TECNOTREE

Next Generation Messaging

Intro Course

Contents

- Tecnotree in Brief
- Introduction to NGM
- Platform
- Services
- Software
- O&M

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Tecnotree in Brief

Facts about Tecnotree

- Established in 1978 – almost 30 years of experience in the telecommunications industry
- Net sales 2006: EUR 71,8 million (69)
- Product lines:
  - **Messaging** (Voice and Video Mail, Media Server, MMSC, SMSC, PMR)
  - **Charging** (Convergent Charging, EAIP, complementary services from partners)
- Approximately 370 employees in 14 locations
- Deliveries to over 80 customers in 60 countries worldwide
- Presence in Europe, Asia Pacific, Middle East, Africa and the Americas
- Listed on the Helsinki Exchange since 2000

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Customer Base

Europe
- Telenor (NOR)
- TeliaSonera (FIN)
- Vodafone Ireland (IRL)
- Elisa (FIN)
- T-Mobile (AU)
- Swisscom (CH)
- TDC Mobil (DK)
- Omnitel (LIT)
- Mobilkom Austria (AU)
- VOXMobile (LUX)
- MTT (RUS)
- MTS (RUS)
- Finnet (FIN)
- A.S.T.R.I.D. (BEL)
- ERVE (FIN)

Latin America
- Americel (BRA)
- Telemig Celular (BRA)
- Telet (BRA)
- Amazonia Celular (BRA)
- Digitel (VEN)
- Digicel (VEN)
- Nuevatel (BOL)
- Conecel (ECU)
- Telgua (GUA)
- PCS Digital (NIC)
- Boatphone (CAR)
- CTI Móvil (ARG)
- ATL (BRA)
- TESS (BRA)
- Brasil Telecom (BRA)
- CTE El Salvador (SAL)

Asia & Middle East
- Chunghwa Telecom (TWN)
- CELCOM (MAL)
- Indosat (IND)
- MTC (KUW)
- STC (KSA)
- CellC (RSA)
- Vodacom (RSA)
- HCPT (IND)
- etc.

Tecnotree operates in 14 locations worldwide and has supplied its products to over 80 customers.

◯ Tecnotree location

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Introduction to NGM

Operator Challenges

- New business models emerging in the telecoms industry
- Accelerated customer demand for tailored services
- Need for greater flexibility
- Increasing competition and lower prices

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Investment Drivers

CAPEX	OPEX	REVENUE
• Low cost of entry • Standards compliance and open architecture • Ease of integration and turnkey delivery • Single platform for multiple services • Future-proofness to IMS networks	• Reliability and availability • Easy customisation • Self-administration • Streamlined operations and maintenance	• Feature-rich services • Hosting capability • Customer segmentation • Fast service creation • Personalisation

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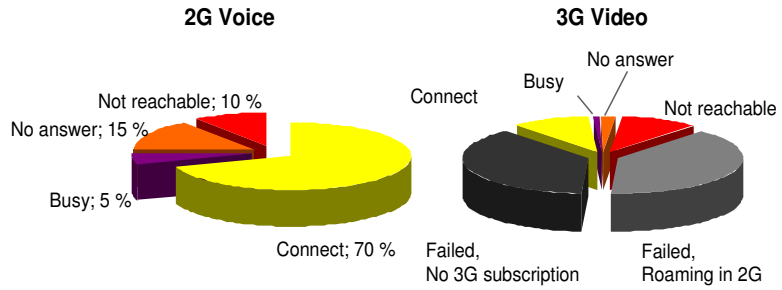
Call completion pattern examples for 2G voice and 3G video services



NOTE: Actual percentages are operator and network specific

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Voice/Fax/Video Mail Universal access

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Open New Technology...

- Solutions based on open standards and open source
- Standard interfaces enable easy integration to the existing infrastructure
- Service creation based on industry standard tools (VoiceXML, J2EE)
- Communication based on open protocols both internally and externally

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... and Open New Terminology

- Java
  - J2EE
- SAN
- LVS
- GFS
- jBoss
- Spring

etc. --> information easily available from WWW sources

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Next Generation Services

The services provided by Tecnotree NGM are divided into four categories:

- **Voice Call Completion Services**
- **Video Call Completion Services**
- **Video Content Services**
- **Short Media Messaging Services**

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Next Generation Services

Voice Call Completion Services

- Next Generation Voice Mail
- iCalled SM
- iCalled Voice

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Next Generation Services

Video Call Completion Services

- Video Mail
- iCalled Video
- Video Announcements
- Video-Audio Fallback

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Next Generation Services

Video Content Services

- Video Portal

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Next Generation Services

Short Media Messaging Services

- iMessaged Video

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Platform

Layered Architecture

- Three-layer architecture:
  - Access
  - Application = Service
  - Storage
- Standard interfaces between the layers

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Layered Architecture

Access Layer

- Contains different access methods:
  - SS#7 telephony access
  - SIP for VoIP access and for Video Gateway connections
  - Firewall for IP access

    etc.
- Telco Server, Proxy Server, Video Gateway, System Gateway

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Layered Architecture

Service Layer

- Responsible for:
  - Generating the actual end-user services delivered by the system
  - Rendering the service for each access
- Messaging Application Servers, IVR Application Servers

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Layered Architecture

Storage Layer

- Contains the actual data storage architecture
- Provides needed protocols and interfaces, such as IMAP and SQL to the actual data
- Infra Servers, Centralised Message Storage

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Layers

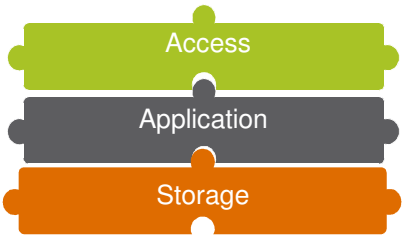
Terminals

Access layer

Access Layer

Application Layer

Databases



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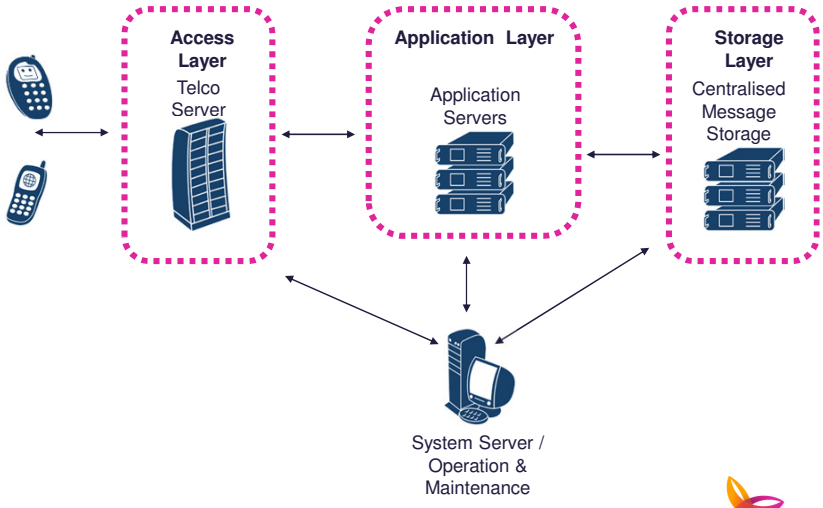
Overall Architecture…



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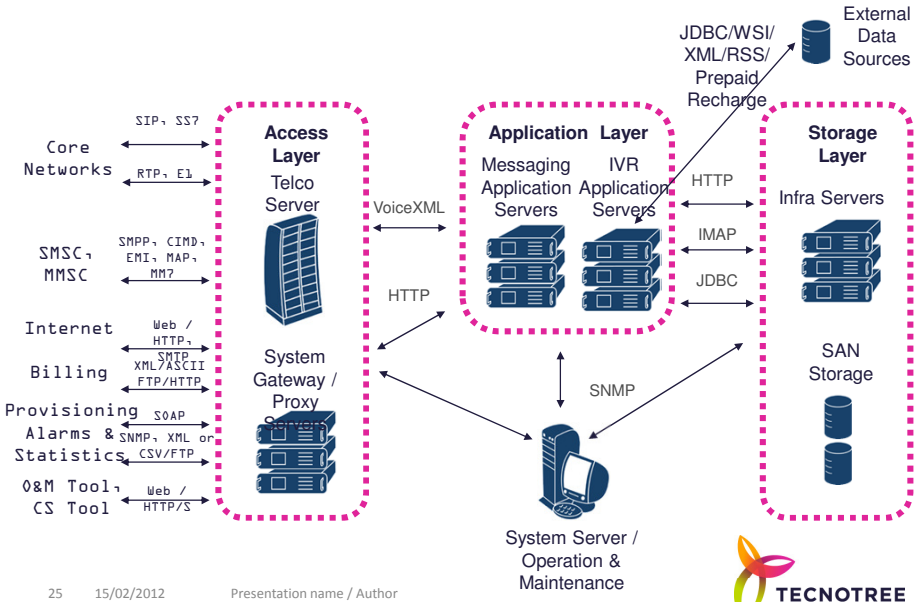
...includes many interfaces



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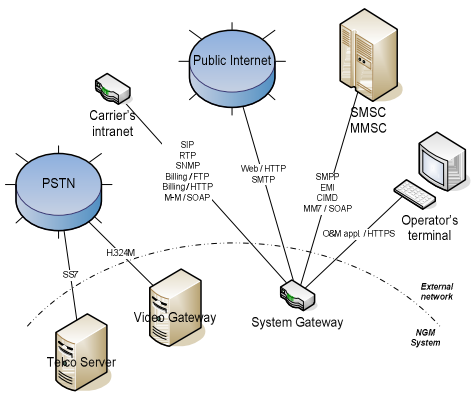
NGM External Interfaces ...



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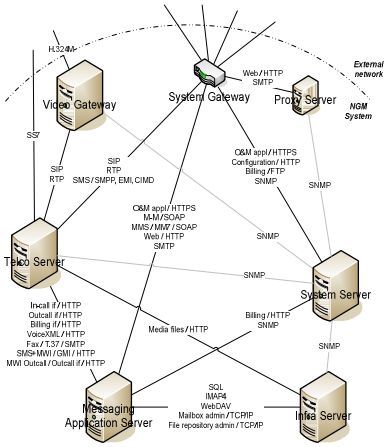
… and NGM Internal Interfaces



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IP Networking

- Very essential part of NGM system:
  - All data transmission between system elements goes through the Ethernet
- Fault tolerant
  - Ethernet network elements (System Gateways and switches) are duplicated
  - Each system element (AS, SS, IS, etc.) is connected to both switches
  - Channel Bonding: Linux feature allowing two Ethernet interfaces (active and passive) from the same system element

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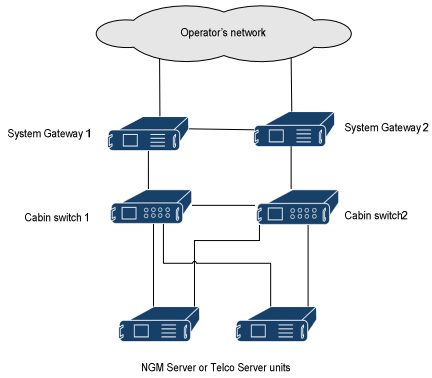
IP Networking

- Basic view of Ethernet connections between the servers



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IP Networking

- The network can be divided from the Tecnotree NGM point of view to
  - External Network
  - Private Network
- Normally the private network is a so-called flat network
  - All devices are in the same subnet
- However, the system can also be grouped into several subnets
  - For example, due to a dispersed geographical system setup

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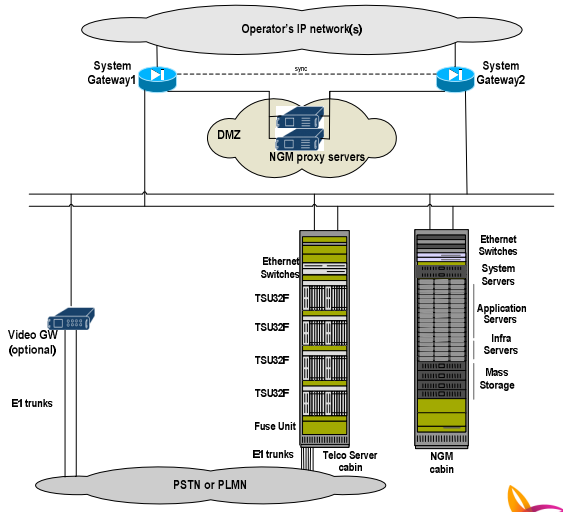
IP Networking



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NGM System Elements

- Telco Server
- Messaging Application Server
- System Server
- Infra Server
- Common Storage
- System Gateway
- IVR Application Server (optional)
- Proxy Server (optional)
- Video Gateway (optional)

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Telco Server

Telco Server TSS200

Telco Server TSS100

- Provides the SS7/ISUP and SIP connectivity to switching network
  - Implements the Media Server functionality incl. voice gateway
  - Interacts with external video gateways for 3G video
  - VoiceXML interpreter
- Subscriber-stateless, session-stateful
- Redundancy and scalability
  - 2N redundancy with two independent CPC cards running signalling (in TSS200 hw)
  - Distribution with SS7 level redundancy
  - Scalability by adding new interface cards and Telco Server Units
- Main technologies
  - Redhat Linux as Operating System
  - SS7 / ISDN PRA signalling, and SIP signalling
  - Voice Browser with Media Controller, Dialogue Controller, and VoiceXML interpreter
  - Integrated SMSC

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Messaging Application Server

Tecnotree OEM Dual Xeon

- Provides the end-user services
- Forms a cluster of servers behind a single virtual IP address
  - Linux Virtual Server
- Stateless with “sticky sessions”
- Redundancy and scalability
  - N+1 redundancy
  - Scalability by adding new nodes to cluster
- Main technologies
  - Red Hat EL 4 Linux OS
  - JBoss J2EE Application Server version 4
  - Java Runtime Environment (JRE)
  - Apache HTTP daemon

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System Server

Tecnotree OEM Dual Xeon

- Installation server
  - Netboot install from System Server
- System-level O&M
  - Alarms
  - Node statuses
  - System statistics
  - Billing CDRs
- Subscriber-stateless, stateful with system configuration data
- Redundancy and scalability
  - 2N redundancy
- Main technologies
  - Red Hat EL 4 Linux OS
  - MySQL
  - Java Runtime Environment (JRE)

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Infra Server

Tecnotree OEM Dual Xeon

- Provides the data storage services for application layer
- Three categories of data
  - MySQL for user and service data
    - accessed with JDBC (HA-JDBC)
  - IMAP for messages
    - Lock-free mailboxes with Courier IMAP
    - Additional proprietary interface to create/delete mailboxes for on-demand services
  - File storage for greetings and prompts
    - HTTP/WebDAV
- Subscriber-stateless
- Redundancy and scalability
  - N+1 redundancy for IMAP and File storage. Scalability by adding new nodes to cluster.
  - 2N redundancy for SQL with two active servers
- Main technologies
  - Red Hat EL 4 Linux OS
  - MySQL, Courier-IMAP
  - Apache HTTP daemon with WebDAV support

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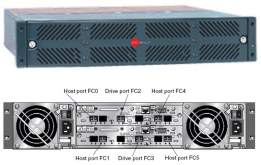
Common Storage



DotHill SanNet-II Fibre Channel RAID array

- Provides the actual data storage
- Fibre Channel based Storage Area Network (SAN)
  - twelve 146GB disks in an array
- Redundancy and scalability
  - Fully redundant with redundant controllers, FC connections, etc. RAID1 and RAID5 utilized.
  - Scalability by adding JBODs i.e. disk arrays

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System Gateway

Tecnotree OEM Dual Xeon

- Isolates NGM system from external networks
  - Firewall
  - Address translation (NAT)
- Supported by network configuration tool
  - Generates also routing and filtering rules
- Stateless operation
  - Connections are not lost even in swap-over
- Redundancy and scalability
  - 2N redundancy
  - Scalability by adding new pairs (e.g. for VoIP)
- Main technologies
  - OpenBSD 3.7 Operating System
  - OpenBSD's internal (kernel) PF firewall

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IVR Application Server (optional)

Tecnotree OEM Dual Xeon

- Utilises easy interactive voice response (IVR) applications developement
  - Playing of voice- and video prompts and recognition DTMFs, which are controlled by service logic built with voice-XML pages
- Can be deployed standalone, or with full NGM system
- Redhat Linux Operating system
- Interfacing towards external databases via customisable Java-bean connectors
- N+1 Redundancy
- two 3.2 GHz Intel Xeon CPU

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Proxy Server (optional)

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- Optional element
  - Required with end-user Web access
  - Required for external IMAP access
- Ensures Web security
  - DMZ - demilitarised zone
- Stateless operation
- Redundancy and scalability
  - N+1 redundancy
  - Scalability by adding new pairs
- Main technologies
  - Red Hat EL 4 Linux OS
  - Web proxy (Web UI)
  - Outbound SMTP proxy (mail relay)

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Video Gateway (optional)

Dilithium DTG 2000

- Provides the 3G video connectivity
- Interacts with Tecnotree Telco Server via
  - SIP and RTP
- IOT performed with
  - Dilithium DTG 2000

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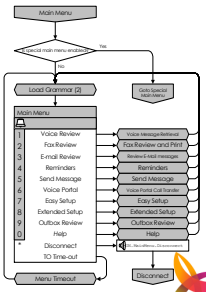
Services

Next Generation Voice Mail

- Mailbox Personalisation
  - Tutorial for mailbox setup
- Two-Stage Access
- Number Blocking
- Automatic Subscriber Creation
- Multiple greetings
  - Personal greeting
  - Absence greeting
  - System greeting
  - Name tag / number greeting
- Support for multiple languages
- Notification
- Intelligent Callback
- Missed Call Notice
- Fax Retrieval
- Web User Interface



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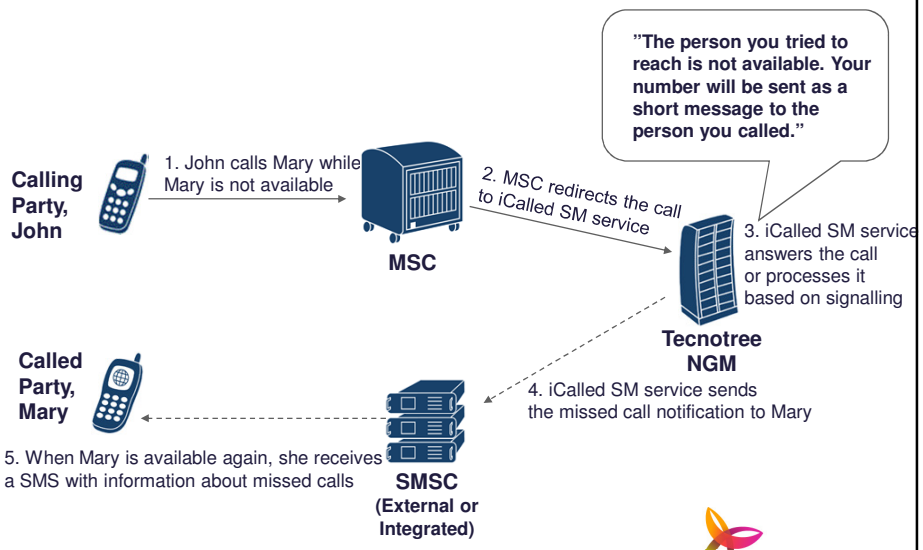
iCalled SM



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iCalled Voice

- When the subscriber cannot be reached, the call is diverted to the iCalled Voice service
- The caller has the possibility to leave a message to the called subscriber
  - The service dynamically creates a temporary voice mailbox to the subscriber
  - SM notification is sent to subscriber
  - After message retrieval temorary box is removed

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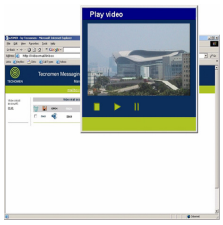
Video Mail

- Voice and Video Greetings
- Missed Call Notice
- Notification
  - SM
  - Email
  - MMS forward
- Message Retrieval
  - Via Video Phone
  - Via Voice Phone
  - Via WWW access
- Mailbox Personalisation
- Web user interface



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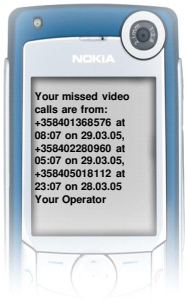
iCalled Video

- Temporary Video Mailbox will be created for Video subscriber who can't be reached
- All video calls are completed successfully
  - Creates chargable airtime
- Called party receives a SM notification with instructions how to retrieve a message
- Video message can be retrieved:
  - Via Video Phone
  - Via Voice Phone
  - Via WWW
- Box is removed after message retrieval



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Video Announcements

- Enables playing of informative video announcements when video call fails
- Operator can choose if video announcement is played for caller in situations where called subsriber can't be reached at all
- Separate access numbers possible for different video announcements

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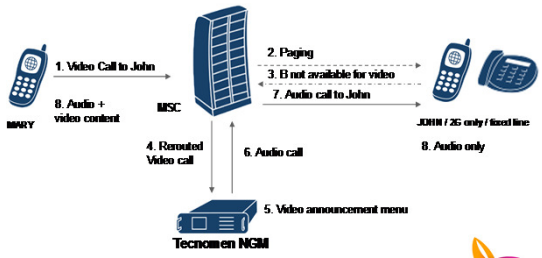
Video-Audio Fallback

- If video call fails due reason that called person is roaming in 2G network, Video-Audio fallback makes voice call still possible, with video content offered by operator
  - Maximises the revenue generated from video calls



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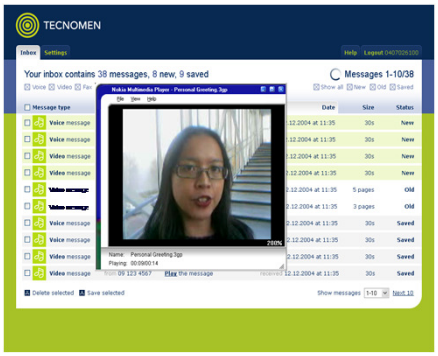
Web User Interface

- Available For both Voice and Video Mail
- Message retrieval and personal settings
  - Listen or view messages
  - Change greetings
  - Set up e-mail forwarding & other settings
- Customisable to fit the operator's look and feel



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Video Portal

- NGM Platform for Video Portal use
  - Easy to Customise for Operator's needs
- Operator can offer various video content:
  - News, music videos, traffic announcements, etc...

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iMessaged Video

- Service in which the caller can send a short video message to someone else without engaging himself/herself into the discussion:
  - Direct Deposit by prefix '*' + MSISN
  - Greetings offered by Operator
  - Temporary message store
  - SM Notification
  - Easy Retrieval by access number

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NGM Target Customer Segments
Voice Call Completion Services

Service	Positioning	Target Segments
Voice Mail – Personalised Service	• For replacement of legacy voice mail systems with a similar service • More flexible, more affordable and more future-proof service architecture than in legacy systems • Supports single mailbox for voice, fax and optionally video	• Traditional voice mail users
iCalledSM and iCalled Voice – on-demand voice services	• Basic call completion services • Extreme cost efficiency based on dynamic resourcing and licensing • Requires users to be provisioned only to HLR • Suitable for driving up the network call completion ratio by being provisioned to all users as a default service • Suitable for completing failed originating calls to other networks	• For segments where the usage of personalised voice mail is low • For segments where voice mail provisioning is not affordable for the operator (e.g. prepaid) • For markets where static voice mail is not a suitable service for end-users due to user behaviour • For competing operator subscribers

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NGM Target Customer Segments
Video Call Completion Services

Service	Positioning	Target Segments
Video Mail – Personalised Service	• Introduction of feature-rich 3G video mail service • Stand-alone service or combined with Voice Mail • Optimises the user experience	• Traditional voice mail users subscribing to 3G video • Premium user segments
iCalled Video – On-demand video mail	• Basic cost optimised video mail service providing full legacy support for 2G handsets • Requires users to be provisioned only to HLR • Suitable for driving up the network video call completion ratio by being provisioned to all video users as a default service • Promotes 3G video by completing video calls to 2G users	• For any 3G video user • For any 2G user • For competing operator subscribers

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NGM Target Customer Segments
Video Call Completion Services

Service	Positioning	Target Segments
Video-Audio Fallback	• Stand-alone service or complementing other call completion services • Increases the 3G video call completion ratio	• For all video call completion segments as a complementary service
Video Announcements	• Simple video announcement service for providing network-wide multimedia announcements • Can be used as video call completion announcement or combined with Intelligent Network services	• Complementing other network services

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NGM Target Customer Segments
Video Content Services

Service	Positioning	Target Segments
Video Portal	• Navigation and view capability for various stored or streamed video content, such as television or web cams • Video content service for increasing user to service 3G circuit-switched traffic	• Premium 3G video users

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NGM Target Customer Segments
Short Media Messaging Services

Service	Positioning	Target Segments
iMessaged Video	• Sending a video message to another user instead of a video call conversation • Promotes the use of video calls for non-conversational communication	• Premium 3G video users

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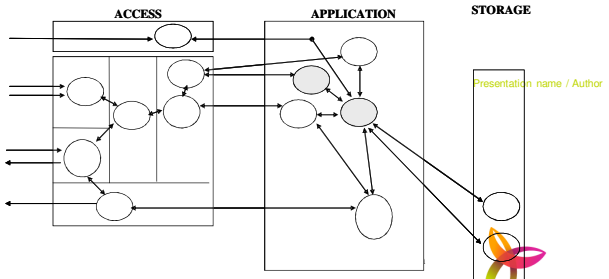
Software

Different Levels of NGM Information Architecture

- **Processes = 'objects':** in-call interfaces, charging, logging, ...
- **Data models:** domain model, service data, subscriber data,...
- **Algorithms:** number conversions, signalling analysis, ...

→ These different viewpoints act as a basis for NGM software architecture



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Overall SW Design 'Insights'

- Vertical scalability with 3-tier architecture
- Horizontal scalability and load balancing with Linux Virtual Server (LVS)
- HTTP-level caching with Squid
- Database caching in MAS with JBoss Cache
  - Database abstraction with Hibernate
  - HA database support via HA-JDBC driver
- Redundancy and disk clustering with Red Hat Global File System (GFS)

→ These insights act as a basis for software design

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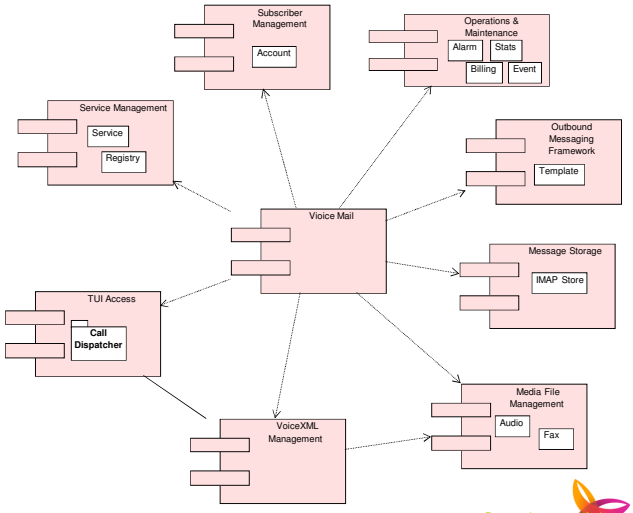
Services Composed of Clearly Designed, Reusable Modules



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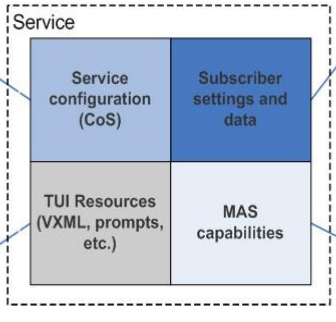
What Builds a Service?

Service configuration:
Configuration for MAS capabilities used *and* the service logic in VoiceXML.
For example:
- Notification templates
- Enabled features
- Message store settings

TUI Resources:
The static presentation and logic layer for the service.
- VoiceXML files
- Prompts
- etc.



Subscriber settings and data:
The subscriber specific settings that control how this service works for this subscriber in particular.
For example:
- What features are enabled for subscriber
- Subscriber specific content (e.g. messages)
- Personalisation (e.g. greetings)

MAS capabilities:
The MAS components utilised by the service. For example:
- Message store
- Notification engine
- Billing

The capabilities are configured through the Service Configuration and subscriber settings.

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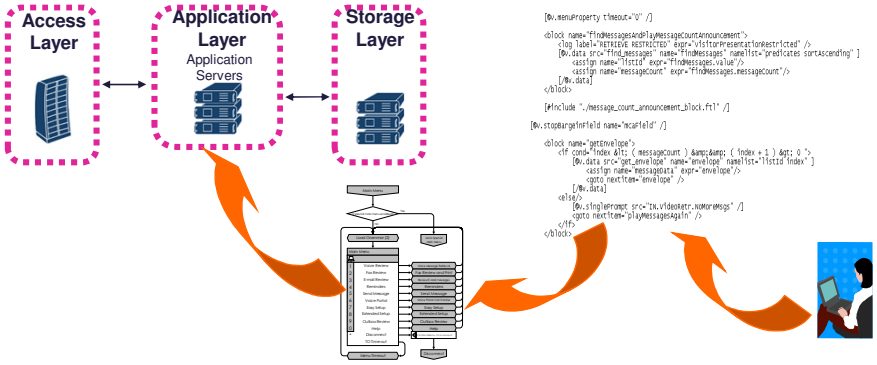
Easy Customisable UI



→Operator can ask Tecnotree personnel to do quick Call Flow modifications
→Call flow appearance is built with easy customisable Voice-XML - pages

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Typical Voice Deposit Call Behaviour

- In-call signalling, address analysis and service triggering rules
  - Account lookup
  - Automatic Subscriber Creation (ASC)
- Distributed service model: TUI and MAS.
- Deposit: encapsulate voice message into e-mail
- Initiate outbound notification
- Execute charging functions

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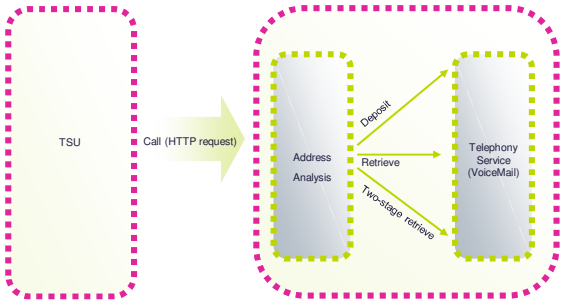
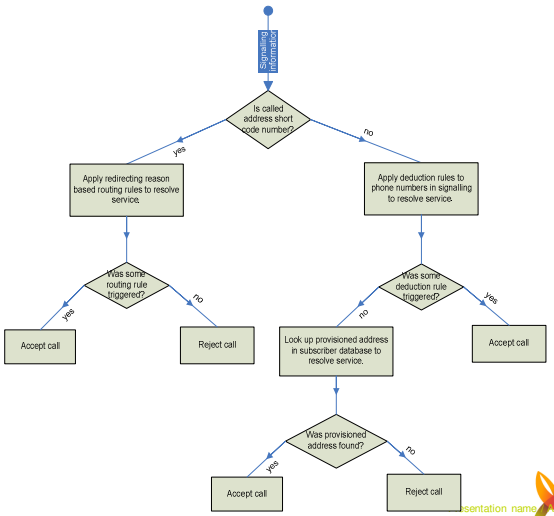
Address Analysis



Address Analysis



Address Deduction Rules

- Mobile Number Portability (MNP) support
- Service address to personal mobile address rules
- Automatic Subscriber Creation (ASC)

Rule name	Service number	Personal number
Operator1	+358 42 SN	+358 40 SN
Operator2	+434 650 11 SN	+434 650 SN
Operator3	+432 688 85 SN	+432 688 8 SN minus first digit

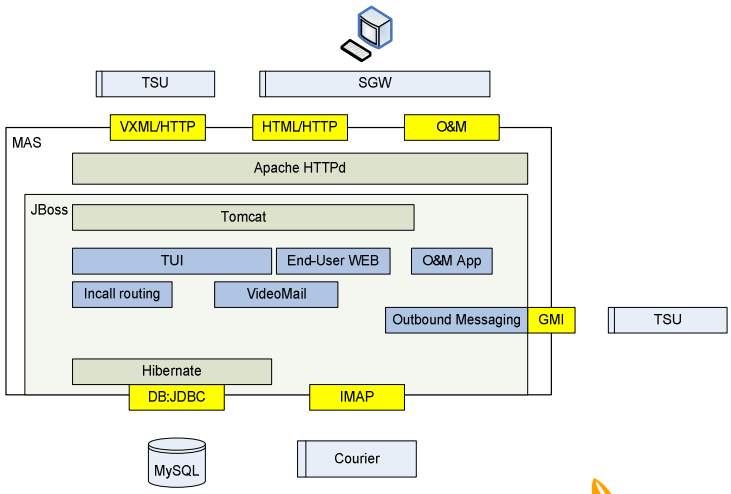
Outbound Messaging Framework (OMF)

- Delivery methods: SM, email, MMS forward
- Notification templates
  - Template language to build rich content
- Notification strategy engine
- Statistics and licensing

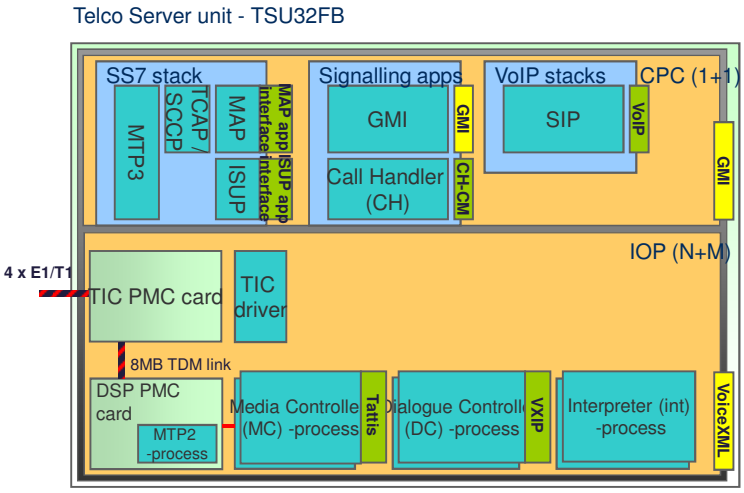
Notification Strategies

- SM notification
- E-mail notification
- MMS forward

Application Server Internal Structure



TSS 200 Internal Structure



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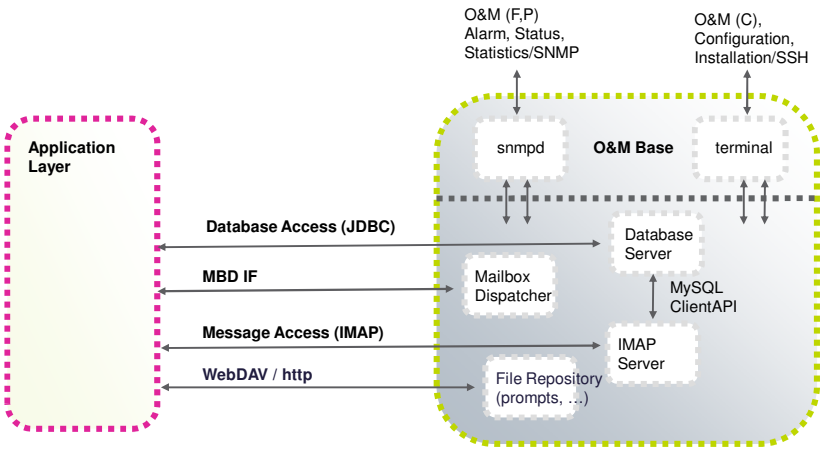
Infra Server Internal structure



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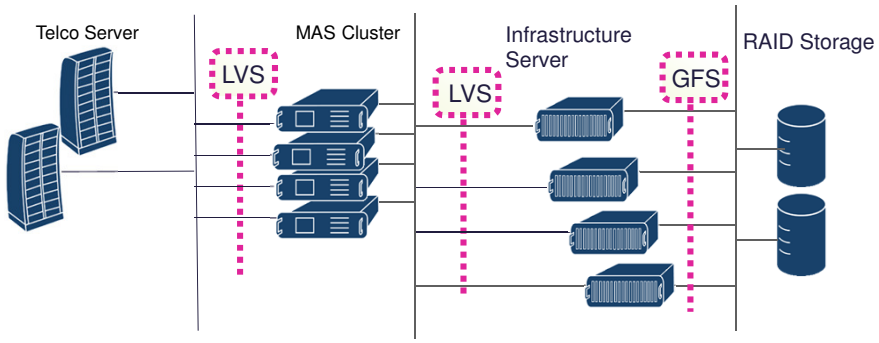
Reliability



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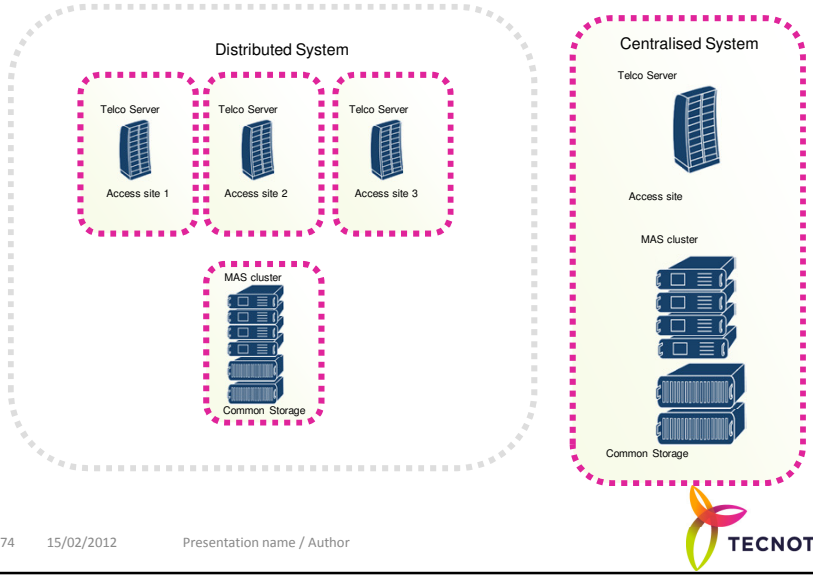
Scalability



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Availability

Element or Unit	Main Task	Redundancy	Comments
IP Network	Connects different network elements together	2N	Redundant central switches and cabinet switches. Critical network elements have at least two Ethernet connections.
Proxy Server	Provides WWW accesses	N+1	When more than one server is used and one goes down, only capacity is decreased
System Gateway	Acts as a firewall in the NGM system	2N	Hot-standby
Telco Server Unit	Handles all signaling, switching and call processing to and from core networks (IP or CS)	2N, distributed	Hot-standby. Has two independent CPC cards running signaling information.

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Availability

Element or Unit	Main Task	Redundancy	Comments
System Server	Responsible for installation and some O&M functions	2N	Not a service-critical unit: if one is down, the systems function normally
Centralised Message Storage	Permanent storage	Redundant	Service-critical unit to subscribers. Has RAID 5 disks. Redundand controllers, FC connections and PSU's.
Messaging Application Server	Cluster running business logic	N+1	If one unit goes down, only capacity will decrease
Infra Server	IMAP Server Database server	N+1 1+1, active-active	If one unit goes down, only capacity will decrease. Two parallel servers serving requests. Writes are parallel and reads are distributed. If one unit goes down, the read capacity will decrease.

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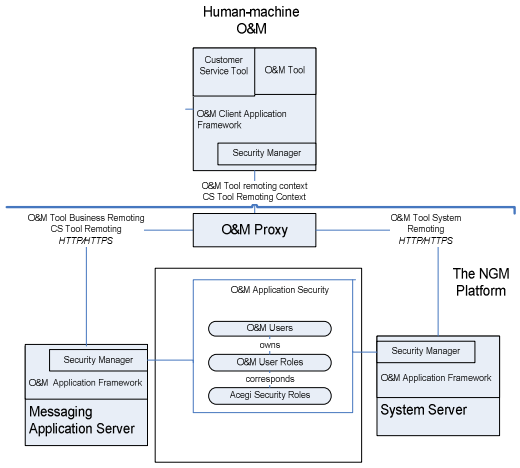
Operations and Maintenance (O&M)

The NGM O&M concept can be divided into two main categories:

- System Management: covers the functional areas related to operating the NGM system as a platform in which interfaces and procedures cover platform-wide functions.
- Business Management: management tools for subscriber and service management and billing.

O&M Application Framework



- System Management
  - Fault management
  - Performance management
  - Platform configuration management
  - Security management
- Business management
  - Subscriber management and provisioning
  - Service management
  - Billing management

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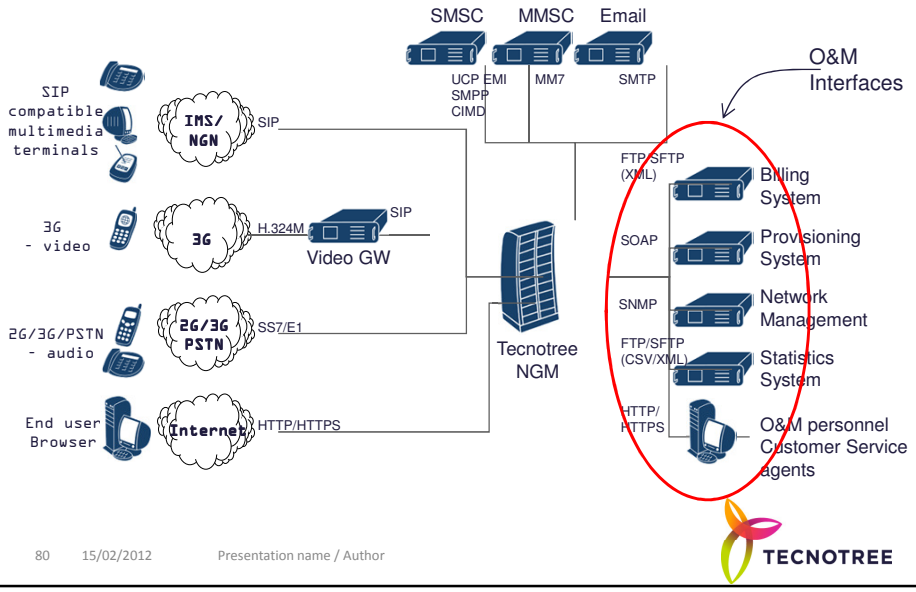
NGM External Interfaces



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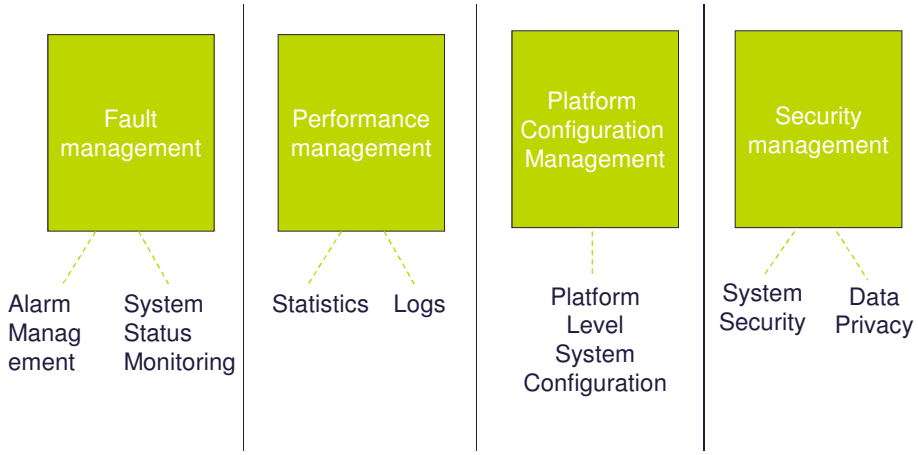
System Management



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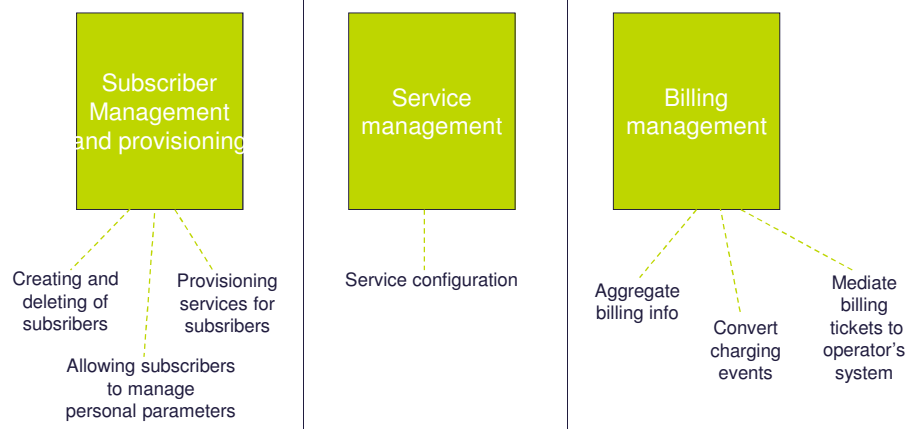
Business Management



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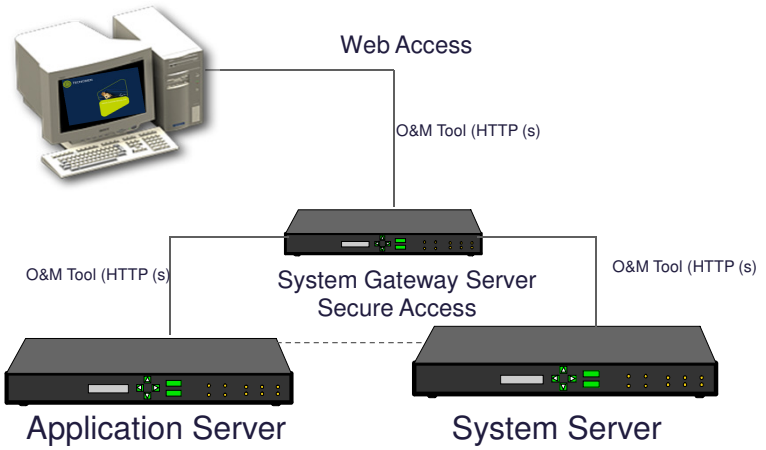
Tecnotree O&M Tool (TOM) -Access



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Management Tools for O&M

- Operation and Maintenance Tool (O&M Tool)

  General O&M management tool for operator personnel

- Customer Service Tool (CS Tool)

  Subscriber management tool for customer service agents and O&M maintenance people

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O&M Tool

- O&M Tool is intended
  - managing subscribers
  - managing and configuring the services
  - viewing alarms and billing information
  - managing O&M users
- The application is web-based and is used with a standard Java-compliant web browser
  - J2SE Runtime Environment version 5.0

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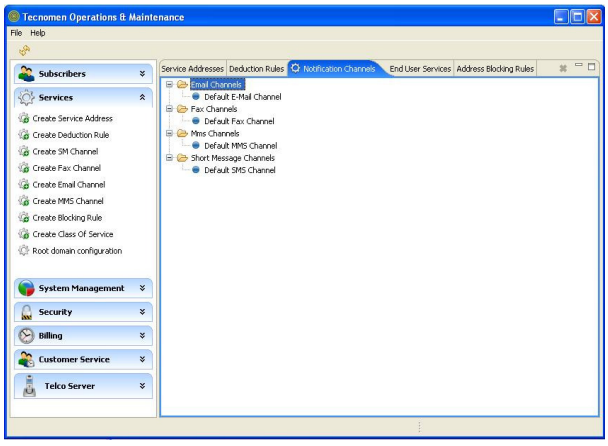
O&M Tool

Perspectives

1. Subscribers
2. Services
3. System Management
4. Security
5. Billing
6. Customer Service
7. Telco Server



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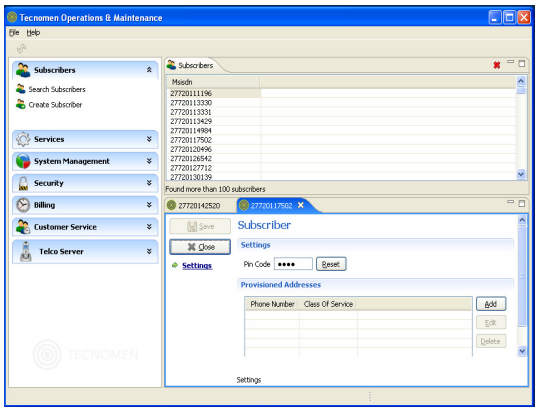
1. Subscribers

Functions

- Searching
- Viewing
- Creating
- Editing
- Deleting

} subscribers

- Managing provisioned service addresses



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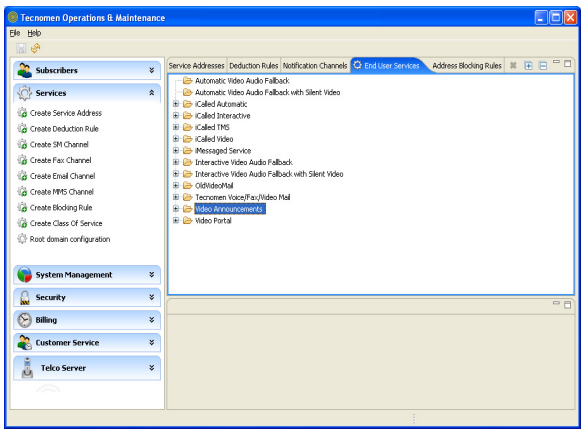
2. Services

Functions

- Configuring the service settings
- Editing SM notification templates
- Managing
  - service addresses
  - deduction rules
  - notification channels
  - blocking rules
  - class of service settings
  - root domain configuration



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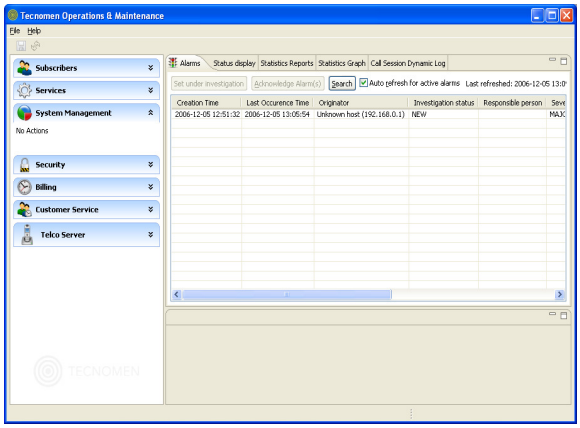
3. System Management

Functions

- Managing alarms
- Monitoring the node status
- Generating
  - online statistics reports
  - online statistics graph
- Managing the call session dynamic log



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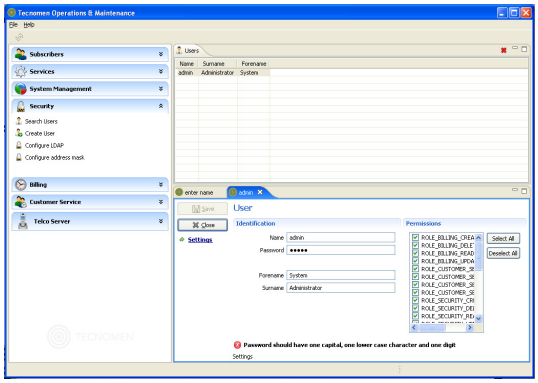
4. Security

Functions

- Viewing
- Creating
- Editing
- Deleting

O&M users

- Editing LDAP configuration



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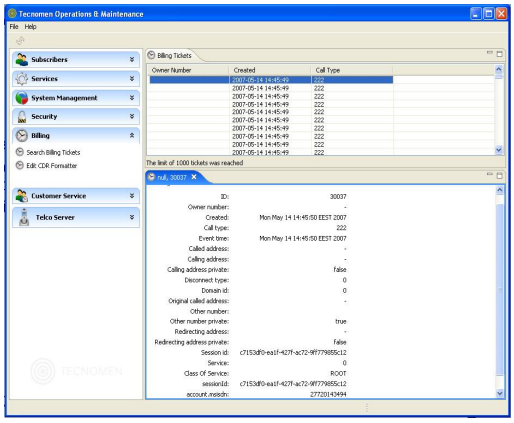
5. Billing

Functions

- Searching and viewing billing tickets
- Modifying the XML CDR format



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Customer Service Tool

- Customer Service Tool (CS Tool) is part of the NGM Operation and Maintenance system
- CS Tool is used for
  - administering the subscribers' accounts and service settings
  - viewing statistics
  - viewing call logs
  - viewing message status
- The application is web-based and is used with a standard Java-compliant web browser
  - J2SE Runtime Environment version 5.0

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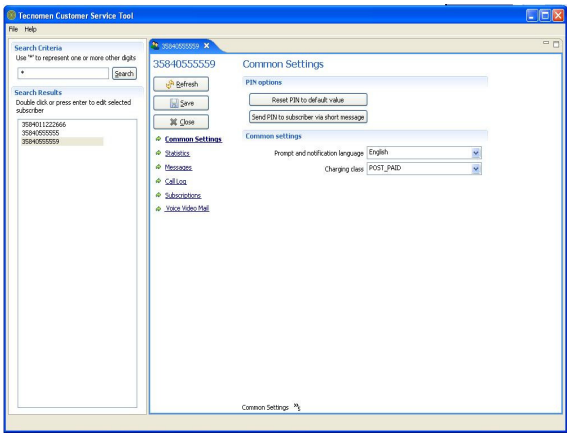
6. Customer Service = CS Tool

Views

- Common Settings
- Statistics
- Messages
- Call Log
- Subscriptions
- Service-specific settings



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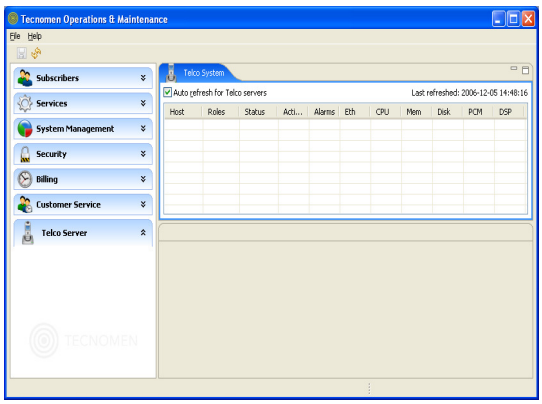
7. Telco Server

Functions:

- Telco Server statistics
- Telco Server management
- Monitoring Telco of Server Processes



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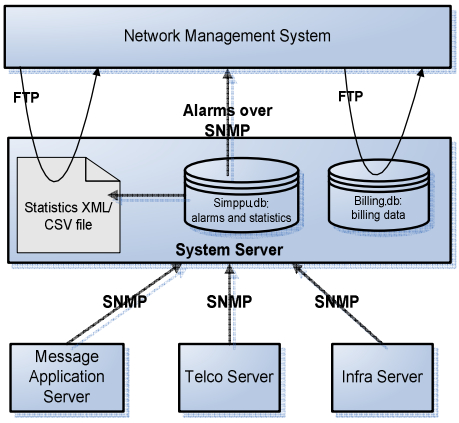
O&M

Alarms and Statistics, Billing, M to M

Alarms, Statistics, and CDRs Collecting and Forwarding Principle



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Alarms and Statistics

- The network elements of the NGM system provide alarms and statistics using SNMP.
- Both alarms and statistics are stored to a local System Server database.
- From statistics, also aggregated reports are generated.

OID	Object identifier	Description
..2451.7	tecMgmt	Contains management MIBs from functional view.
..2451.8	tecEntityExp	Contains management MIBs from physical view – EXPERIMENTAL.
..2451.9	tecMgmtExp	Contains management MIBs from functional view – EXPERIMENTAL.

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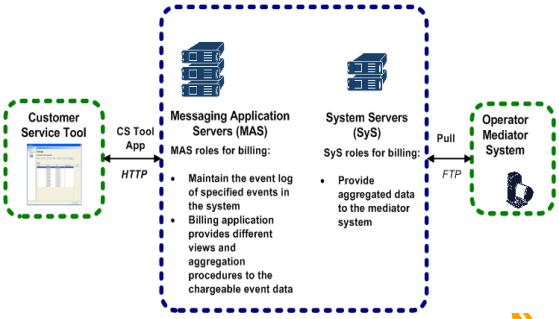
Billing

- The billing information is aggregated from the NGM system using chargeable events, and those events are converted into suitable presentation for mediation and system monitoring purposes.



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Machine to Machine Provisioning

- The Machine-to-Machine (M2M) provisioning interface is designed to allow external systems to interact with the NGM system without human interaction
- The M2M provisioning interface is provided for an external operator machine to maintain subscriber accounts and to provision them the NGM services. The interface enables to perform the following operations:
  - create a subscriber
  - modify an existing subscriber
  - delete an existing subscriber
  - search subscribers

```
<?xml version="1.0"?>
 <soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Body>
   <createServiceSubscription version="1" xmlns="http://tecnomen.com/m2m">
    <primarySubscriberAddress>436506543456</primarySubscriberAddress>
    <provisionedServiceAddress>4365011987654</provisionedServiceAddress>
    <subscriberName>John Doe</subscriberName>
    <pin>1234</pin>
    <password>poorPassword</password>
    <language>en</language>
    <segmentName>Basic Subscribers</segmentName>
    <services>
     <service name="Basic VoiceMail">
      <params>
       <param name="provisionMissedCallNotice" value="1"/>
      </params>
     </service>
    </services>
   </createServiceSubscription>
  </soap:Body>
</soap:Envelope>
```


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