Tutorial 2006

Overview of the

IP Multimedia System (IMS)
- *Principles, Architecture and Applications*

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Abstract

This tutorial provides a technical overview of the architecture, components and protocols of the emerging 3GPP IP Multimedia Subsystem (IMS) / 3 GPP2 Multimedia Domain (MMD) which provides the technological basis for the provision of mobile multimedia services within 3G packet networks. This tutorial looks at the driving forces for the IMS architecture definition, introduces the key signalling and control protocols of all IP networks (i.e., SIP and Diameter) forming the basis for IMS component interactions, and explains the key IMS elements and their interactions. Special attention will be given to the IMS application server options, namely CAMEL, OSA/Parlay and SIP AS. The tutorial ends with an overview of the FOKUS IMS play ground (www.fokus.fraunhofer.de/ims).

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The Presenter

Prof. Dr. Thomas Magedanz

Thomas Magedanz (PhD) is professor in the electrical engineering and computer sciences faculty at the Technical University of Berlin, Germany, leading the chair for next generation networks (Architektur der Vermittlungsknoten – AV).

In addition, he is director of the "3G beyond" division at the Fraunhofer Institute FOKUS, which also provides the national 3G beyond test and development centre in Germany.

He is senior member of the IEEE, editorial board member of several journals, and the author of more than 200 technical papers/articles. He is the author of two books on IN standards and IN evolution.

Based on his 18 years of experience in the teaching of complex IT and telecommunication technologies to different customer segments in an easy to digest way, Dr. Thomas Magedanz is a globally recognised technology coach. He regularly provides strategic and technology briefings for major operators and telecom vendors, as well he acts often as invited tutorial speaker at major telecom conferences and workshops around the world.

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Contact

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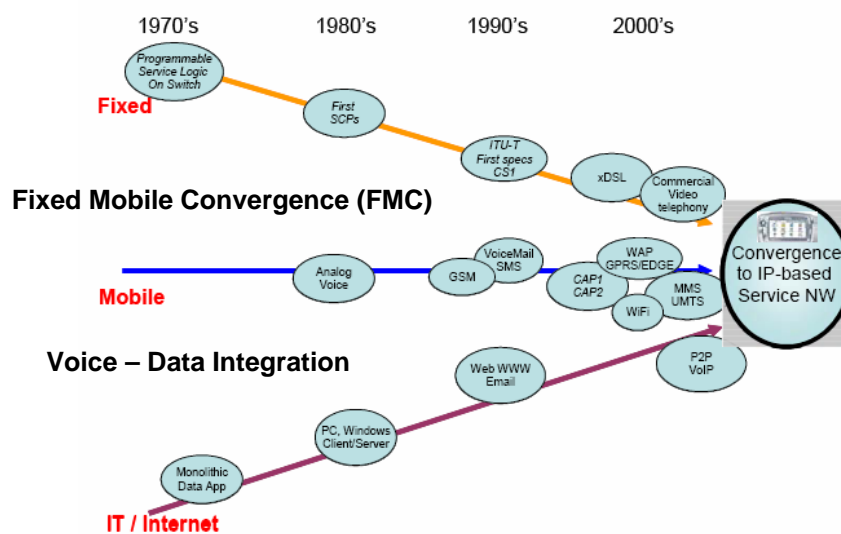   14513 Berlin, Germany

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Overview

- **IMS Motivation**
- **IMS Overview**
- **IMS Key protocols (IETF SIP and Diameter)**
- **IMS Key components**
- **IMS Application Server options**
- **Sample IMS Multimedia Applications**
- **The IMS Playground @ FOKUS**
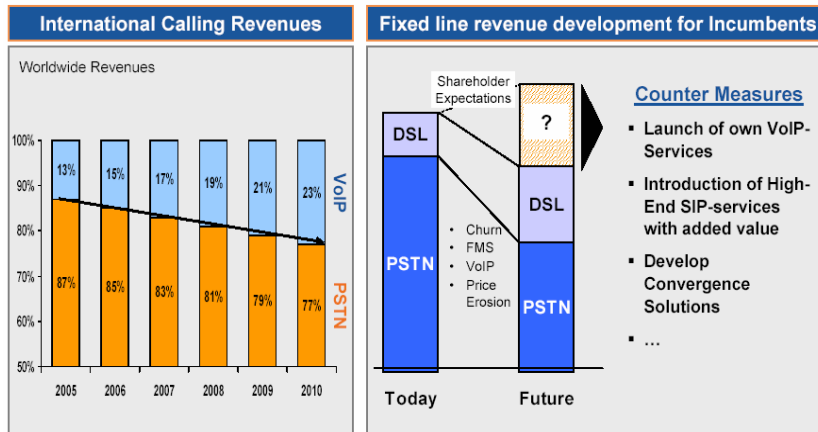- **Summary**
- *References & Acronyms*

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Evolution towards Converged Networks

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VoIP Impact becomes visible in the Fixed World

The traditional voice market is declining. Operators have to explore new market opportunities to fill the revenue gap!

International Calling Revenues

Worldwide Revenues

Year	VoIP	PSTN
2005	13%	87%
2006	15%	85%
2007	17%	83%
2008	19%	81%
2009	21%	79%
2010	23%	77%

Fixed line revenue development for Incumbents

Shareholder Expectations

Today: DSL / PSTN
- Churn
- FMS
- VoIP
- Price Erosion

Future: ? / DSL / PSTN

Counter Measures
- Launch of own VoIP-Services
- Introduction of High-End SIP-services with added value
- Develop Convergence Solutions
- …

Source: Gartner 2005, Pyramid 2005, Detecon Research.

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War is not on networks, it is on services !

- **Physical networks become transparent**
- **Market entry barriers for services vanish**
- **Value Chain splits horizontally**
- **Clear & present threats**
  - **losing VAS revenues**
  - **losing subscriber ownership**
  - **losing control over the Mobile Value Chain**
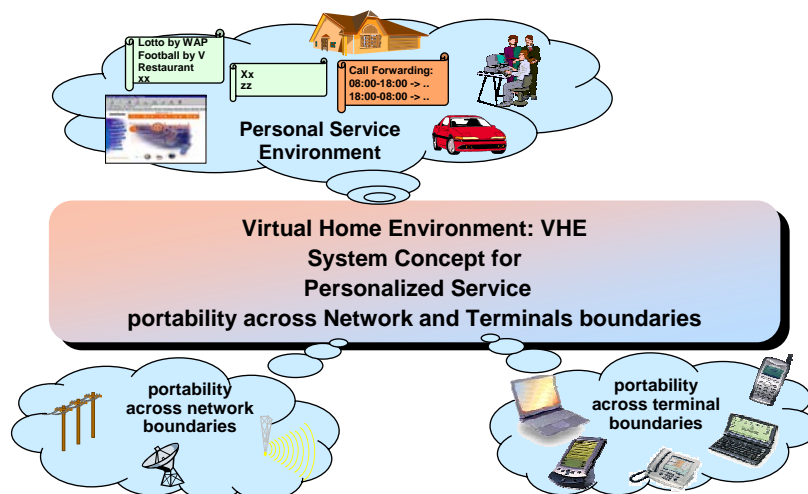

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Action Points for Operators

- **VoIP is putting significant voice revenues at risk!**
    - **Plain old VoIP services (= cheap) will become a commodity**
- **High-end „SIP-services" (➔ beyond VoIP services) allow for compensation**
    - **Use the opportunity to fill the increasing fixed voice revenue gap by new lifestyle orientated SIP-services**
        - **Rich VoIP services (including Multimedia Services)**
        - **Customized VoIP (lessons learned from the mobile world, i.e. ring tones, wall papers, etc.)**
        - **FMC VoIP services (enhancing VoIP to the mobile domain)**
- **FMC is the common battle field also addressed by Mobile NOs**
- **Do we have to distinguish between fixed and mobile operators in the mid – long run??**
    - **See France Telecom, Telecom Italia, Telefonica, watch out Deutsche Telekom**
- **Selected Value added Service architecture has to be bullet proof from both angles of view (Service Integration)**
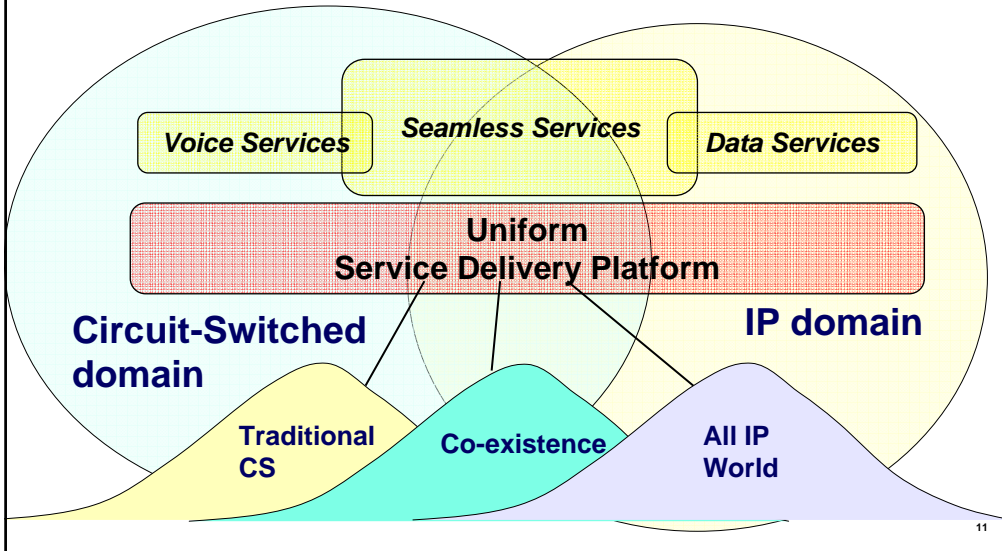- ➔ **The IP Multimedia System represents this common ground!**
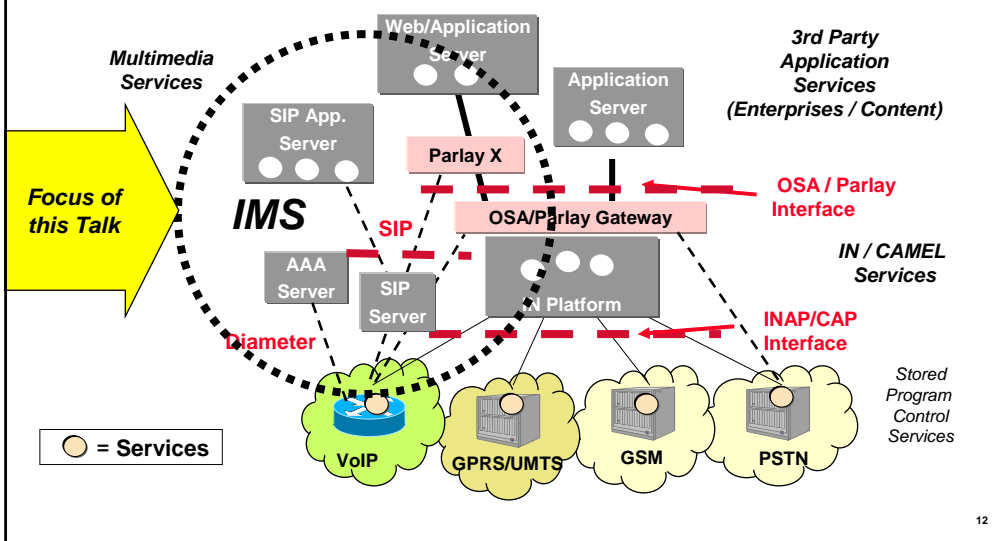
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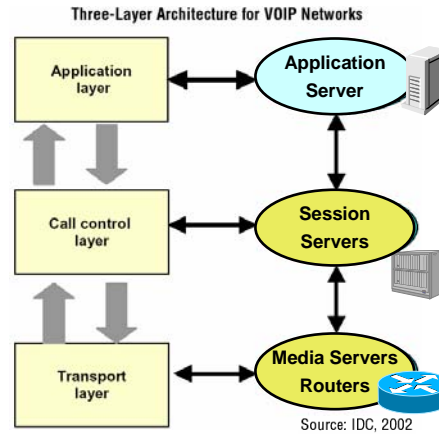

Pre-FMC = 3GPP Virtual Home Environment

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Network Convergence

Voice Services

Seamless Services

Data Services

**Uniform
Service Delivery Platform**

**Circuit-Switched
domain**

IP domain

**Traditional
CS**

Co-existence

**All IP
World**

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Evolution of Service Delivery Platforms

*Multimedia
Services*

Web/Application
Server

*3rd Party
Application
Services
(Enterprises / Content)*

SIP App.
Server

Application
Server

Parlay X

*Focus of
this Talk*

IMS

SIP

OSA/Parlay Gateway

**OSA / Parlay
Interface**

*IN / CAMEL
Services*

AAA
Server

SIP
Server

IN Platform

**INAP/CAP
Interface**

Diameter

*Stored
Program
Control
Services*

⬤ = Services
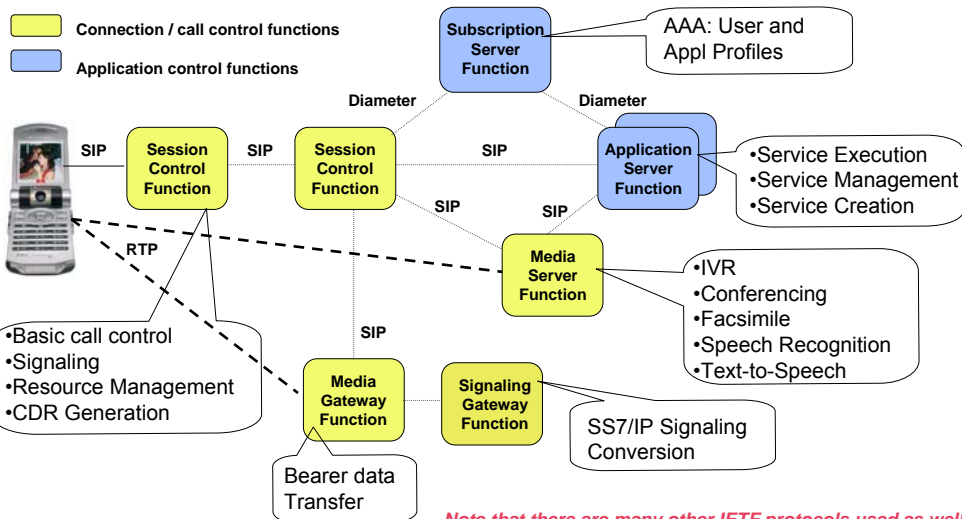
VoIP

GPRS/UMTS

GSM

PSTN

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Next Generation Network 3 Tier Architecture

- **Enhanced services for the next generation network will be enabled by a tiered architecture where "Application Servers" will provide an independent service layer for the execution of enhanced services and content**

- **Session / Call Control based on advanced signaling protocols (i.e. SIP) is performed in Softswitches, or "Session Servers"**

- **Transport of signaling and content (incl. Voice) data will be done by Routers in the classical IP fashion. Dedicated nodes, i.e. "Media Gateways" and "Media Servers" are in charge for processing content data controlled by the Call Servers.**

Three-Layer Architecture for VOIP Networks

Application layer	⟷	Application Server
Call control layer	⟷	Session Servers
Transport layer	⟷	Media Servers Routers

Source: IDC, 2002

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Next Generation All IP Reference Architecture

- Connection / call control functions
- Application control functions

Subscription Server Function — AAA: User and Appl Profiles

Diameter · Diameter

Session Control Function — SIP — **Session Control Function** — SIP — **Application Server Function**
- Service Execution
- Service Management
- Service Creation

SIP · SIP

Media Server Function
- IVR
- Conferencing
- Facsimile
- Speech Recognition
- Text-to-Speech

- Basic call control
- Signaling
- Resource Management
- CDR Generation

RTP

SIP

Media Gateway Function — **Signaling Gateway Function**
SS7/IP Signaling Conversion

Bearer data Transfer

Note that there are many other IETF protocols used as well, e.g. SDP, Megaco, SCTP, RTCP, MSRP, XCAP, etc.

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Motivation for IMS

- **The Hope:** *Compete with classic internet services at weak points:*
  - *Provide QoS, security & charging and*
  - *enable real integrated multimedia services*
- **The Solution: the IP Multimedia System (IMS) as minimum common denominator**
- **Killer applications vs. universal service delivery platform**
  - **Flexible service creation and service deployment is key**
  - **Openess to third party developers / providers (➔ controlled enabling)**
  - **Integrated services – integration of existing and emerging services**
  - **Provide service uniform and seamless across different fixed and mobile networks**
- **BUT: who will provide the „global" IMS and owns the customer??**

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# IMS Idea: Try to get Control of IP Services
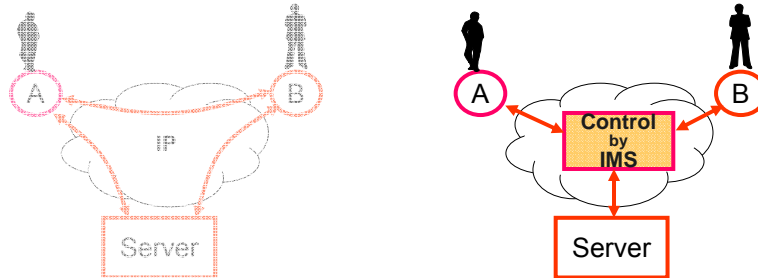
- **The IP network allows free communication between endpoints**
- **IMS is able to control S(IP) services on an IP network**

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IMS enabling Control of GPRS / IP services

IMS Core Idea:

- Define an *IP Multimedia Overlay-Network over GPRS (for Session control based on Internet protocols!)*
- *Data (Media) transport (as well as signaling transport) via GPRS*
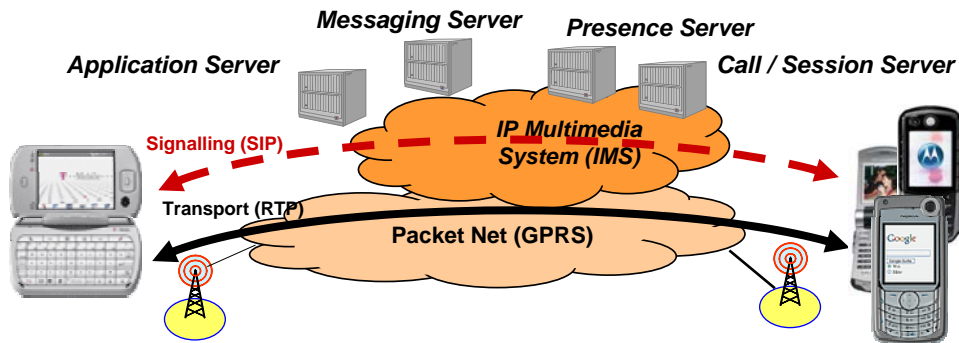- *Provide control (QoS, security, Charging) for IP services and person-to-person communication*
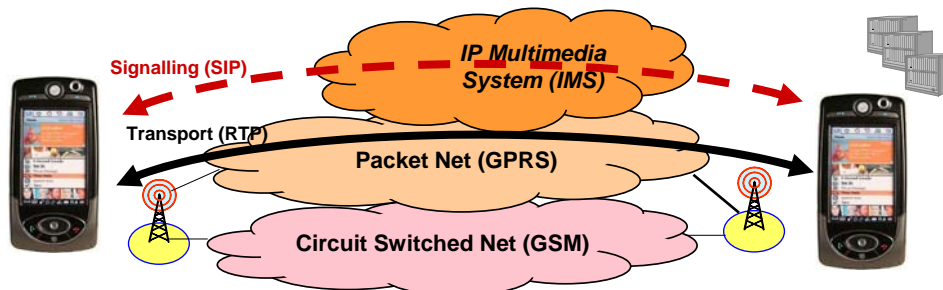
Note that IMS is for fixed networks applicable too 18

IMS Motivation – Flexible Service Provision

Provision of service enablers

- **Presence and Group server are considered key for the future**
- **Example: Push to Talk, but more generally community services**

Messaging Server

Presence Server

Application Server

Call / Session Server

IP Multimedia System (IMS)

Signalling (SIP)

Transport (RTP)

Packet Net (GPRS)

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IMS Architecture Principles

- **IMS does NOT standardise specific services, but enablers**
- **BUT supports inherently multimedia over IP, VoIP, IM, presence (SIP)**
- **IMS enables the flexibility in providing Multimedia over IP services !!**

Architecture

Applications

IMS and **Service Enablers**

Network
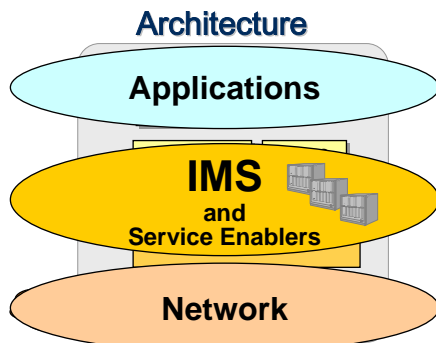
- **Horizontal Architecture**
- **Build on existing IETF and telco SDP standards**
- **Use standard service enablers (e.g. Presence, GLMS/XDMS, etc.)**
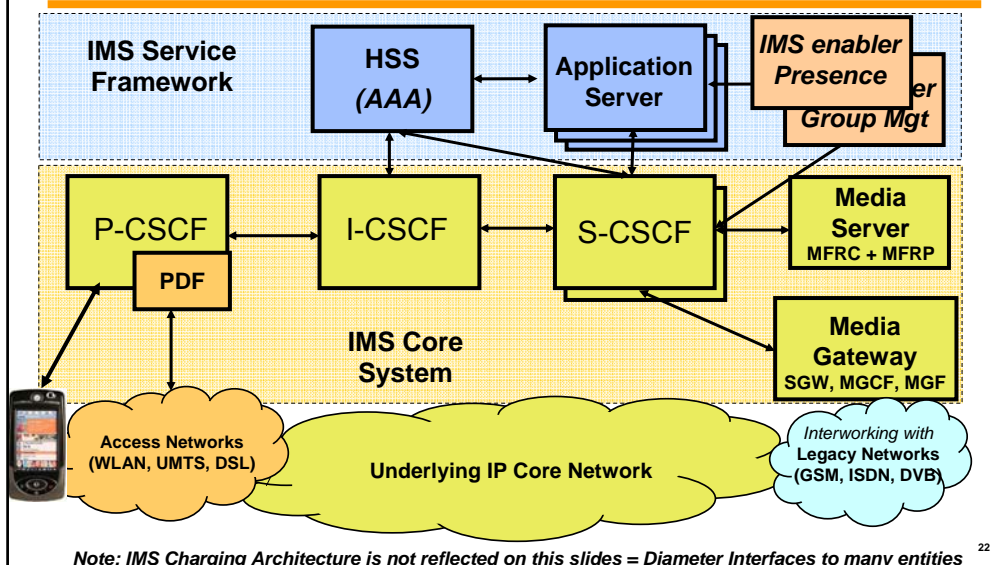- **Modular design and open interfaces**

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3GPP IP Multimedia Subsystem (IMS)

- The IMS was originally standardised by 3GPP as part of UMTS Release 5
  - Basic VoIP, IM, Presence support on top of GPRS
  - Adaptations to "real word" have been made in Release 6 (QoS, PoC support)
  - Release 7 will look at unified IMS for all IP access networks (DSL, WLAN, etc.)
- The IMS is based on the IP world protocols, namely
  - SIP (Session Initiation Protocol) for Session Control, and
  - Diameter for AAA (Authentication, Authorisation & Accounting)
  - plus many others, i.e. SDP, RTP, RTCP, MGCP, etc.
- Key components of the IMS architecture are
  - **Extended AAA Server (Home Subscriber System – as evolution of the HLR)**
  - **SIP servers / soft switches**
  - **Media Servers & Media Gateways**
  - **and Application Servers**

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IMS Layers: Transport, Session Control, Apps

Note: IMS Charging Architecture is not reflected on this slides = Diameter Interfaces to many entities

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IMS Major Components

- The IMS is an Overlay Session/Service Control architecture on top of the packet domain (GPRS, UMTS, WLAN, DSL) based on IP technologies and IETF protocols (e.g. SIP, Diameter):
  - **IMS Core**
    - **S-CSCF (Serving Call Session Control Function) the IS anker point in the home network**
    - **I-CSCF (Interrogating Call Session Control Function) providing topology hiding**
    - **P-CSCF (Proxy Call Session Control Function) Entrypoint into IMS world**
    - **MS (Media Server) – Media Server hosting special resources**
    - **MGF (Media Gateway) for Interworking with legacy networks**
    - **PDF (Policy Decision Function) for QoS Control using Polícies (COPS)**
  - **IMS Application Layer**
    - **HSS (Home Subscriber System) for maintaining subscriber and AS profiles**
    - **AS (Application Server Function) for hosting applications**
    - **IMS enablers (e.g. Presence, Group Mgt.) are specific ASs with generic functions**
 - **And the IMS end system (IMS Client) plays an important role real multimedia / IMS services**

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IMS Layers: Transport, Session Control, Apps
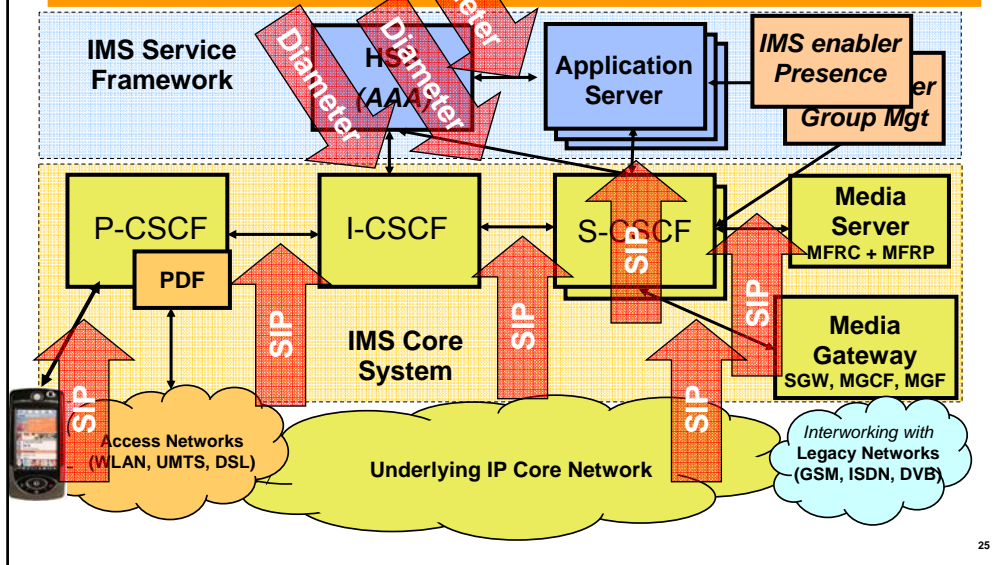
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IETF Session Initiation Protocol (SIP)

- **SIP is THE VoIP protocol enabling to initiate, terminate, and modify service sessions**
  - **Multimedia(!) sessions (*not just voice-centric!*)**
  - **Point-to-point and multiparty**
- **Support for**
  - **registration and modification of multiple user location information**
  - **caller and callee authentication / call authorization**
  - **privacy for call signaling and media streams**
  - **media path with ensured QoS**
- **Flexible service creation**
  - **support through SIP servers (located inside and outside the network)**
- **Extensible protocol to cover new communication aspects**
  - **Such as for presence and instant messaging**
- **Used together with Session Description Protocol**
  - **No Bearer support (RTP and RTCP are used for that) !!**
- **Developed and maintained by IETF (MMUSIC and SIP WGs)**
- **RFC 3261: www.ietf.org/html.charters/sip-charter.html**

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Local SIP Architecture
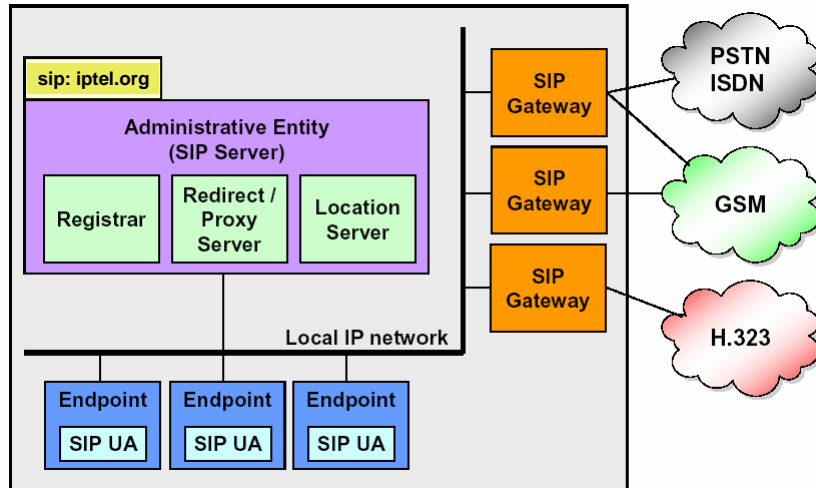
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Basic SIP Requests

- **REGISTER:** allows Clients to register their current location (one or more addresses)
- **INVITE:** is used to initiate a call.
- **ACK:** is sent by a client to confirm that it has received a final response from a server, such as 200 OK.
- **BYE:** is sent either by the calling agent or by the caller agent to abort a call
- **CANCEL:** can be sent to abort a request that was sent previously as long as the server has not yet sent a final response.
- **OPTIONS:** allows clients to learn a servers capabilities. The server will send back a list of the methods it supports.

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Additional SIP Requests

- **SUBSCRIBE:** starts or stops session or user supervision (event monitoring)
- **NOTIFY:** informs subscribed entity about occurred events
- **PUBLISH:** enables an entity to modify presence information
- **MESSAGE:** allows to send an instant message
- **REFER:** informs an recepient to contact a dedicated SIP user (e.g. MWI)
- **PRACK:** PRovisional ACKnowledgement
- **UPDATE:** Change of media (SDP) during session setup
- **INFO:** Exchange of any application layer information (e.g. DTMF)

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SIP Responses

SIP Responses defined as (HTTP-style):

- **SIP-Version SP Status-Code SP Reason-Phrase**
- **CRLF** (SP=Space, CRLF=Carriage Return and Line Feed)
- **Example:** `SIP/2.0 404 Not Found`
- **First digit gives Class of response:**

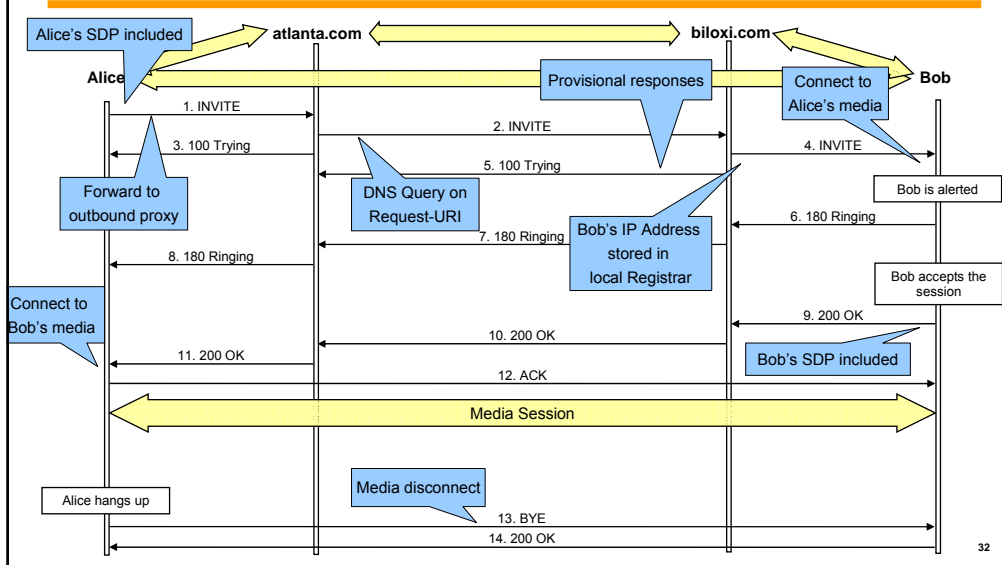|	Description	Examples
1xx	Informational – Request received, continuing to process request.	180 Ringing 181 Call is Being Forwarded
2xx	Success – Action was successfully received, understood and accepted.	**Plus 183 Session in Progress** 200 OK
3xx	Redirection – Further action needs to be taken in order to complete the request.	300 Multiple Choices 302 Moved Temporarily
4xx	Client Error – Request contains bad syntax or cannot be fulfilled at this server.	401 Unauthorized 408 Request Timeout
5xx	Server Error – Server failed to fulfill an apparently valid request.	503 Service Unavailable 505 Version Not Suported
6xx	Global Failure – Request is invalid at any server.	600 Busy Everywhere 603 Decline

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SIP Message Body = SDP

- **Message body can be any protocol**
- **However, in most implementations it is SDP (Session Discription Protocol)**
  - **SDP - Session Description Protocol**
  - **RFC 2327 4/98 by Handley and Jacobson**
    - **http://www.ietf.org/rfc/rfc2327.txt**
  - **Used to specify info about a multi-media session.**
  - **SDP fields have a required order**
  - **For RTP - Real Time Protocol Sessions:**
    - **RTP Audio/Video Profile (RTP/AVP) payload descriptions are often used**
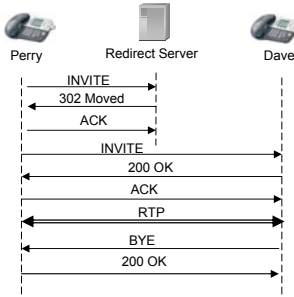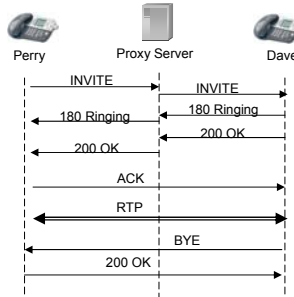
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A SIP Signalling Scenario
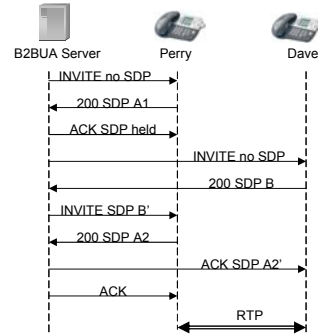
SIP Server Operation Models

Redirect Server

Perry — Redirect Server — Dave

| INVITE |
| 302 Moved |
| ACK |
| INVITE |
| 200 OK |
| ACK |
| RTP |
| BYE |
| 200 OK |

Transaction-oriented, Routing, Translation Services

Proxy Server

Perry — Proxy Server — Dave

INVITE	INVITE
180 Ringing	180 Ringing
200 OK	200 OK
ACK
RTP
BYE	BYE
200 OK

Call Management, Event-driven Services

B2BUA Server

B2BUA Server — Perry — Dave

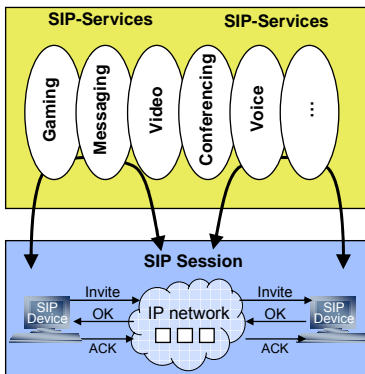| INVITE no SDP |
| 200 SDP A1 |
| ACK SDP held |
| INVITE no SDP |
| 200 SDP B |
| INVITE SDP B' |
| 200 SDP A2 |
| ACK SDP A2' |
| ACK |
| RTP |

Call (Leg) Creation and Manipulation Services

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Application Evolution - The SIP Influence

SIP as an open communications protocol is considered a key enabler for real-time converged communications and the development of interactive services.

SIP session and SIP-enabled services

SIP-Services   SIP-Services

Gaming | Messaging | Video | Conferencing | Voice | …

SIP Session

Invite — IP network — Invite
SIP Device — OK — SIP Device
ACK — ACK

basic SIP functionality

User Presence/Availability
Establishment of user presence and availability (buddy-list functionality of IM)

User Location&Mobility
Establishment of current IP address. Support of personal and terminal mobility

Multimedia Support
Supports voice, e-mail, IM, video and any other form of application with session characteristics

Call Setup & Processing
Establishment and management of communication parameters (e.g. codec, timeframe, …)

SIP-enabled services

- Unified Messaging
- Chat
- Multimedia Conferencing
- Push-to-talk
- Online Games
- Distributed Virtual Realtiy Systems
- Push Services
- Interactive Entertainment
- IP-PBX, IVR

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IETF Diameter Protocol for AAA

- New IETF protocol for Authentication, Authorization and Accounting (AAA) services
    - Internet Draft "DIAMETER Framework" (1998) by IETF AAA WG
    - RFC 3588 DIAMETER Base Protocol (2003)
- Developed based on the requirements of 3G mobile network operators, ISPs and other IETF groups since 2001
- Used in the 3GPP IMS for HSS access
- Extends the RADIUS functionalities:
    - Introduction of Agent roles (proxy, relay, redirect & translation agents)
    - Enables server-initiated messages
    - Uses UDP, TCP and new SCTP protocol for reliable message transport
    - Is backward compatible to RADIUS infrastrutures by using translation agents
    - Integrates vendor specific commands and AVPs
    - Explicit modular structure = is extendible

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IETF AAA Work Group

- **GOAL**
    - **Develop the Diameter Standard based on the requirements of other IETF WGs (NASREQ, MOBILE IP, ROAMOPS), 3GPP and 3GPP2**
- **WG defines: message format, error messages, accounting support, IPv6 support, backward compatibility with RADIUS, data model, security framework, Management Information Base (MIB)**

- **Achievements:**
    - **RFC 3588 Diameter Base Protocol**
    - **Several other AAA RFCs**
    - **multiple Diameter application drafts**

- **Web link: www.ietf.org/html.charters/aaa-charter.html**

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Diameter Base Protocol

- **RFC 3588 approved in September 2003 (NEW)**
- **provides an AAA framework for applications**
- **works for local AAA and in roaming situations**
- **The RFC defines**
    - **agent roles**
    - **sessions and connections**
    - **header, AVP and data formats**
    - **Command codes, AVPs, Result codes and Diamter application IDs**
    - **the state machines used within Diameter**
    - **error handling, failover algorithms**
    - **basic accounting procedures**

- **Web link: ftp://ftp.rfc-editor.org/in-notes/rfc3588.txt**

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Diameter Extensions of the Base Protocol

- **Diameter is designed in terms of a Base Protocol (RFC 3588) and an extensible set of applications**
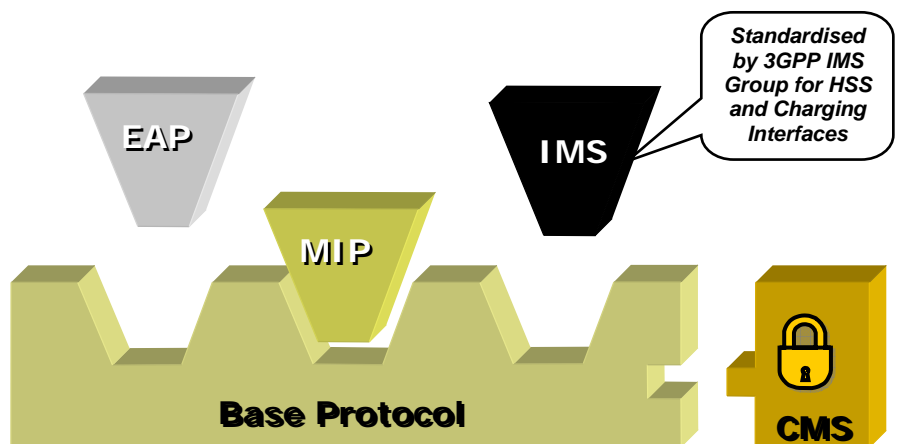
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IMS 3GPP Evolution

- **IMS brainstroming started in Release 4, without real specs.**
- **IMS Release 5 is the first complete specification of IMS finished in 2003 (but based on some unrealistic assumptions;-( )**
- **Key features of IMS Release 5:**
  - **IMS Architecture:** IMS Architecture, network entities, reference points (interfaces) between the network entities.
  - **User Identities:** Public/Private User Identity, usage of the SIP-URI and TEL-URI, ISIM, the use of the USIM instead of the ISIM.
  - I**MS Session Control:** IMS Registration, IMS Session Routing, Session-Modification and Teardown, SIP Signaling Compression.
  - **IMS Service Control:** invocation/control of IMS Application Servers based on Filter Criteria in the CSCF. IM-SSF and there-use of CAMEL Services. Interconnect with the OSA-GW and the use of OSA services.
  - **QoS Mechanisms:** QoS Preconditions, QoS/Media Authorization based on the PDF.
  - **Security Mechanisms:** IMS User Authentication, Message Integrity Protection, IMS Network Domain Security.
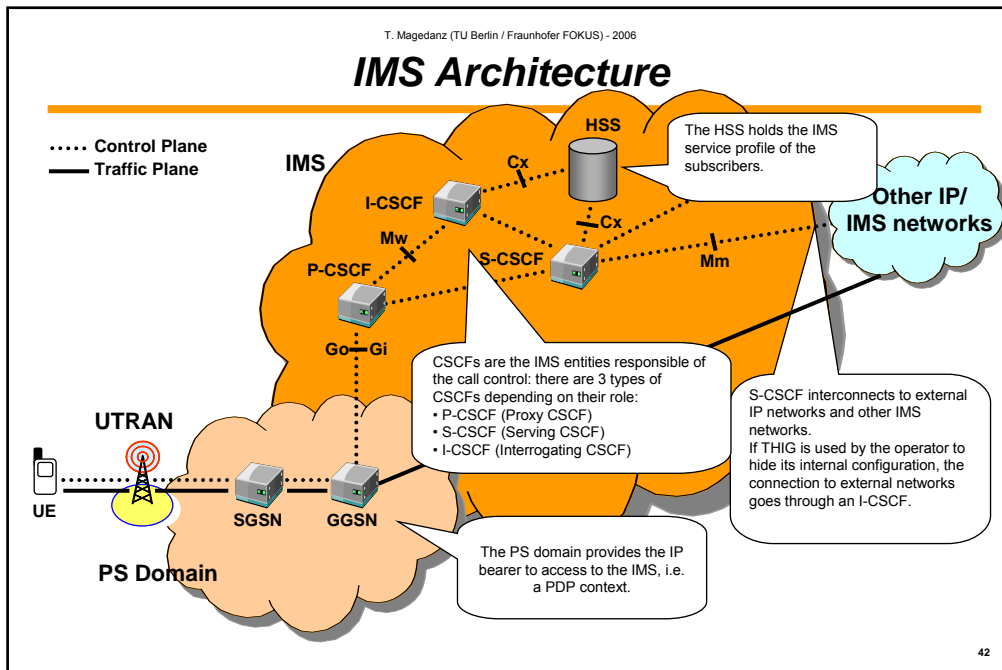
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IMS 3GPP Release 6

- **Release 6 adapted IMS to the real world (i.e. lack of IMS SIM cards, IPv6 deployment, competing PoC standards), etc.) and was finished end of 2005**
- **Key Features defined in Rel-6 IMS:**
  - **IMS Interworking:** IMS Interworking to the CS-Domain (more details for CS and PSTN), Interworking with SIP Clients in the Internet (IPv4/v6 Interworking), WLAN access to the IMS (not completed)
  - **IMS Session Control:** multiple registrations, routing of group identities.
  - **Security Mechanisms:** confidentiality protection of SIP messages, use of public key infrastructure, Ut-interface security, early IMS security
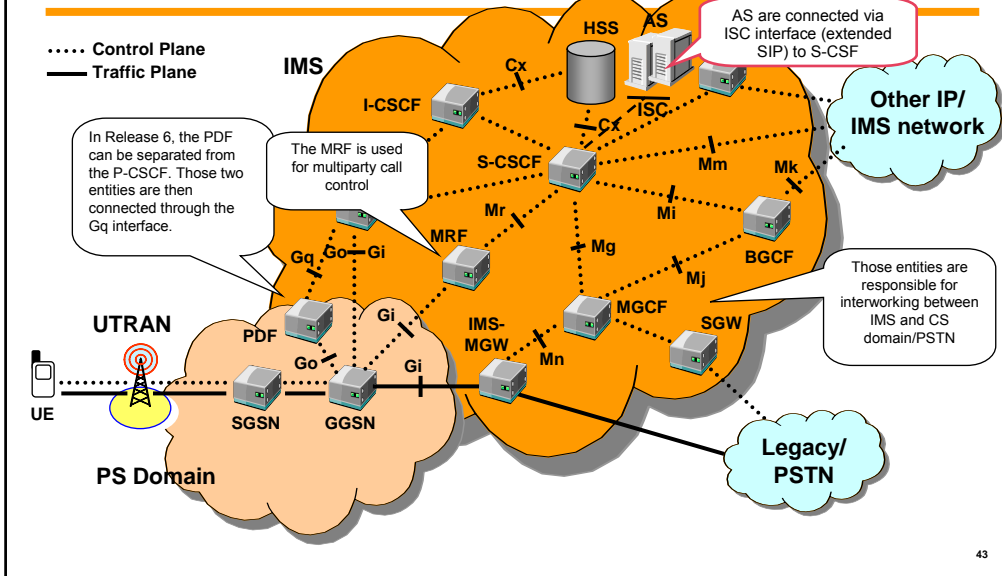 - **IMS Services:** Presence, Instant Messaging, Conferencing, group management.
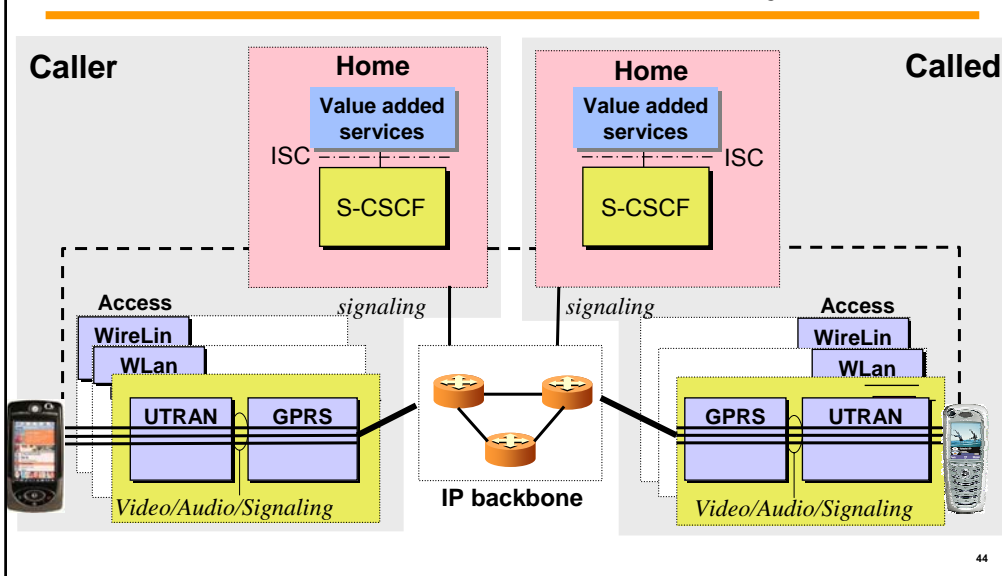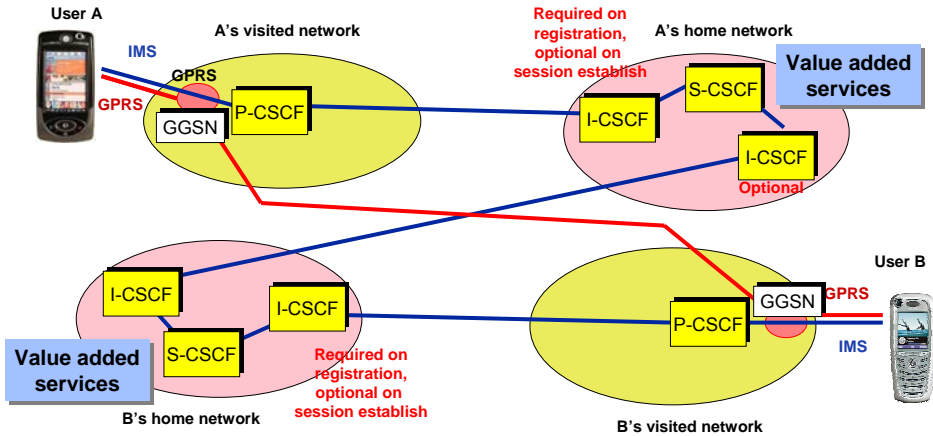
41

IMS Architecture

····· Control Plane
── Traffic Plane

IMS

HSS

The HSS holds the IMS service profile of the subscribers.

Other IP/ IMS networks

I-CSCF

Cx

Cx

Mm

Mw

P-CSCF

S-CSCF

Go Gi

CSCFs are the IMS entities responsible of the call control: there are 3 types of CSCFs depending on their role:
• P-CSCF (Proxy CSCF)
• S-CSCF (Serving CSCF)
• I-CSCF (Interrogating CSCF)

S-CSCF interconnects to external IP networks and other IMS networks.
If THIG is used by the operator to hide its internal configuration, the connection to external networks goes through an I-CSCF.

UTRAN

UE

SGSN

GGSN

PS Domain

The PS domain provides the IP bearer to access to the IMS, i.e. a PDP context.

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IMS Architecture (cont.)

- **·····** Control Plane
- **——** Traffic Plane

IMS

HSS
AS

AS are connected via ISC interface (extended SIP) to S-CSF

Other IP/ IMS network

Cx

I-CSCF

Cx

ISC

In Release 6, the PDF can be separated from the P-CSCF. Those two entities are then connected through the Gq interface.

The MRF is used for multiparty call control

S-CSCF

Mm

Mk

Mr

Mi

Gq Go Gi

MRF

Mg

BGCF

Those entities are responsible for interworking between IMS and CS domain/PSTN

Mj

UTRAN

Gi

IMS-MGW

MGCF

SGW

PDF

Go

Gi

Mn

UE

SGSN

GGSN

PS Domain

Legacy/ PSTN

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IMS-Session: Home Networks are always involved

Caller

Home

Value added services

ISC

S-CSCF

Home

Value added services

ISC

S-CSCF

Called

signaling

signaling

Access

WireLin

WLan

UTRAN **GPRS**

Video/Audio/Signaling

IP backbone

Access

WireLin

WLan

GPRS **UTRAN**

Video/Audio/Signaling

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IMS: Separation of Signaling and Media transport

mobile to mobile session

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IMS User Identity Concept

Each IMS User has at least one private and one or more public User Identities

- **IMS Private User Identity:**
  - **belongs to the IMS operator**
  - **is not used for routing of SIP messages**
  - **uses the format defined in RFC 2486**
    - **Example: user-X@ims.operator.com"**
  - **is stored on the ISIM card (in the mobile phone) and in the HSS (in the IMS User Profile)**

- **IMS Public User Identity:**
  - **is public and may be subject to Number Portability**
  - **is used for routing of SIP messages**
  - **may use the SIP-URI format defined in RFC 3261 and/or the TEL-URI format defined in RFC 2806**
    - **Example SIP-URI: "sip:user-X@company-X.com"**
    - **Example TEL-URI: "tel:+491231234567"**
  - **At least one Public User Identity is stored on the ISIM card**
  - **All Public User Identities are stored in the HSS**

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Public Service Identities (PSIs)

- **Similar to public user identities, but allocated to services (ASs) rather than users**
- **Used to identify specific applications Servers (enablers), such as presence or group list servers**
- **Typically take the form of a SIP URI or TEL URI**
  - **sip: songdownload@t-online.de, presence@t-online.de, chat@partner.de**
  - **tel: +49-900-123-456**
- **PSIs are treated as PUIs, i.e. easy routing of SIP requests to ASs (as end user systems ➔ also called „service routing"**
- **Public Service Identities are not authenticated**
  - **i.e., there is no corresponding private user (service) identity**

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How the IMS differs from RFC 3261 SIP Servers

- **The IMS was designed based on RFC 3261 (the CSCF is basically also a SIP Server)**
  … but includes much more!
- **Additional functions were added to the IMS:**
  - **Subscriber Management, Service Control, Single-Sign-On User Authentication,**
  - **QoS/Media Authorization, Charging and Charging Correlation,**
  - **Resource Management, Interworking, Compression, Conferencing Support, Regulatory**
  - **Service Support, etc.**
- **Most of the IMS functions were taken from the IETF or were afterwards defined in the IETF:**
  - **Update (RFC331), Preconditions (RFC3312), PRACK (RFC3262), Offer/Answer (RFC 3264), QoS/Media Authorization (RFC 3313), Event Notification (RFC 3265),**
  - **Tel-URIs (RFC 2806), 3GPP P-Headers (RFC3455), Service-Route (RFC3608),**
  - **Asserted ID (RFC3325), DNS-Support (RFC 3263), SigComp (RFC3320, RFC3485, RFC 3486),**
  - **ENUM (RFC2916, RFC2915), SIP Refer (RFC3515), Digest AKA (RFC 3310),**
  - **Path-Header (RFC 3327), Security-Mechanism-Agreement (RFC3329), etc.**
- **A Service Infrastructure Network could also be built up starting with a standard RFC 3261 SIP Server.**
- **When extended to support the same Support Functions, then such a solution becomes similar to the IMS.**

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User Registration and Authentication

UE	SGSN	HLR	GGSN	CSCF's	HSS	IMS-AS

GPRS Attach

PDP Context Activation

IMS Registration and User Authentication

IMS Service Access

Bearer Level Authentication

IP Transport setup

IMS Registration

IMS Service Access

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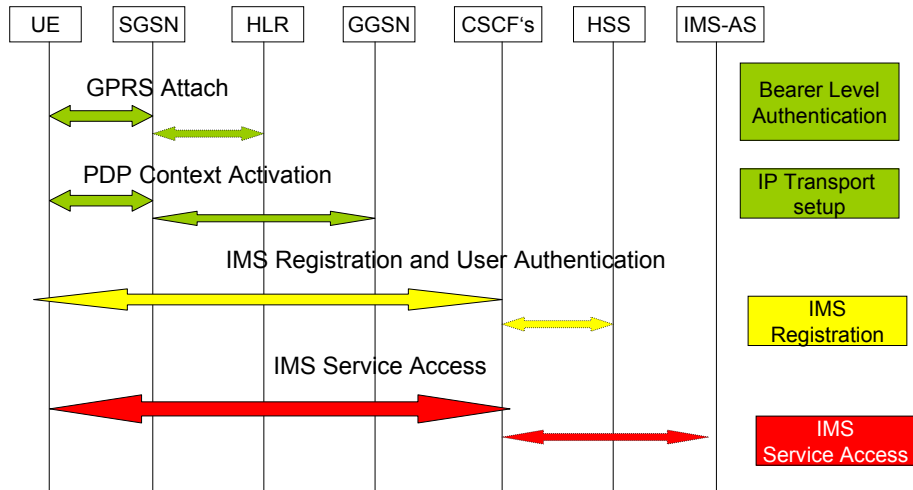
IMS Session Setup & Control

- **This happens after User Registration (and Authentication!)**
- **Why do we need the IMS Session Setup ?**
    - **1. Capability Negotiation (e.g. negotiation of session components, codecs, port numbers, addresses, etc.)**
    - **2. Network Resource Reservation and the support of QoS Preconditions**
- **Additional Functions performed by the IMS during the IMS Session Setup:**
    - **Routing to the Terminating IMS (= the IMS of the B-Party)**
    - **Routing / Breakout to the PSTN / CS-Domain when the B-Party is not in the IMS, but in the PSTN / CS-Domain**
    - **Service Control / Invocation of Application Servers to trigger the execution of Originating- and/or Terminating IMS Services**
    - **Integrity/Confidentiality Protection of SIP Messages**
    - **QoS/Media Authorization**
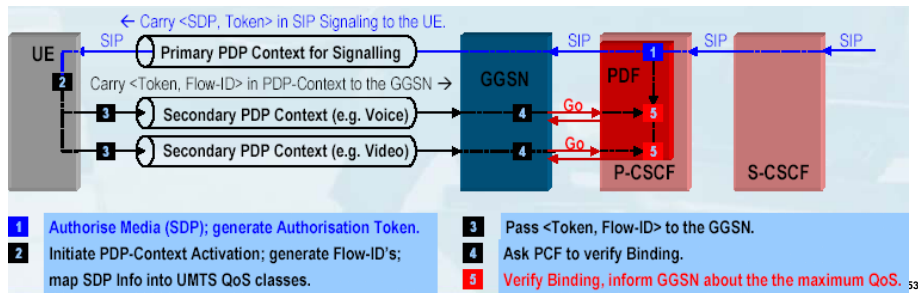   - **SIP Signaling Compression**

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IMS QoS Support

- The actual Network QoS for IMS services is provided by the Access Network (e.g. based on UMTS QoS) and the IMS network infrastructure (e.g. based on Diff-Serv support in routers and switches).

- The IMS provides a correlation and control mechanism based on the use of the Policy-Decision-Function (PDF).

- Key functions of the PDF:
  - acts as Policy Decision Point (PDP):
    - the GGSN is the corresponding Policy Enforcement Point (PEP).
  - authorizes and controls the resource usage for each bearer (e.g. GPRS/UMTS PDP-Context):
    - this prevents the misuse of Network QoS and the theft of service.
    - this allows to limit the resource consumption.
  - exchanges Charging Correlation Identifiers with the GGSN (ICID, GPRS Charging ID):
    - this allows the correlation of charging information generated in the PS-Domain (SGSN, GGSN) and in the IMS (e.g. CSCF, AS).
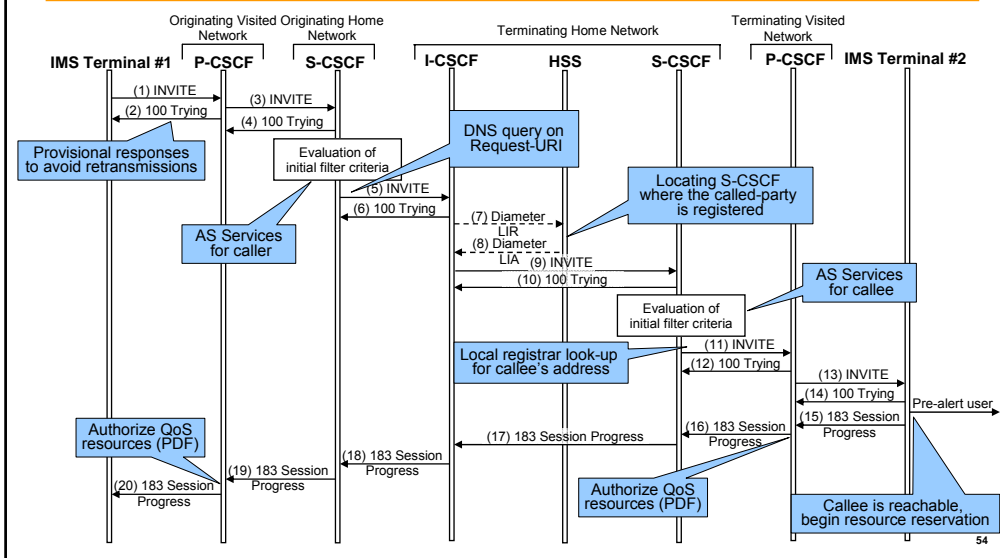
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IMS Session Control – Complex Scenario

| S | Service Control | 2 | Resource Authorization | 3 | Same as 1,2 | O | Open gate |
| 1 | Token generation | RR | Resource Reservation | B | Verify binding | | |

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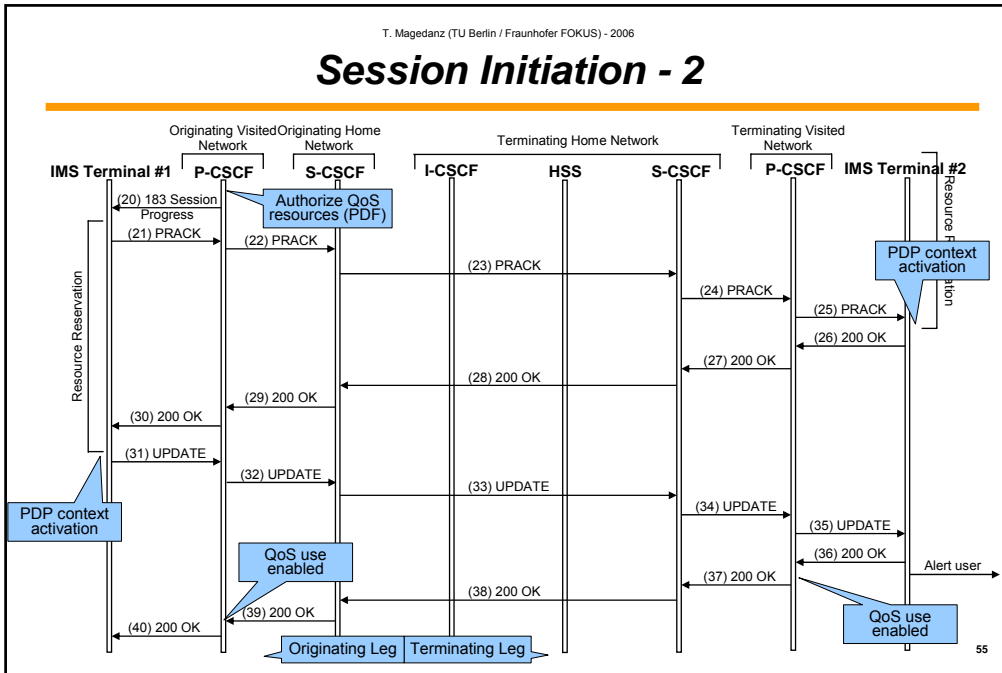Page 26
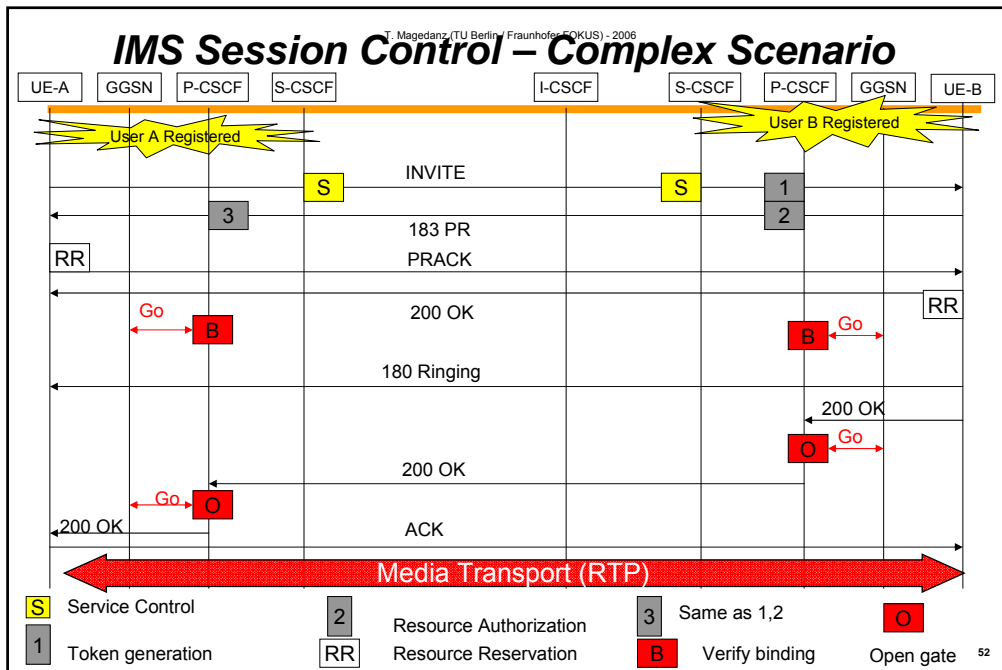
IMS Session Binding and QoS Bearer Control

- **The Media/QoS Authorisation is performed on a per-session basis using the Go-interface and an IMS Authorisation Token used for the IMS Session Binding.**
  - **enables the IMS to: authorise/open/close/modify the IMS Bearer Path (e.g. for Voice/Video Traffic).**
- **IMS Application Servers are not involved in the IMS Session Binding Procedure**.
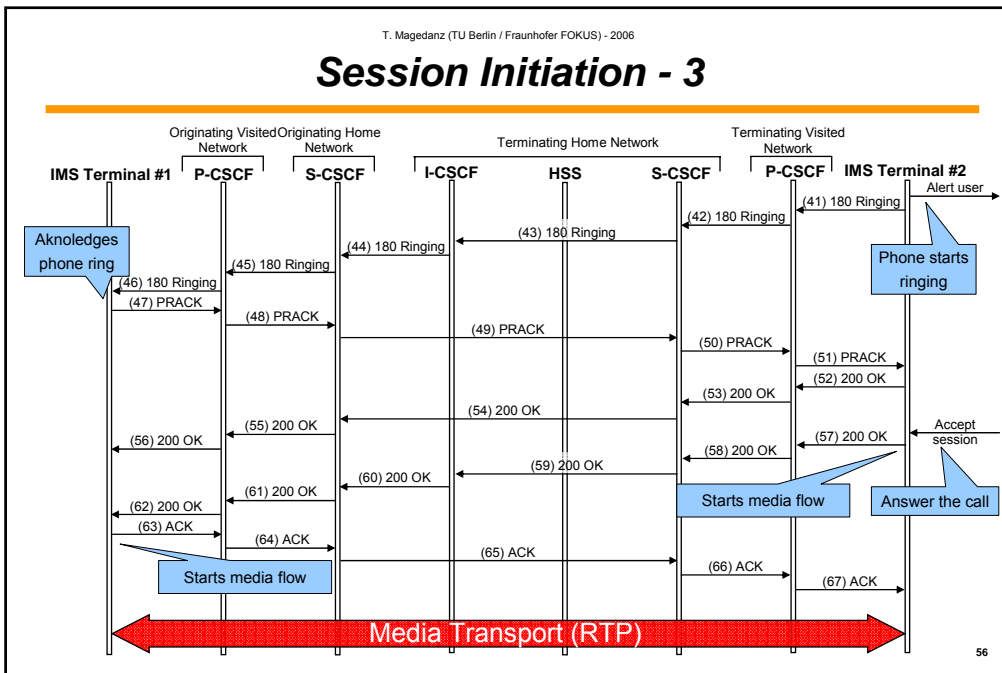

← Carry <SDP, Token> in SIP Signaling to the UE.

Carry <Token, Flow-ID> in PDP-Context to the GGSN →

1	Authorise Media (SDP); generate Authorisation Token.	**3**	Pass <Token, Flow-ID> to the GGSN.
2	Initiate PDP-Context Activation; generate Flow-ID's; map SDP Info into UMTS QoS classes.	**4**	Ask PCF to verify Binding.
		5	Verify Binding, inform GGSN about the the maximum QoS.

Session Initiation - 1

Session Initiation - 2

Session Initiation - 3

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IMS charging and operator strategy

Pricing based on transport

Microsoft **msn**

Mobile Operator **GGSN** — € 1 per MByte —

Instant Messaging
Chat Sessions
Voice Communication
Video Communication
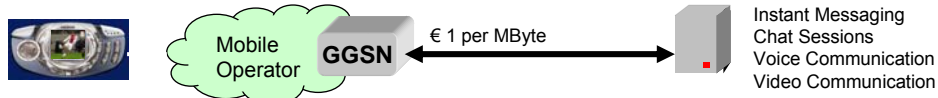
Pricing based on services

IMS

Mobile Operator **GGSN**

€ 0,02 per Instant Message

€ 0,10 per Minute for 128 kbit/s Video

€ 2 per Month for Presence
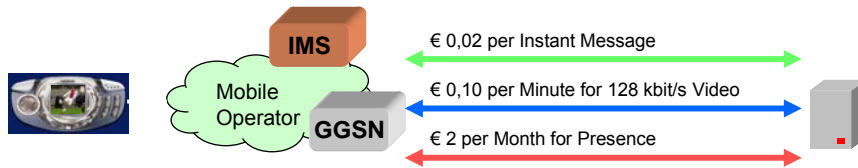
IMS charging provides operators to be more than "bit pipe" provider

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IMS Charging Architecture

- **The IMS is designed to satisfy multiple business models**
- **The IMS charging model provides high flexibility**
- **Examples:**
  - **Charging based on time, bandwidth (AMR vs. G711), media stream (audio, video), services (e.g. instant message, content, etc.), events (presence, warnings etc.)**
- **IMS supports two charging architectures**
  - **Offline Charging (e.g. for post paid contracts)**
  - **Online Charging (e.g. for prepaid contracts)**
- **Main protocol used for charging is Diameter**
  - **With addition of a few AVPs in the Diameter base protocol**
  - **With the addition of a credit control application to support offline charging (Rf interface)**
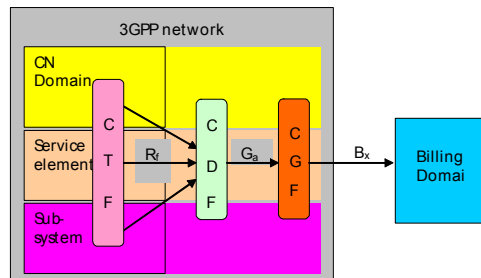
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IMS Charging Architecture

Diameter

File Transfer

CAP

Billing System

SIP-AS
(Supplement
Service)

P-CSCF

S-CSCF

Messaging Server

IMS Elements

**Offline
Charging**

**Online
Charging**

**Bearer
Elements**
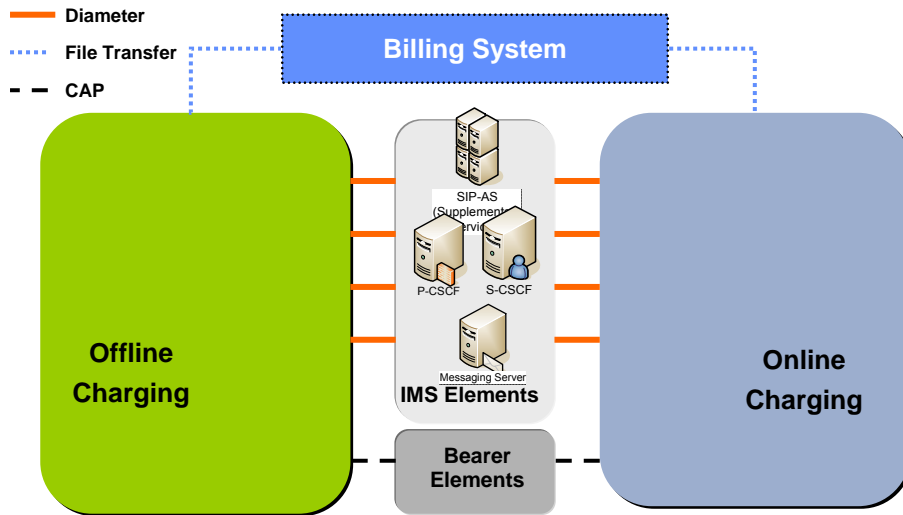
59

# *Offline Accounting Principles*

- **Charging Trigger Function (CTF)**
  - **watches for accountable events**
  - **sends them**
- **Charging Data Function (CDF)**
  - **construct CDRs from events received via Rf reference point**
  - **events may be of several types**
- **Charging Gateway Function (CGF)**
  - **collect, validate and (persistantly) store CDRs (in files)**
  - **forward batch files to Billing domain**

3GPP network

CN Domain

Service element

Sub-system

C T F

R_f

C D F

G_a

C G F

B_x

Billing Domai

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Online Accounting Principles

- **Charging Trigger Function**
    - **Sends events for authorization to OCF**
    - **Must delay resource usage until permission is granted**
    - **Must support quota supervision during resource usage/consumption**
- **Online Charging Function has 2 modules**
    - **Session based Charging**
        - **charges network / user sessions (e.g. voice calls, GPRS PDP contexts or IMS sessions)**
    - **Event based Charging**
        - **event-based online charging (also referred to as "content charging") in conjunction with any application server (e.g. SIP) or service NE**
- **Account Balance Management Function**
- **Rating function (for data volume, session time & service events)**
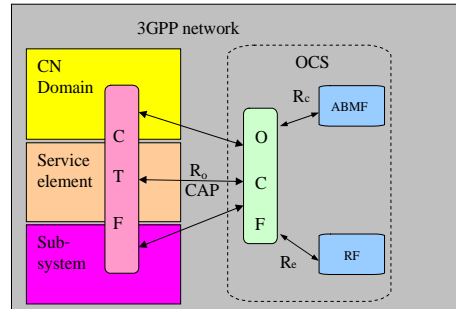
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IMS Security

- **Two security solutions are proposed**
- **Full IMS security**
    - **Standardized in Release 5 and 6 with full features**
    - **Defines security in the network and the terminals**
    - **Requires ISIM and rich features in the terminal, P-CSCF and S-CSCF**
- **Early IMS Security**
    - **Standardised in Release 6**
    - **Idea: Reuse GPRS authentication (and IP address) for IMS authentication**
    - **Developed for early IMS deployment without existance of all security enablers**
    - **Not stringend as the full IMS security solution**
    - **Intended to have minimal impact on existing terminals**
   - **Offers less security but good enough for early deployment**

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Complete IMS Security Solution

- **Divided into:**
    - **Network Domain Security (already existing for GPRS)**
    - **Access Domain Security (linked to SIP and CSCFs / HSS)**
- **SIP Security is provided on a hop-by-hop fashion**
    - **End-to-end security is not supported !**
- **Terminals accept a UICC (Universal Intergraded Circuit Card) that contains an ISIM (IMS Subscriber Identity Module) application**
- **The ISIM stores identities (public, private), home domain, and long term security keys**
- **The S-CSCF authenticates the user at SIP registration time**
- **The security mechanism is negotiated (but only IPSec is supported so far)**
- **Authentication scheme based on the UMTS AKA (Authentication and Key Agreement) called IMS AKA**
- **Delegate identity enforcement to the P-CSCF**
- **P-CSCF and UE establish an IPSec connection for integrity protection (Release 5 onwards) and confidentiality (Release 6 onwards)**

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Complete IMS Security
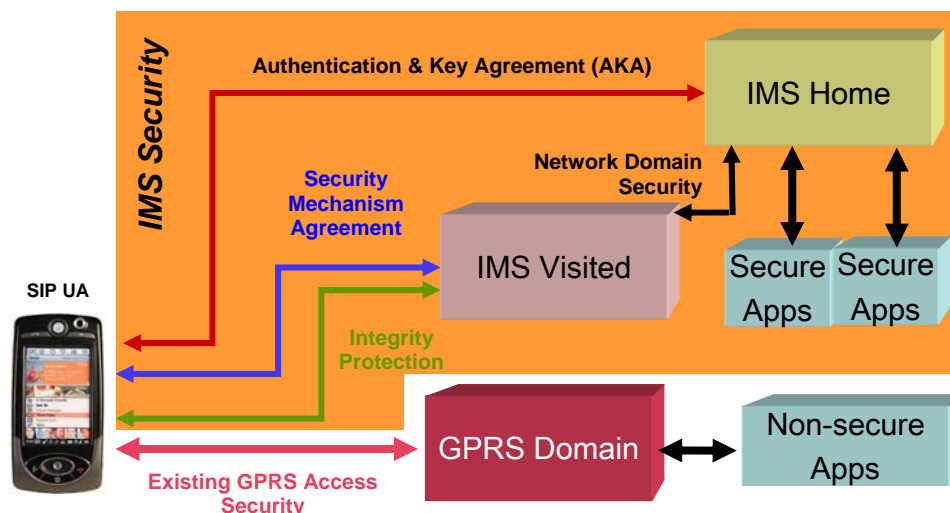
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Overview

- **IMS Motivation**
- **IMS Overview**
- **IMS Key protocols (IETF SIP and Diameter)**
- **IMS Key components**
- **IMS Application Server options**
- **Sample IMS Multimedia Applications**
- **The IMS Playground @ FOKUS**
- **Summary**
- **Q&A and IMS Playground Demos**
- *References & Acronyms*

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IMS Service Invocation and Interaction

- **Service triggers on initial SIP requests at SIP Proxy (S-CSCF)**
- **Service Proxy proxies request to corresponding AS based on triggers and Filters**
- **AS acts as user agents, proxy server, 3PCC or B2BUA**
- **AS may Record-Route SIP request to stay in signalling path**
- **Service Proxy maintains the states between dialogs sent to/from applications**
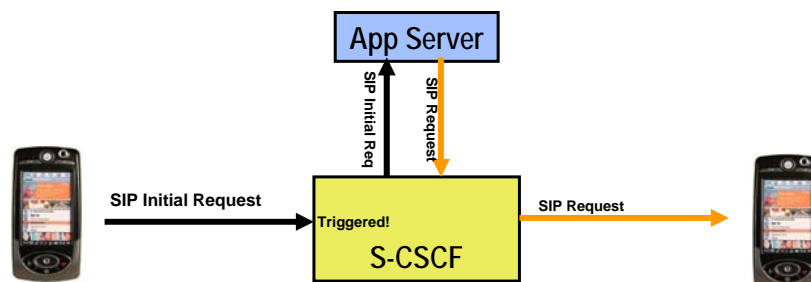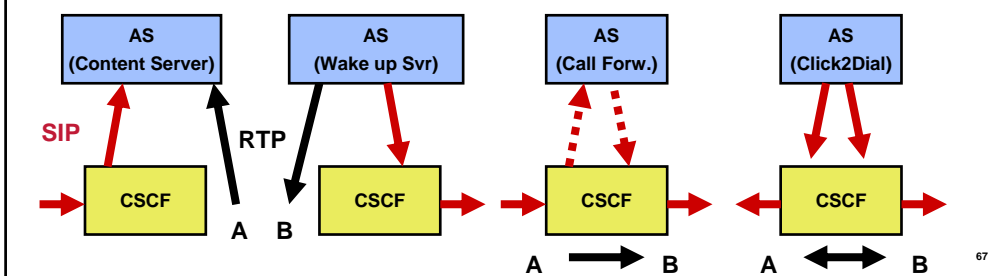

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SIP enables different AS Modes of Operation

Four modes of operation are distinguished:

• **Application Server acting as terminating UA, or redirect server**

• **Application Server acting as originating UA**

• **Application Server acting as a SIP proxy**

• **Application Server performing third party call control/ B2BUA mode**

AS (Content Server)	AS (Wake up Svr)	AS (Call Forw.)	AS (Click2Dial)

SIP   **RTP**

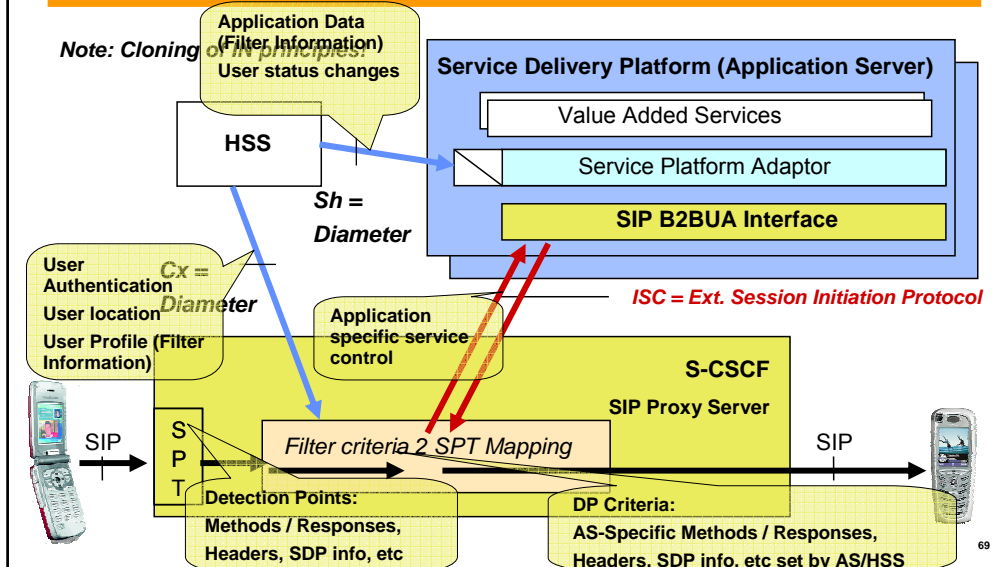| CSCF	CSCF	CSCF	CSCF

A   B

A → B   A ↔ B

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How does a SIP AS Provide Enhanced Services

• **S-CSCF determines that a call requires enhanced service processing**
  – *Filtering* **may be based on calling / called party or other mechanism (defined by filtering criteria) eg. SIP message type, header fields, etc.**

• **Based on filtering criteria, the S-CSCF determines the address of the Application server and *relays* the call to the AS function. The Application Server receives the call and invokes the appropriate service logic taking one of the following actions:**
  – *Redirects the call to a new destination*
  – *Send the call back through the S-CSCF in order to monitor subsequent call events (ie act as a SIP Proxy)*

• **The Application Server (based on some other input) can also set-up calls between *other* entities in the network (ie. act as a *B2BUA*)**

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Major Service Platform Interfaces

Note: Cloning of IN principles!

Application Data (Filter Information) User status changes

HSS

Sh = Diameter

Service Delivery Platform (Application Server)

Value Added Services

Service Platform Adaptor

SIP B2BUA Interface

User Authentication

Cx = Diameter

User location

User Profile (Filter Information)

Application specific service control

ISC = Ext. Session Initiation Protocol

S-CSCF

SIP Proxy Server

SIP

S P T

Filter criteria 2 SPT Mapping

SIP

Detection Points:

Methods / Responses, Headers, SDP info, etc

DP Criteria:

AS-Specific Methods / Responses, Headers, SDP info, etc set by AS/HSS

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Cx (and Dx) Interface

- **Cx - Interface supports information transfer between S-CSCF and HSS**
  - **Diameter application for user profile handling & user authentication**
    - **to exchange location information**
    - **to authorize a user to access the IMS**
    - **to exchange authentication information**
    - **to download and handle changes in the user data stored in the server**
- **Dx – Interface between I-CSCF and the Subscription Locator Function (SLF) – in case of HSS look-up**
  - **Diameter redirect agent functionality to retrieve an HSS address**

- **Both RPs are pecified in 3GPP TS 29.228 and TS.29.229**
  - **TS 29.228 IM Cx and Dx interfaces; Signalling flows and message contents**
 - **TS 29.229 IM Cx and Dx interfaces based on the Diameter protocol; Protocol details**
  - **(http://www.3gpp.org/ftp/Specs/archive/2x_series/2x.xxx)**

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Sh Interface

- **Interface between HSS and Application Server (AS)**
- **Diameter application that allows a Diameter server and a Diameter client:**
    - to download and update transparent and non-transparent user data
    - to request and send notifications on changes on user data

- **Further information on the Sh reference point is provided in**
    - **TS 29.328 IM Sh interface; Signalling flows and message contents**
    - **TS 29.329 IM Sh interface based on the Diameter protocol; Protocol details**

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IMS Filter Criteria

- **IFC Details:**
  - the IFC contents:
    - **1) Trigger Point**
    - **2) Service/AS Identifier**
  - Trigger Point contains one or more Service Triggers linked via the logical expressions (AND, OR, NOT, EQUAL)
  - Service Trigger includes:
    - **1) Request URI content**
    - **2) SIP Method, eg. INVITE, REGISTER ...**
    - **3) SIP Header content**
    - **4) Session Mode (originating, terminating)**
    - **5) SDP content**
- **AS Identifier have SIP URI format e.g. sip:As1@as.operator.com**

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IMS Initial Filter Criteria

- The IFC is the key point for service provisioning in IMS and specified in 3GPP TS 23.218 and 29.228
- The S-CSCF downloads the IFC's for a particular user from HSS and has the ability to forward SIP messages to an appropriate Application Server (SIP AS, OSA SCS)
- AS application/service invocation is triggered as a result of a pattern matching on any SIP header or body
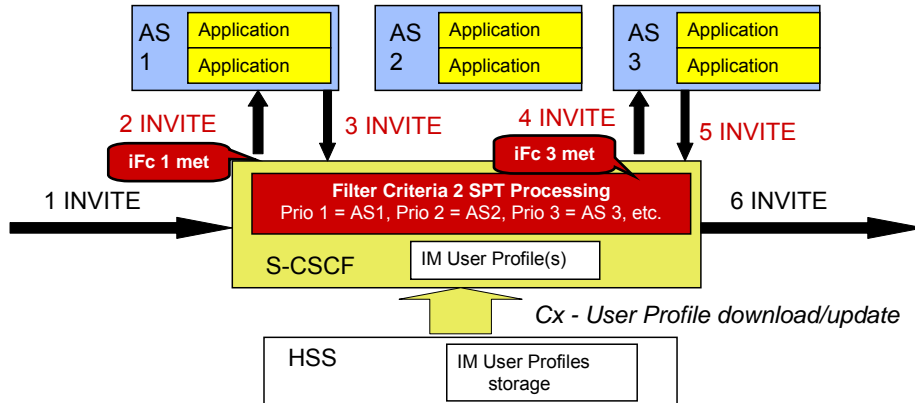
Scalability of the IMS

Page 37
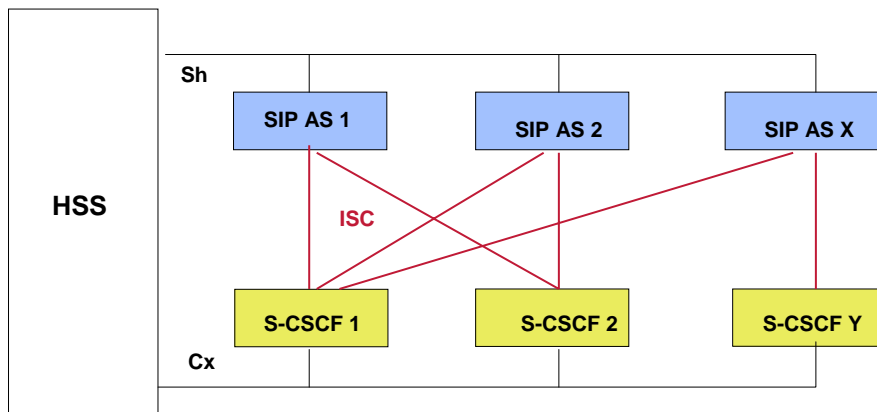
Requirements for an Application Server

- **Same as the definition for application servers it is hard to set the boundaries of the requirements for application servers.**
- **There are "must have" requirements for application servers.**
  - **Same requirements on scalability, fauth tolerance, security and so on as for any other entity in an IMS environment.**
  - **An Application Server must have at least one Application Programming Interface (ISC).**
  - **An Application Server must have at least one standard compliant network interface.**
- **There are "may have" requirements for application servers.**
  - **Certain applications require multiple standard compliant network interfaces.**
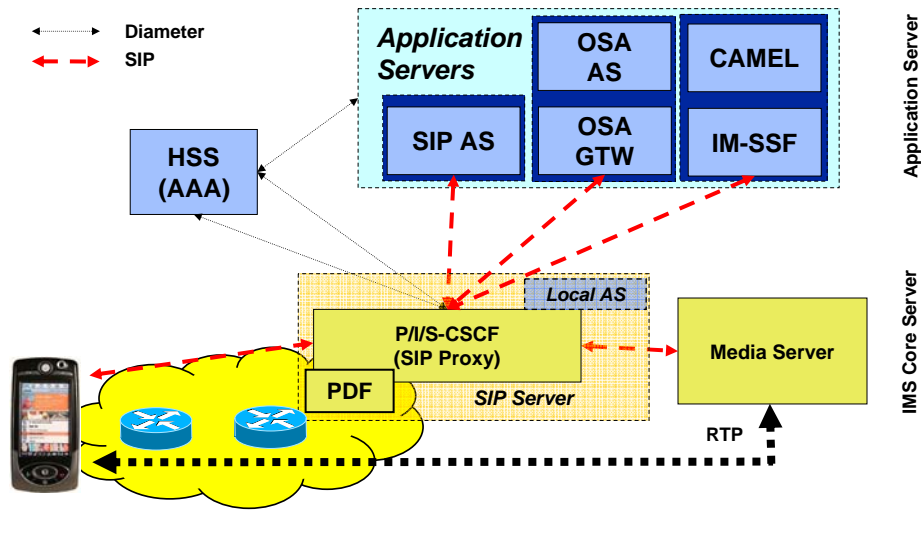 - **Certain applications require multiple Application Programming Interfaces.**

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Network Interfaces and APIs of a SIP AS
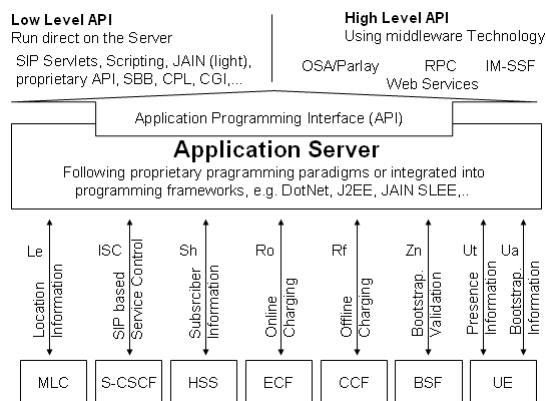
- **Within this Part of the tutorial we have a close look into all parts of an application server!**

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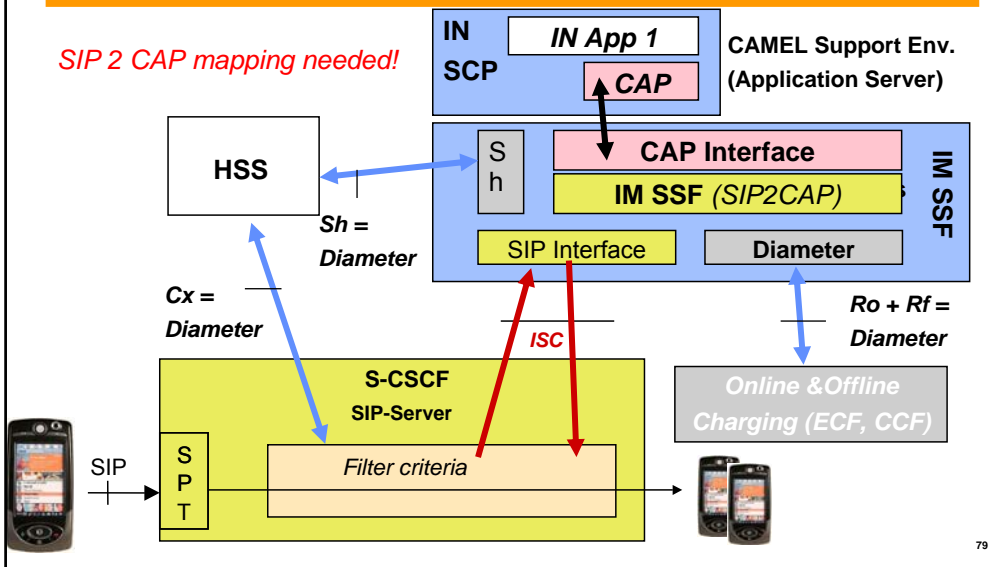## *IMS Application Server Options*
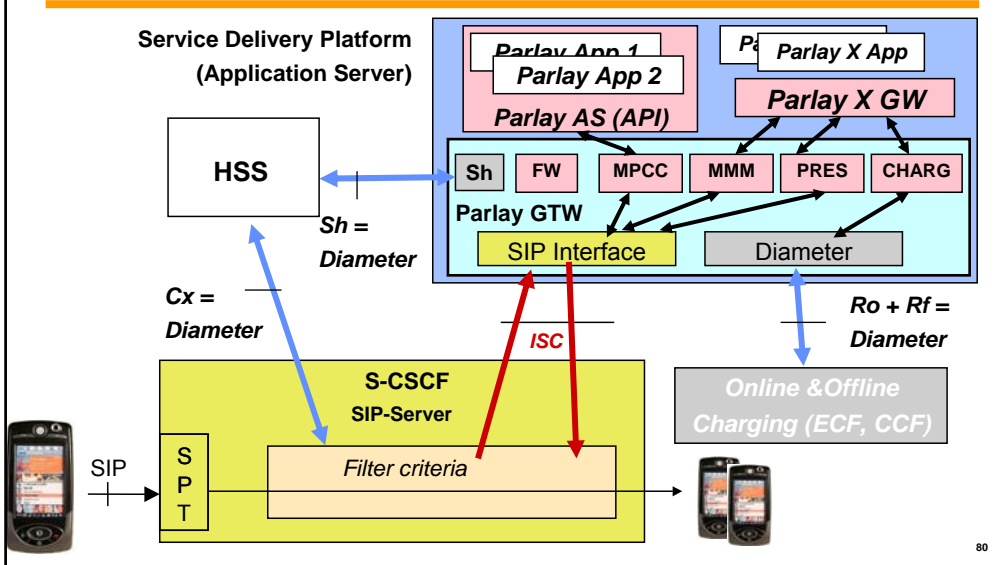
Different AS Alternatives

- **CAMEL Services via Camel Support Environment (CSE):**
  – intended for the support of existing IN Services (provides service continuation).
- **OSA Services via Open Service Access Service Capability Server:**
  – intended for the support of 3rd Party Application Providers. OSA SCS provides access and resource control.
- **IMS services on SIP-Application Server:**
  – intended for new services. A multitude of widely known APIs (CGI, CPL, SIP Servlets) is available.
- **IMS services directly on the CSCF (similar to SIP AS):**
  – SIP-AS co-located on the CSCF
  – seems to be useful for simple services. May be beneficial for the Service Availability and the Service Performance.
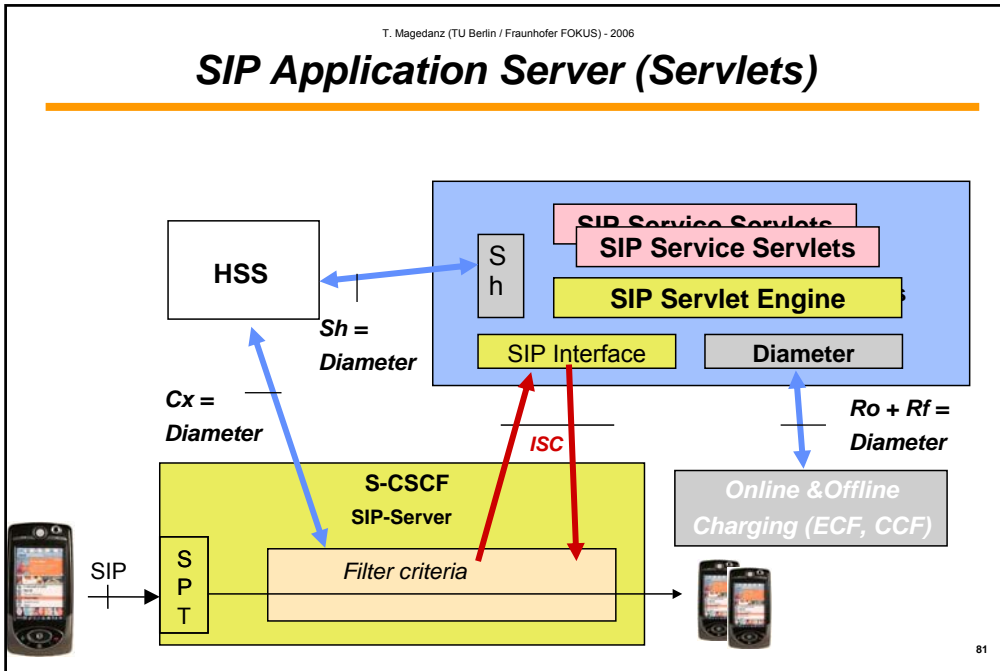
Page 39

CAMEL Reuse within IMS

SIP 2 CAP mapping needed!

IN SCP

IN App 1

CAP

CAMEL Support Env.
(Application Server)

HSS

S h

CAP Interface

IM SSF *(SIP2CAP)*

IM SSF

Sh = Diameter

SIP Interface

Diameter

Cx = Diameter

Ro + Rf = Diameter

ISC

S-CSCF
SIP-Server

Online &Offline
Charging (ECF, CCF)

SIP

S P T

Filter criteria

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OSA / Parlay AS within IMS

Service Delivery Platform
(Application Server)

Parlay App 1

Parlay App 2

Parlay X App

Parlay AS (API)

Parlay X GW

HSS

Sh | **FW** | **MPCC** | **MMM** | **PRES** | **CHARG**

Parlay GTW

Sh = Diameter

SIP Interface

Diameter

Cx = Diameter

Ro + Rf = Diameter

ISC

S-CSCF
SIP-Server

Online &Offline
Charging (ECF, CCF)

SIP

S P T

Filter criteria

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Page 40
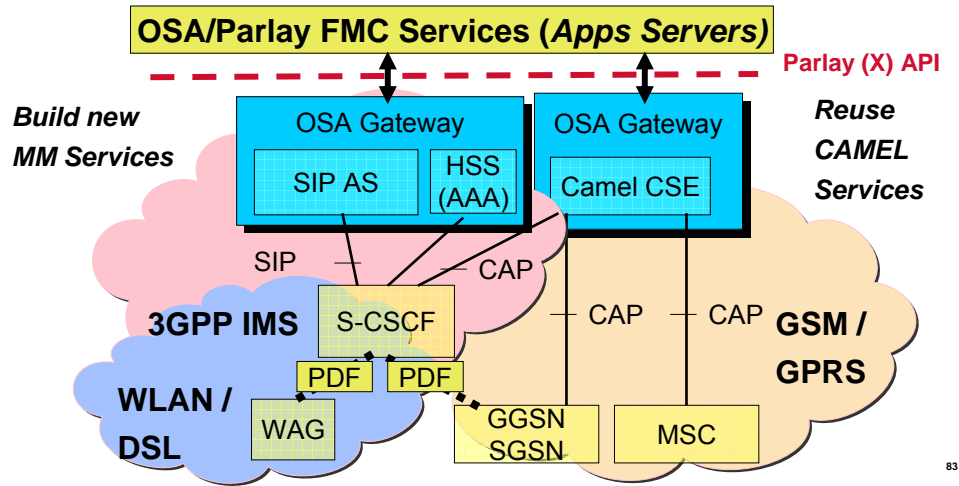
SIP Application Server (Servlets)

SIP AS vs. CAMEL vs. OSA/Parlay

- **CAMEL** supports:
  - **legacy IN** services in 2G and 3G networks
  - Services based on **proven** and **reliable IN** technology (reuse!)
  - But CAMEL is expensive and limited in evolution

- **SIP AS** supports:
  - **Multimedia conferencing** services, integrated with HTTP
  - Exploitation of cheaper **internet** technology
  - Easier service creation, but not yet proven for carrier grade services

- **OSA** is an API (!!) which could be mapped to boh CAMEL and SIP
  - **OSA is enabling EAI in Telecoms**
  - Proven technology (reuse of existing services in NGN)
  - Support implementation of different business model (walled vs. open garden)
  - Best support of 3rd parties

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Relating OSA/Parlay vs. CAMEL vs. SIP AS

*Seamless NGN Services (opt. by 3rd Parties)*

OSA/Parlay FMC Services (*Apps Servers*)

Parlay (X) API

Build new MM Services

OSA Gateway

SIP AS | HSS (AAA)

OSA Gateway

Camel CSE

Reuse CAMEL Services

SIP — CAP

3GPP IMS — S-CSCF

PDF | PDF

WLAN / DSL — WAG

GGSN SGSN

CAP — CAP

MSC

GSM / GPRS

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Overview

- **IMS Motivation**
- **IMS Overview**
- **IMS Key protocols (IETF SIP and Diameter)**
- **IMS Key components**
- **IMS Application Server options**
- **Sample IMS Multimedia Applications**
- **The IMS Playground @ FOKUS**
- **Summary**
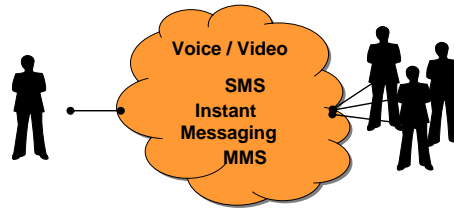- **Q&A and IMS Playground Demos**
- *References & Acronyms*

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IMS integrates different Communication Services

Pre-IMS Communication ("Service Islands")

Voice
SMS
Instant Messaging
MMS
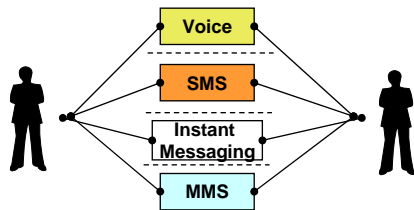
From the usage of specific individual communication services ...

IMS Communication ("Combinational Services")

Voice / Video
SMS
Instant Messaging
MMS

... to the integrated usage of different communication services centered around presence information and within groups (➔ communities)

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IMS Applications

IP Multimedia Subsystem (IMS)

Server–to-User:
• Push Services
• Click to Dial
• Click to Chat
• Presence

User–to-User:
• Voice over IP
• Video calls
• Text (Instant Messaging)
• Push to Talk
• Gaming

Packet Switched

User – to – Server:
• MMS
• Streaming
• Content Browsing

Multi-user:
• Voice conferencing
• Video conferencing
• Document sharing/
• Collaborative Working

Circuit Switched

User–to–User:
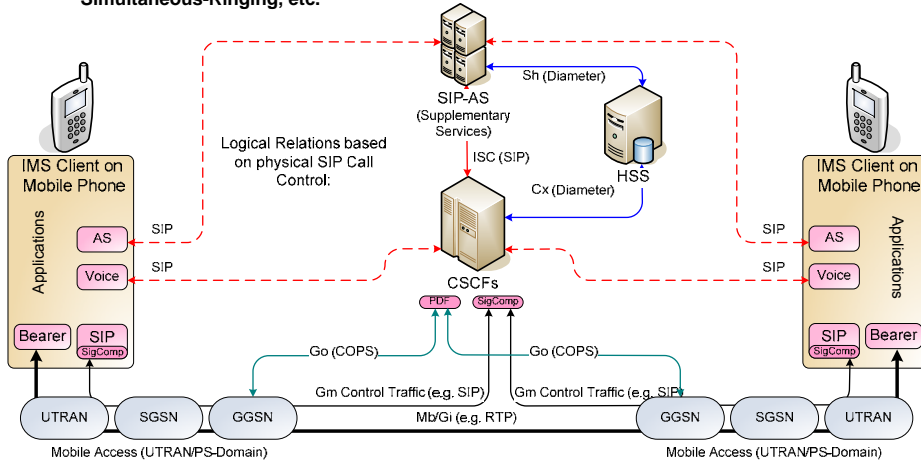• Standard Voice calls

Bandwidth Requirement

Number of Applications

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# IMS for VoIP Supplementary Services

- **Example IMS Service Architecture for an IMS Voice/Video/Data telephony service:**
  - **the SIP-AS provides Supplementary Services such as e.g. Call-Forwarding, Call-Barring, Simultaneous-Ringing, etc.**

IMS for Presence, Push 2 Talk, IM

- **Example IMS Service Architecture for the IMS services:**
  - **Presence,**
  - **Push-to-Talk (PTT),**
  - **Instant Messaging (IM)**

Page 44
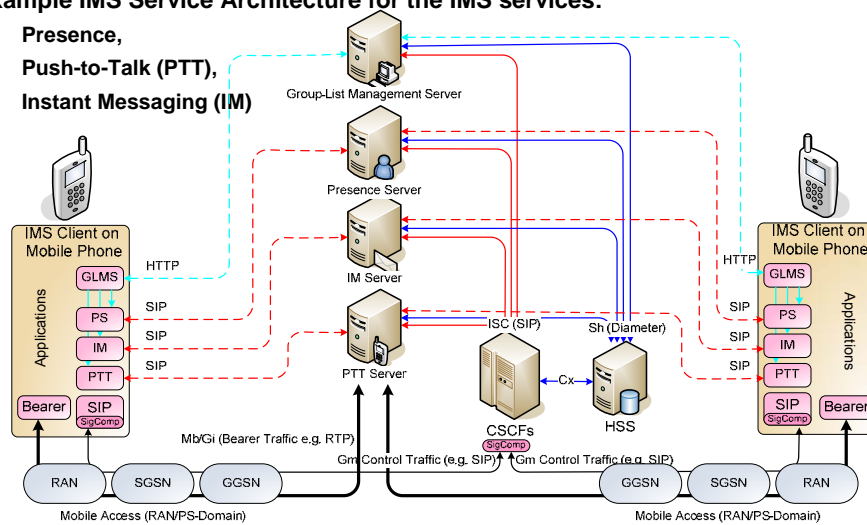
OMA Service Enablers and IMS

- **IMS provides the following:**
  - Routing and reachability
  - Authentication and transitive trust
  - Signaling compression
  - Privacy
  - User profile storage
  - Charging, accounting
  - Interface to the access network
- **OMA SIP-based service enablers are specified on top of IMS as common platform, e.g.**
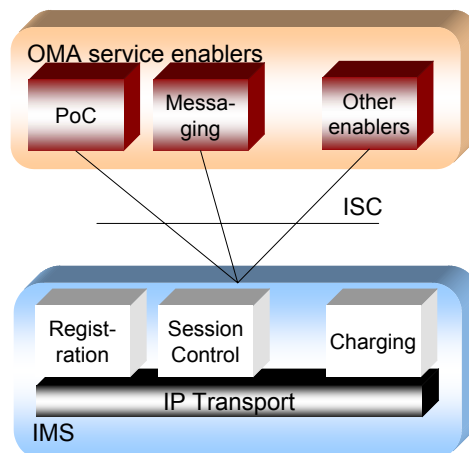 - **Presence, Group Management, etc.**

Standards

OMA for Application Enablers

3GPP for Network Architecture

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OMA Service Enablers and IMS

OMA service enablers

PoC | Messa-ging | Other enablers

ISC

Regist-ration | Session Control | Charging

IP Transport

IMS

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Push to Talk over Cellular (PoC)

- **PoC is standardised in the Open Mobile Alliance (OMA), Rel. 1 in 2005**
- **First specification process was initiated by the MENSA (Motorola, Ericsson, Nokia, Siemens, AT&T Wireless) consortium in 2002, 2003**
- **PoC is a way of communication that uses half-duplex connections**
  - **similar to walkie-talkie functionality**
  - **allows to deliver a talk burst to a collection of users**
- **PoC client is (usually) in the handset as a soft client**
- **PoC server has ambiguous functionality: It manages both the signalling and also the media**
  - **By definition the PoC server is acting as a SIP AS, connecting to IMS CN through the ISC interface**
- **OMA PoC does not consider access network issues (any access network can be used)**
- **OMA PoC requires the XML Document Management (XDM) enabler for group session configuration**
- **OMA PoC may use OMA XDMS architecture for presence as a presence enabler**
- **Dedicated floor control messages are used to grant access to the floor to ensure semi-duplex paradigm**

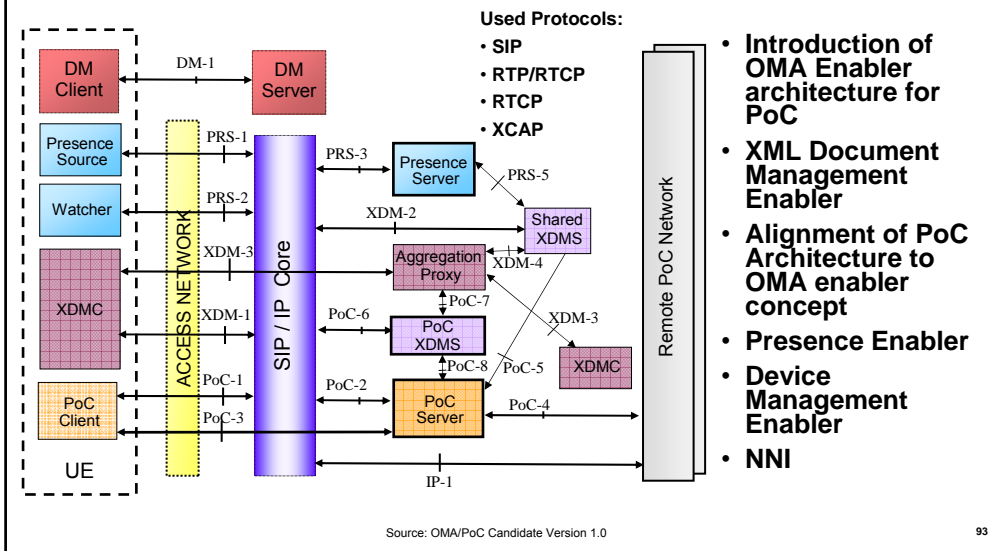91

MENSA PoC Architecture Rel. 1 (2002)
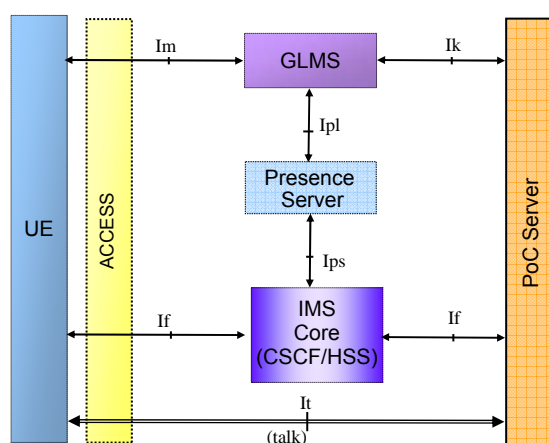
- **Introduction of Group List and Management Server**
- **No presence functionality required**
- **No Network-Network Interworking (NNI)**
- **No automated device configuration**

Source: PoC MENSA Rel. 1.1

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OMA PoC Architecture Rel. 1 (2005)

Used Protocols:
- **SIP**
- **RTP/RTCP**
- **RTCP**
- **XCAP**

- **Introduction of OMA Enabler architecture for PoC**
- **XML Document Management Enabler**
- **Alignment of PoC Architecture to OMA enabler concept**
- **Presence Enabler**
- **Device Management Enabler**
- **NNI**

Source: OMA/PoC Candidate Version 1.0

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3GPP2 Multimedia Domain (MMD)

- **3GPP2 MMD is a reference architecture model for cdma2000 family based wireless core network**
- **Main specifications:**
- **- "All-IP Core Network Multimedia Domain: Overview"**
  - **http://3gpp2.org/Public_html/specs/X.S0013-000-0_v1.0_022604.pdf**
- **- "IP Network Architecture Model for cdma2000 Spread Spectrum Systems"**
  - **http://3gpp2.org/Public_html/specs/S.R0037-0_v3.0_111303.pdf**
- **based on IP protocols, elements and principles**
- **Main protocols are (IETF's) SIP, DIAMETER and Mobile IP**
- **Consists of:**
  - **Packet Data Subsystem (PDS): supports general packet data service**
  - **IP Multimedia Subsystem (IMS): provides multimedia session capabilities**

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3GPP2 vs. 3GPP

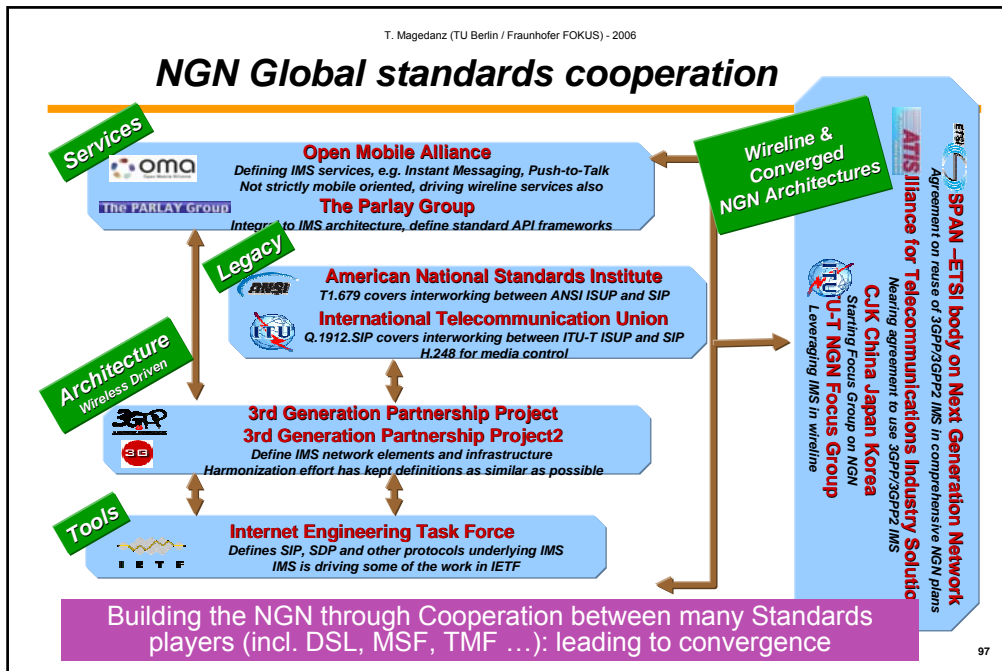| Feature	3GPP	3GPP2
Mobility management	GPRS tunneling	Mobile IP
IP version	IPv4 and IPv6	IPv6
HSS	Database and AAA	Database only, separated AAA
Speech codec	AMR	EVRC and SMV
P-CSCF discovery	Through PDP context activation and DHCP	No support of PDP context
Si interface	Between HSS and IM-SSF (CAMEL)	Not defined, since there is no CAMEL
Smart card	Defined a UCC (USIM or ISIM)	Configuration and security stored in the IMS terminal or in R-UIM (Removable User Identity Module)
P-CSCF location	P-CSCF and GGSN are in the same network	P-CSCF and PDSN (Packet Data Service Node == GGSN) may be in different network
Anchored GGSN/PDSN	Allocated prior to registration	May change even during a session
Go interface	Defined between PDF & GGSN	Not defined yet
Location information	Through Sh interface	Through a Position Server and Position Determining Entity (PDE)

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The NGN Definition

- A new telecommunications network for broadband fixed access
- NGN facilitates convergence of networks and services
- NGN enables different business models across access, core network and service domains
- NGN will be an IP based network
- SIP will be used for call & session control
- 3GPP release 6 IMS will be the base for NGN IP Multimedia Subsystem
- NGN enables any IP access to Operator IMS; from
  - Mobile domain
  - Home domain
  - Enterprise domain
- NGN enables service mobility
- NGN enables interworking towards circuit switched voice
- NGN maintains Service Operator control for IMS signalling & media traffic
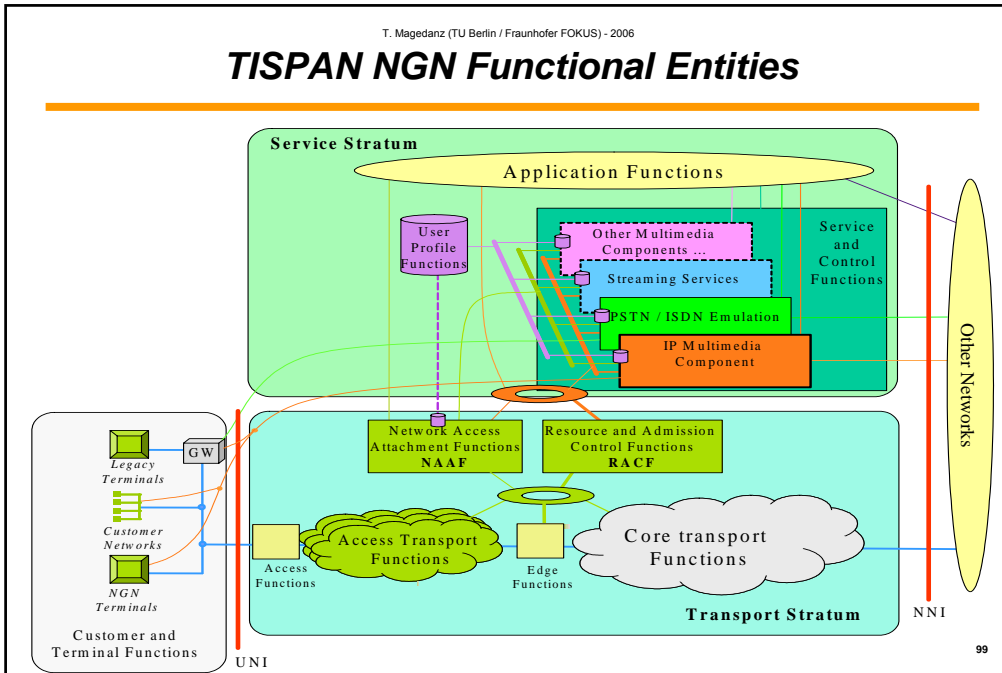
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NGN Global standards cooperation

Services

Open Mobile Alliance
Defining IMS services, e.g. Instant Messaging, Push-to-Talk
Not strictly mobile oriented, driving wireline services also

The Parlay Group
Integr. to IMS architecture, define standard API frameworks

Legacy

American National Standards Institute
T1.679 covers interworking between ANSI ISUP and SIP

International Telecommunication Union
Q.1912.SIP covers interworking between ITU-T ISUP and SIP
H.248 for media control

Architecture
Wireless Driven

3rd Generation Partnership Project
3rd Generation Partnership Project2
Define IMS network elements and infrastructure
Harmonization effort has kept definitions as similar as possible

Tools

Internet Engineering Task Force
Defines SIP, SDP and other protocols underlying IMS
IMS is driving some of the work in IETF

Wireline & Converged NGN Architectures

ATIS **Alliance for Telecommunications Industry Solutio**

ITU-T NGN Focus Group
CJK China Japan Korea
Starting Focus Group on NGN
Leveraging IMS in wireline

ETSI SPAN –ETSI body on Next Generation Network
Agreement on reuse of 3GPP/3GPP2 IMS in comprehensive NGN plans
Nearing agreement to use 3GPP/3GPP2 IMS

Building the NGN through Cooperation between many Standards players (incl. DSL, MSF, TMF …): leading to convergence
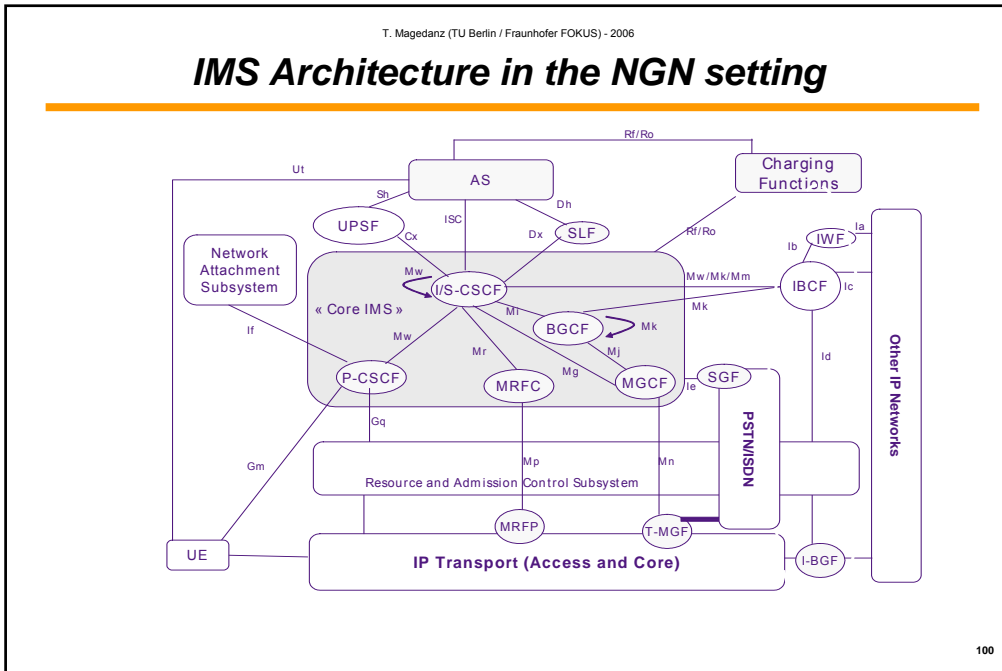
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ETSI TISPAN

- The European Telecommunications Standards Institute (ETSI) is an independent, non-profit organization, whose mission is **to produce telecommunications standards** for today and for the future.
- The Next Generation Network will provide:
  - A multi-service, multi-protocol, multi-access, IP based network - secure, reliable and trusted
    - **Multi-services**: delivered by a common QoS enabled core network.
    - **Multi-access**: several access networks; fixed and mobile terminals.
    - **Not one network**, but different networks that interoperate seamlessly
  - An enabler for Service Providers to offer
    - **real-time and non real-time communication services**
    - between **peers** or in a **client-server** configuration.
  - **Nomadicity and Mobility**
    - of both users and devices
    - intra- and inter-Network Domains, eventually between Fixed and Mobile networks
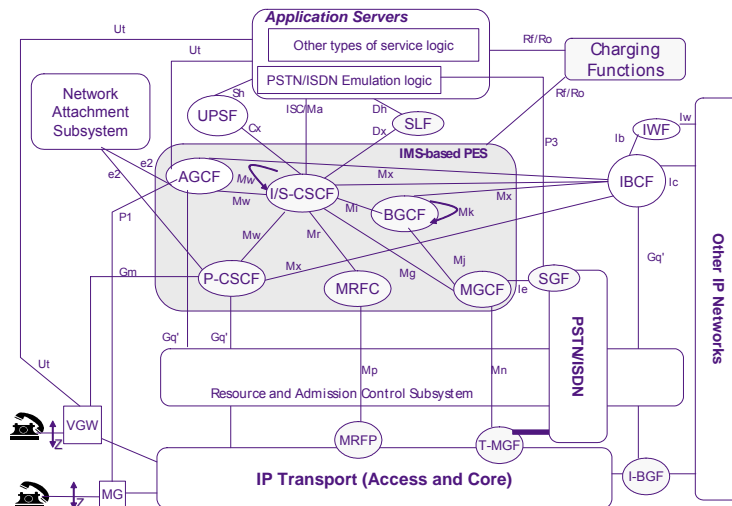
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TISPAN NGN Functional Entities

Service Stratum

Application Functions

User Profile Functions

Other Multimedia Components ...

Streaming Services

PSTN / ISDN Emulation

IP Multimedia Component

Service and Control Functions

Other Networks

Network Access Attachment Functions **NAAF**

Resource and Admission Control Functions **RACF**

Legacy Terminals

GW

Customer Networks

NGN Terminals

Access Functions

Access Transport Functions

Edge Functions

Core transport Functions

Transport Stratum

NNI

Customer and Terminal Functions

UNI

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IMS Architecture in the NGN setting

Rf/Ro

Ut

AS

Charging Functions

Sh

Dh

UPSF

ISC

Dx

SLF

Rf/Ro

Ia

IWF

Cx

Ib

Ic

Network Attachment Subsystem

Mw

I/S-CSCF

Mw/Mk/Mm

IBCF

« Core IMS »

Ml

BGCF

Mk

Mk

If

Mw

Mr

Mg

Mj

Id

Other IP Networks

P-CSCF

MRFC

MGCF

Ie

SGF

Gq

PSTN/ISDN

Gm

Mp

Mn

Resource and Admission Control Subsystem

MRFP

T-MGF

UE

IP Transport (Access and Core)

I-BGF

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TISPAN PES - Functional Architecture

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3GPP R6 and TISPAN R1 NGN: R6 comparison

- Network Attachment System
  - 3GPP: GPRS entities + HLR (PS part)
  - TISPAN: NASS entities

- Resource Admission Control
  - 3GPP: PDF and GGSN
  - TISPAN: RACS entities +
    RCEF and BGF entities

- MM Session Control
  - 3GPP: IMS (R6)
  - TISPAN (R1) IMS (R6)

- **TISPAN Documentation:**
  - *http://portal.etsi.org/docbox/tispan/Open/NGN-R1/Stable_Drafts/*

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Upcoming IMS Release 7

- **Emergency calls in PS and IMS**
  - **TR 23.867 - Two building blocks: IMS and PS side. IMS side is given priority to meet TISPAN Rel1 schedule. TISPAN inputs and requirements will be taken into account**
- **End-to-end QoS**
  - **TR 23.802 provides various scenarios and mechanisms to manage and guarantee e2e QoS**
- **Policy Control Evolution and Charging**
  - **TS 23.803 - Evolution of the Policy Control and IP Flow Based Charging**
    - **addition of subscription profile to Policy Control**
    - **Merging of Go and Gx interface**
- **Mp (MRFC - MRFP) interface protocol definition**

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Overview

- **IMS Motivation**
- **IMS Overview**
- **IMS Key protocols (IETF SIP and Diameter)**
- **IMS Key components**
- **IMS Application Server options**
- **Sample IMS Multimedia Applications**
- **The IMS Playground @ FOKUS**
- **Summary**
- **Q&A and IMS Playground Demos**
- *References & Acronyms*

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Joseph von Fraunhofer (1787 - 1826)

The person who has given the name is a good example for what we do!

Scientist
Discovery of "Fraunhofer-Lines" within the sun light spectrum

Inventor
New processing methods for lense crafting

Entrepreneur
Director of a glass works factory
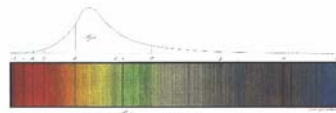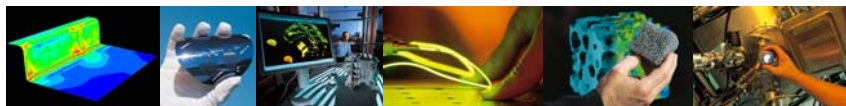

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Fraunhofer Society: Profile

58 Institutes   **12 750 Employees**

1 Billion € Budget

7 Alliances
- **Microelectronics**
- **Production**
- **Information and Communication Technology**
- **Materials and Components**
- **Life Sciences**
- **Surface Technology and Photonics**
- **Defence and Security**

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Fraunhofer FOKUS Facts

– **FOKUS has been founded 1988 in Berlin, Germany**
– **220 employees: scientists, students, technicians originating from 30 nations**
– **FOKUS is THE Telecoms R&D institute within the Fraunhofer Society**
   - **Fraunhofer Society is the biggest German R&D organisation, total # of 12.000 employees)**
   - **60 institutes in total, 15 institutes in ICT**
– **FOKUS works since 17 years on convergence of IT, telecoms, internet and home entertainment and performs applied research and development projects**
   - **Performs strategic studies, solution concepts, system integration and prototyp developments**
   - **Strong cooperation with universities & Establishment of spin offs (e.g. iptelorg.com)**
– **FOKUS fundung: 20% state, 80% industry R&D projects**
   - **Key to success: Strategic Partnerships with big players (DTAG, NTT, etc)**
– **Main R&D Vision:** *„I-centric communications"* **and** *„autonomic communications"*

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NGN Testbed @ Fraunhofer FOKUS

National 3Gb R&D Projects
European 3Gb R&D Projects

mHealth | mGov | mXXX. | Other Apps
Applications

Parlay Playground

Web services | Parlay | IMS* | AAA | SIP
IMS Playground
3Gb Roaming | Service Platforms & Middleware | Other platforms

UMTS FDD/TDD | GSM / GPRS | WLAN a/b/x | DVB-S/T | Other Netws
3Gb Network Technologies

Engineering Tools, Conformance Testing, Measurments, and Management

Nat. Open 3Gb Test & Development Center
– **Provision of a unique 3Gb Testbed covering all three 3G beyond layers**
– **Foundation for industrial and academic projects**
   - **Applications development support**
   - **Applications validation**
   - **Service Platform prototyping**
   - **Infrastructure component testing**
   - **Network Technologies integration**
   - **....**
– **Officially supported by**

*www.fokus.fraunhofer.de/national_host*

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IMS playground @ FOKUS

- **forms a globally unique state of the art IMS infrastructure featuring all major IMS componentsand interfaces**
- **is a key infrastructure of the FOKUS NGN Service Delivery Platform test and development center**
- **comprises**
  - **a full IMS based on own developments**
  - **additional best of bread carrier grade components from partners**
- **Goals:**
  - **Provision of an open IMS platform and planned interconnection to Operator IMS test beds**
  - **Interoperability test of IMS components (S-CSCFs, Media Gateways, SIP AS, etc.)**
  - **Environment for development of new MM applications, application platform extensions and IMS mobility, QoS and security reasearch**
- **Contact: www.fokus.fraunhofer.de/ims**

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OPEN IMS Playground Overview
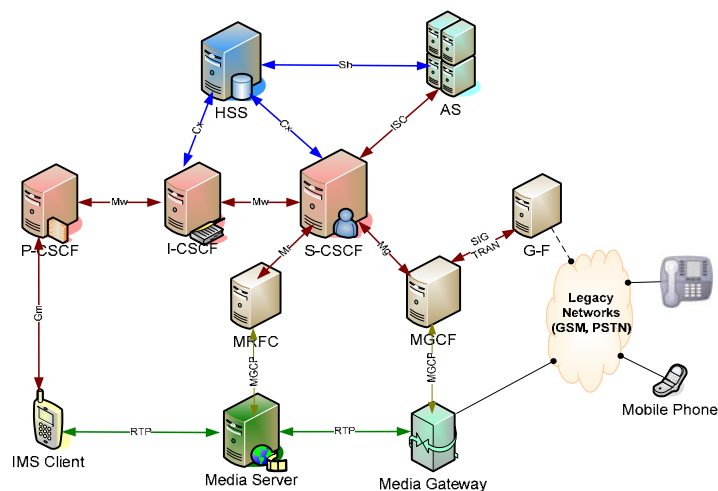
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FOKUS – Components in the IMS Playground
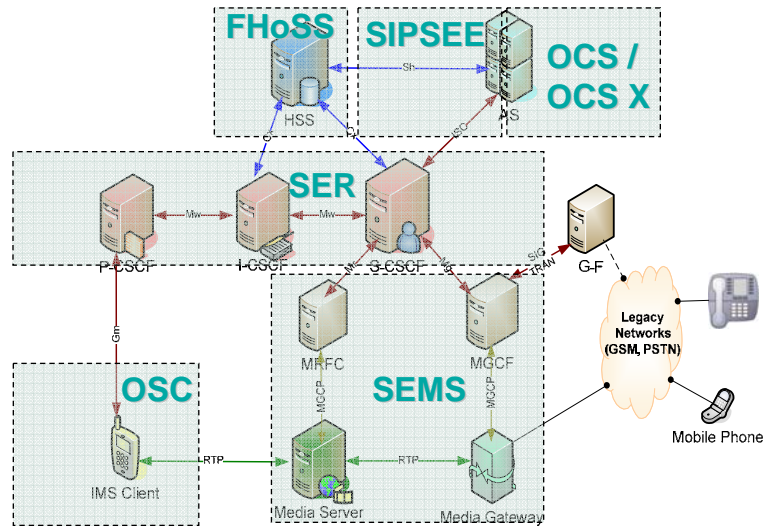
FOKUS – developed IMS Components

- *IMS Core*
  - **Call Session Control Functions**
    - **SIP proxy with 3GPP features - *SER***
  - **Home Subscriber Server**
    - **Diameter based AAA Server- *FHoSS***
  - **Media Server**
    - **Media Streaming – *SEMS***

- *IMS Application Layer*
  - **IMS compliant SIP Clients – *OSC***
  - **Application Server**
    - **SIP Servlet AS – *SIPSEE***
    - **Parlay X Gateway – *OCS-X***
    - **Parlay Gateway – *OCS***

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Integration of Partner Components @ FOKUS IMS PG

Note: This is not a complete Partner List!
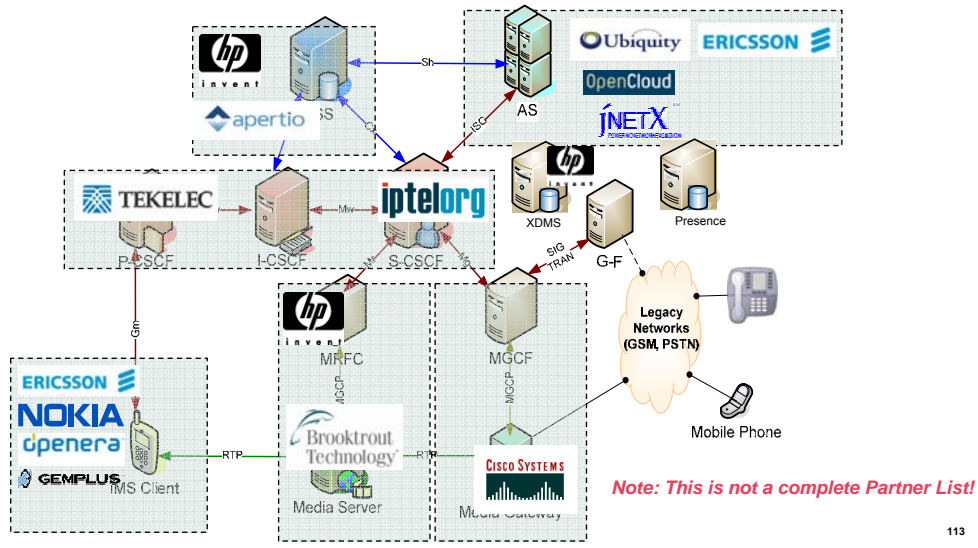
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Reference Customers

– Consulting on IMS development strategies for major vendors
– Consulting on bids and gap analysis of commercial products for key global integrator
– Extensions (Interfaces/Reference Points) of commercial solutions of various vendors
– Implementation of prototypes for vendors and operators
– Integration and Compliancy testing of commercial solutions
– Consulting on IMS integration strategies for major German Operator
– Interoperability testing for major European vendors
– IMS Load- /Perfomance testing for key global hardware vendor
– Application Service development for major German operator
– Consulting for establishing IMS Testbeds at remote sites
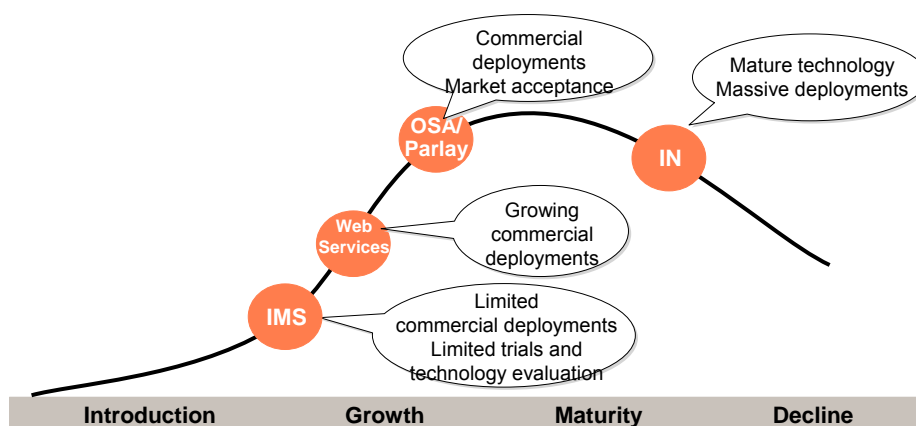– Plus German and European R&D projects on Feature Interaction and Service composition

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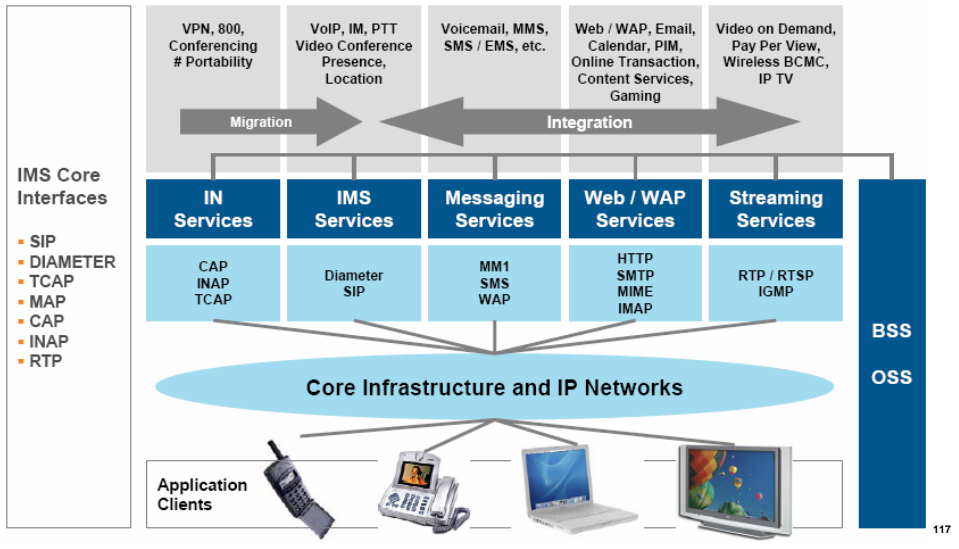- **Q&A and IMS Playground Demos**
- *References & Acronyms*

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Service Layer technology maturity

Commercial deployments
Market acceptance

Mature technology
Massive deployments

OSA/ Parlay

IN

Web Services

Growing commercial deployments

IMS

Limited commercial deployments
Limited trials and technology evaluation

| **Introduction** | **Growth** | **Maturity** | **Decline** |

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Legacy Services leveraged for Combi. Services

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IMS Introduction Challenges

– **IMS Integration Challenges**
  - **Core Network, SCE&SDP, OSS/BSS, Charging System**
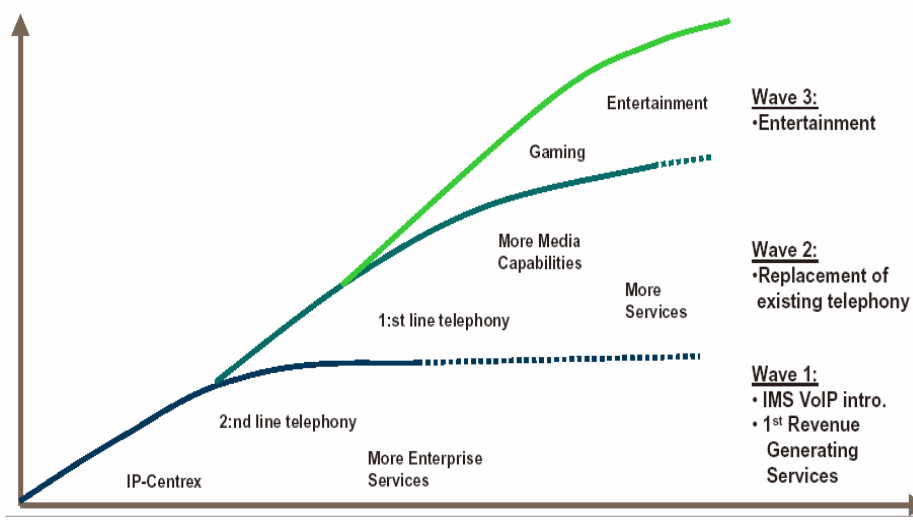

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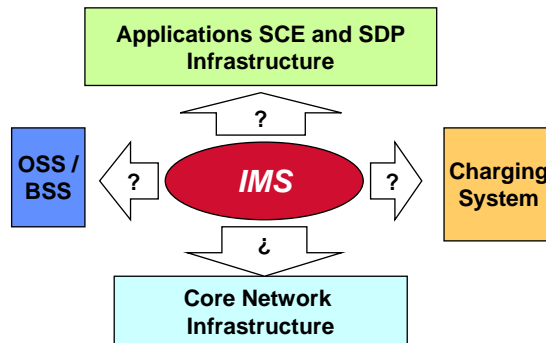
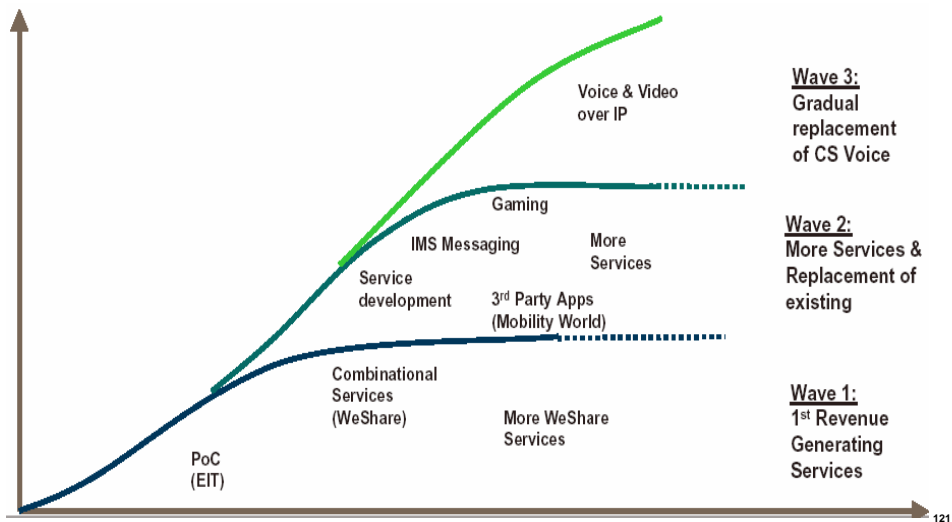# Single Vendor versus Multiple Vendor Strategie

- – **Single Vendor Strategy**
  - • **Pros: Probably faster Integration**
  - • **Cons: Vendor lock, potentially limited innovation, no vendor is good in all aspects!**

- – **Multi Vendor Strategy**
  - • **Pros: Choose best of bread vendors, competition (lower prices), more innovation**
  - • **Cons: More complex integration, Whom to blam in case of problems?**

- – **Realistic Scenario**
  - • **IMS Core likely to come from one vendor – assuring basic operation**
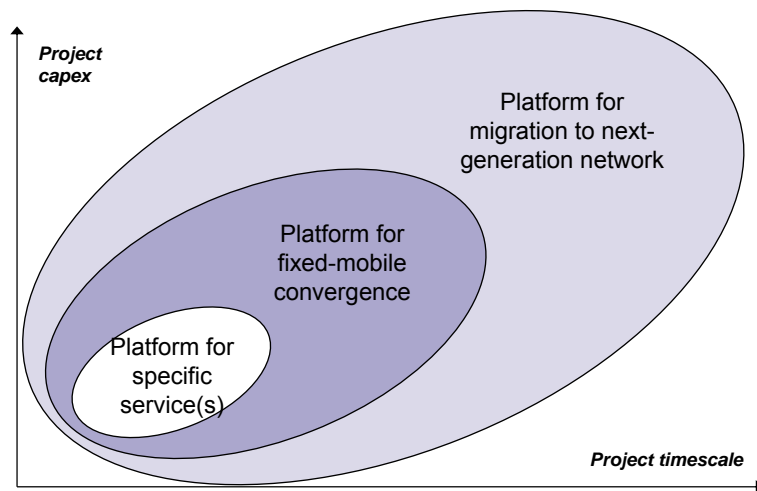 - • **Applications layer based on multiple vendors – servce innovation & flexibility**
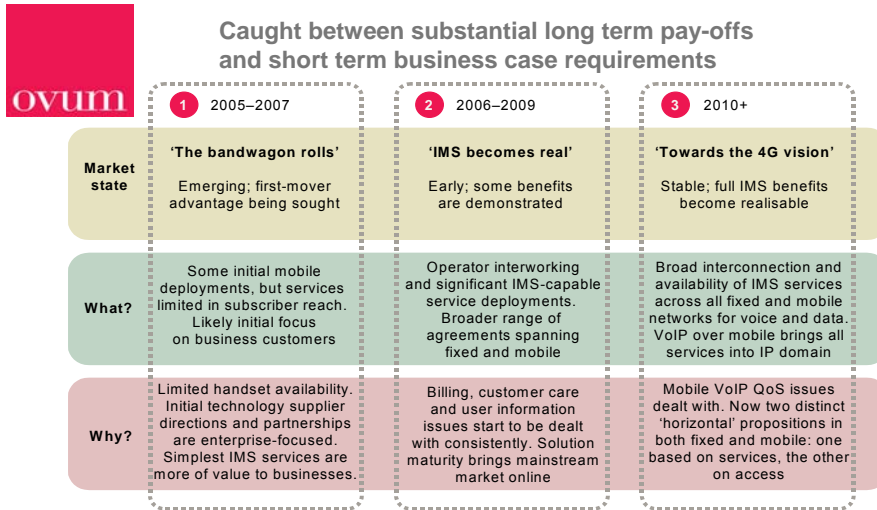
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Wireline IMS Introduction

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Wireless IMS Introduction
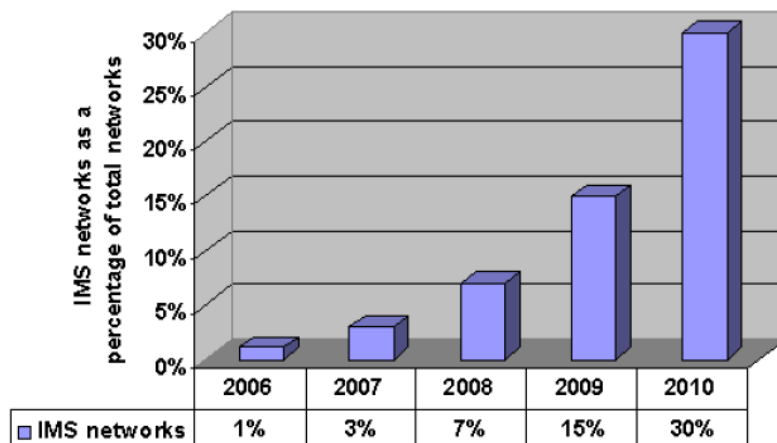

IMS Deployment Contexts
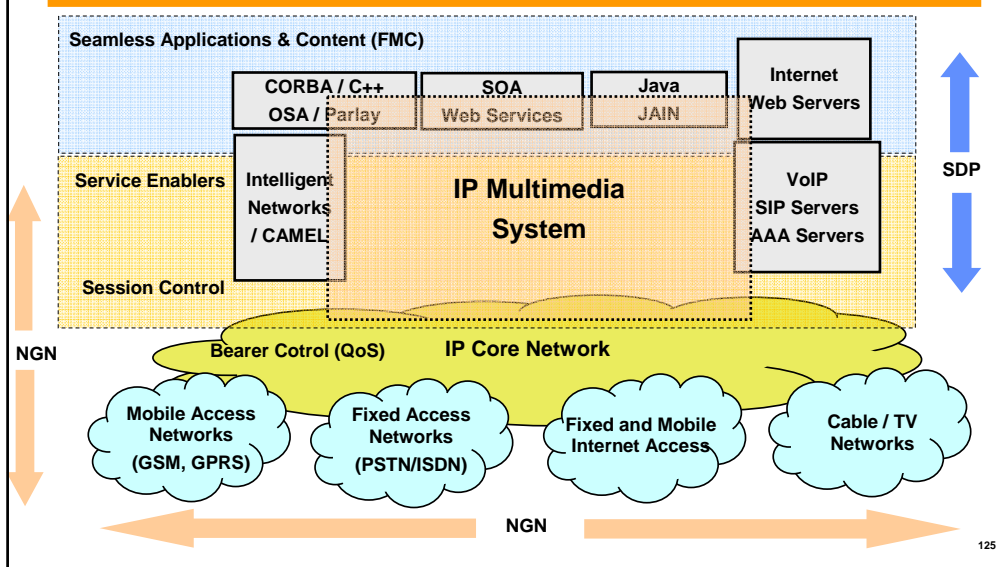
Ovum's view of the 3 phases of IMS adoption

Caught between substantial long term pay-offs and short term business case requirements

	1 2005–2007	**2** 2006–2009	**3** 2010+
Market state	**'The bandwagon rolls'** Emerging; first-mover advantage being sought	**'IMS becomes real'** Early; some benefits are demonstrated	**'Towards the 4G vision'** Stable; full IMS benefits become realisable
What?	Some initial mobile deployments, but services limited in subscriber reach. Likely initial focus on business customers	Operator interworking and significant IMS-capable service deployments. Broader range of agreements spanning fixed and mobile	Broad interconnection and availability of IMS services across all fixed and mobile networks for voice and data. VoIP over mobile brings all services into IP domain
Why?	Limited handset availability. Initial technology supplier directions and partnerships are enterprise-focused. Simplest IMS services are more of value to businesses.	Billing, customer care and user information issues start to be dealt with consistently. Solution maturity brings mainstream market online	Mobile VoIP QoS issues dealt with. Now two distinct 'horizontal' propositions in both fixed and mobile: one based on services, the other on access

Source: Ovum

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IMS Deployment Worldwide

IMS networks	2006	2007	2008	2009	2010
	1%	3%	7%	15%	30%

Source: visiongain

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NGN Service Platforms

Seamless Applications & Content (FMC)

CORBA / C++	SOA	Java	Internet
OSA / Parlay	Web Services	JAIN	Web Servers

IP Multimedia System

Service Enablers — Intelligent Networks / CAMEL

VoIP SIP Servers AAA Servers

SDP

Session Control

NGN

Bearer Cotrol (QoS) — **IP Core Network**

- Mobile Access Networks (GSM, GPRS)
- Fixed Access Networks (PSTN/ISDN)
- Fixed and Mobile Internet Access
- Cable / TV Networks

NGN

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IMS to „unglue" the value chain

GSM value chain

Network Transport → Value Added Services
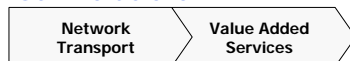
- **Tight vertical integration of network and services**
- **Limited access for 3rd Parties (MVNO, Service Provider)**
- **Operators struggle to offer attractive service portfolio**

IMS value chain

Network Transport → NG Service Network Provider ("wholesale") → Service/Application Provider ("retail")

- **Loose vertical integration of networks, services and applications**
- **Standardized interfaces allow easy integration of partners**

Focus on core competencies and economies of scale

Enriched service offerings for target communities

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SKYPE - Shows demand for Community Services

- 51 million registered users
- IMS functionality at a fraction of cost
- Client: PC's, WLAN/DECT/BT phones
- Cross Operator community
- On net calls „free" off net calls pay
- Standardized API's. Lots of apps
- 30% of users are SME's

However Skype is limited as Group and presence management is limited and integration with Click to Talk, Click to SMS, Location awareness, etc. is missing ➔ This is the operator opportunity!!!
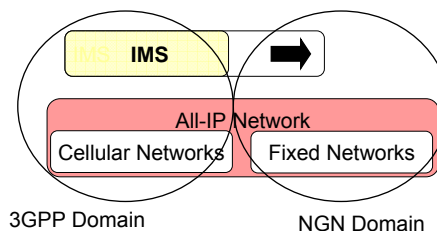
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From PTT to Community-Support

- **PoC/PTT basically defines a specific service based on generic enablers (Presence, GLMS/XDMS, FOTA)**
- **Infact PoC/PTT could be regarded as a specific instantiation of a group communication framework**
- **Making money with PoC/PTT is unclear**
- **Making money with SMS and voice calls is clear**
- **Idea:**
  - **Reuse PoC/PTT enablers for other communication services as well**
    - ➔ **Integrated Presence driven IM, email, SMS, MMS, VoIP, CS-Calls, Video calls, etc.**
  - **Provide group communication to those who really need it**
    - ➔ **well established Communities (Sports, Work, health, fun) will appreciate this!**

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IMS is a perfect basis for eCommunity services

- **IMS is today considered as the common platform for FMC and NGNs**
- **A convergent community-service can ideally be based on the IMS platform granting:**
  - **convergence and compatibility between fixed/mobile networks**
  - **multi-media and converged services support**
  - **providing key community service enablers, such as**
    - **Group Management**
    - **Presence**
    - **IM / PoC**
    - **generic VoIP/MMoIP support, etc.**

IMS

All-IP Network

Cellular Networks   Fixed Networks

3GPP Domain   NGN Domain

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Mapping of eCommunity Features to IMS Enablers

- **Support of various end user systems (PC from home, Notebook/Phone on the go) for seamless communications everywhere an any time**
- **Dynamic group management (open vs. closed groups)**
- **Presence information of community members**
- **Location information of community members and navigation support**
- **Click to communicate functionality (voice calls, video calls, SMS, MMS, email, IM, PoC, etc)**
- **Common multimedia archives and shared White Boards**

- **IMS is designed as an overlay to various access networks and also defines Gateways to legacy technologies (CS networks)**
- **XDMS enabler supports Group management**
- **Presence enaler supports presence**
- **Location information can be optained from dediacted Location servers (Le interface) or from HSS/SIP registrars**
- **SIP Servlet application server can provide „Click to" serivces via HTML service page or dedicated client application in end systems**
- **IMS „Push to" functionality e.g. via INFO method**

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Mapping of eCommunity Features to IMS Enablers (cont.)
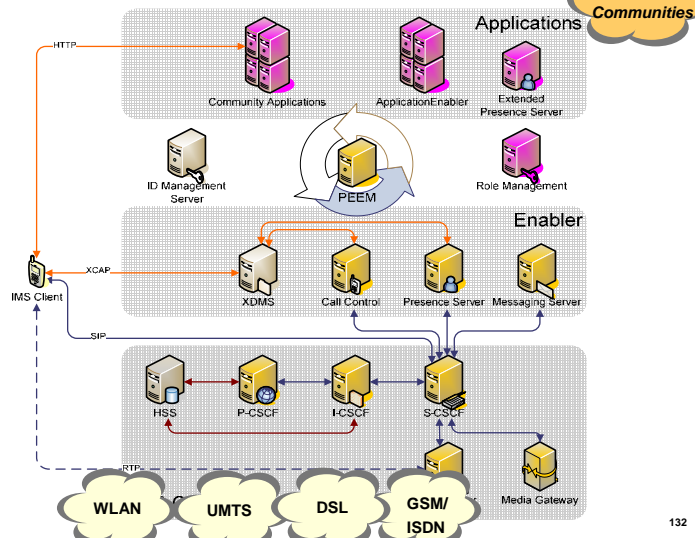
- **Automated appointment scheduling & logistical support**
- **Optional profile matching capabilities for bringing people together**
- **In the future: Virtual reality support**
- **Communities are third party driven!**
- **Support of third party services targeted towards specific communities**

- **Application server integration with corporate databases/outlook**
- **Application Server and optional HSS interrogation**
- **IMS supports any media (here interactive dynamic rendered video) and application server control (VR server)**
- **Usage of OSA/Parlay and later OMA OSE will enable controlled 3rd party services in IMS**

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Prototyping eCommunities within the FOKUS IMS Playground
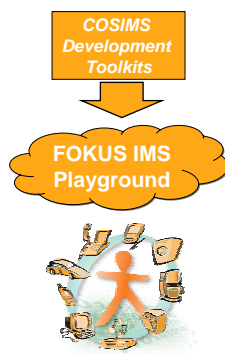
Together with T-Systems, HP and T-Labs eCommunity services are trialed with real life users

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Overview

- **IMS Motivation**
- **IMS Overview**
- **IMS Key protocols (IETF SIP and Diameter)**
- **IMS Key components**
- **IMS Application Server options**
- **Sample IMS Multimedia Applications**
- **IMS Playground @ FOKUS**
- **Summary**
- **Q&A**
- **References & Acronyms**

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Any Questions?

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Overview

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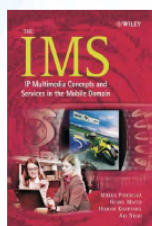- **Summary**
- **Q&A**
- **References & Acronyms**

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Recommended IMS Books

Two books on the market describe IMS
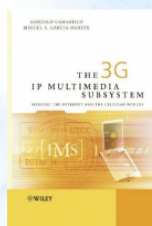
- "The 3G IP Multimedia Subsystem: Merging the Internet and the Cellular Worlds".
  - Gonzalo Camarillo and Miguel-Angel Garcia-Martin
  - Published by John Wiley and Sons Ltd.
  - ISBN: 0470871563
  - June 2004

- "The IMS: IP Multimedia Concepts and Services in the Mobile Domain".
  - Miikka Poikselkä, Georg Mayer, Hisham Khartabil, and Aki Niemi.
  - Published by John Wiley and Sons Ltd.
  - ISBN: 047087113X
  - April 2004

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