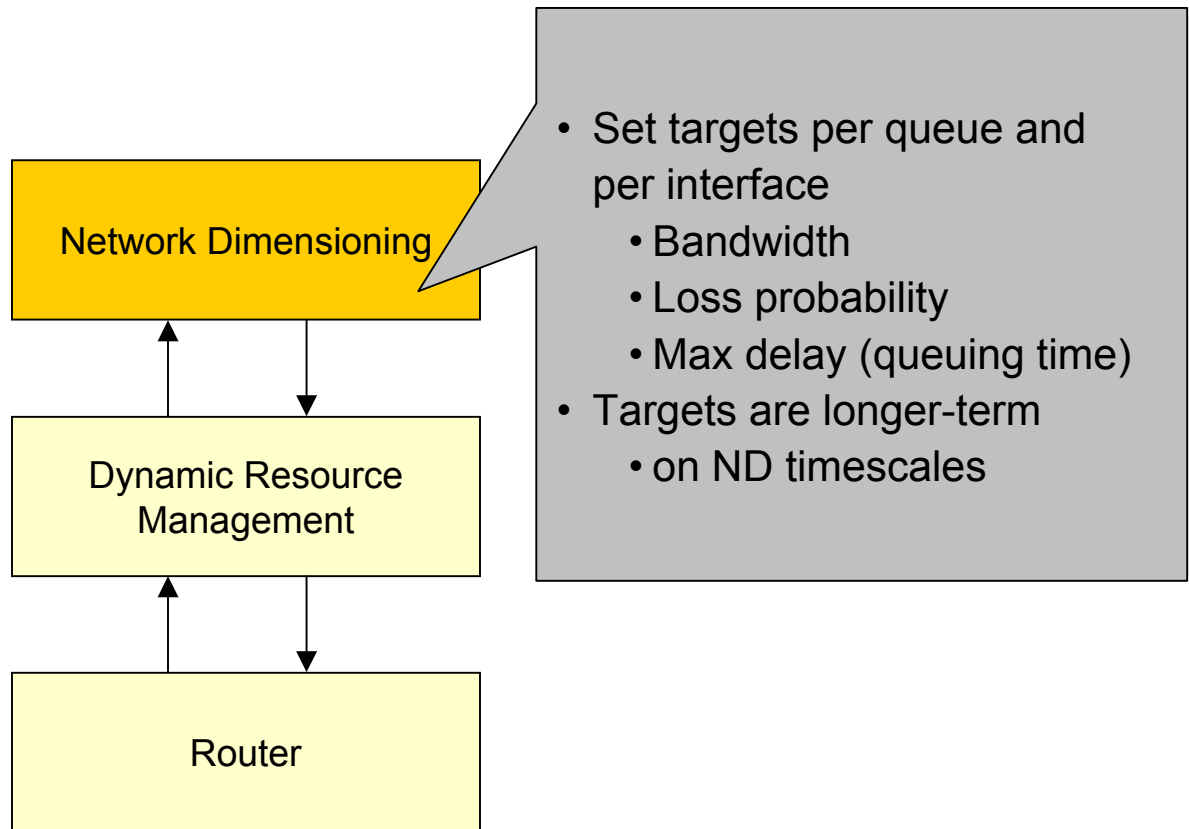
Note: Monitoring subsystem and Policy Consumer are implied but not shown explicitly

MPLS TE - DRsM



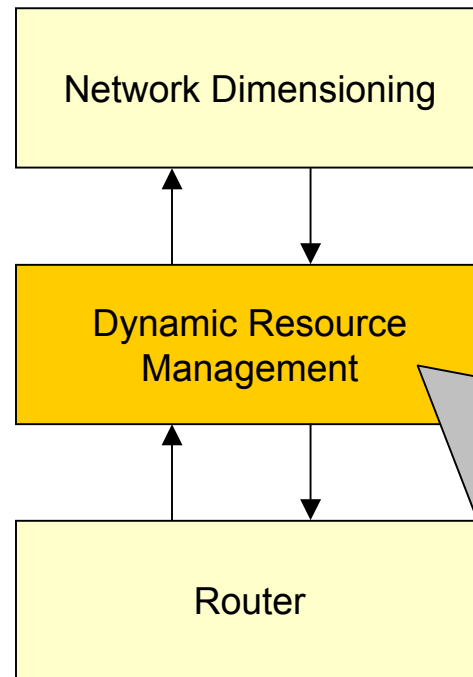


MPLS TE - DRsM





MPLS TE - DRsM



- Configure queues
 - Type
 - Drop tail, RED, etc.
 - Queue parameters
 - Precedence/drop levels
 - Size
- Configure scheduling parameters
 - RR, WRR, PRI, etc.
- Objectives:
 - Dynamic link partitioning
 - Meet targets specified by ND
 - Ensure queue/scheduling parameters are set to allow shorter-term traffic fluctuations



MPLS TE - DRsM

