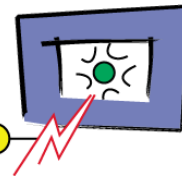


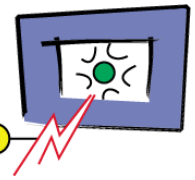
service Management & QoS Provisioning

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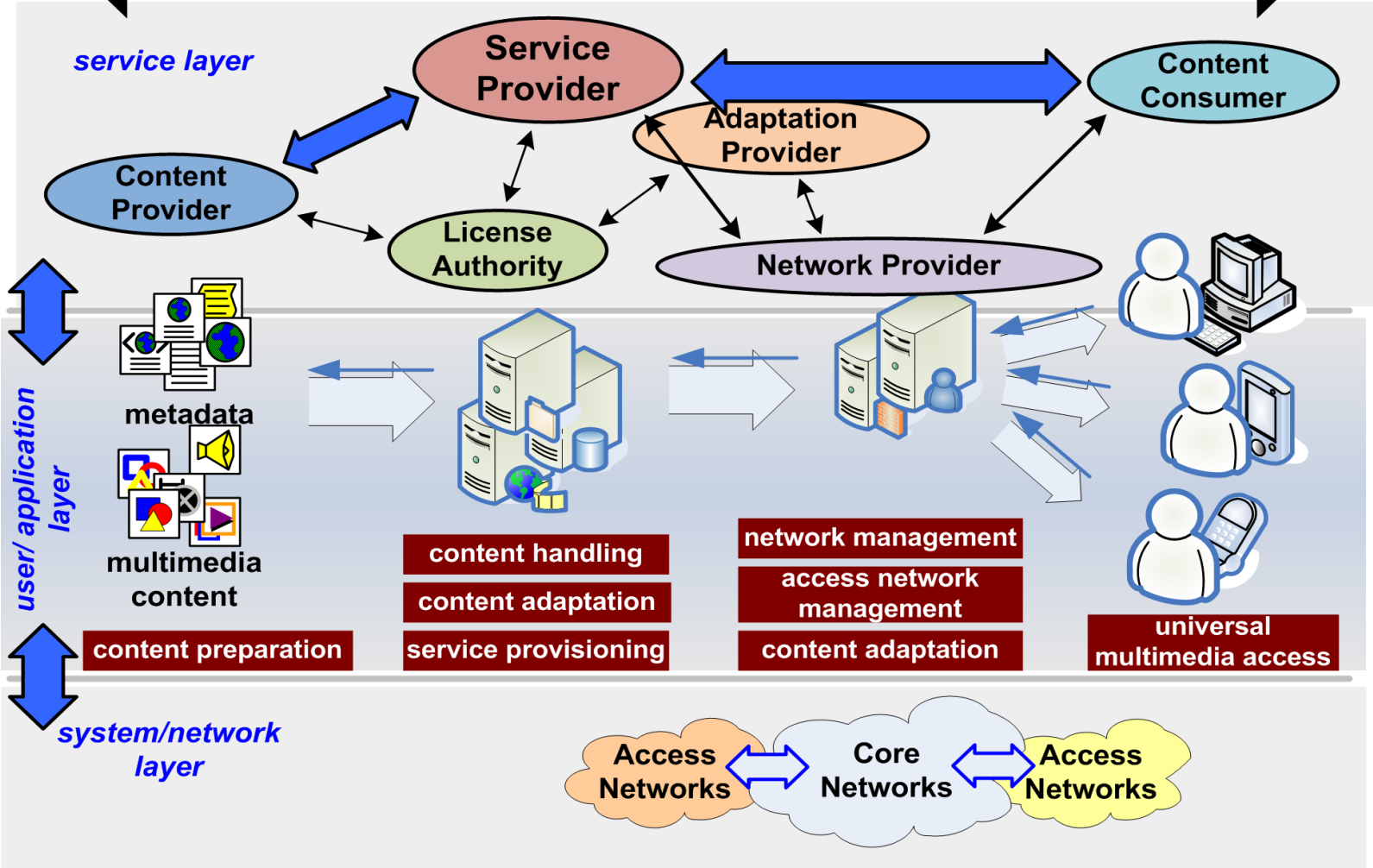


1. ***Service Types, Service Offering and Handling***
2. ***Parties Involved in Service Offering***
3. ***Enthroned Service Enablers***
4. ***Service Management Functions***
5. ***QoS Mapping***
6. ***End-to-end QoS Provisioning***
7. ***Resource Management & QoS Provisioning***
Inter-domain, Intra-domain, AAN, and AN
8. ***Network & Service Monitoring***
9. ***Conclusions***

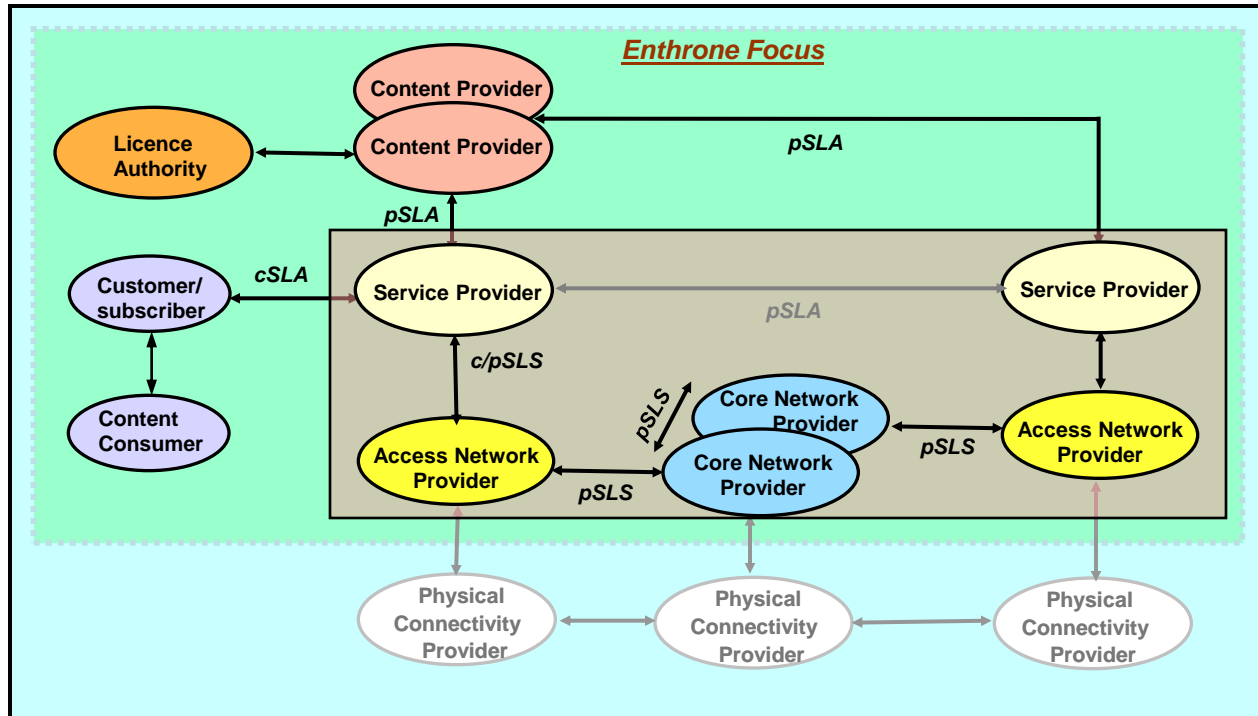
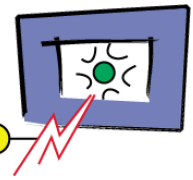


- **What types of services are envisaged?**
 - **User level services** – are high level QoS-based services that are offered and delivered to consumers e.g., Multimedia content, offered by SPs.
 - **Connectivity services** – are QoS-based plain connectivity between network edge nodes to provide reachability between hosts in the networking address space (e.g., IP). This is offered by NPs.
- **How is offered?**
 - **Agreement (contract) based** – at both customer-provider and provider-provider levels
 - **The contract** – specifies the forwarding service a customer should receive.
 - **Two epochs** – subscription and invocation
- **How is handled?**
 - **Service Enablers** – “EIMS Managers” as the technologies for use in the deployment and operation of a service

Parties involved in service offering



Business Relationships



Service Enablers (1)



ENTHRONE Integrated Management Supervisor

QoS, Adaptation, Service Management

EIMS End-to-End QoS Manager

EIMS Service Manager

EIMS Adaptation Manager

EIMS Terminal Device Manager

Metadata Management and Search (MATool)

EIMS Metadata Manager

EIMS Search Manager

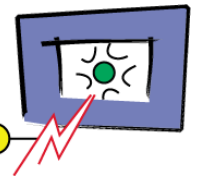
Enhanced Features

EIMS Multicast Manager

EIMS Caching and CDN Manager

Interfaces

ENTHRONE Adapters



EIMS End-to-End QoS Manager

- Provisioning of the **best Digital Item configuration** towards the content consumer by utilizing metadata from all business actors along the delivery chain

EIMS Adaptation Manager

- Provisioning of **adaptation decisions** according to **dynamically changing context** conditions (across service/network layers)

EIMS Caching and CDN Manager

- Provisioning of content (Digital Items) in a CDN including **ranking, placement, distribution**, etc
- Definition of **Caching Policies** to define **local cache provisioning parameters**

EIMS Multicast Manager

- Provisioning of **multicast communication services**

EIMS Metadata Manager

- Central component (MATool) responsible for metadata **collection, aggregation, conversion**, etc.

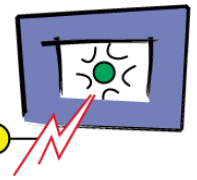
EIMS Terminal Device Manager

- Management of **heterogeneous end-user devices**, Capturing the **capabilities of the terminal, PQoS, License** handling

EIMS Search Manager

- **Searching/Browsing** for Digital Items

Service Enablers (3)

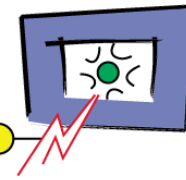


EIMS **Service Manager** – *SrvMngr*

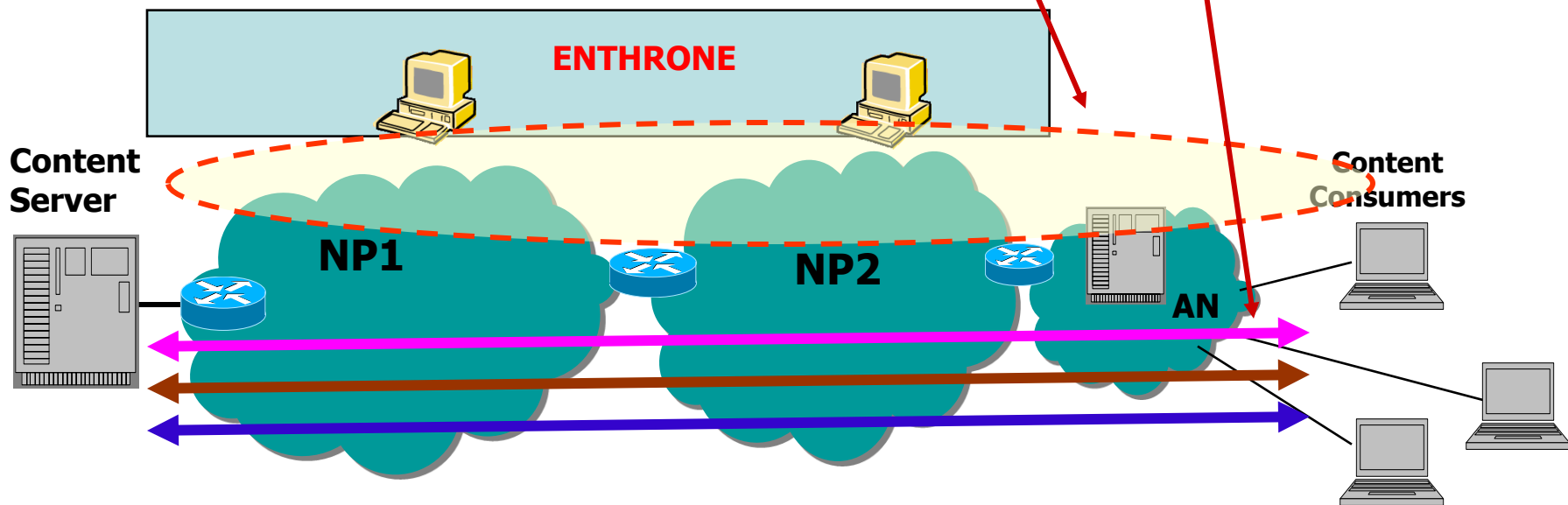
- Customer Service Manager (**CustSrvMngr**): service logic
- Network Service Manager (**NetSrvMngr**): network connectivity service
- Service Monitoring (**ServMon**): keep track of end-to-end QoS level of a particular service

➤ Introducing two instances of Service Management functionality:

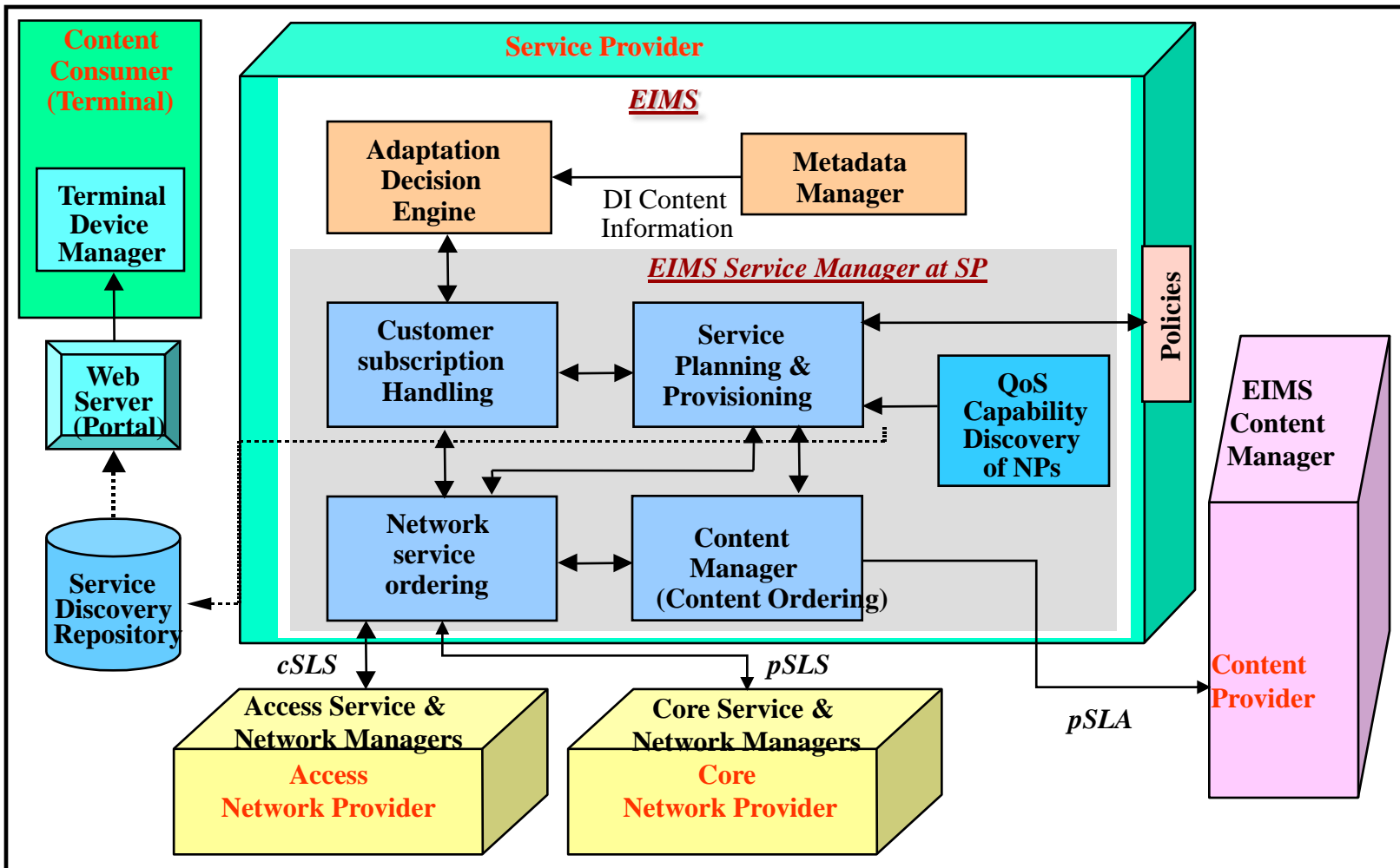
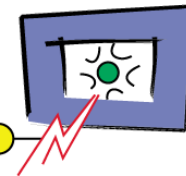
- Service Manager @ SP
- Service Manager @ NP

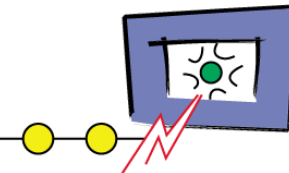


- General Functions
 - Set-up of QoS-enabled multi-domain traffic trunk
 - For different classes of services
 - Provide support for service continuity
 - Service and Network Monitoring

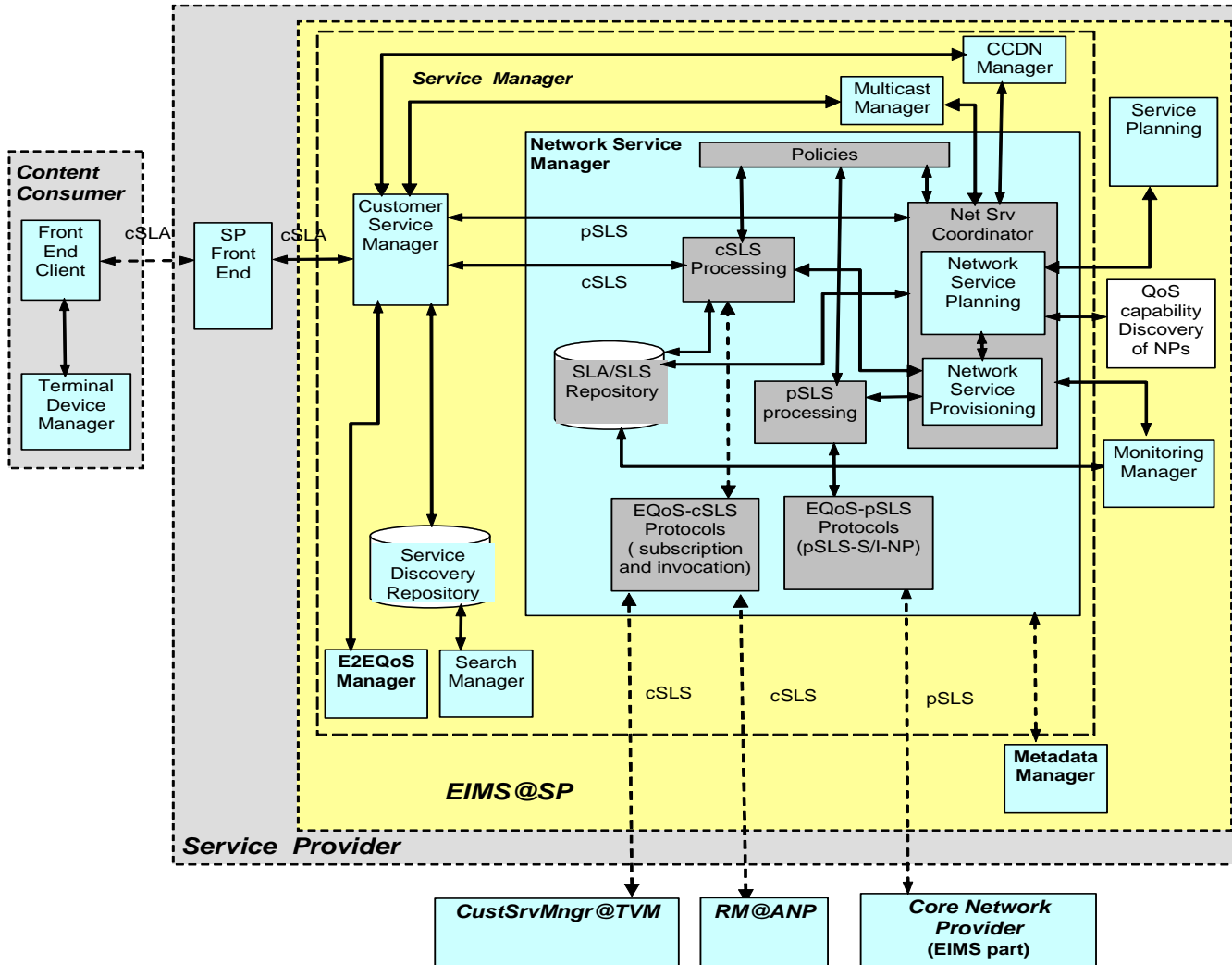


Service Manager @ SP (1)

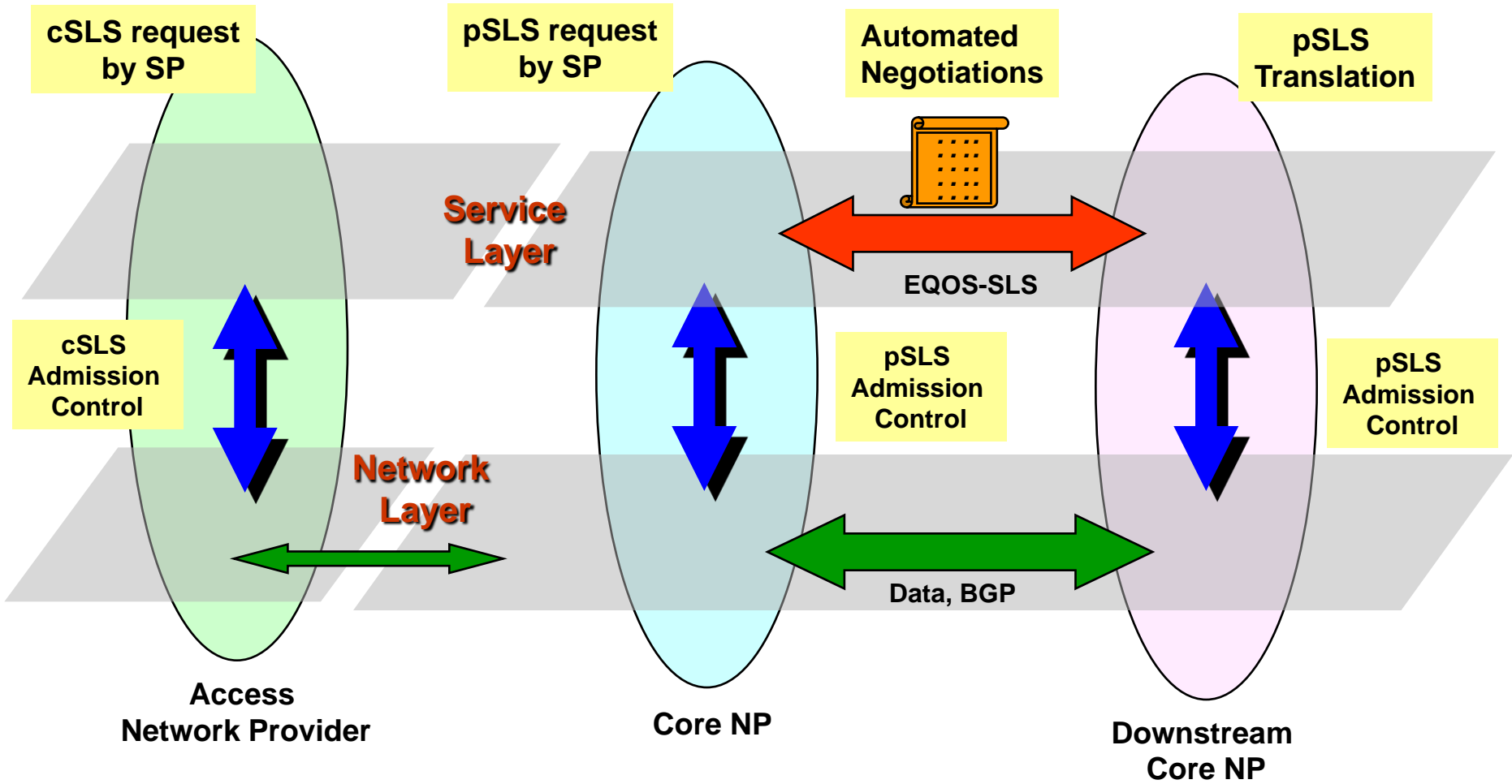
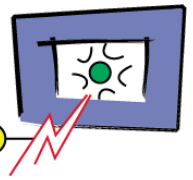




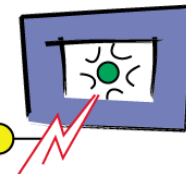
Network Service Manager at Service Provider



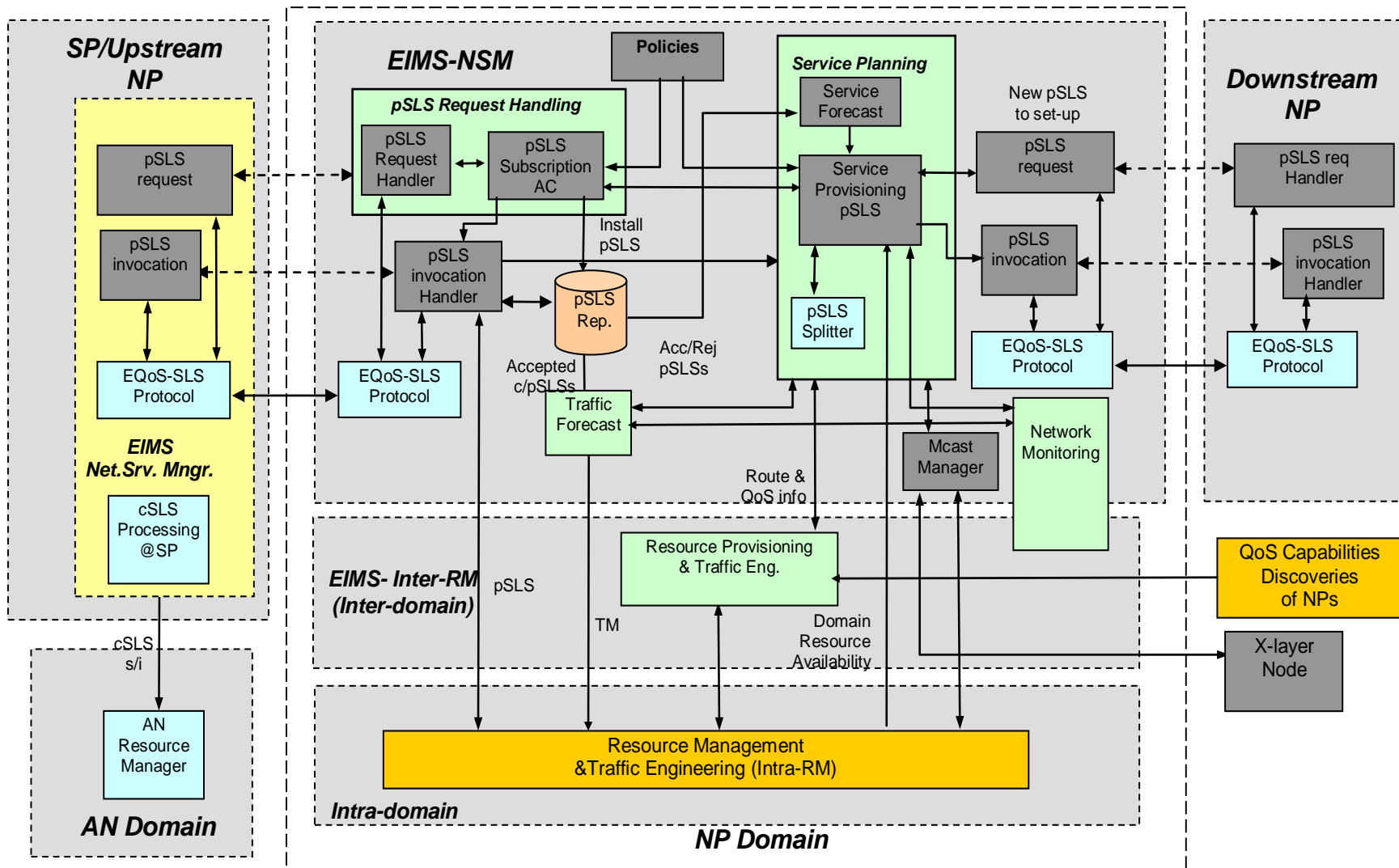
Service Management @ NP (1)



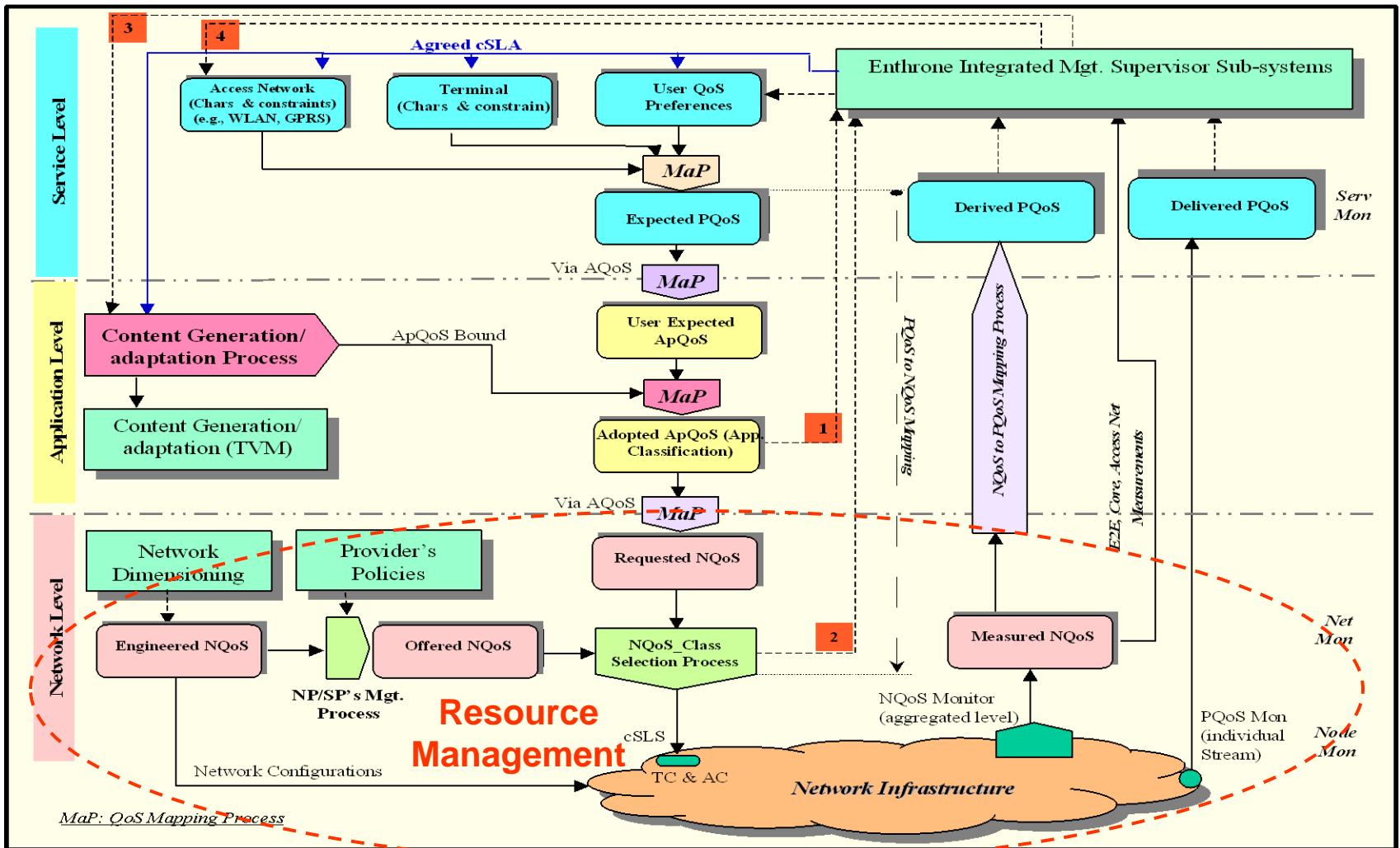
Service Management @ NP (2)



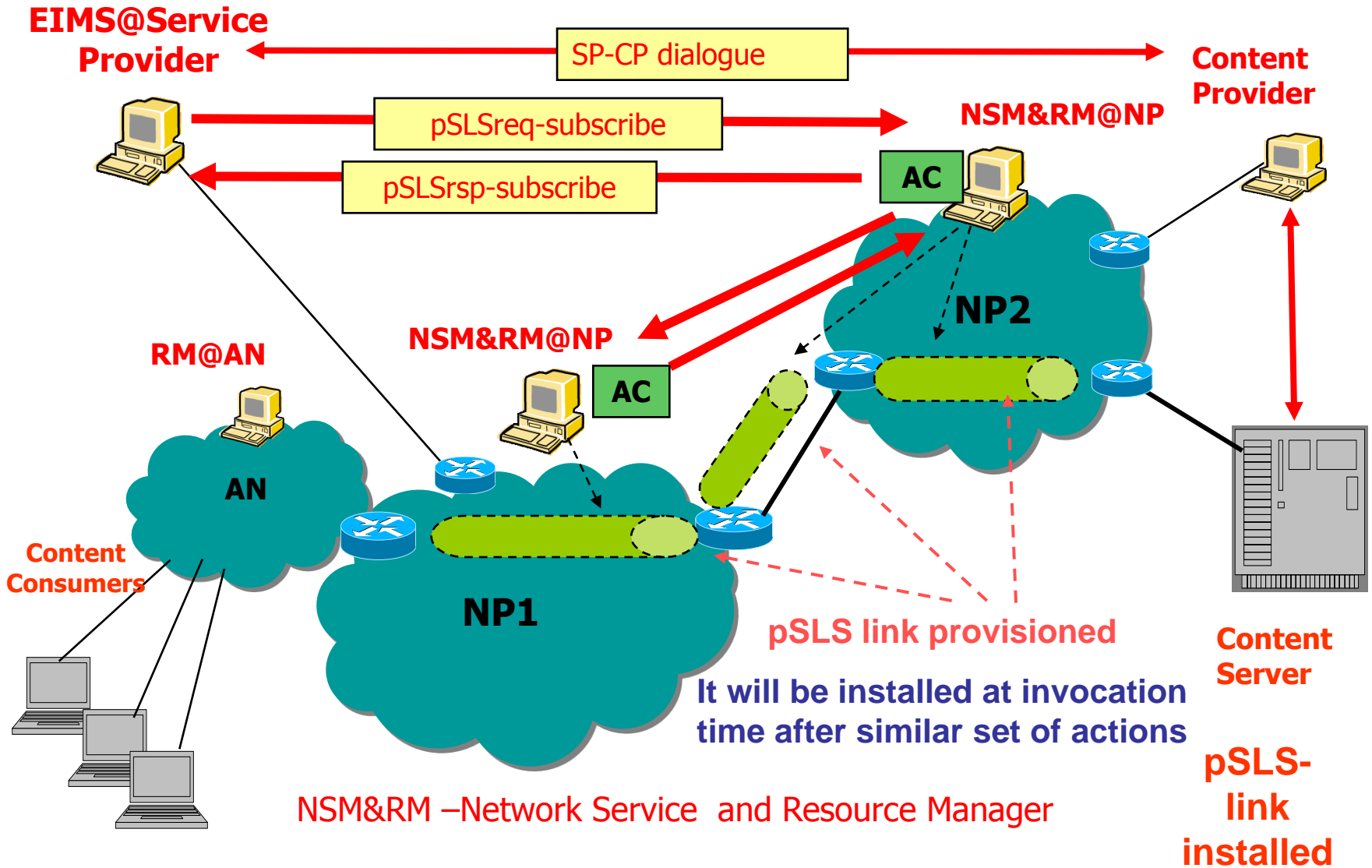
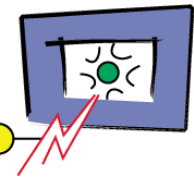
Network Service Manager at Network Provider



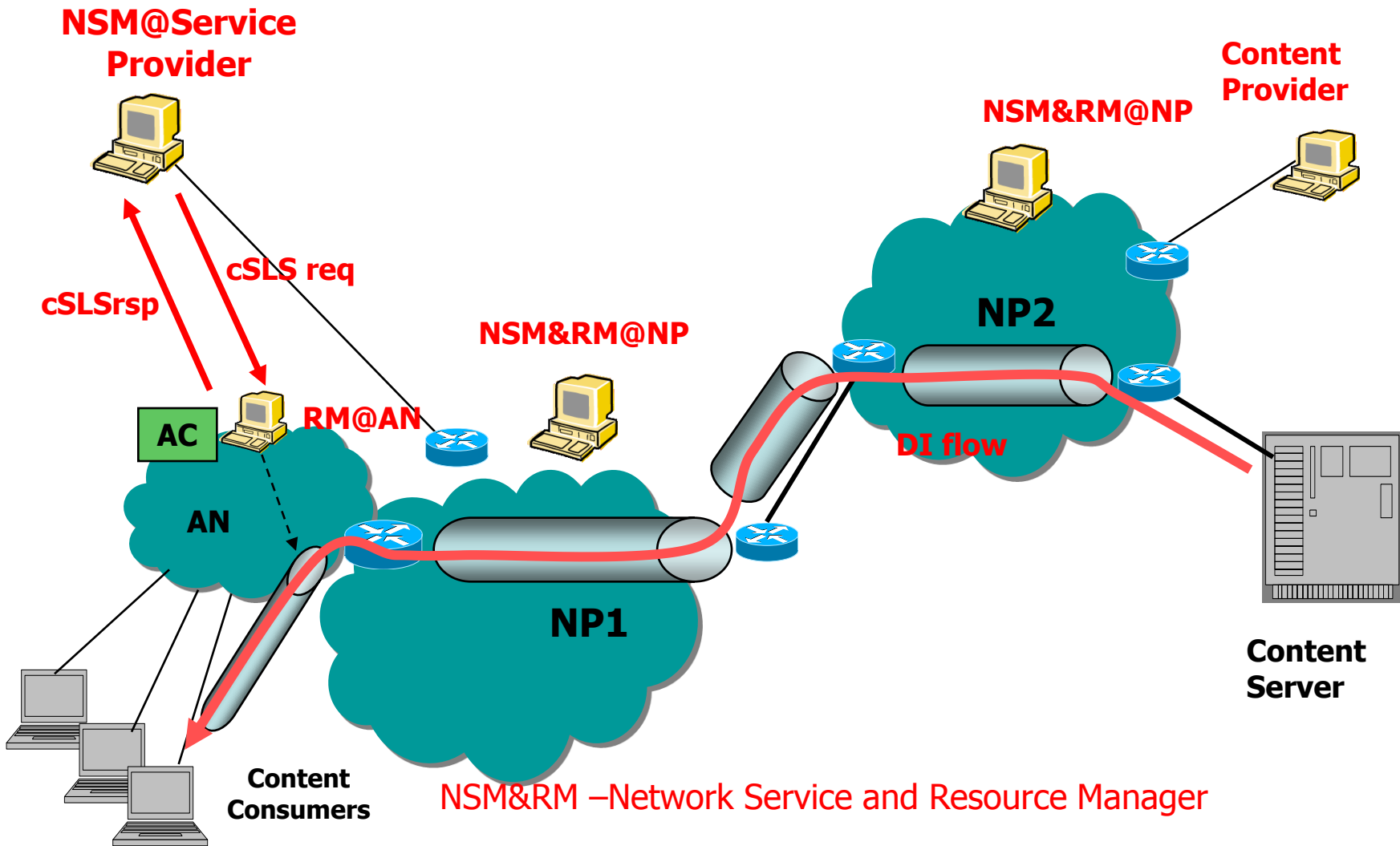
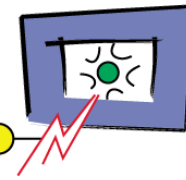
QoS Mapping



Connectivity Service (pSLS set-up)

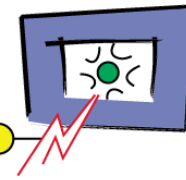


Connectivity Service (cSLS set-up)

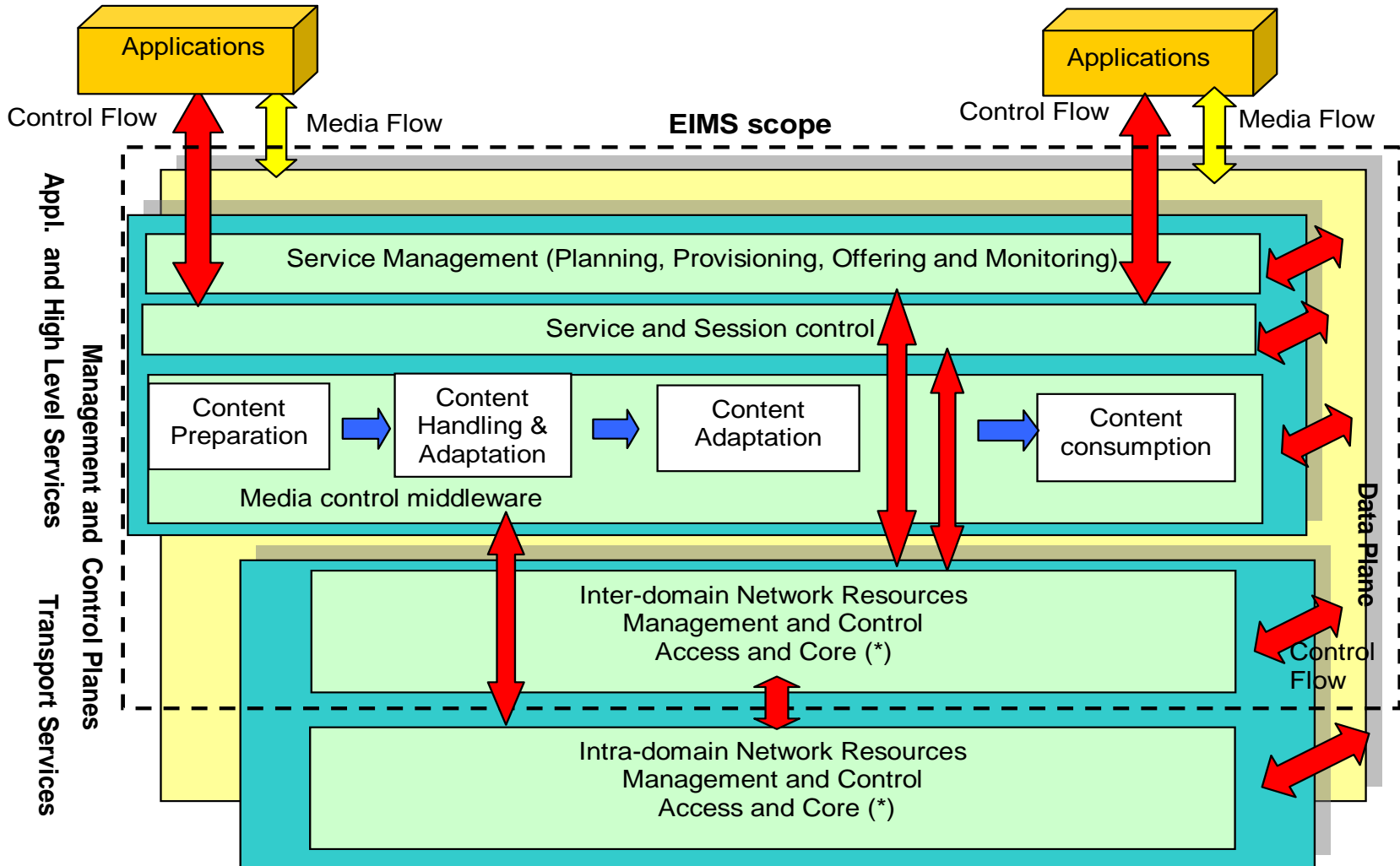


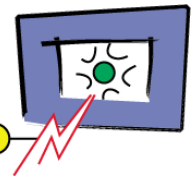
NSM&RM – Network Service and Resource Manager

End-to-end QoS Provisioning

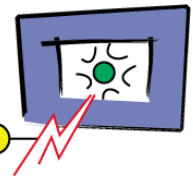


Separating Service Management from Resource Management

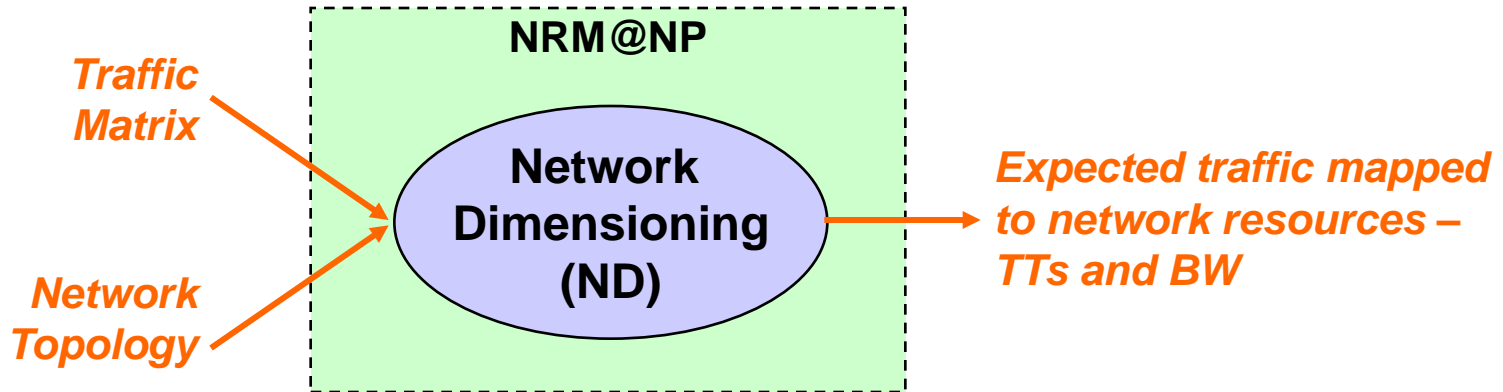




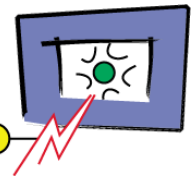
- Offering E2E QoS enabled IP connectivity services with several classes of services having different levels of guarantees
- Inter-domain Resource Management (RM) for setting-up QoS enabled pSLS-associated traffic trunks (TT)
- Intra-domain RM in each AS core domain
 - Based on DiffServ technology, MPLS in the IP networks
- RM for QoS provisioning in Aggregation Access Networks (WiMax)
- RM for QoS provisioning in Access Networks (WiFi, Mesh) and interoperability with core networks
- Overlay Multicast QoS provisioning at TT level



- Network Resource Manager @ NP - MPLS-based Traffic Engineering



- Network dimensioning based on the traffic matrix is performed to achieve the network provider's objectives with respect to:
 - delay/loss of the intra-domain routes (QoS provisioning)
 - network load balancing (resource optimization)
 - The algorithm we demonstrate:
 - translates loss/delay in hop-count constraints
- and aims at:
- minimizing overall network utilization
 - minimize maximum link utilization (avoid overloading parts of the network)



Problem formulation of the 2 ND objectives

- Minimize overall network cost (the sum of link costs)

$$\min \sum_{l \in E} \sum_{h \in H_l} f_{l,h}(x_{l,h})$$

- Minimize maximum link load

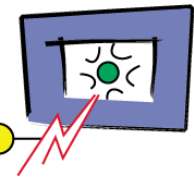
$$\min \max_{l \in E} \left(\sum_{h \in H_l} f_{l,h}(x_{l,h}) \right)$$

- Combining the two objectives into one

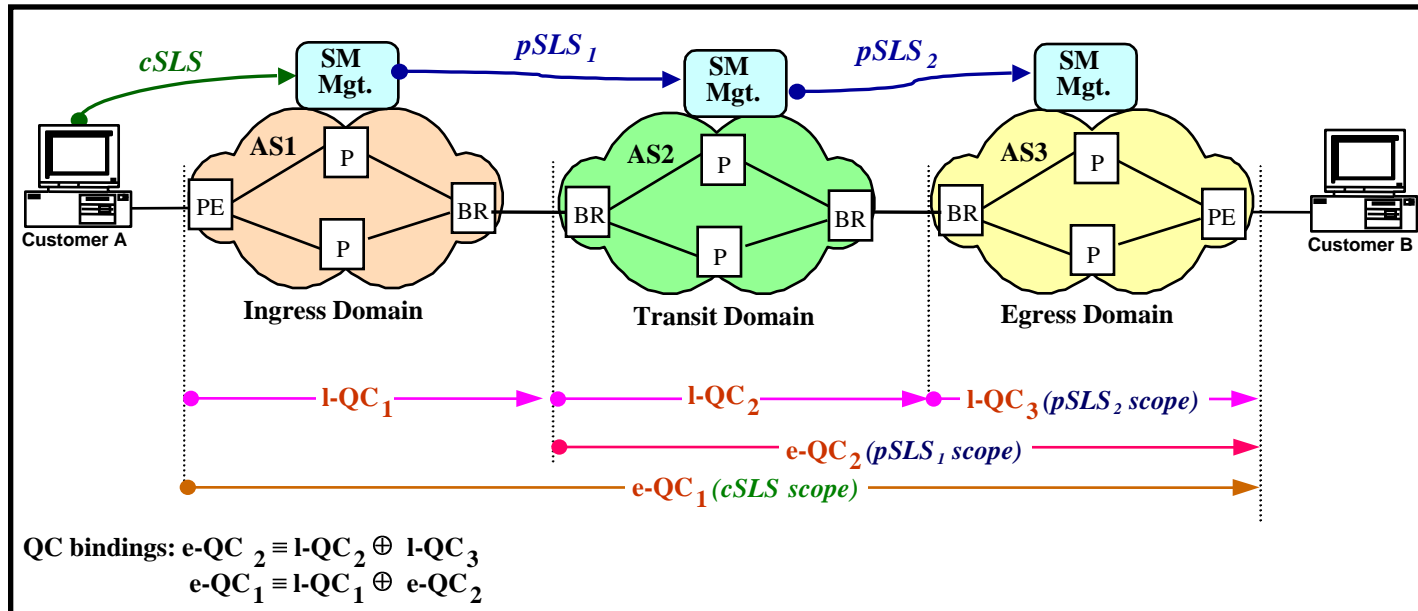
$$\min \sum_{l \in E} \left(\sum_{h \in H_l} f_{l,h}(x_{l,h}) \right)^n, n \geq 1$$

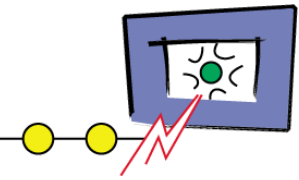
$n = 1$ optimizes overall network cost

$n \rightarrow \infty$ optimizes max link load

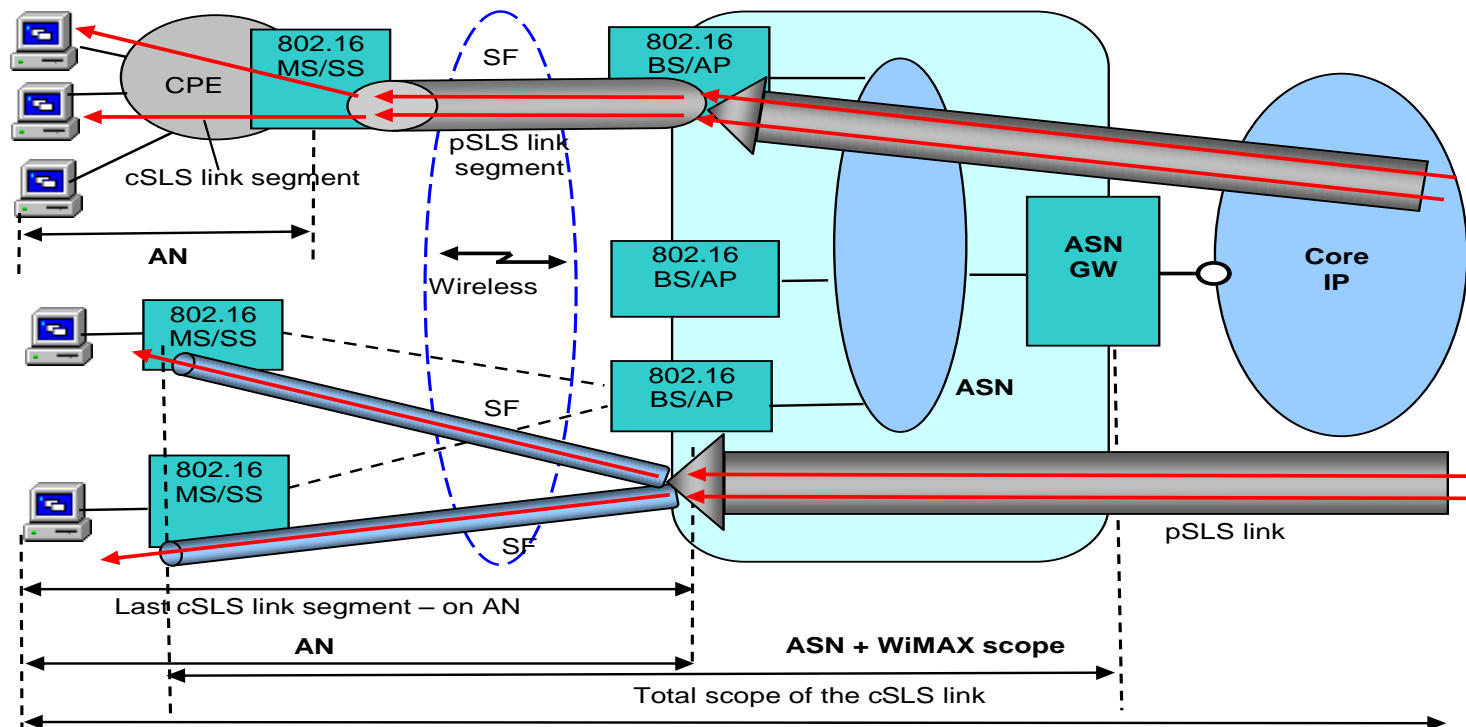


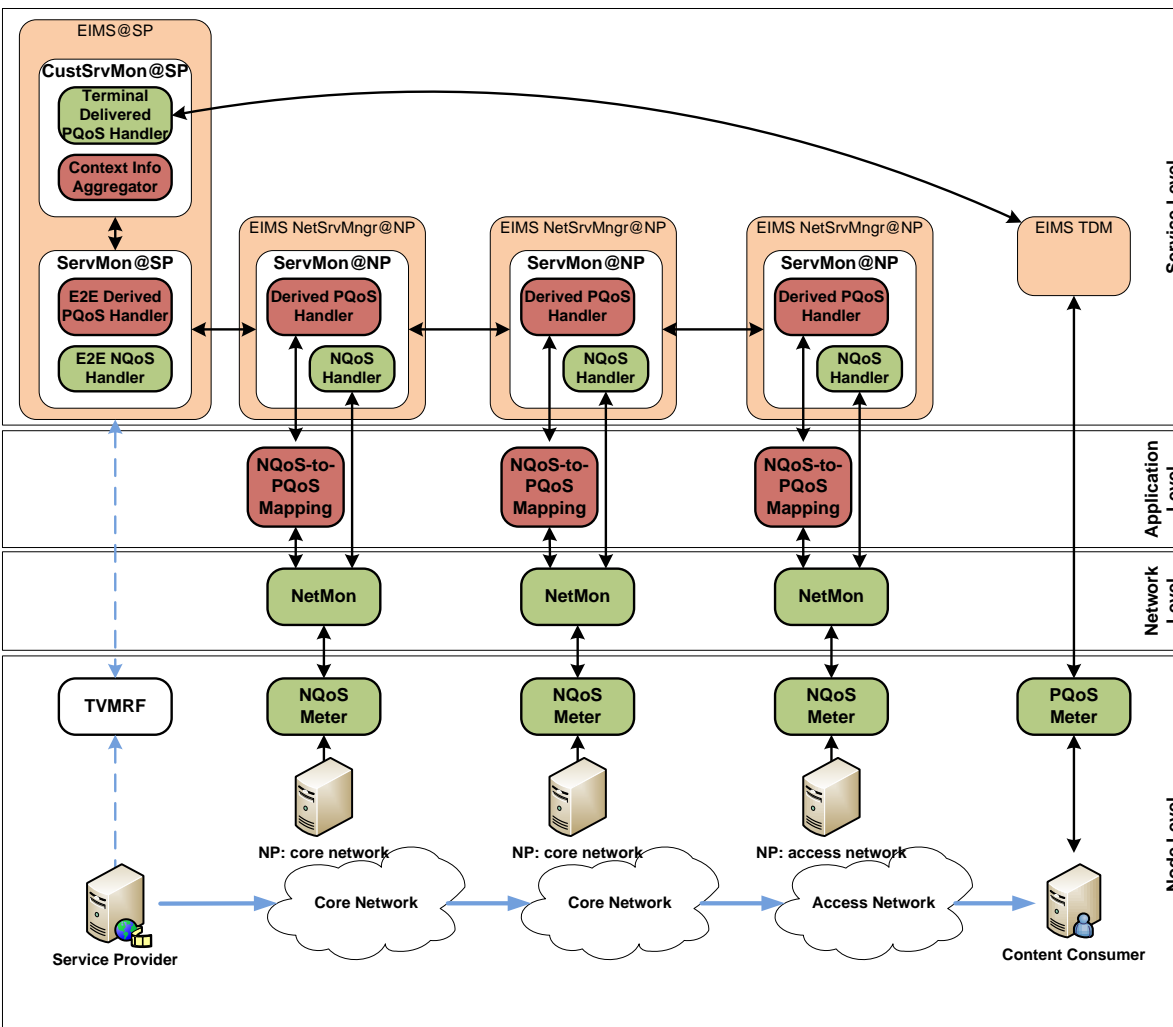
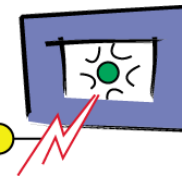
Multi-domain environment – Cascaded QoS peering model





- Access Aggregation Network (IEEE 802.16d/WiMAX)
 - Extension of pSLS



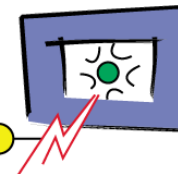


Two types of Monitoring

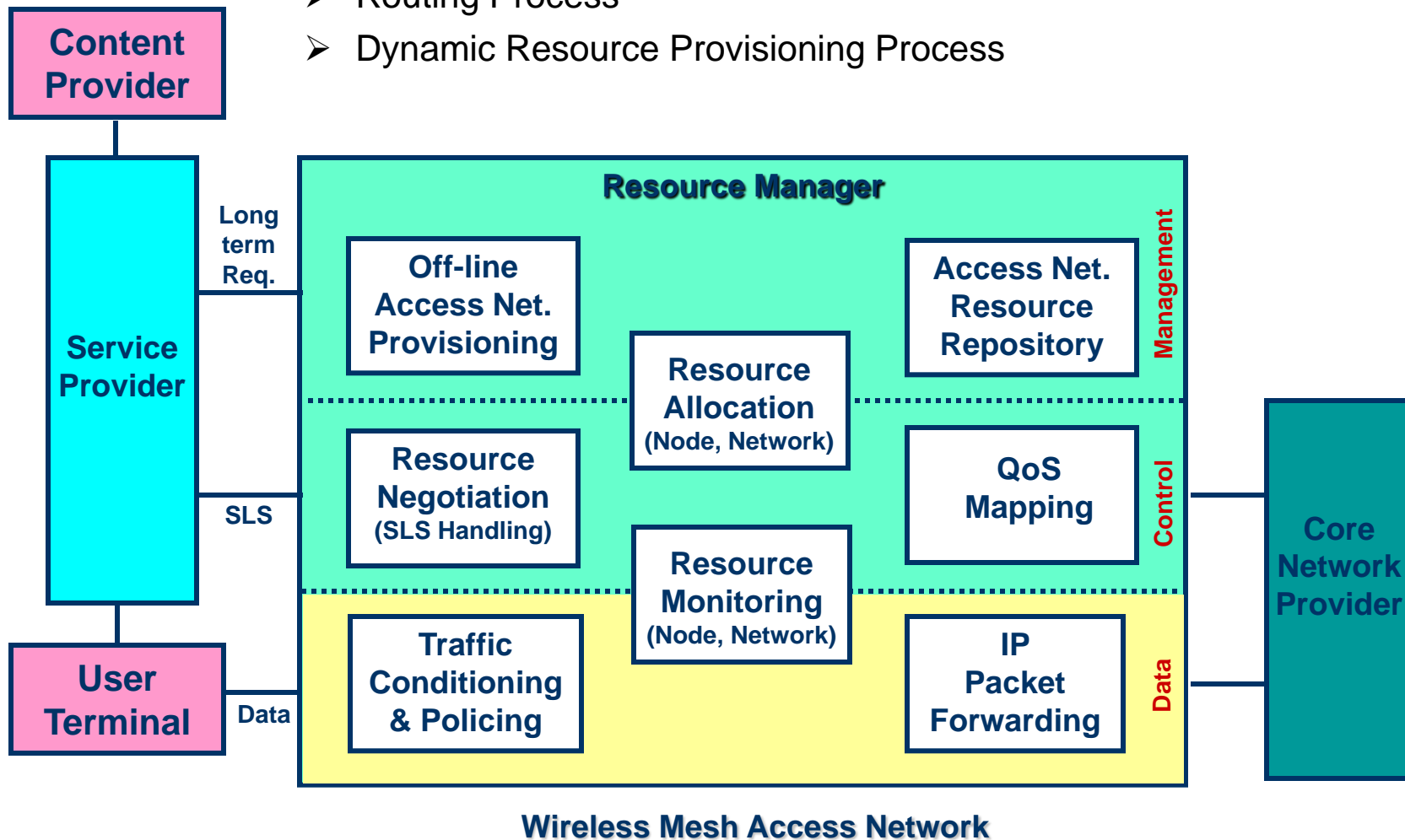
- Monitoring at TT level
- Flow level monitoring

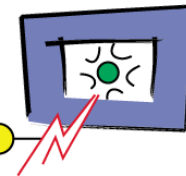
NQoS ⇒ PQoS Mapping

- Measure current network conditions on aggregated streams (NQoS)
- Mapping to PQoS resulting in an approx. of PQoS delivered to a number of app streams



- Off-line Resource Provisioning Process
- Routing Process
- Dynamic Resource Provisioning Process





- Specified the two service types that are dealt with in Enthroned***
- Services are offered based on SLA/SLS agreements***
- Introduced the involved business entities and their relationship***
- Explained EIMS and its service enablers for offering these services***
- Given the service management functions at both @SP and NP***
- Described functional architecture for end-to-end QoS provisioning***
- Explained resource management and QoS Provisioning at intra-domain and inter-domain levels as well as AANs and Ans***
- Described Network & Service Monitoring functions.***