End-to-end QoS in IP Multimedia Subsystem

TELECOM PARIS
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HDIP Project
June 2006

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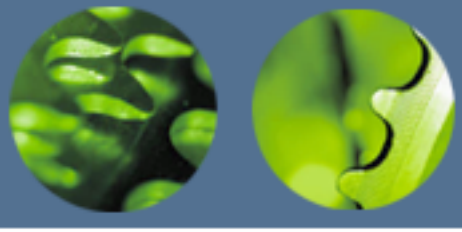
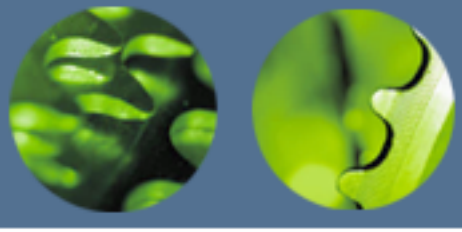


Introduction to IMS

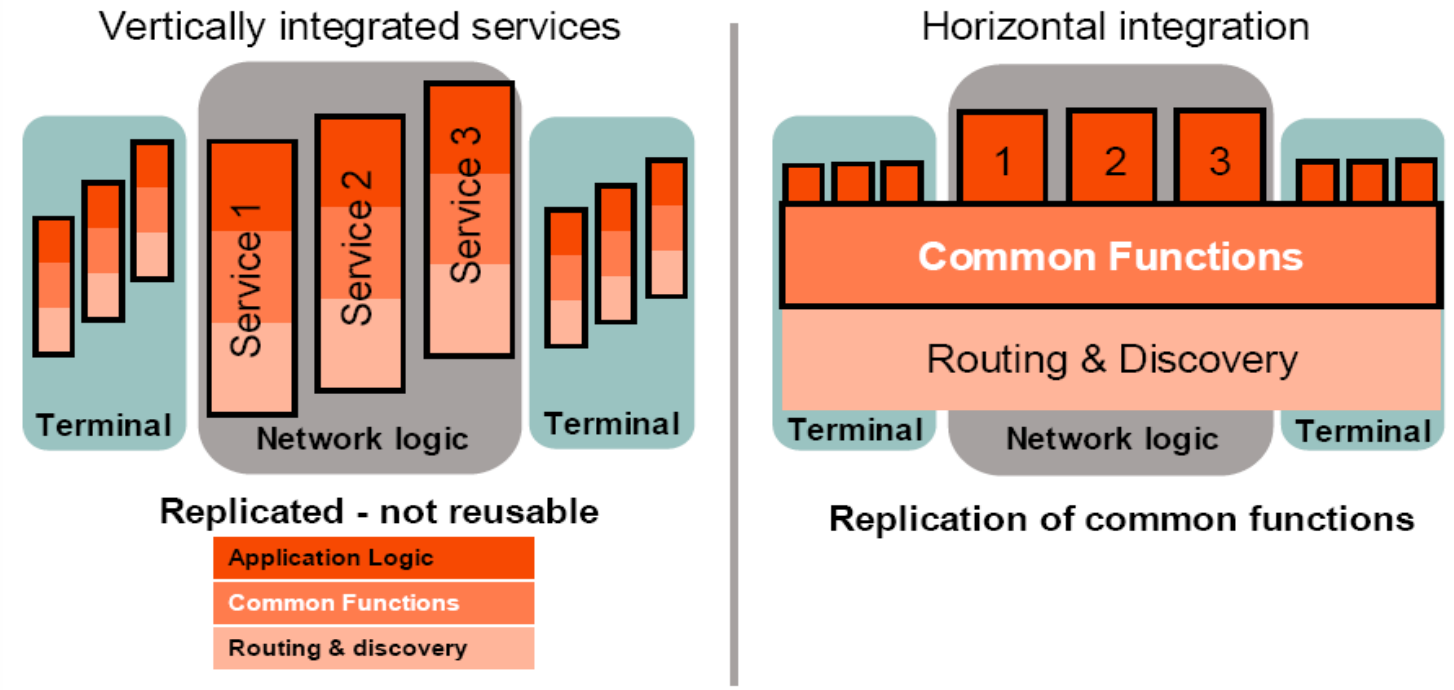
Presented By: Umit AYGUN



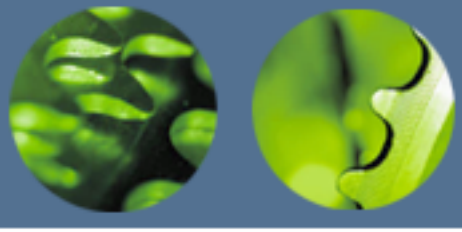
Introduction

- IMS – IP Multimedia Subsystem – is an international, recognized industry standard specification defined by the 3rd Generation Partnership Project (3GPP).
- IMS is based upon the widely adopted Internet standard technology Session Initiation Protocol (SIP).
- It specifies interoperability and roaming; provides bearer control, charging and security.
- IMS enables services to be delivered in a standardized, well-structured way.
- It speeds up the service creation and provisioning process, while enabling legacy interworking.

Benefits

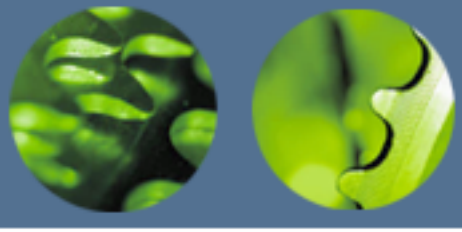


No need for new network elements each time a new service is added.



Features & Capabilities

- ***Multimedia session management*** *: with SIP, dynamic sessions.*
- ***Quality of Service*** *: with PDF, specified QoS levels.*
- ***Mobility management*** *: with HSS and CSCF*
- ***Service control*** *: with the Subscriber Service Profile (SSP)*
- ***Access-aware networks*** *: adaptation of services to the access methods.*
- ***Standard interfaces*** *: by 3GPP*
- ***Safe communication*** *: no services/requests to/from anonymous end-users.*
- ***Simple access to services*** *: One authentication for all authorized IMS services.*
- ***Service interoperability*** *: single inter-operator relationship to be established and built upon for each service.*



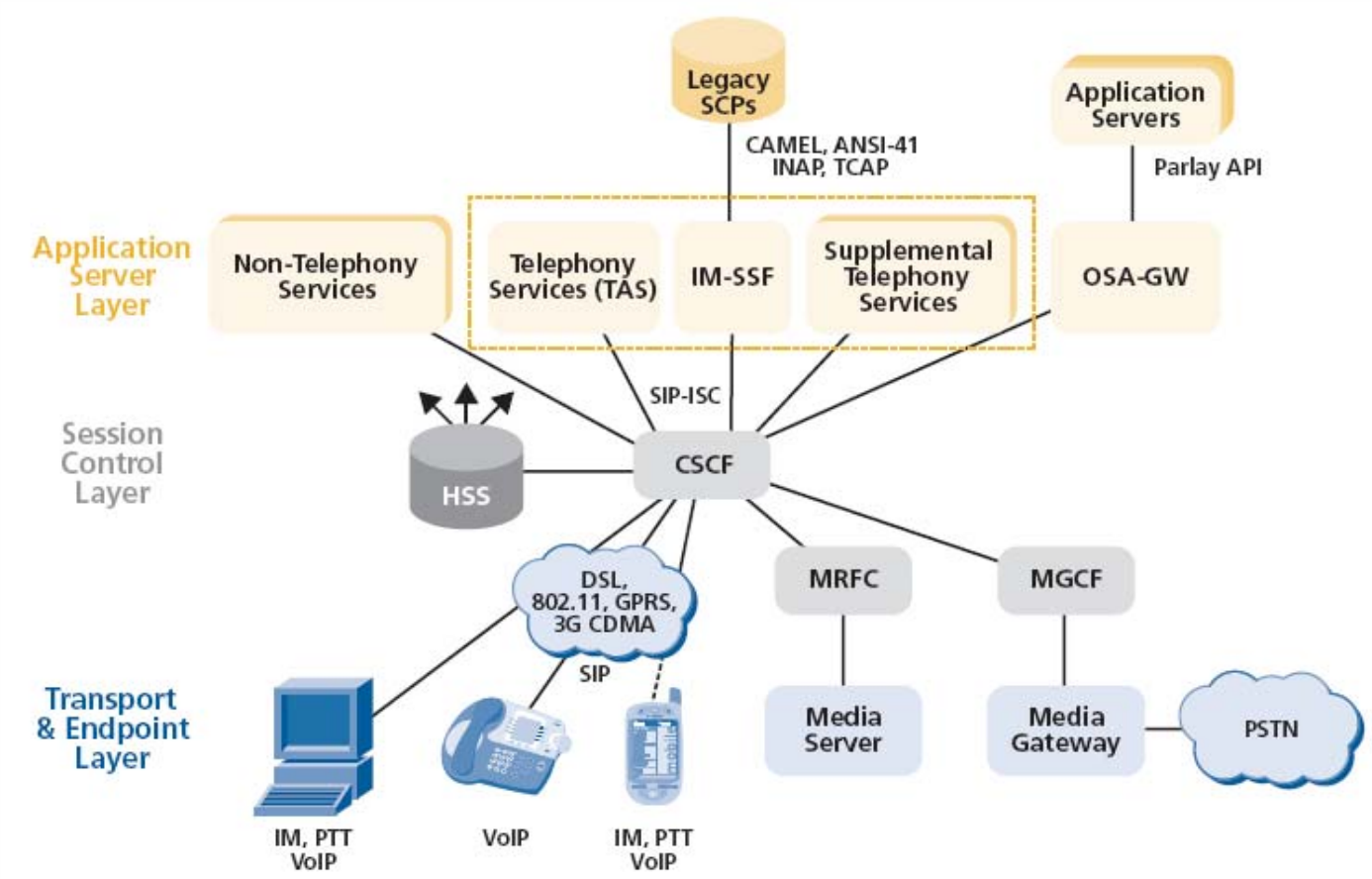
Architecture

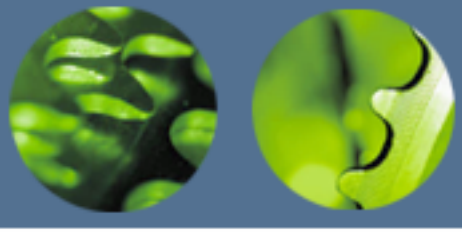
With the 3GPP Release 5 and Release 6 specifications, IMS enables many network functionalities to be **reused** and shared across multiple access networks, allowing for rapid service creation and delivery.

The architecture consists of;

- Service Layer,
- Control Layer,
- Connectivity Layer.

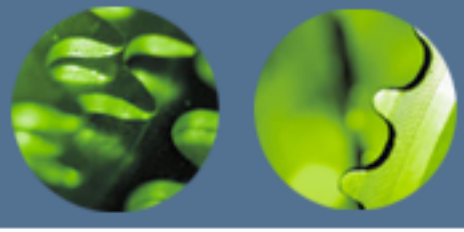
Simplified View of IMS





Service Layer

- ***SIP Application Servers*** *: Hosts and execute services*
- ***Telephony Application Server*** *: basic call processing services (digit analysis, routing, call setup, call waiting, call forwarding, conferencing)*
- ***IP Multimedia – Services Switching Function (IM-SSF)*** *: interworking of the SIP message to the corresponding CAMEL*
- ***Open Service Access – Gateway (OSA-GW)*** *: interaction with legacy applications*
- *Supplemental Telephony Application Servers*
- *Non Telephony Application Servers*



Control Layer

Proxy-CSCF (P-CSCF)

- Serves as the initial point of contact for the user terminal to network.
- Performs a stateful SIP proxy function.
- Sends the SIP REGISTER request received from the UE to an I-CSCF determined using the home domain name, as provided by the UE.
- Sends all subsequent SIP messages from the UE to the S-CSCF, whose name the P-CSCF has received as part of registration.
- Inserts a valid public user identity for UE initiated requests.

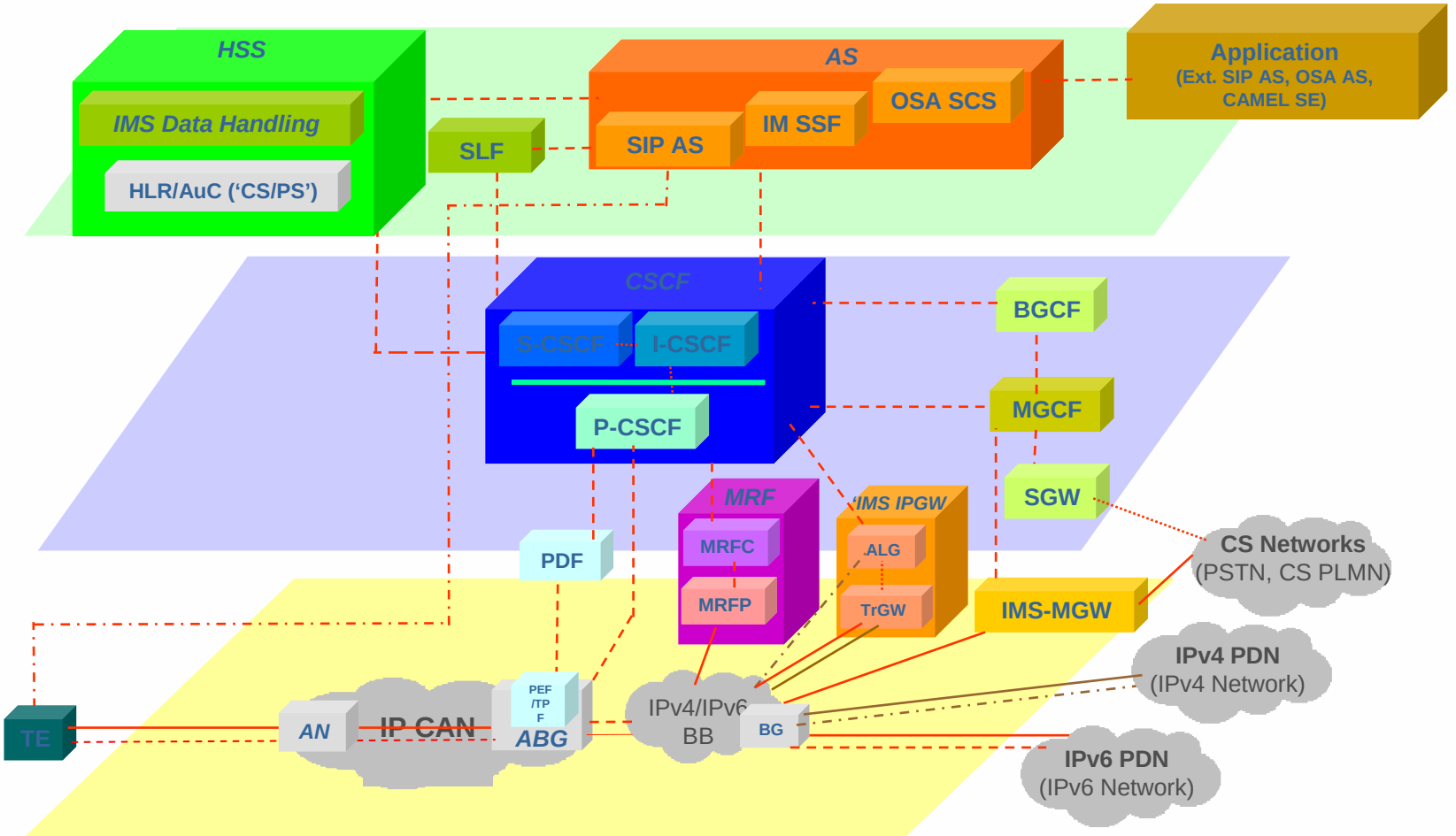
Interrogating-CSCF (I-CSCF)

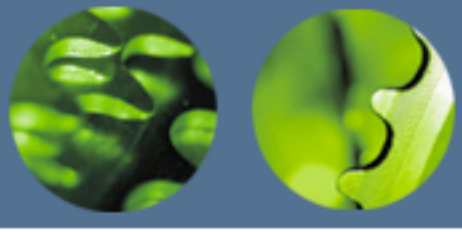
- Serves as the initial point of contact from other networks.
- Performs a stateless SIP proxy function.
- Selects a S-CSCF for a user during SIP registration.
- Routes SIP requests received from another network to the S-CSCF.
  - Queries the HSS for the address of the S-CSCF.
  - If no S-CSCF is currently assigned, then assigns an S-CSCF to handle the SIP request.

Serving-CSCF (S-CSCF)

- Acts like a SIP Registrar, it binds the public user ID to a location.
- The S-CSCF retrieves the subscriber profile from the HSS.
- Provides session control for the endpoint's sessions..
- Handles SIP routing for originating and terminating endpoints.
- Ensures that the media for a session, as indicated by SDP, are within boundaries of subscriber's profile.

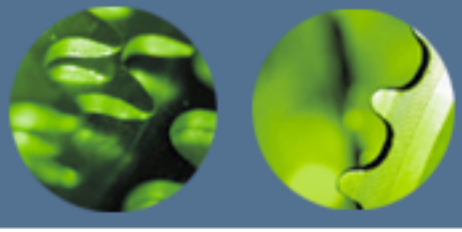
Architectural Overview





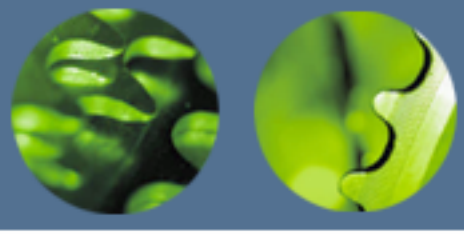
Other Entities

- ***Policy Decision Function (PDF)***
- ***Home Subscriber Server***
- ***Signalling Gateway Function***
- ***Media Gateway Control Function (MGCF)***
- ***Breakout Gateway Control Function (BGCF)***
- ***Multimedia Resource Function Controller (MRFC)***
- ***Multimedia Resource Function Processor (MRFP)***
- ***MSC and Gateway MSC Server***



QoS in IMS

Presented By: Masood KHOSROSHAHY

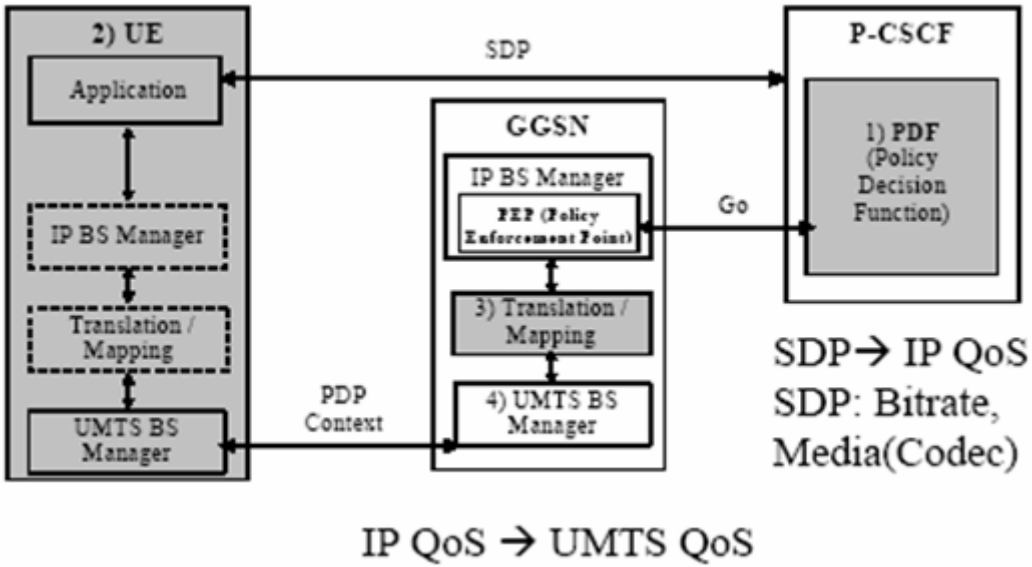


QoS in IMS

- Interaction between the user plane and the control plane results in:
  Being able to control quality of service

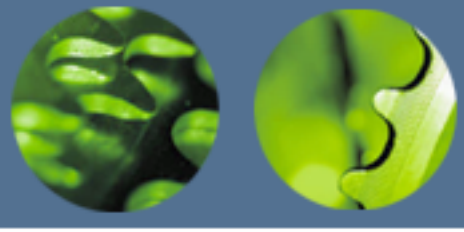
- Service-Based Local Policy (SBLP):
  overall interaction between the GPRS and the IMS

Functional entities involved in the SBLP



- Policy Enforcement Point:
  Is a logical entity that enforces policy decisions made by the PDF.
- Policy decision function:
  Is a logical policy decision element that uses standard IP mechanisms to implement SBLP in the IP media layer.

- IP Bearer Service (BS) manager:
  Manages the IP BS using a standard IP mechanism
- Translation/Mapping function:
  Provides the inter-working between the mechanism and parameters used within the UMTS BS and those used within the IP BS
- UMTS BS manager:
  Handles resource reservation requests from the UE.

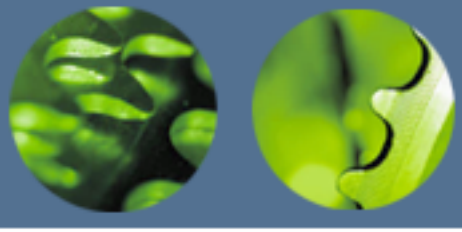


Bearer Authorization

- Session establishment and modification in the IMS:
  an end-to-end message exchange using SIP and SDP
- If an operator applies the SBLP:
  the P-CSCF will forward the SDP information to the PDF
- The PDF notes and authorizes the IP flows of the chosen media components
- PDF: Mapping from SDP parameters to authorized IP QoS parameters for transfer to the GGSN via the Go interface
- UE: it performs its own mapping from SDP parameters to UMTS QoS parameters in PDP context activation or modification.

Bearer Authorization...*continued*

- GGSN: On receiving the PDP context activation or modification, asks for authorization information from the PDF.
- PDF: compares and returns an authorization decision to the GGSN (IP QoS parameters and packet classifiers).
- GGSN: maps the authorized IP QoS parameters to authorized UMTS QoS parameters
- Finally GGSN compares the UMTS QoS parameters from the PDP context request against the authorized UMTS QoS parameters.
- If the UMTS QoS parameters from the PDP context request lie within the limits authorized by the PDF:
  PDP context activation or modification will be accepted.

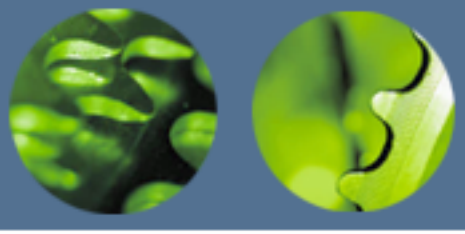


Some details of the aforementioned steps

- IP QoS authorization data collected in PDF:
  - Flow Identifier
  - Data rate
  - QoS class

- Authorization token:
  - Unique identifier across all PDP contexts associated with an access point name.
  - Created in the PDF when the authorization data are created.
  - UE includes it in a PDP context activation/modification request.

- Media grouping
  - In Release 5, GGSN is able to produce only one GGSN call detail record (CDR) for a PDP context.
  - keep-it-separate indication: a mechanism on the IMS level to force the UE to open separate PDP contexts for each media component.

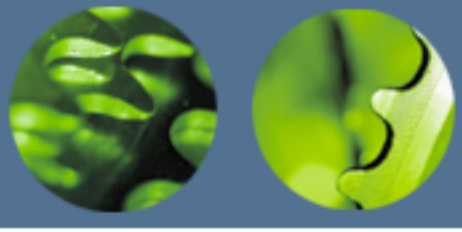


Resource Reservation & other issues

- A brief description of the “Resource Reservation” process was given.

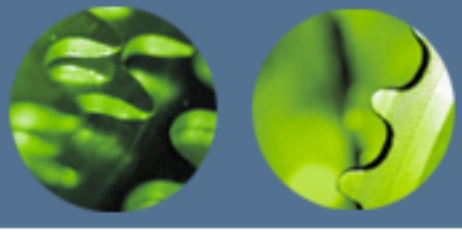
- In the report, the details of the processes carried out by each element are given.
  - UE functions
  - GGSN functions
  - PDF functions

- In the report, some other issues are also explained:
  - Indication of bearer loss/recovery
  - Revoke function
  - etc.



Differentiated Services

Presented By: Masood KHOSROSHAHY



Differentiated Services

- Scalable form of QoS
- Maintain per-flow QoS becomes a monumental task for large networks.
- DiffServ works at class level

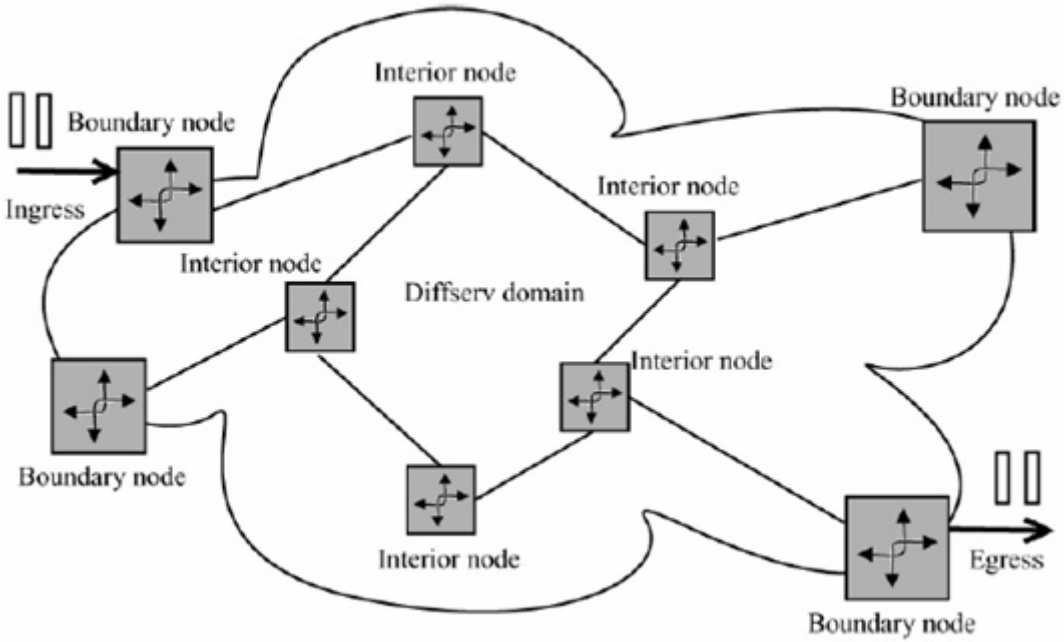
- DiffServ Architecture:

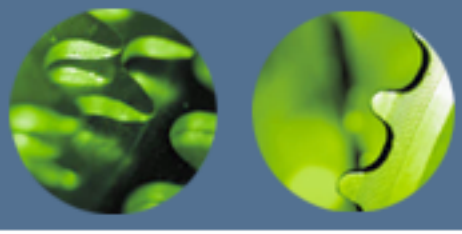
  - Marking each packet's header with one of the standardized codepoints.

  - Each packet containing same codepoint receives identical forwarding treatment by routers and switches in the path.

DiffServ Architecture

- Diffserv domain with a set of interior (core) routers and boundary (edge) routers:

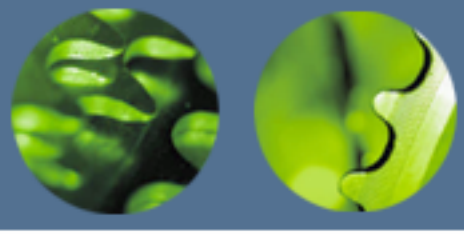




DiffServ Architecture

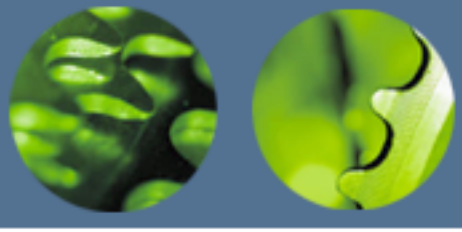
- The ingress boundary router:
  - Required to classify traffic into microflows
  - Diffserv microflows are subjected to policing and marking: traffic conditioning

- Diffserv interior nodes:
  - All forwarding and policing are performed on aggregates
  - Their ability to process packets at high speeds becomes viable



Per-Hop Behaviors

- Diffserv model defines certain behaviors a packet may receive at each hop.
- Flows identified by the same Diffserv Code Point (DSCP) belong to a behavior aggregate (BA).
- Expedited forwarding (EF) PHB:
  A low loss, low latency and a low jitter service with bandwidth assurance.
  Code point 101110 is used for the EF PHB.
- The assured forwarding (AF) PHB:
  - A means for a provider to offer different levels of forwarding assurances
  - Four AF classes are defined: each class gets allocated a certain amount of forwarding resources (buffer space and bandwidth).
- Best Effort (BE) PHB:
  Has the lowest priority compared to other PHB groups.

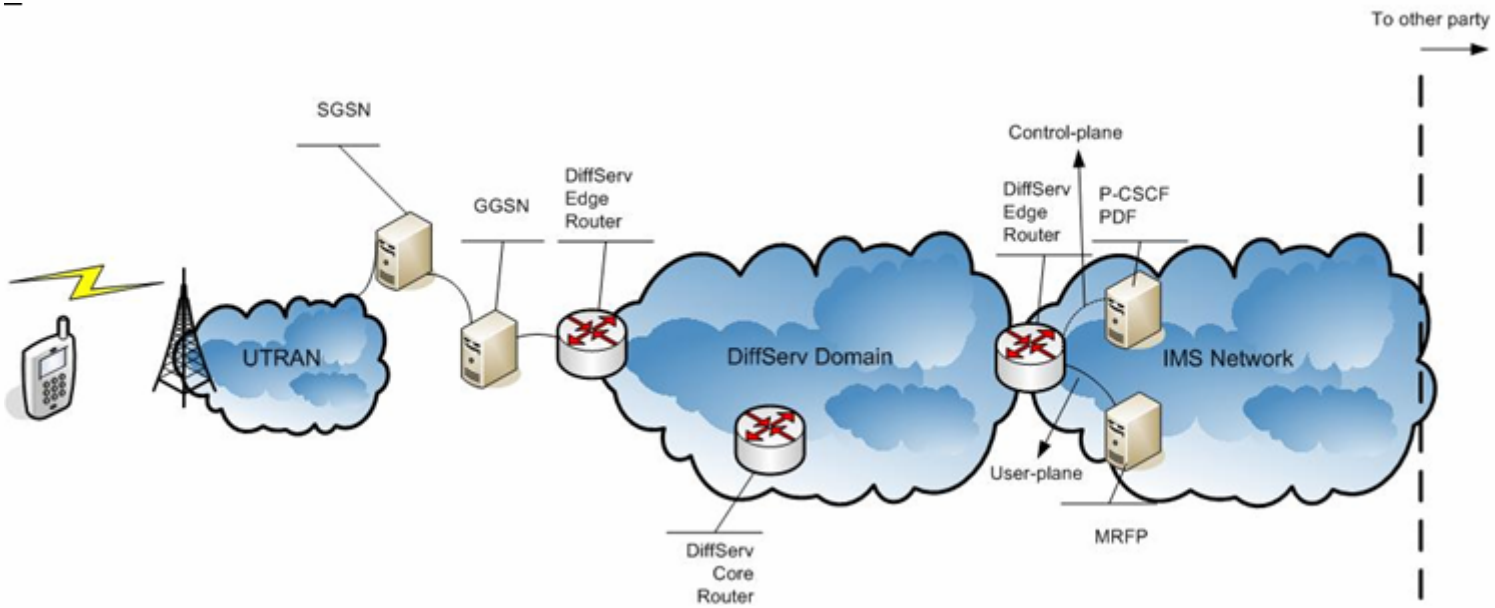


QoS support in IMS using DiffServ

Presented By: Masood KHOSROSHAHY

QoS support in IMS using DiffServ

- DiffServ domain could be potentially between any two elements.
- This scenario:
  DiffServ domain between the GGSN and the IMS network elements.
- The proposed usage of DiffServ QoS method
  in the context of “End-to-end IMS QoS”:

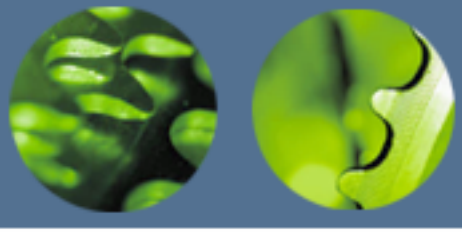


Some Details of the Scenario

- Primary PDP context: Used for IMS signaling
- Secondary PDP context(s): Used for transmission of media
- Mapping between UMTS Traffic Classes and DiffServ Code Points:

DiffServ DSCP	UMTS Traffic Class	Traffic Handling Priority
EF	Conversational	N/A
AF4	Streaming	N/A
AF3	Interactive	1
AF2		2
AF1		3
BE	Background	N/A

- Primary PDP context:
  Interactive UMTS traffic class – AF31 DSCP (011010)
- Secondary PDP context(s) (Carrying a real-time service):
  Conversational UMTS Traffic Class –EF DSCP (101110)



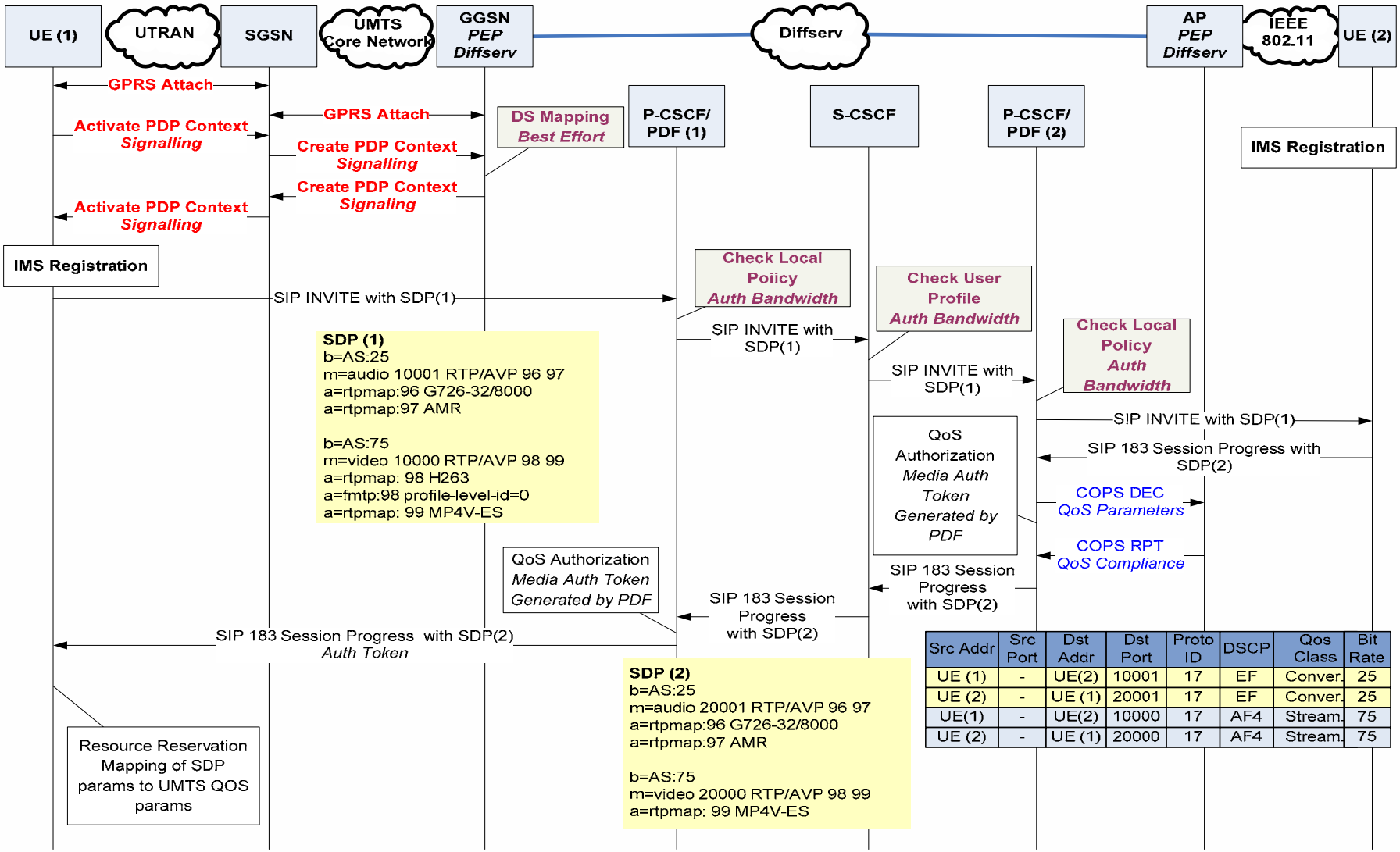
Scenarios

Presented By: Yassine KACEMI

IMS Session Scenario

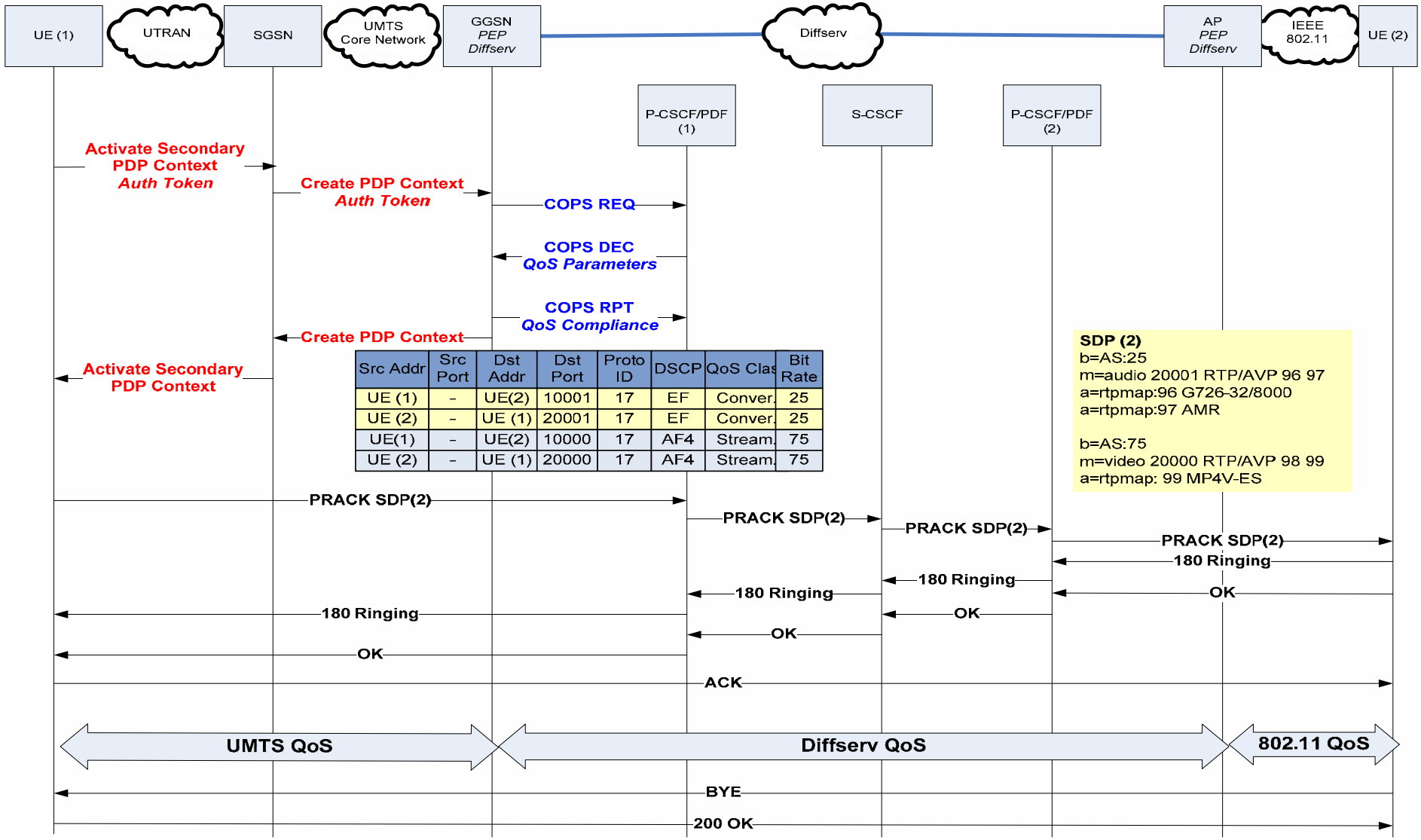
- Visio IMS session (Audio and Video)
- 2 Users UMTS and IEEE 802.11
- Diffserv domain in IMS
- QoS negotiation using SDP
- Audio
  - AMR/G726 with 25 kbit/s
- Video
  - MPEG-4 with 75 kbit/s
- Flow Filters
  - 5-tuples (IP addresses, Ports, Protocol)
- Mapping QoS Class with DS Code Points

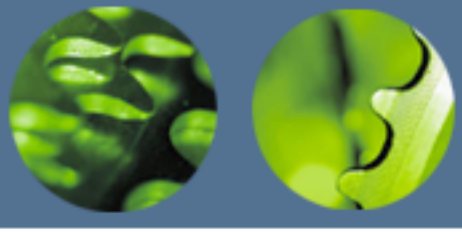
Visio Session Scenario - 1



Src Addr	Src Port	Dst Addr	Dst Port	Proto ID	DSCP	Qos Class	Bit Rate
UE (1)	-	UE(2)	10001	17	EF	Conver.	25
UE (2)	-	UE (1)	20001	17	EF	Conver.	25
UE(1)	-	UE(2)	10000	17	AF4	Stream.	75
UE (2)	-	UE (1)	20000	17	AF4	Stream.	75

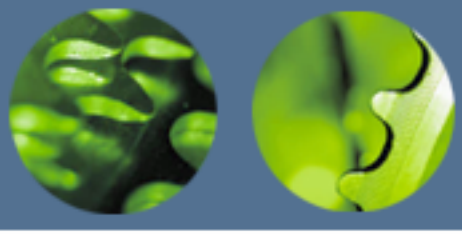
Visio Session Scenario - 2





Annex: New QoS control mechanisms

Presented By: Umit AYGUN



ANNEX : New QoS Control Mechanisms

Single domain limitation for E2E QoS control mechanism in UMTS ; Problems with multidomain data path, inter-technology, inter-operation.

The limitations in the existing UMTS system:

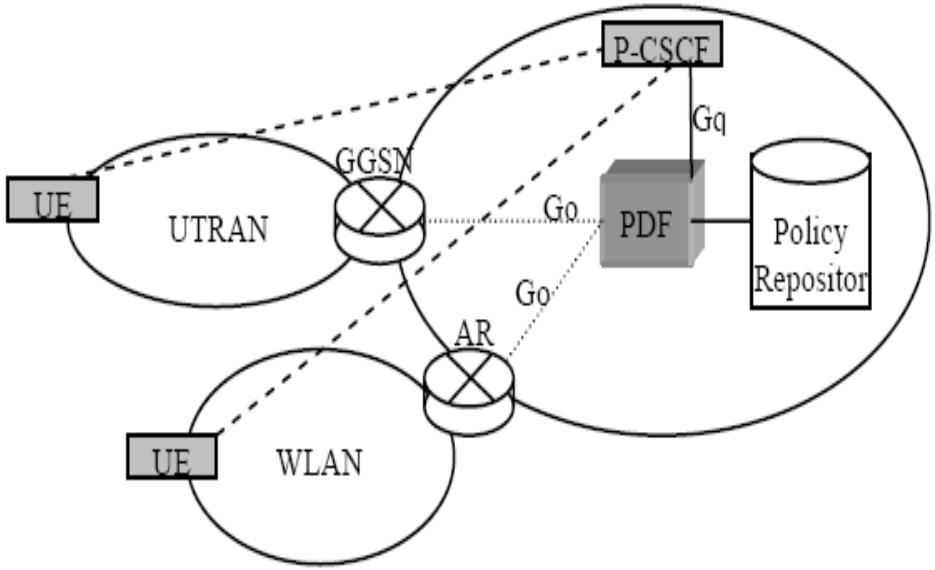
- No E2E resource based admission control: The GGSN can perform local resource based admission control and won't care about service network or external network.
- PCF is limited to SIP signaled services: PCF is supposed to be in P-CSCF which is a SIP Proxy. So it can support only SIP based multimedia application.
- PCF scope limited to GGSN: PCF only serves GGSN as the policy control function and doesn't control other network elements such as inter-domain edge routers.

The existing limitations can be divided in two categories:

- Architectural problems.
- Weakness of signalling protocols.

Architecture 1

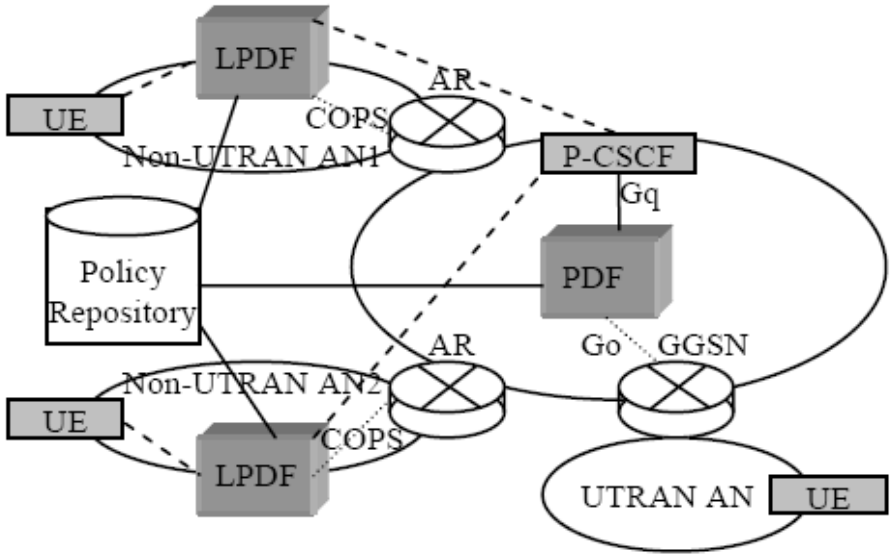
- QoS signaling and protocol, availability of resources in access and UMTS-CN can be completely **different.**
- Need **more co-ordination** between session and bearer layers.
- PCF can control the edge router of other access networks when:



1. the operators of all access networks are the same
2. there is a big trust between two operators and the access network operator has agreed that the policies be pushed by the core network operator.

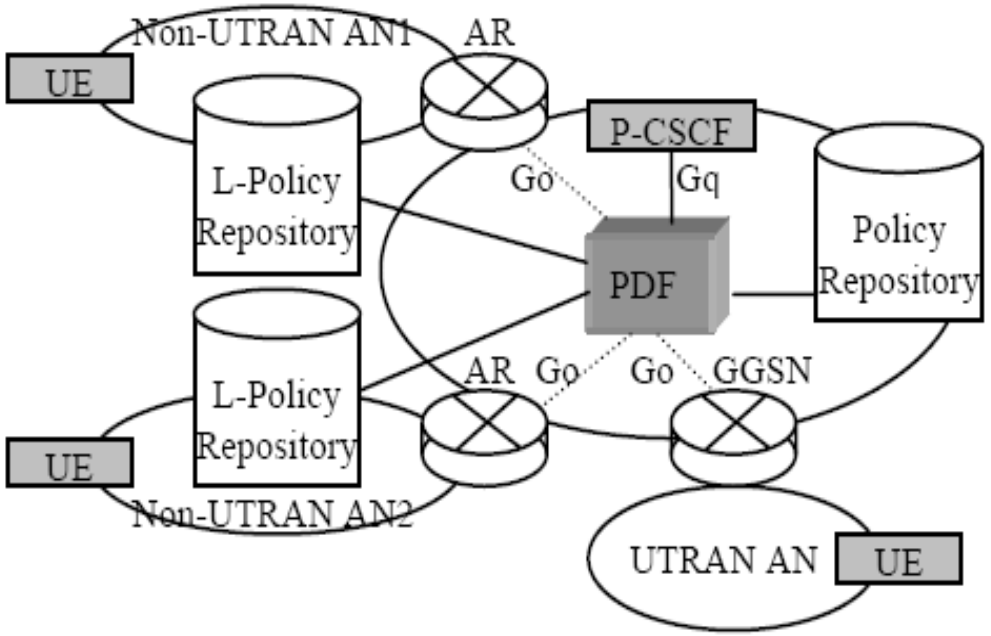
Arch 2. Local PDF (LPDF)

- To exchange the policies with the PDF in the IMS (PCF)
- To control the edge router of the access network.
- It will support SIP and acts as a SIP proxy.
- Will cost more but will be more dynamic for policy enforcement.



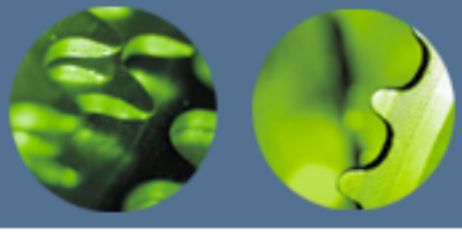
Arch 3. Local Policy Repositories

- Will exchanges their policies with a **shared S-PDF.**
- S-PDF will control the edge routers of all access networks.
- No need for session signaling in the access networks, so decreased costs.
- No dynamic policy exchange.
- S-PDF may be the **bottle-neck** of the system.



Signaling

- QoS parameters in SDP : **codec** and **bit-rate**.
- No one-to-one mapping between SDP QoS parameter and UMTS QoS classes.
- No possibility for user to have different level of QoS for a certain media. (e.g. Video with low quality).
- New extensions to SIP : facilitate the coordination between bearer and application level for resource reservation.
- Those extensions to SDP proposed;
  - The Traffic Information (TI) : the traffic type of the bearer associated with codec (bandwidth, packet size).
  - Sensitivity Information (SI) : defines the parameters like end-to-end delay, delay jitter and maximum packet loss that defines the level of quality that a user wish to have.



Thank you for your attention!