Network attendant service in 3G networks

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- 3G network service architecture
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  - CAMEL, OSA, SIP, Others
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Introduction

- Trio Network Solutions Oy (former Abacus Solutions Oy)
  - subsidiary of Trio AB: 90 employees in Sweden, Finland, Norway and Denmark
  - Trio Listed in Stockholm Stock Exchange
- Trio provides enterprise reachability solutions worldwide
- Trio Network Solutions Oy provides corporate mobile solutions to mobile operators and enterprises
  - Trio Mobile Office is a telephony service from mobile operators. Enables companies to replace fixed telephony with a mobile switchboard function and mobile telephones.

Operator references

Telenor Mobil

ProffNett

Vodafone Sweden

Vodafones trådlösa kontor

TeliaSonera Finland

Vaihdepalvelu

Spring Mobile

Total, Spring Mix

One Austria

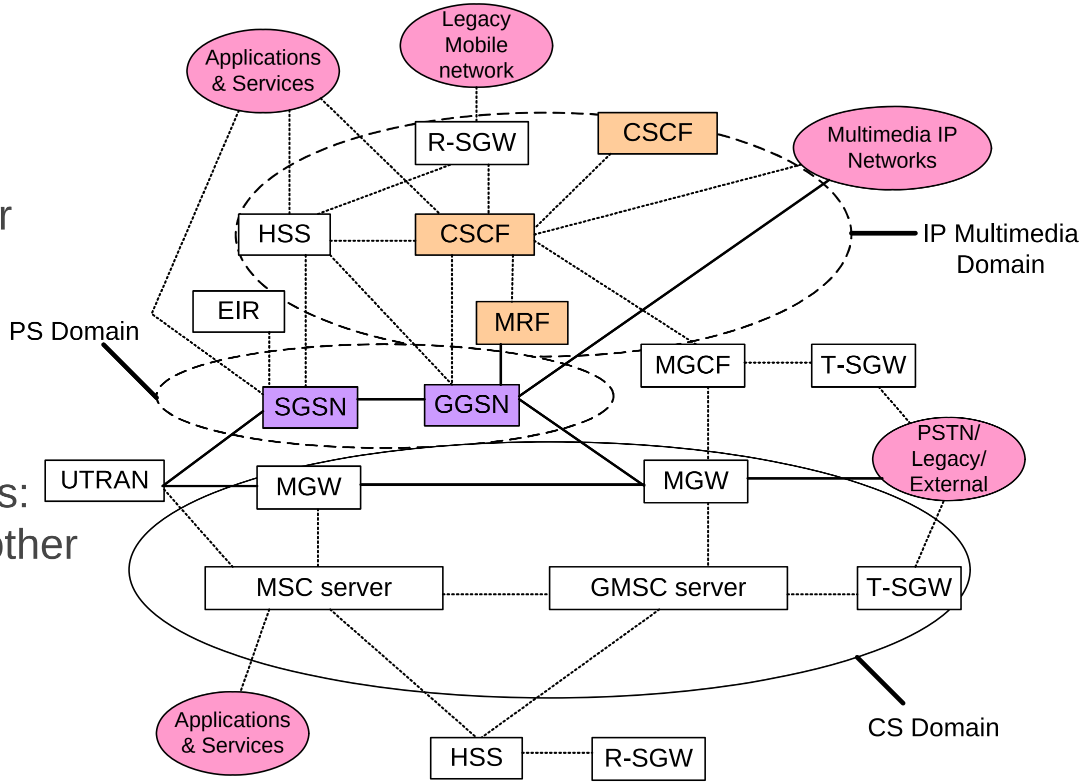
Objectives and methodology

- Study the implementation of a network attendant service in 3G networks
  - 3GPP Release 5
- Analyse the standardised service delivery platforms and alternative solutions
- Compare the available solutions and propose the most efficient choice for implementing a network attendant service in 3G networks
- Methodology
  - Literature study: 3GPP specifications, books and articles
  - Operator and equipment vendor interviews for market study
  - Current Service Node-based solution as a basis
  - Analytical Hierarchy Process to compare alternatives

3G network service architecture

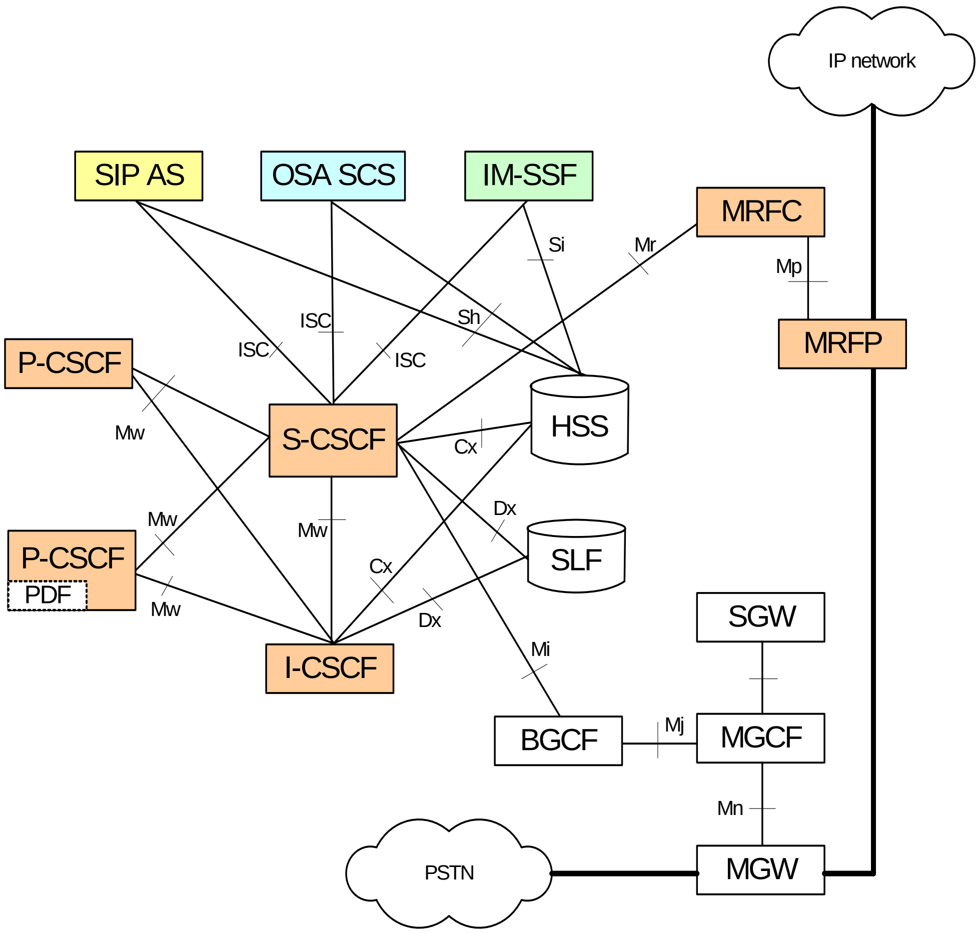
UMTS Release 5

- Circuit-switched domain
  - Voice and multimedia over circuits
  - IN, CAMEL, SN
- Packet-switched domain
  - IP connectivity to terminals: access to the Internet or other external IP networks
- IP Multimedia domain
  - IM services: multimedia conferencing, voice communications, messaging
  - SIP for signalling


Applications & Services
Legacy Mobile network
R-SGW
CSCF
Multimedia IP Networks
HSS
CSCF
IP Multimedia Domain
EIR
MRF
PS Domain
MGCF
T-SGW
SGSN
GGSN
PSTN/ Legacy/ External
UTRAN
MGW
MGW
MSC server
GMSC server
T-SGW
CS Domain
Applications & Services
HSS
R-SGW

IP Multimedia Subsystem

- Application servers
  - SIP AS, OMA SCS, IM-SSF
- Proxy-CSCF
  - Fist contact point btw an IMS terminal and IMS network
- Interrogating-CSCF
  - Contact to the subscriber’s home network
- Serving-CSCF
  - Central node of the signalling plane
- Media Resource Function (MRF)
  - Handles media resources
  - MRFC interprets SIP to H.248
  - MFRP handles the media streams
- Media Gateway (MGW)
  - Media conversions btw CS and PS networks: PCM and RTP

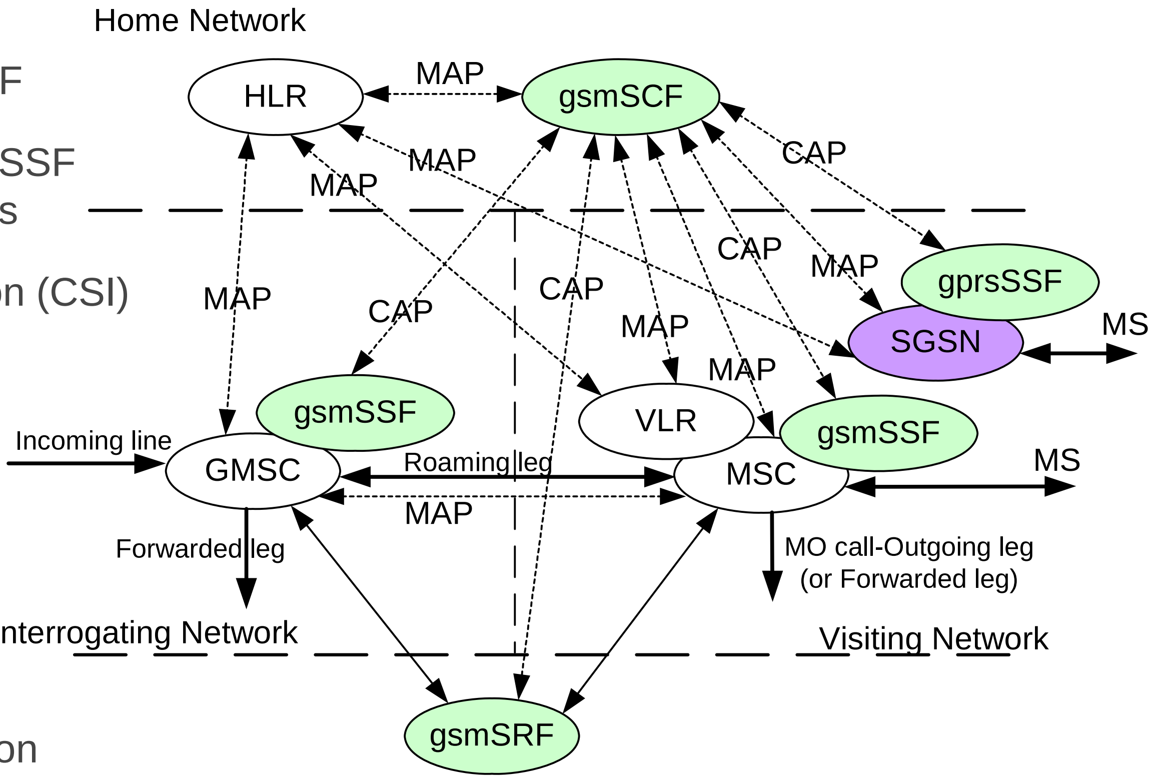

IP network
SIP AS
OSA SCS
IM-SSF
MRFC
Si
Mr
Mp
ISC
Sh
ISC
ISC
MRFP
P-CSCF
Mw
S-CSCF
HSS
Cx
Dx
Mw
Mw
SLF
P-CSCF
PDF
Cx
Mw
Dx
SGW
I-CSCF
Mi
BGCF
Mj
MGCF
Mn
PSTN
MGW

CAMEL

- Customised Applications for Mobile network Enhanced Logic
- GSM specialised Intelligent Network feature
- Support for Operator Specific Services for roaming subscribers
- Standardised in phases by ETSI
  - CAMEL1(R96), CAMEL2(R97), CAMEL3(R99), CAMEL4(R5)
- Basic Call State Model concept for call handling
- Protocols: CAMEL Application Part (CAP), Mobile Application Part (MAP)
- Services for circuit-switched, packet-switched and IP multimedia domain

CAMEL phase 4 architecture

- CAMEL service logic in gsmSCF
- gsmSCF interacts with the gsmSSF towards the MSC to control calls
- CAMEL Subscription Information (CSI) stored in HLR
- Specialised Resource Function (gsmSRF)
  - Announcements
  - DTMF
- HLR MAP Any Time Interrogation
  - Subscriber status, location


Home Network
HLR
MAP
gsmSCF
MAP
MAP
CAP
CAP
MAP
gprsSSF
MAP
CAP
CAP
MAP
SGSN
MS
MAP
gsmSSF
VLR
gsmSSF
Incoming line
GMSC
Roaming leg
MSC
MS
MAP
Forwarded leg
MO call-Outgoing leg
(or Forwarded leg)
Interrogating Network
Visiting Network
gsmSRF

Open Service Access

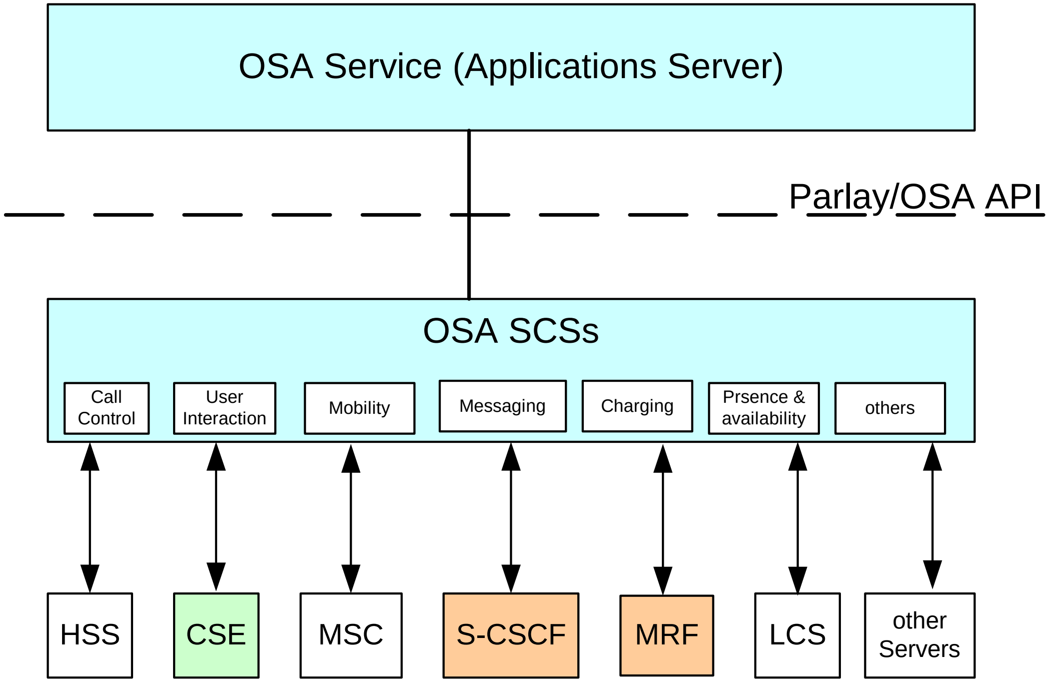
- Standardised by 3GPP
- Application Programming Interfaces APIs
- Applications developed by operators or third parties can make use of network functionalities through a set of Service Capability Features (SCF)
- OSA APIs are independent of where or which network capabilities are implemented in the network
- Framework for authentication and authorisation, Discovery
- Only standardised secure method to access network capabilities in IP Multimedia Subsystem (IMS)

Open Service Access

- OSA applications developed in Application Servers using the OSA APIs to interact with OSA services

- Service Capability Servers (SCS) act as gateways between network entities and applications

- Mapping to network protocols vendor specific
  - MAP, CAP, INAP, Megaco, SIP, SMS

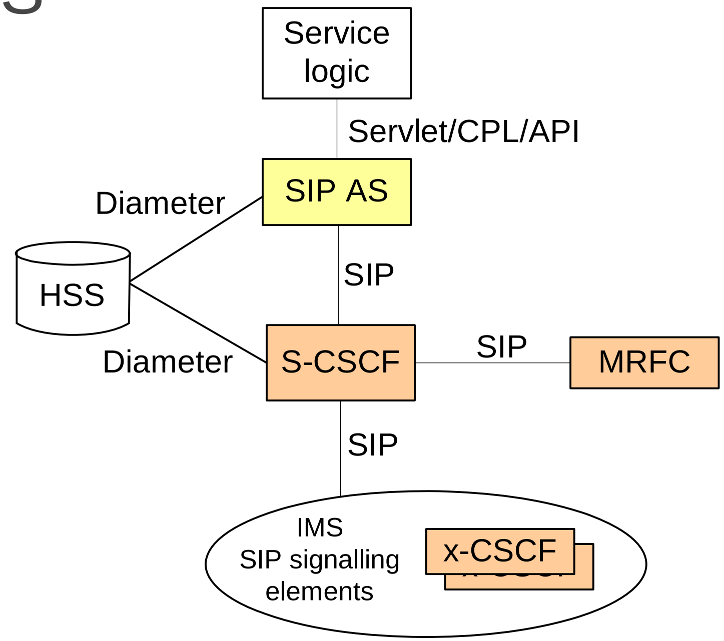

OSA Service (Applications Server)
Parlay/OSA API
OSA SCSs
Call Control
User Interaction
Mobility
Messaging
Charging
Prsence & availability
others
HSS
CSE
MSC
S-CSCF
MRF
LCS
other Servers

Session Initiaton Protocol

- IETF has defined SIP originally for multimedia call control for the fixed Internet
  - Text-based application layer signalling protocol
- Chosen as the main IP Multimedia Subsystem protocol for call control because of the interconnectivity requirement between 3GPP networks and fixed IP networks
  - SIP used for session control
  - Session Description Protocol (SDP)

SIP AS service architecture

- Services created in SIP AS
    - Call Processing Language (CPL)
    - Service Creation Markup Language (SCML)
    - SIP Common Gateway Interface (SIP CGI)
    - SIP Servlets
    - JAIN SIP
    - Parlay APIs
    - VoiceXML for user interaction


Service logic
Servlet/CPL/API
SIP AS
Diameter
HSS
SIP
Diameter
S-CSCF
SIP
MRFC
SIP
IMS SIP signalling elements
x-CSCF

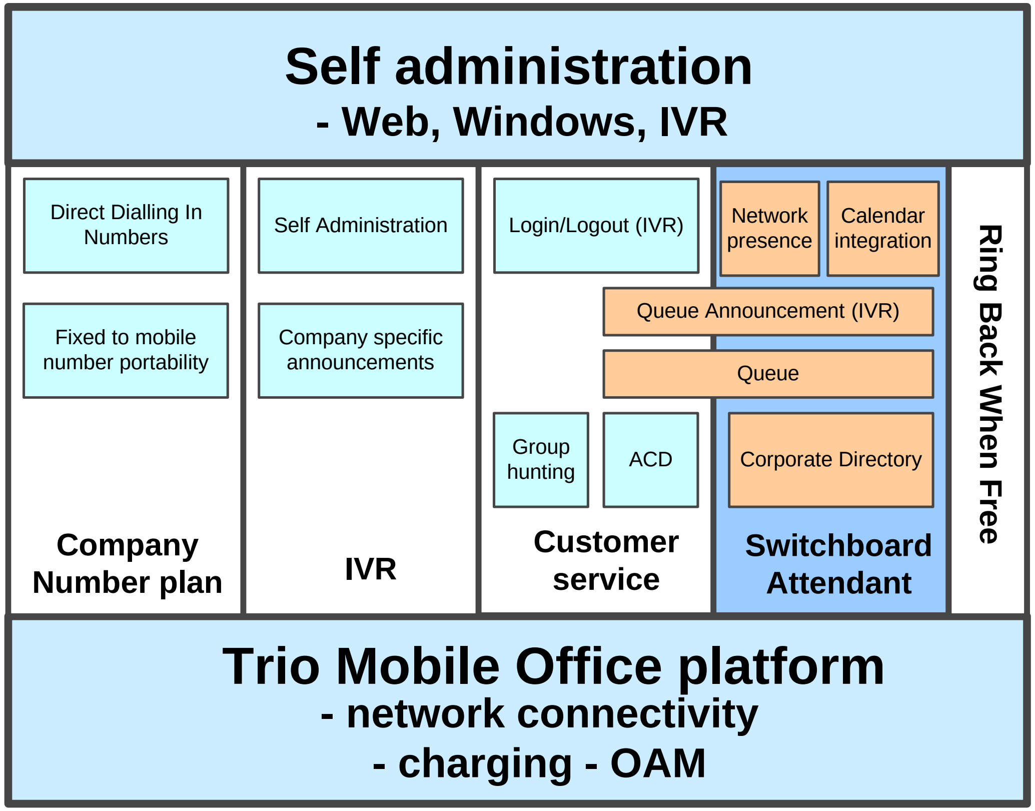
Other technologies

- Java APIs for Integrated Networks (JAIN)
- Parlay X
- Open Mobile Alliance
- Intelligent Networks
- Service Node
- Mobile Execution Environment
- UMTS SIM Application Toolkit

3G network attendant service

Network attendant service

- Call handling application for switchboard attendants



Self administration
- Web, Windows, IVR

Direct Dialling In Numbers

Fixed to mobile number portability

Company Number plan

Self Administration

Company specific announcements

IVR

Login/Logout (IVR)

Group hunting

ACD

Customer service

Network presence

Calendar integration

Queue Announcement (IVR)

Queue

Corporate Directory

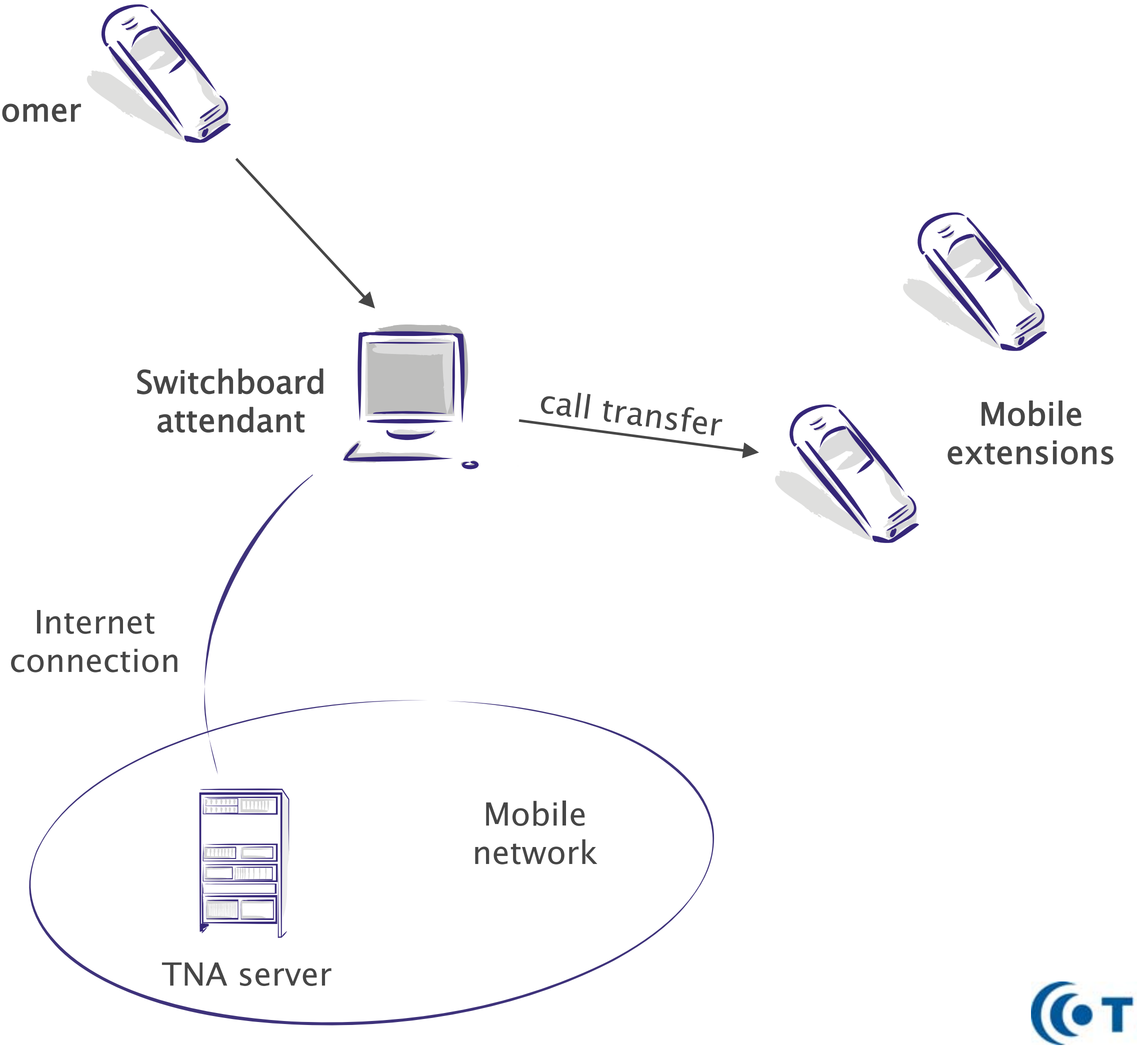
Switchboard Attendant

Ring Back When Free

Trio Mobile Office platform
- network connectivity
- charging - OAM

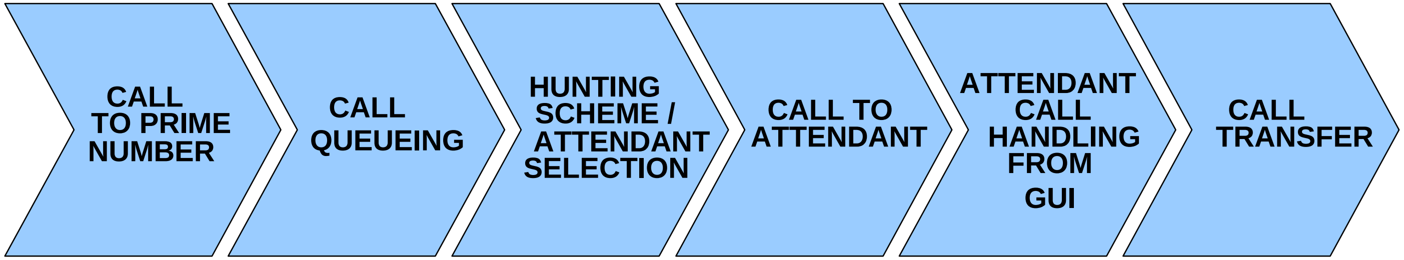
- Mobile or fixed phones
- Call handling
- Corporate directory
- Messaging
- Presence information
- Call queuing
- Automatic call distribution (ACD)

TNA conceptual model


Customer
Switchboard attendant
call transfer
Mobile extensions
Internet connection
Mobile network
TNA server

Network attendat service contd.

- An attendant establishes an open line between her phone and the Trio Network Attendant System
- Attendant use a graphical user interface, attendant client, to handle calls.
- Call and queue information displayed in the client
- Corporate directory, SMS and email messaging
- Logical call flow:



CALL TO PRIME NUMBER

CALL QUEUEING

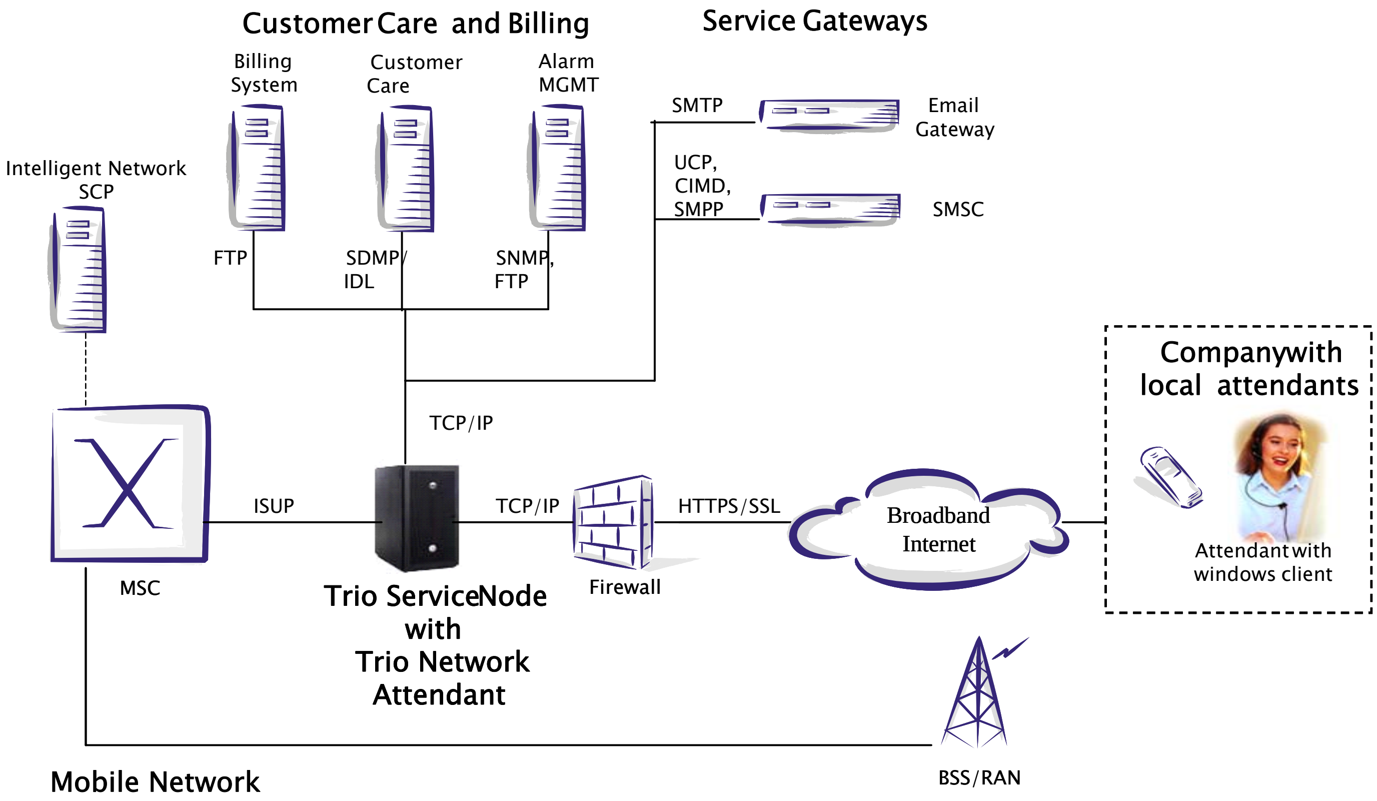
HUNTING SCHEME / ATTENDANT SELECTION

CALL TO ATTENDANT

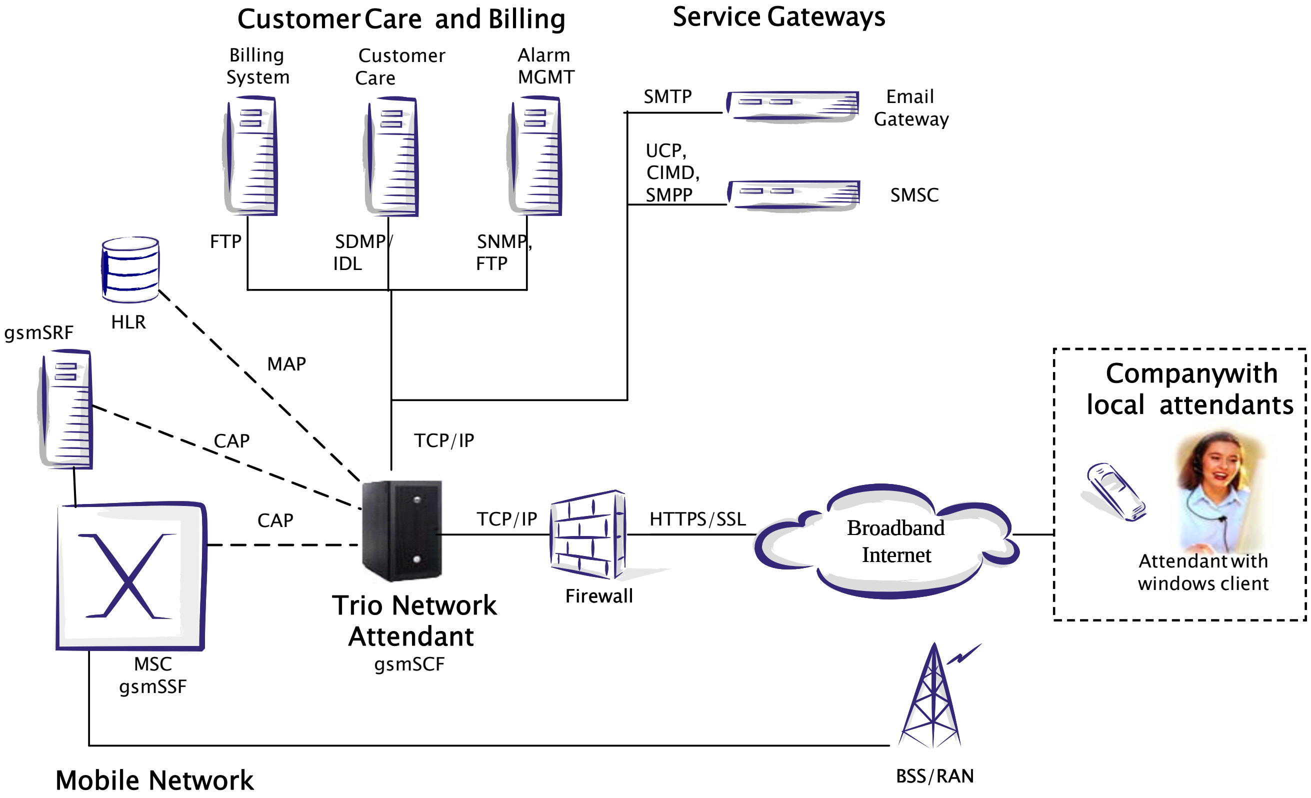
ATTENDANT CALL HANDLING FROM GUI

CALL TRANSFER

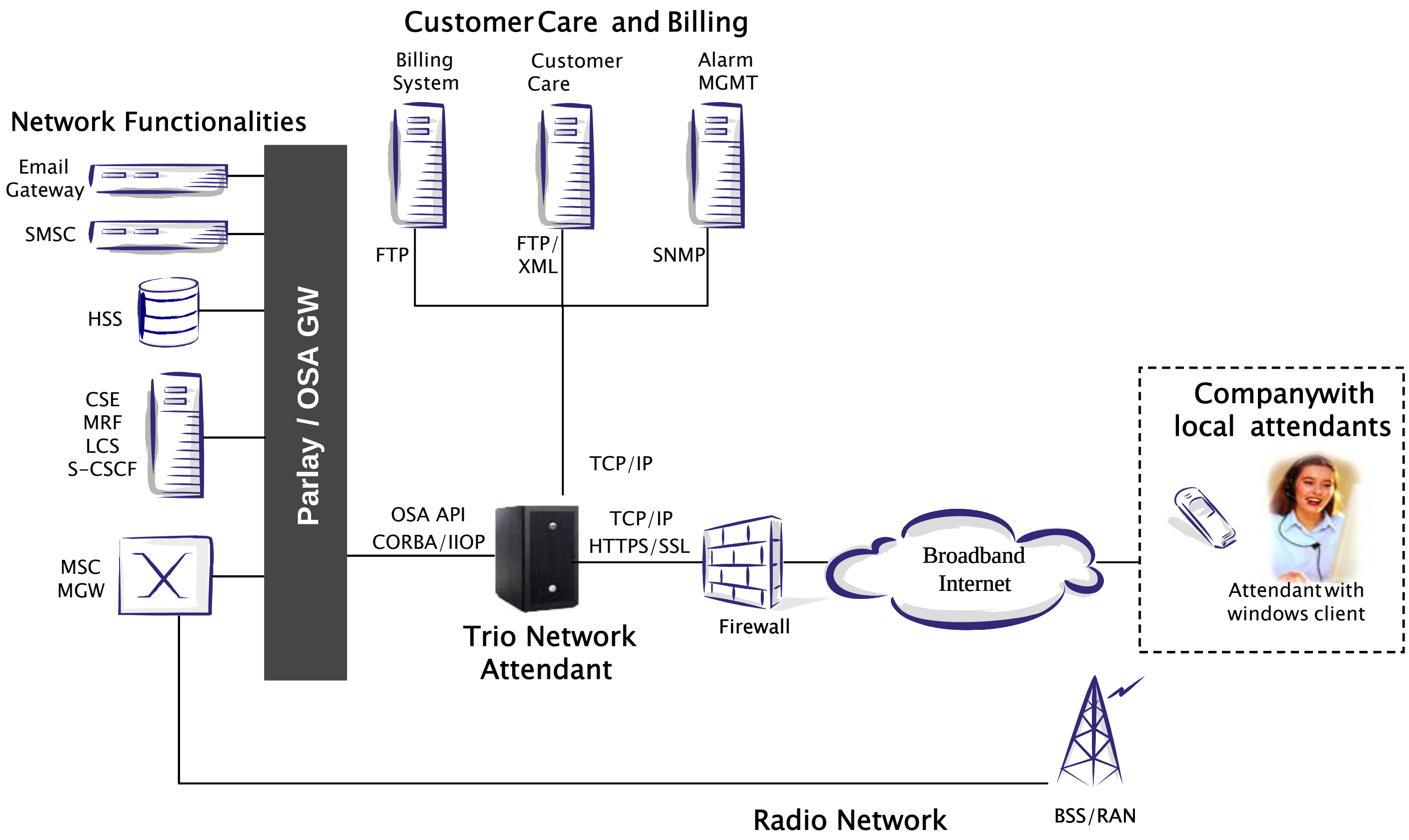
2G TNA Architecture


Customer Care and Billing
Service Gateways
Billing System
Customer Care
Alarm MGMT
SMTP
Email Gateway
UCP, CIMD, SMPP
SMSC
Intelligent Network SCP
FTP
SDMP/ IDL
SNMP, FTP
TCP/IP
Company with local attendants
ISUP
TCP/IP
HTTPS/SSL
Broadband Internet
Attendant with windows client
MSC
Trio ServiceNode with Trio Network Attendant
Firewall
Mobile Network
BSS/RAN

CAMEL - TNA

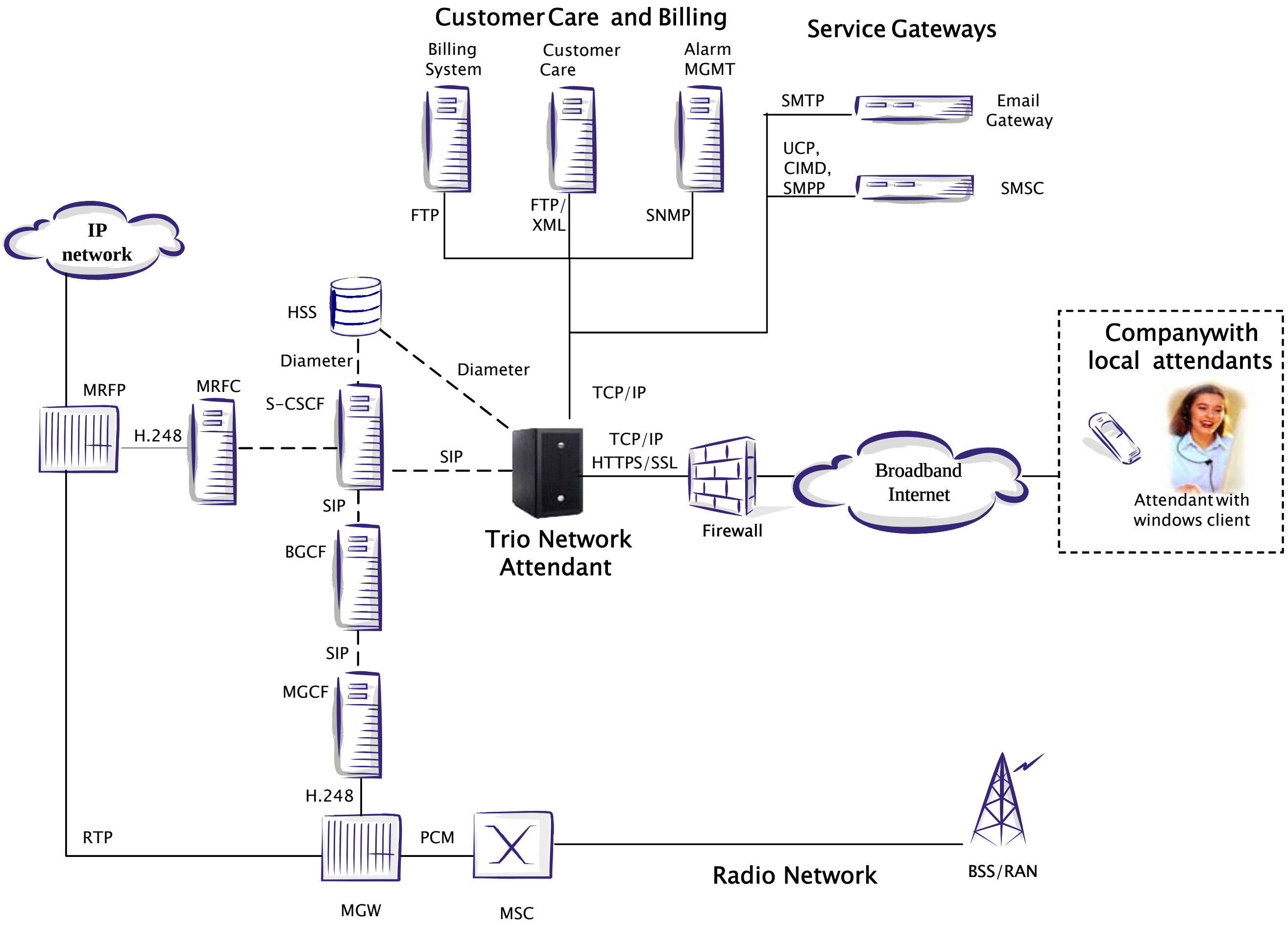

Customer Care and Billing
Service Gateways
Billing System
Customer Care
Alarm MGMT
SMTP
Email Gateway
UCP, CIMD, SMPP
SMSC
FTP
SDMP/ IDL
SNMP, FTP
HLR
gsmSRF
MAP
CAP
TCP/IP
CAP
TCP/IP
HTTPS/SSL
Broadband Internet
Companywith local attendants
Attendant with windows client
Firewall
Trio Network Attendant
gsmSCF
MSC gsmSSF
Mobile Network
BSS/RAN

OSA - TNA


Customer Care and Billing
Billing System
Customer Care
Alarm MGMT
Network Functionalities
Email Gateway
SMSC
HSS
CSE
MRF
LCS
S-CSCF
MSC
MGW
Parlay / OSA GW
FTP
FTP/ XML
SNMP
TCP/IP
OSA API
CORBA/IIOP
TCP/IP
HTTPS/SSL
Trio Network Attendant
Firewall
Broadband Internet
Companywith local attendants
Attendant with windows client
BSS/RAN
Radio Network

Minna Bloigu 2005

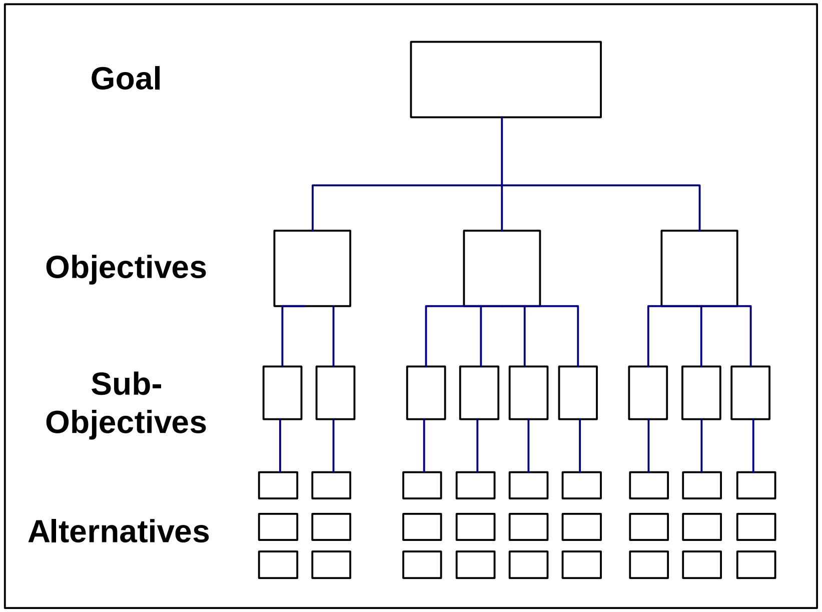
SIP - TNA


Customer Care and Billing
Billing System
Customer Care
Alarm MGMT
FTP
FTP/ XML
SNMP
Service Gateways
SMTP
Email Gateway
UCP, CIMD, SMPP
SMSC
IP network
HSS
Diameter
Diameter
TCP/IP
Companywith local attendants
MRFP
MRFC
S-CSCF
H.248
SIP
TCP/IP HTTPS/SSL
Firewall
Broadband Internet
Attendant with windows client
SIP
BGCF
Trio Network Attendant
SIP
MGCF
H.248
RTP
PCM
Radio Network
BSS/RAN
MGW
MSC

Technology comparison

Analytical Hierarchy Process AHP

- Developed by T. Saaty 1980
- A systematic method for comparing a list of objectives and alternatives
- Pie chart model
  - Goal of the decision-making is the whole chart
  - Each wedge represents an objective contributing to the goal
  - AHP helps determine the relative importance of each wedge
- Pairwise comparisons
  - Each pair of factors is compared to establish a ratio of relative importance between the factors



AHP contd.

- Verbal scale comparison to numerical values

Numerical value	Verbal scale	Explanation
1.0	Equal importance of both elements	Two elements contribute equally
3.0	Moderate importance of one element over another	Experience and judgement favour one element
5.0	Strong importance of on element over another	An element is strongly favoured
7.0	Very strong importance of one element over another	An element is very strongly dominant
9.0	Extreme importance of one element over another	An element is favoured by at least an order of magnitude
2.0, 4.0, 6.0, 8.0	Intermediate values	Used to compromise btw two judgments

AHP contd.

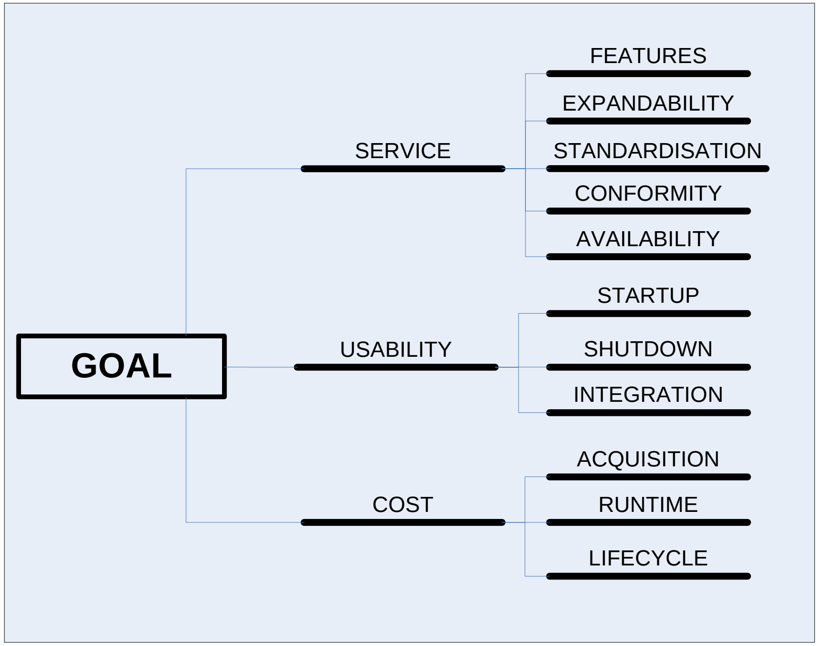
- Form a pairwise comparison matrix A
  - The number in the i_{th} row and j_{th} column gives the relative importance of objective O_i as compared with objective O_j

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} = \begin{bmatrix} \frac{O_1}{O_1} & \frac{O_1}{O_2} & \frac{O_1}{O_3} & \frac{O_1}{O_4} \\ \frac{O_2}{O_1} & \frac{O_2}{O_2} & \frac{O_2}{O_3} & \frac{O_2}{O_4} \\ \frac{O_3}{O_1} & \frac{O_3}{O_2} & \frac{O_3}{O_3} & \frac{O_3}{O_4} \\ \frac{O_4}{O_1} & \frac{O_4}{O_2} & \frac{O_4}{O_3} & \frac{O_4}{O_4} \end{bmatrix}$$

- Vector of weights w
- Eigenvalue problem: $Aw = \lambda_{\max} w$
- Consistency measure calculated using the eigenvalues of the normalised comparison matrix

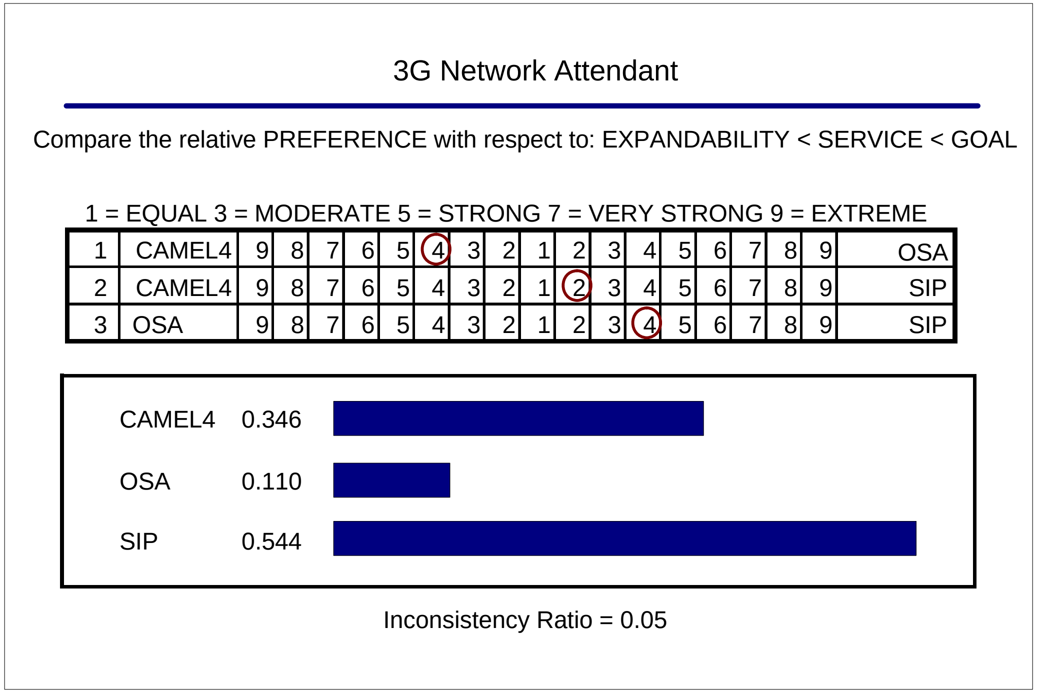
AHP hierarchy for the network attendant service

- Goal: Select best techhnology solution for the network attendant service in 3G networks
- Alternatives
  - CAMEL4
  - OSA
  - SIP
- Objectives
  - Service creation and technology benefits
  - System usability and maintenance
  - Cost


FEATURES
EXPANDABILITY
SERVICE
STANDARDISATION
CONFORMITY
AVAILABILITY
STARTUP
GOAL
USABILITY
SHUTDOWN
INTEGRATION
ACQUISITION
COST
RUNTIME
LIFECYCLE

Comparison of alternatives and objectives

- Compare alternatives first pairwise for each-sub-objective
- Compare sub-objectives pairwise for to get overall importance within main objective
- Compare objectives pairwise for the goal



3G Network Attendant

Compare the relative PREFERENCE with respect to: EXPANDABILITY < SERVICE < GOAL

1 = EQUAL 3 = MODERATE 5 = STRONG 7 = VERY STRONG 9 = EXTREME

1	CAMEL4	9	8	7	6	5	[✓ 4]	3	2	1	2	3	4	5	6	7	8	9	OSA
2	CAMEL4	9	8	7	6	5	4	3	2	1	[✓ 2]	3	4	5	6	7	8	9	SIP
3	OSA	9	8	7	6	5	4	3	2	1	2	3	[✓ 4]	5	6	7	8	9	SIP

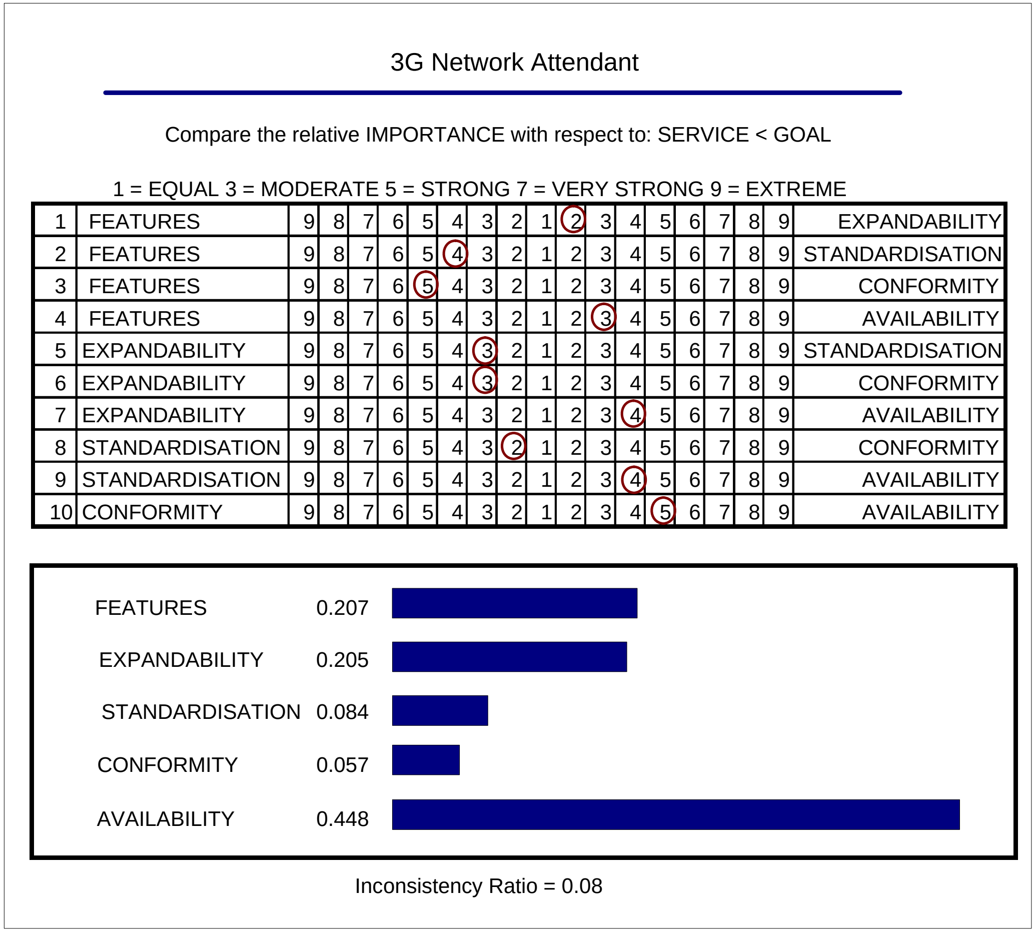
CAMEL4	0.346
OSA	0.110
SIP	0.544

Inconsistency Ratio = 0.05

Judgements and priorities with respect to service expandability

Comparison of alternatives and objectives

- Compare sub-objectives pairwise for to get overall importance within main objective



3G Network Attendant

Compare the relative IMPORTANCE with respect to: SERVICE < GOAL

1 = EQUAL 3 = MODERATE 5 = STRONG 7 = VERY STRONG 9 = EXTREME

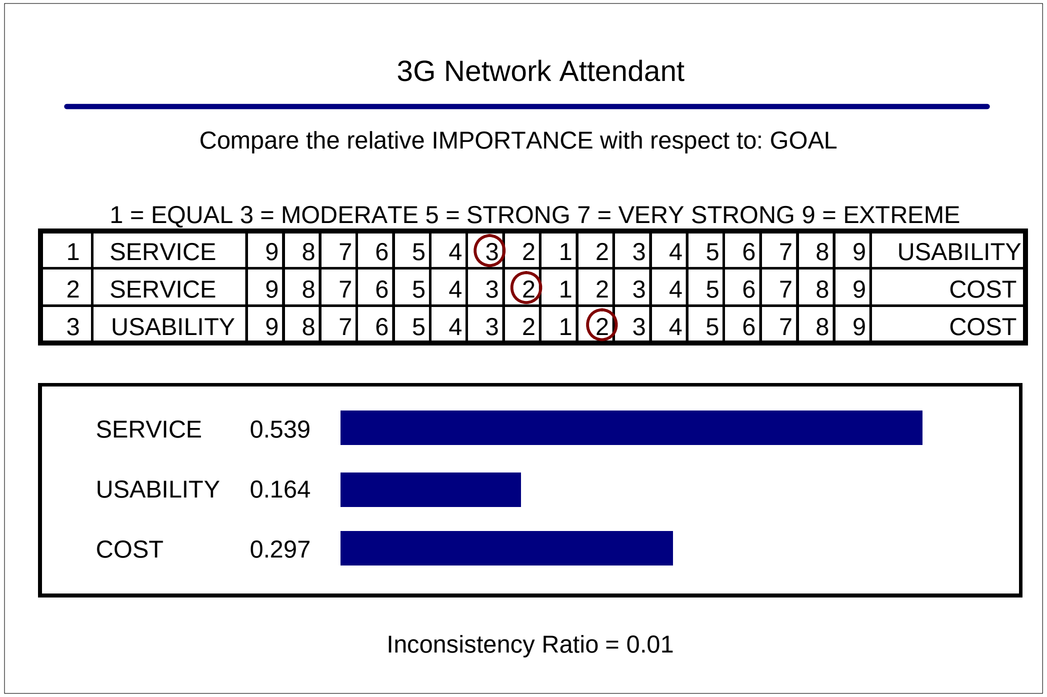
1	FEATURES	9	8	7	6	5	4	3	2	1	[✓ 2]	3	4	5	6	7	8	9	EXPANDABILITY
2	FEATURES	9	8	7	6	5	[✓ 4]	3	2	1	2	3	4	5	6	7	8	9	STANDARDISATION
3	FEATURES	9	8	7	6	[✓ 5]	4	3	2	1	2	3	4	5	6	7	8	9	CONFORMITY
4	FEATURES	9	8	7	6	5	4	3	2	1	2	[✓ 3]	4	5	6	7	8	9	AVAILABILITY
5	EXPANDABILITY	9	8	7	6	5	4	[✓ 3]	2	1	2	3	4	5	6	7	8	9	STANDARDISATION
6	EXPANDABILITY	9	8	7	6	5	4	[✓ 3]	2	1	2	3	4	5	6	7	8	9	CONFORMITY
7	EXPANDABILITY	9	8	7	6	5	4	3	2	1	2	3	[✓ 4]	5	6	7	8	9	AVAILABILITY
8	STANDARDISATION	9	8	7	6	5	4	3	[✓ 2]	1	2	3	4	5	6	7	8	9	CONFORMITY
9	STANDARDISATION	9	8	7	6	5	4	3	2	1	2	3	[✓ 4]	5	6	7	8	9	AVAILABILITY
10	CONFORMITY	9	8	7	6	5	4	3	2	1	2	3	4	[✓ 5]	6	7	8	9	AVAILABILITY

FEATURES	0.207
EXPANDABILITY	0.205
STANDARDISATION	0.084
CONFORMITY	0.057
AVAILABILITY	0.448

Inconsistency Ratio = 0.08

Comparison of alternatives and objectives

- Compare objectives pairwise for the goal



3G Network Attendant

Compare the relative IMPORTANCE with respect to: GOAL

1 = EQUAL 3 = MODERATE 5 = STRONG 7 = VERY STRONG 9 = EXTREME

1	SERVICE	9	8	7	6	5	4	[✓ 3]	2	1	2	3	4	5	6	7	8	9	USABILITY
2	SERVICE	9	8	7	6	5	4	3	[✓ 2]	1	2	3	4	5	6	7	8	9	COST
3	USABILITY	9	8	7	6	5	4	3	2	1	[✓ 2]	3	4	5	6	7	8	9	COST

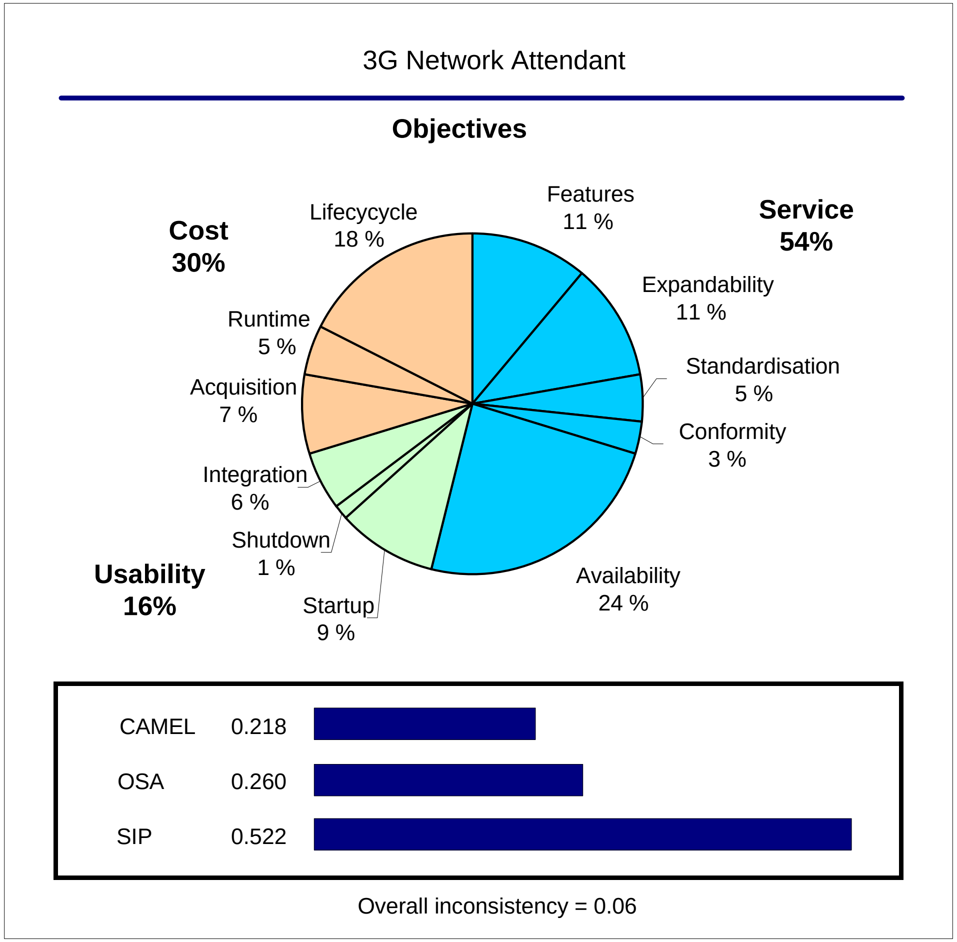
SERVICE	0.539
USABILITY	0.164
COST	0.297

Inconsistency Ratio = 0.01

Results and Conclusions

Results

- Overall
  - SIP 52%
  - OSA 26%
  - CAMEL 22%
- Objectives
  - Service 54%
    - SIP 52%
    - CAMEL 29%
    - OSA 19%
  - Cost 30%
    - SIP 56%
    - OSA 31%
    - CAMEL 13%
  - Usability 16%
    - SIP 44%
    - OSA 42%
    - CAMEL 14%



Conclusions

- Overall preference for a network attendant service in 3G networks would be to implement the service in the IP Multimedia Subsystem using a Session Initiation Protocol Application Server

- SIP-based solution was evaluated to offer better service creation and technology benefits than the other compared alternatives and at a lower cost. In addition, it was favoured from the usability and maintenance perspective as well.

- In the overall results, a SIP-based solution favourably satisfied all three main objectives. Hence, it was proposed as the best choice for a next generation attendant service.

- However, if the operators are not going to deploy IMS, there is neither going to be adequate network support nor a market for a SIP-based attendant service.
  - Technology availability in operator networks the most important individual category.
  - Estimated result, more profound market study needed to support the decision-making.

Thank You!

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http//:www.trio.com

Abbreviations

3G	Third Generation
3GPP	3rd Generation Partnership Project
ACD	Automatic Call Distribution
API	Application Programming Interface
CAMEL	Customised Applications for Mobile network Enhanced Logic
CAP	CAMEL Application Part
CDR	Call Detail Record
CN	Core Network
CORBA	Common Object Request Broker Architecture
CSCF	Call Session Control Function
CSE	CAMEL Service Environment
DTMF	Dual-Tone Multi-Frequency
ETSI	European Telecommunications Standards Institute
FTP	File Transfer Protocol
GGSN	Gateway GPRS Support Node
GMSC	Gateway Mobile service Switching Centre
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HPLMN	Home Public Land Mobile Network
HSS	Home Subscriber Server
I-CSCF	Interrogating-CSCF
IDL	Interface Definition Language
IETF	Internet Engineering Task Force
IMS	IP Multimedia core network Subsystem
IN	Intelligent Network
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
JAIN	Java APIs for Integrated Networks
LCS	Location Services
MAP	Mobile Application Part
Megaco	Media gateway control protocol
MExE	Mobile Execution Environment
MGCF	Media Gateway Control Function
MGCP	Media Gateway Control Protocol
MGW	Media Gateway
MRF	Media Resource Function
MRFC	Media Resource Function Controller
MRFP	Media Resource Function Processor

Abbreviations

MSC	Mobile service Switching Centre
MSISDN	Mobile Subscriber ISDN Number
OMA	Open Mobile Alliance
OSA	Open Service Access
OSS	Operator Specific Service
Parlay APIs	Parlay Application Programming Interfaces
PBX	Private Branch Exchange
P-CSCF	Proxy Call Session Control Function
PLMN	Public Land Mobile Network
PSE	Personal Service Environment
QoS	Quality of Service
RTP	Real-time Transport Protocol
SCE	Service Creation Environment
SCS	Service Capability Server
S-CSCF	Serving-CSCF
SGSN	Serving GPRS Support Node
SIP	Session Initiation Protocol
SLF	Subscriber Location Function
SMPP	Short Message Peer to Peer
SMS	Short Messaging Service
SMSC	SMS Centre
SN	Service Node
SOAP	Simple Object Access Protocol
SRF	Specialised Resource Function
SS7	Signalling System No. 7
TS	Technical Specification
UCP	Universal Computer Protocol
UML	Unified Modelling Language
UMTS	Universal Mobile Telecommunications System
USAT	USIM Application Toolkit
USIM	Universal Subscriber Identity Module
UTRAN	UMTS Terrestrial Radio Access Network
VHE	Virtual Home Environment
VMSC	Visiting Mobile service Switching Centre
VPLMN	Visiting Public Land Mobile Network
VPN	Virtual Private Network
WLAN	Wireless Local Area Network
WSDL	Web Service Definition Language
XML	Extensible Markup Language