

Mobile Network Management (IMT-2000 Management)

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OUTLINE

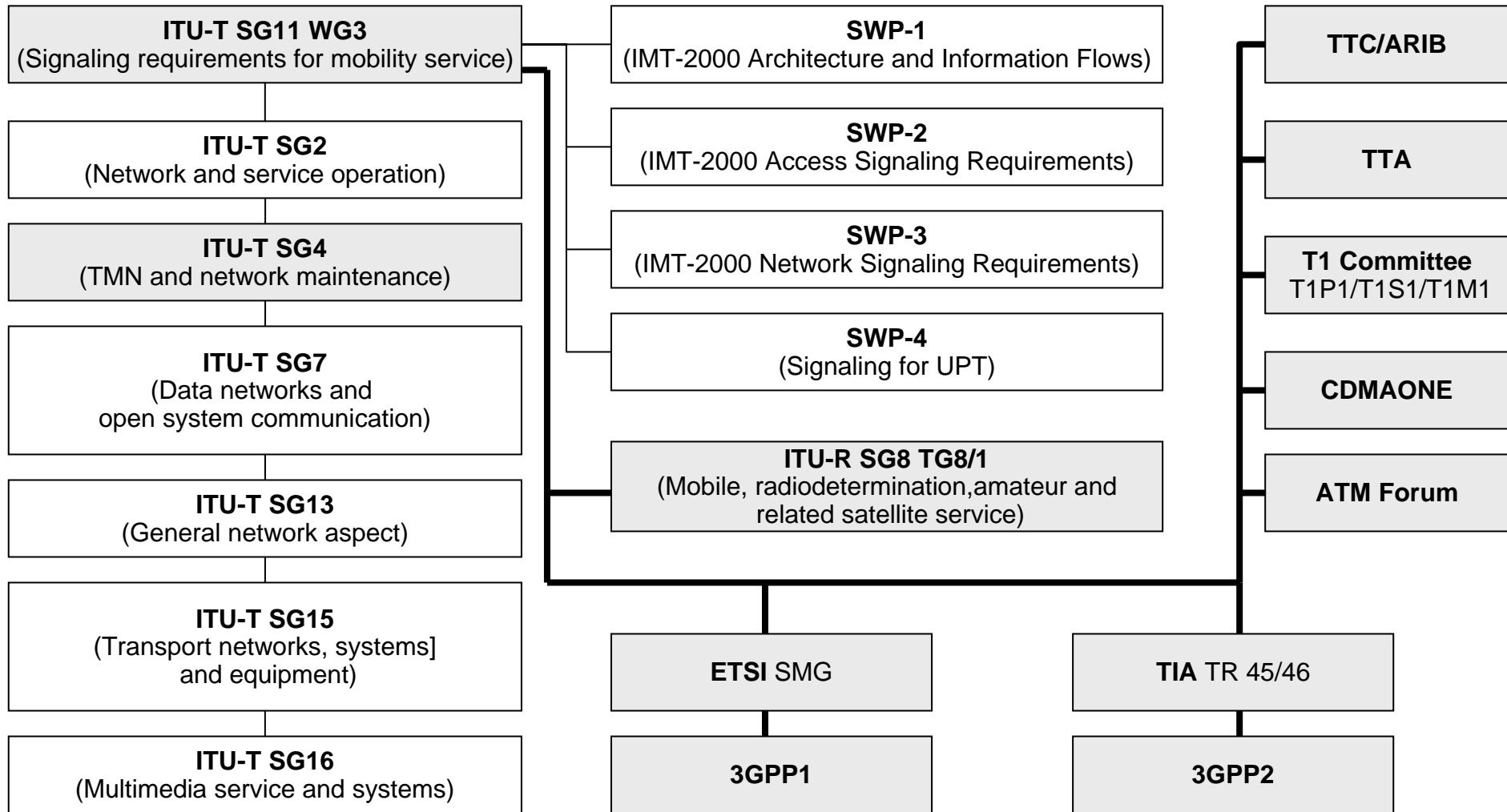
- IMT-2000 Standardization**
- IMT-2000 Management Framework**
- IMT-2000 Network Management**
- IMT-2000 Service Management**
- Management System Architecture and Supporting Technologies**
- Implementation of IMT-2000 Management Service**

IMT-2000 STANDARDIZATION

IMT-2000 OBJECTIVE

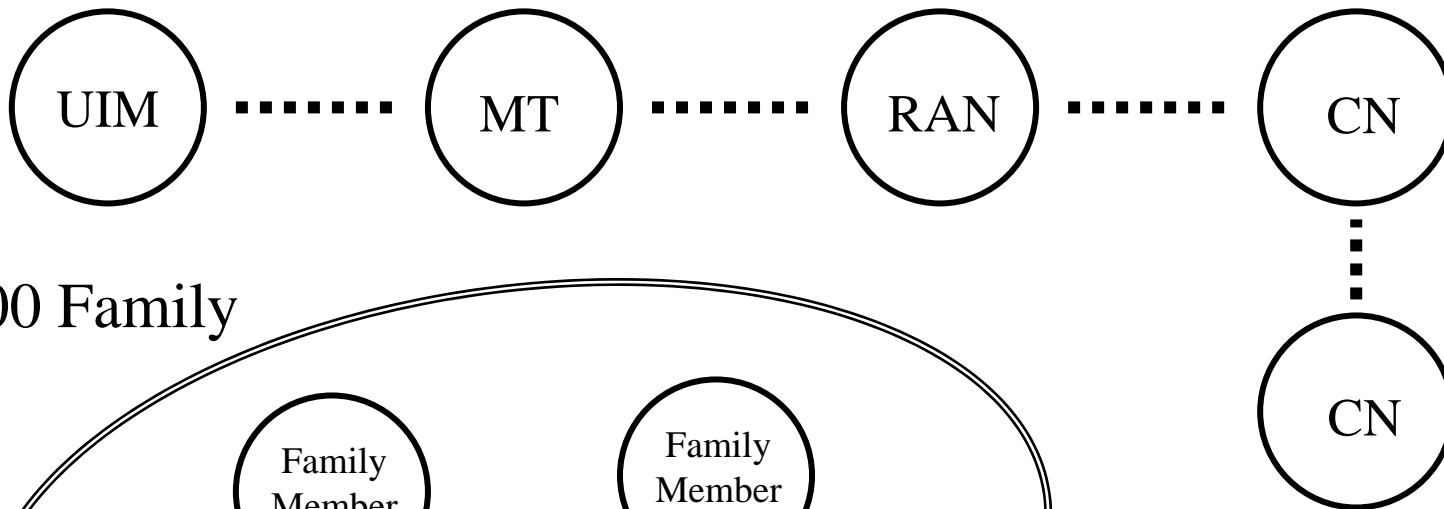
- Global Service and Global Roaming Available in Year 2000s
- Flexible and Seamless Service Provision Independent of Location
- Wider Range of Services and Terminals
- Support of High Speed Access
- Support of Packet Mode Services (e.g., Internet)
- Fixed/Mobile and Public/Private
- Improved Operational Efficiencies
- Evolution from 2nd Generation

IMT-2000 STANDARDIZATION GROUPS

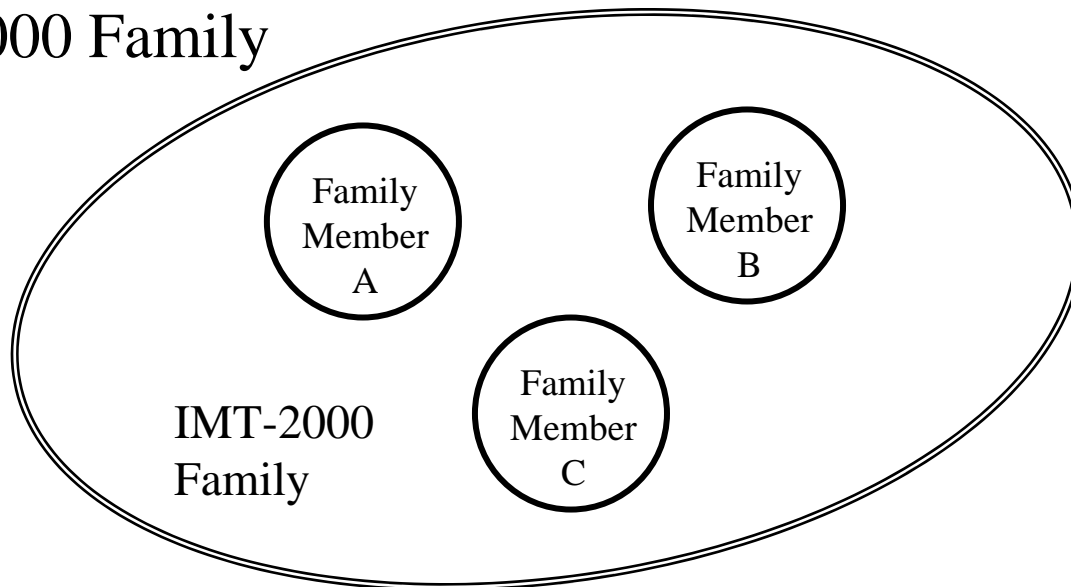


IMT-2000 FUNCTION MODEL

Functional Model



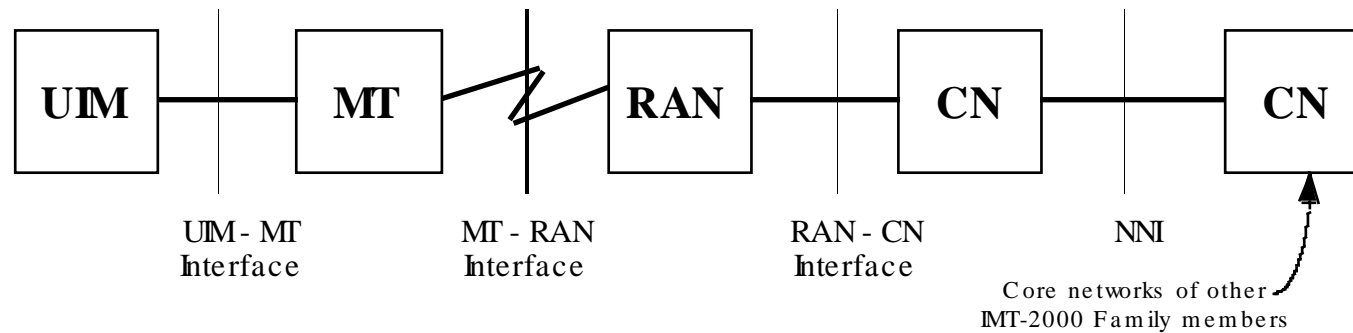
IMT-2000 Family



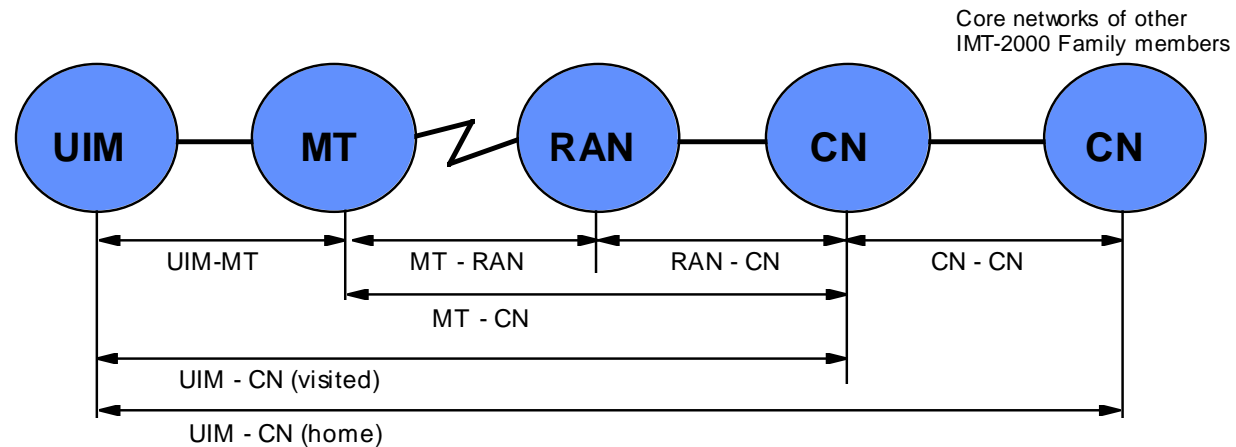
UIM= User Identity Module
 MT= Mobile Terminal
 RAN= Radio Access Network
 CN= Core Network

IMT-2000 SYSTEM ARCHITECTURE

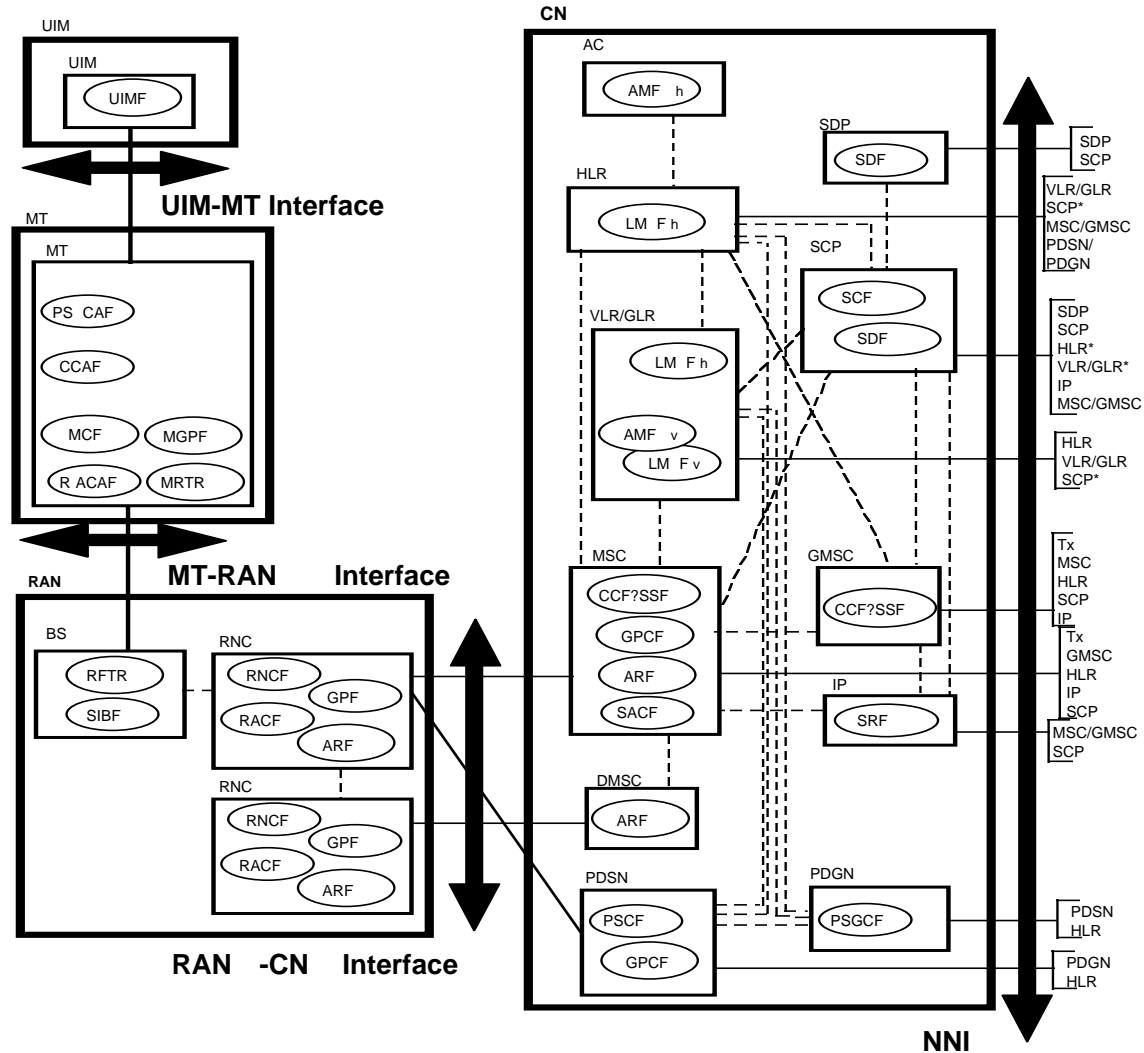
Functional Model and Interfaces



Functional communications



IMT-2000 NETWORK REFERENCE MODEL

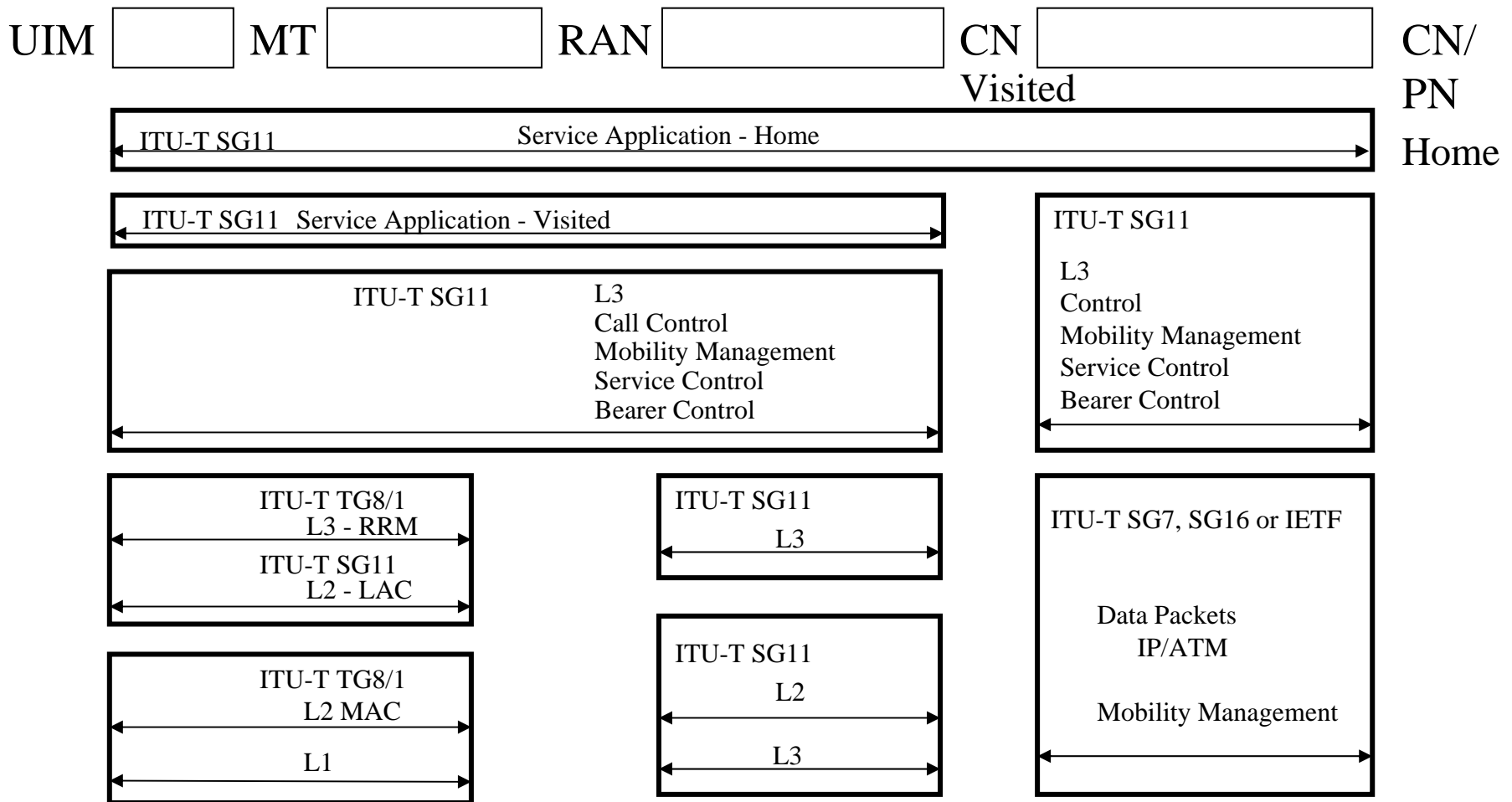


IMT-2000 PROTOCOLS

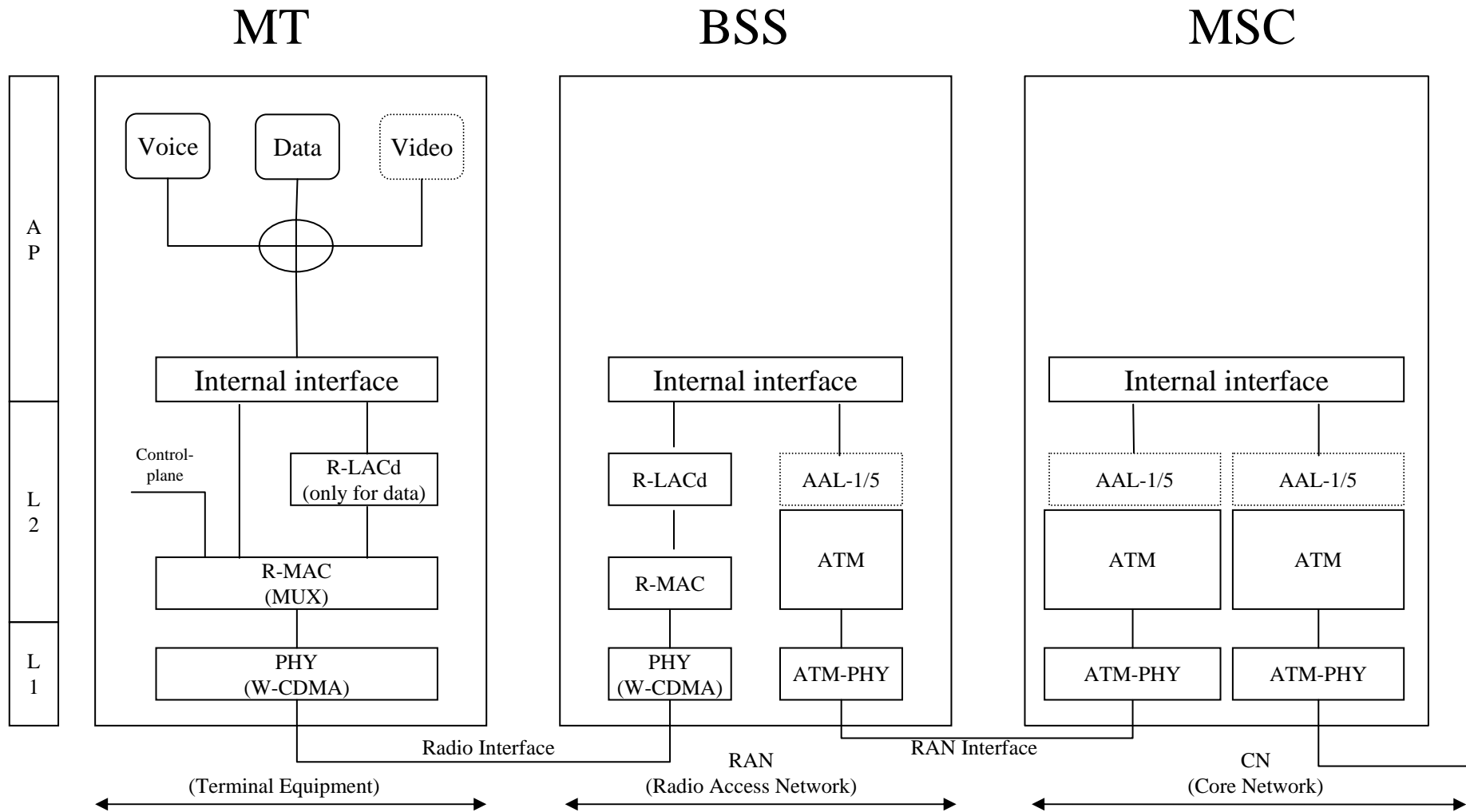
Interface	Japan	Europe	U.S.A
UIM-MT	In process	In process	In process
MT-RAN	L1: Asynchronous W-CDMA implement -> based on GSM	L1: W-CDMA or ATDMA L2,3: GSM CAI	L1: Synchronous W-CDMA L2,3: IS-95 (L2)+GSM-like (L3)
RAN-CN	ITU-T standardization or PDC MAP	GSM MAP	IS-634
CN	PDC MAP	GSM MAP	IS-41C
IN	INAP CS2	CAMEL	WIN(IS41 format)
CN-CN	Based on GSM and ITU-T standardization	Based on GSM and standardization	Global roaming VHE concept standardization New protocol

VHE : Virtual Home Environment (to support service portability between networks)

IMT-2000 PROTOCOL STRUCTURE



IMT-2000 PROTOCOL STACK - USER PLANE



ALL type(f.s):ALL-1(CBR:voice, video), ALL-5(VBR:signaling&data), AAL-2(VBR:voice, video):f.s under optics

IMT-2000 SERVICES

- IMT-2000 Dominated by Data Services**
- Data Communication Between Devices**
- Internet and Multimedia**
- High Quality Voice**
- Flexible Mixed/Multi-Service Provision Based on Compliance to ITU IMT-2000 Recommendations**
- Global Roaming Service**

IMT-2000 MANAGEMENT

MAMAGING IMT-2000

□ Scope:

- Address the roles, relationship and objectives of working teams establishing standards and services for managing mobile / wireless networks to implement UMTS, and IMT-2000 3G wireless / mobile network

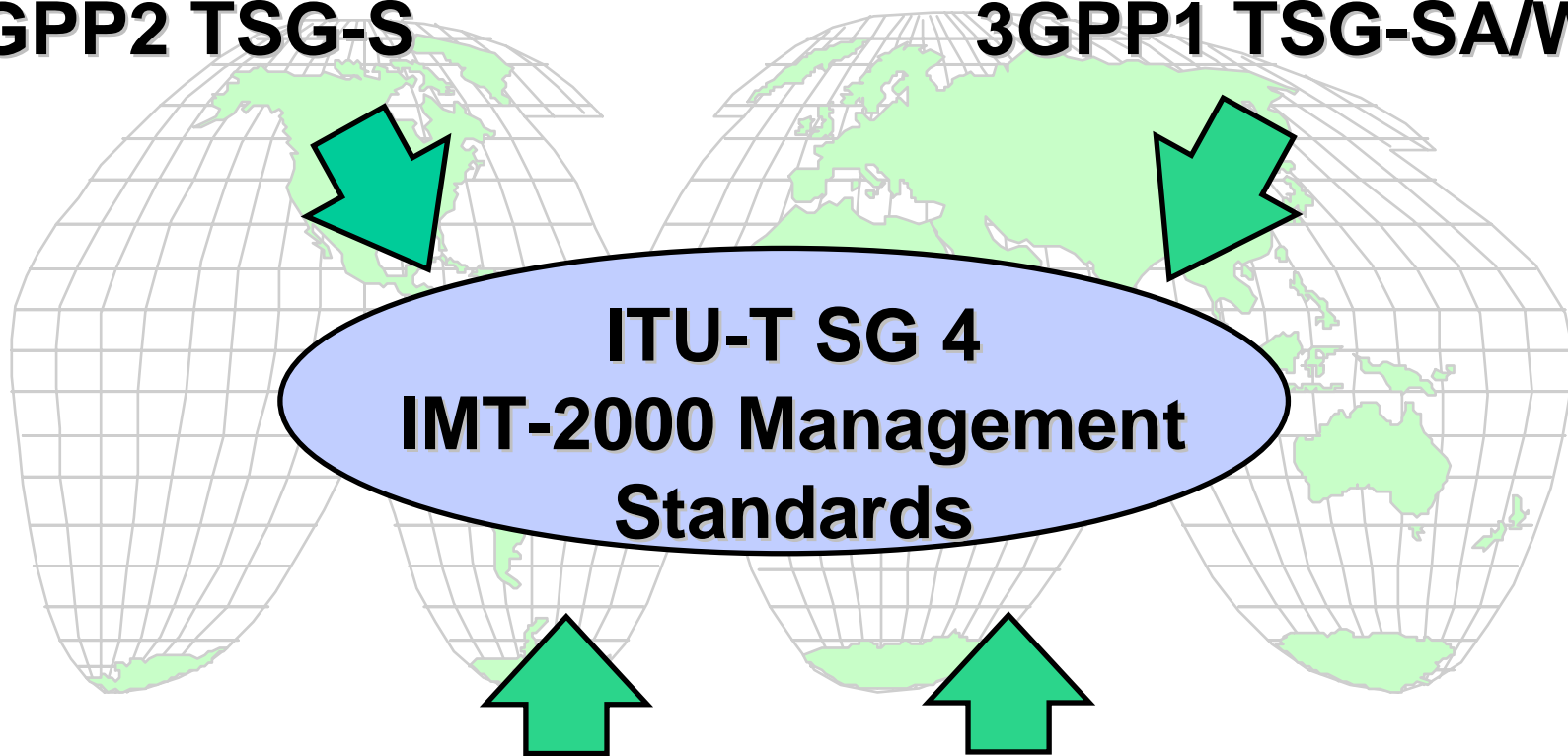
□ Outcomes:

- TR45.7 (North America), TMN5 (Europe), TTC (Asia/Japan) and ITU-T SG4 (IMT-2000) are collaborating effectively for Configuration, Performance, Fault Management, and Object Models.
- Service Management Challenges, QOS Management, and Service Portability are much different for Mobile Services.

IMT-2000 MANAGEMENT STANDARDIZATION

T1/TIA TR-45.7
3GPP2 TSG-S

ETSI TMN5 & SMG6
3GPP1 TSG-SA/WG5



TMForum Mobile Team

TTC/ARIB/TTA

IMT-2000 NM STANDARDIZATION

- ❑ **ITU-T SG4 : IMT-2000 Network Management Standardization**
- ❑ **TIA TR45.7 & T1M1.5 :**
 - Lucent Technology (USA) : IMT-2000 TMN Management Functional Requirements Contribution on Configuration : Service Provisioning.
 - Motorola (USA) : IMT-2000 TMN Management Framework Contribution on Security: Audits-Counts of Fraudulent Use.
- ❑ **ETSI SMG5**
 - UMTS 21.06, version 3.0.0 : Universal Mobile Telecommunications System (UMTS) ; Network and Service Management Requirements for UMTS.
 - ETSI 201 385 v1.1.1 : Telecommunications Management Network (TMN); Universal Mobile Telecommunications System (UMTS); Management architecture framework; Overview, processes and principles.
- ❑ **TTA/ARIB**
 - Document Vol. 1 (Spec. No. 5) : Requirements and Objectives for a 3G Mobile Services and System.
- ❑ **3GPP1 (Third Generation Partnership Project) TSG-SA/WG5, 1998 Dec**
 - Developing the overall network management (NM) concept of the 3G system.
 - Specifying the NM high level framework.
 - Coordinating all other TSGs to have the actual detailed specification work of OA&M for the 3G system based on GSM core network.
 - ARIB, ETSI, T1, TTA and TTC partnership.
- ❑ **3GPP2 (Third Generation Partnership Project) TSG-S (Systems and Services Aspects)**
 - Definition of high level requirements for OAM&P across all 3GPP2 TSGs.
 - ANSI, TIA, TTA, TTC and ARIB partnership

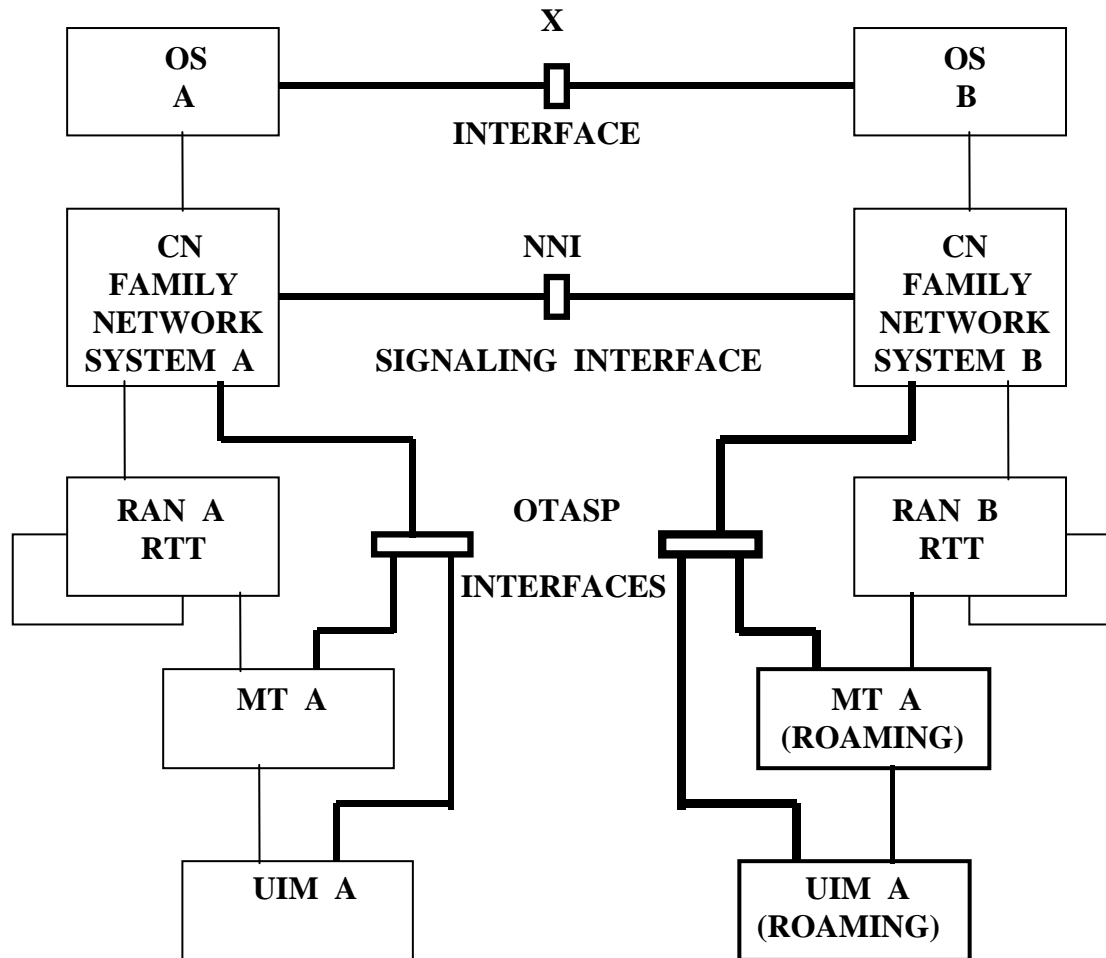
TMForum MOBILE TEAM

- Promote Mobile and Wireless in the TMForum.
- Philosophy
 - ◆ Recognize special needs of Mobile / Wireless.
 - ◆ Utilize and apply TMForum's expertise (e.g. TelOpsMap) to the Mobile Industry.
 - ◆ Contribute Mobile perspective to TMForum programs.
 - ◆ Avoid overlap, and work in co-operation with other standards organizations.
- Maintain liaisons to ETSI TMN5 and TR45.
- Build a relationship to ITU-T SG4 and IMT-2000.
- Complete initial IMT-2000 Project.
- Mobile Team is in TMForum program #4 - Service Assurance.

IMT-2000 NETWORK OPERATION & MANAGEMENT RELATED ITU RECOMMENDATIONS

Study Group	Recommendation	Subject
ITU-R SG8	1079	speech and voiceband data Performance Requirements
ITU-R SG8	1168	Framework of IMT-2000 management
ITU-T SG2	-	Numbering, Addressing and identification for IMT-2000
ITU-T SG2	E.750	Introduction to the E.750-series of Recommendation on Traffic engineering aspects of networks supporting mobile and UPT Services
ITU-T SG2	E.751	Reference Connections for Traffic engineering on land mobile networks
ITU-T SG2	E.752	Reference Connections for Traffic engineering of maritime of aeronautical systems
ITU-T SG2	E.760	Terminal mobility Traffic modeling
ITU-T SG2	E.770	Land mobile and fixed network interconnection GOS concept
ITU-T SG2	E.771	Network GOS parameters and target values for circuit-switched public land mobile services
ITU-T SG2	E.773	Maritime and aeronautical mobile grade of service concept
ITU-T SG2	E.774	Network GOS parameters and target values for maritime and aeronautical mobile services
ITU-T SG2	E.780	Traffic engineering methods for land mobile systems
ITU-T SG4	M.3200	Prose description on IMT-2000 as a managed area
ITU-T SG4	M.32xx	TMN Management Service for IMT-2000
ITU-T SG4	M.3400	TMN Management Function Sets (IMT-2000 related)
ITU-T SG4	M.31xx	IMT-2000 Management Information
ITU-T SG7	X.115	Address Translation Service definition
ITU-T SG7	X.116	Address Translation Registration Protocol
ITU-T SG12	G.174	Transmission Performance Objectives for Terrestrial Digital Wireless Systems Using Portable Terminals to Access the PSTN
ITU-T SG13	I.37w	Network Architecture and Capabilities for IMT-2000
ITU-T SG13	I.580	Interworking B-ISDN/64K
ITU-T SG13	I.581	Interworking Requirements B-ISDN
ITU-T SG13	I.35z	Framework for Mobile Performance
ITU-T SG13	I.5xw	Network Interworking between IMT-2000 and other types of Networks
ITU-T SG13	TBD	Network related synchronization
ITU-T SG13	I.5xz	UPT/Mobile Interaction
ITU-T SG13	I.140	Attribute technique for the characterisation of ISDN services and network capabilities (for IMT-2000)
ITU-T SG13	I.340	ISDN Connection Types (For IMT-2000)

IMT-2000 FAMILY MANAGEMENT INTERFACE



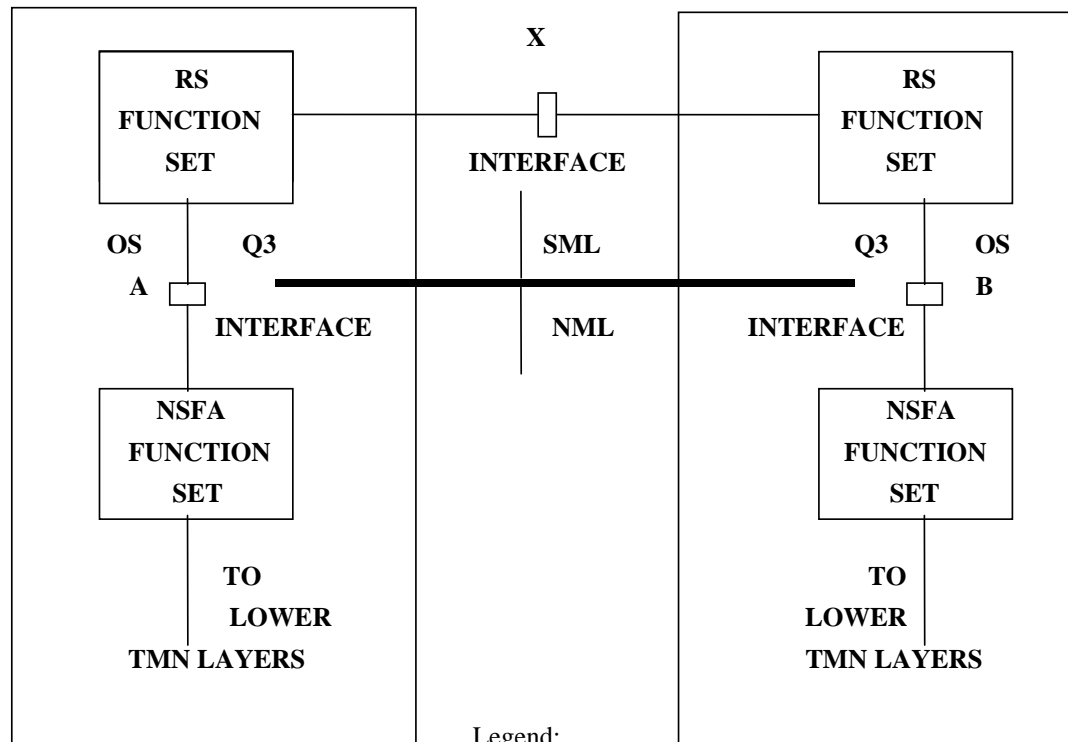
OS = Operations System,
RAN = Radio Access Network,
MT = Mobile Terminal,
UIM = User Identity Module

CN = Core Network,
RTT = Radio Transmission Technology
OTASP = Over The Air Service Provisioning,

NNI = Network-to-Network,

- ❑ Three potential interfaces
 - The “X” interface between two OSs,
 - The NNI interface as signaling information,
 - The air (OTASP) interface to either a MT or to a UIM.
- ❑ This function set is defined as:
 - This set supports requests that the specified service and/or features be activated, changed, or deactivated as a result of the negotiated customer solution.
- ❑ X interface common generic forms:
 - **Send <data>** : manager role OS sends <data> to agent role OS
 - **Retrieve <data>** : manager role OS retrieves all or part of <data> from agent role OS
 - **Change <data>** : manager role OS changes part of <data> stored in agent role OS
 - **Delete <data>** : manager role OS requests agent role OS to delete <data>

OS LAYERING



RS = Request for Service (function set)

SML = Service Management Layer

NML = Network Management Layer

NSFA = Network Service Feature Administration (function set)

- ❑ The X interface communication be peer-to-peer within the TMN service management layer.
- ❑ The received provisioning data must proceed downward of the TMN layers to eventually effect the network elements
- ❑ The internal OS “Q3” interfaces will transport the data
- ❑ A new function set, for the “Provisioning” function set group, is defined to transfer data over the “Q3” interface between the SML and the NML
- ❑ Network Service Feature Administration : This set supports the transfer of service provisioning data between the SML and NML that arrives/goes over the “X” interface

IMT-2000 MANAGEMENT SERVICES (M.1168)

IMT-2000 Management Services

Management services commonly used in fixed and IMT-2000 network

- TMN management
- TMN security management
- Staff work scheduling management
- Transport network management
- Commonly channel signaling system management
- etc.

IMT-2000 specific network management services described in the framework of IMT-2000 management

- 1) Radio resource related management service
- 2) MS mobility related management service
- 3) Charging and accounting management service
- 4) User/user terminal equipment management service
- 5) Security management service

Management services extended for IMT-2000 on the basis of fixed network management services

- Switching management
- Security management
- QoS/GOS management
- IN management
- etc.

Newly defined management services

- BS management
- MS management
- etc.

RADIO RESOURCE RELATED MANAGEMENT SERVICE

- MSC management
- Fixed/transportable/mobile BS management
- Home/roaming MS management
- Satellite radio resource management
- Management of radio channel quality between MS and BS
- Management of traffic load in each cell
- Management of point to multi-point connections in radio common control channel
- Inter-operator information exchange regarding radio resource related management

MS MOBILITY RELATED MANAGEMENT SERVICES

- Handover performance management
- Location/paging area management
- Mobility pattern measurement
- MSC management with regard to MS mobility
- Fixed/transportable/mobile BS management with regard to MS mobility
- Home/roaming MS management with regard to MS mobility
- Inter-operator information exchange regarding MS mobility related management

CHARGING & ACCOUNTING MANAGEMENT SERVICES

- Charging for mobile public pay telephones
- Charging based on diversified accounting parameters
- Inter-administration accounting
- Charging notification
- Inter-operator information exchange regarding charging and accounting management

USER & USER TERMINAL EQUIPMENT MANAGEMENT SERVICES

- Management of user identity
- Management of subscriber and its subscription
- Management of user terminal equipment attached to mobile termination
- Management of complaints from both home and roaming users
- Inter-operator information exchange regarding user and user terminal equipment management

SECURITY MANAGEMENT SERVICES

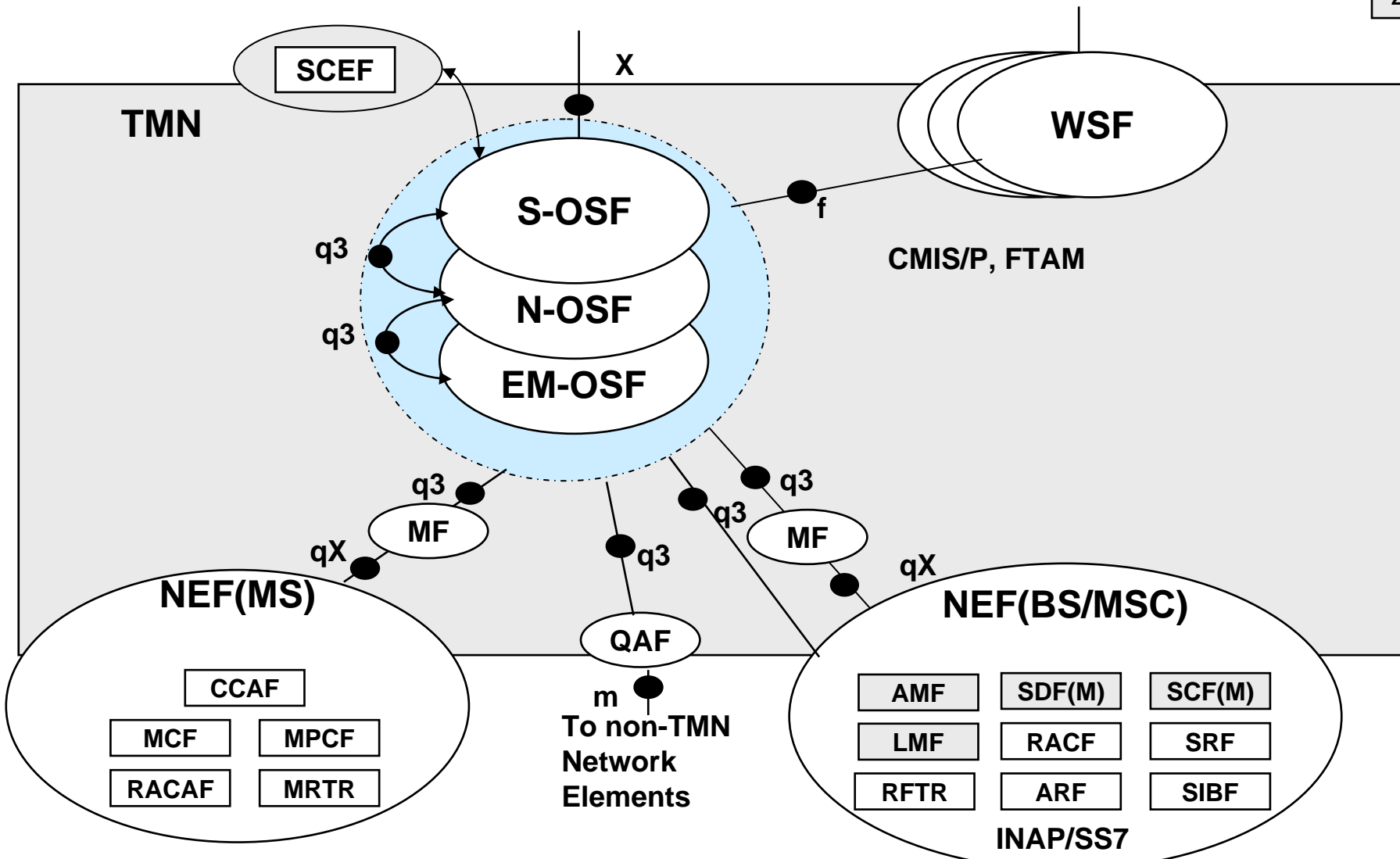
- Management of FPLMTS-specific security mechanism
- Key management
- Encryption management
- Authentication management
- Access control management
- Service barring list management
- Security audit management
- Management of subscriber related credential information
- Information exchange regarding security management

IMT-2000 NETWORK MANAGEMENT

REQUIREMENTS FOR NETWORK MANAGEMENT

- Minimization of complexity
- Manageability of heterogeneous equipment
- Provision of communication via standardized interfaces
- Minimization of cost for management
- Supporting Flexible configuration capability
- Allowing remote control
- Allowing interoperability between Network Operator/Service providers for the exchange of management and charging information
- Scalability for management of increasing network resources
- Re-using of existing relevant standards
- Assurance of system performance

TMN BASED IMT-2000 MANAGEMENT



IMT-2000 SERVICE MANAGEMENT

REQUIREMENTS FOR SERVICE MANAGEMENT

- Minimizing operation costs of IMT-2000
- Supporting introduction and removal of services
- Control of access to IMT-2000 services
- Allowing management of services over shared infrastructure
- Allowing interoperability between Network Operator/Service providers for the exchange of management and charging information
- Providing Quality of Service management
- Standardization of service management should not prevent competition between manufacturers nor between operators

INTEROPERABILITY OF SERVICE MANAGEMENT

- ❑ Interoperable with other networks as well as other IMT-2000 networks and service providers
- ❑ Support co-operative management capabilities
- ❑ Supporting function over interworking interface for interoperability
 - retrieval of supported management functions
 - configuration of Service Level Agreements (SLA)
 - request for supported management functions within a SLA
 - transparency whether the request comes from a human operator or another management system

SERVICE MANAGEMENT LIFE CYCLE

SERVICE MANAGEMENT LIFE CYCLE

CREATION

PROVISION

INVOCATION

DELETION/
EVOLUTION

Service Management Functional Requirements

Usage Monitoring

Statistical information shall be gathered and maintained concerning the usage of services

Performance Monitoring

Statistical information shall be gathered and maintained concerning system performance throughout the service life cycle

Status Monitoring

UMTS services are expected to be implemented through the inter-operation of sub-services from multiple operators. In order to present status information for subscriber-facing interaction, status information relating to these sub-services needs to be exchanged

Control

Delivery of a reliable user-configurable service depends on the exchange, across operator boundaries, of service control functions. Such functions would control and manage service invocation, service usage, deal with testability, resilience and load control mechanisms

SERVICE PROVISIONING

- ❑ Get customer onto Network
 - Customer profile: Service data
- ❑ Billing/Charging Support
 - Common billing records across CNIs (since customer may roam)
- ❑ Security
 - Audits: Counts of fraudulent use
- ❑ Performance Management
 - Quality of service, Network performance monitoring
 - Network congestion control, Access blockage
 - IN congestion
- ❑ Fault Management
 - Connectivity failures
 - Trouble tickets

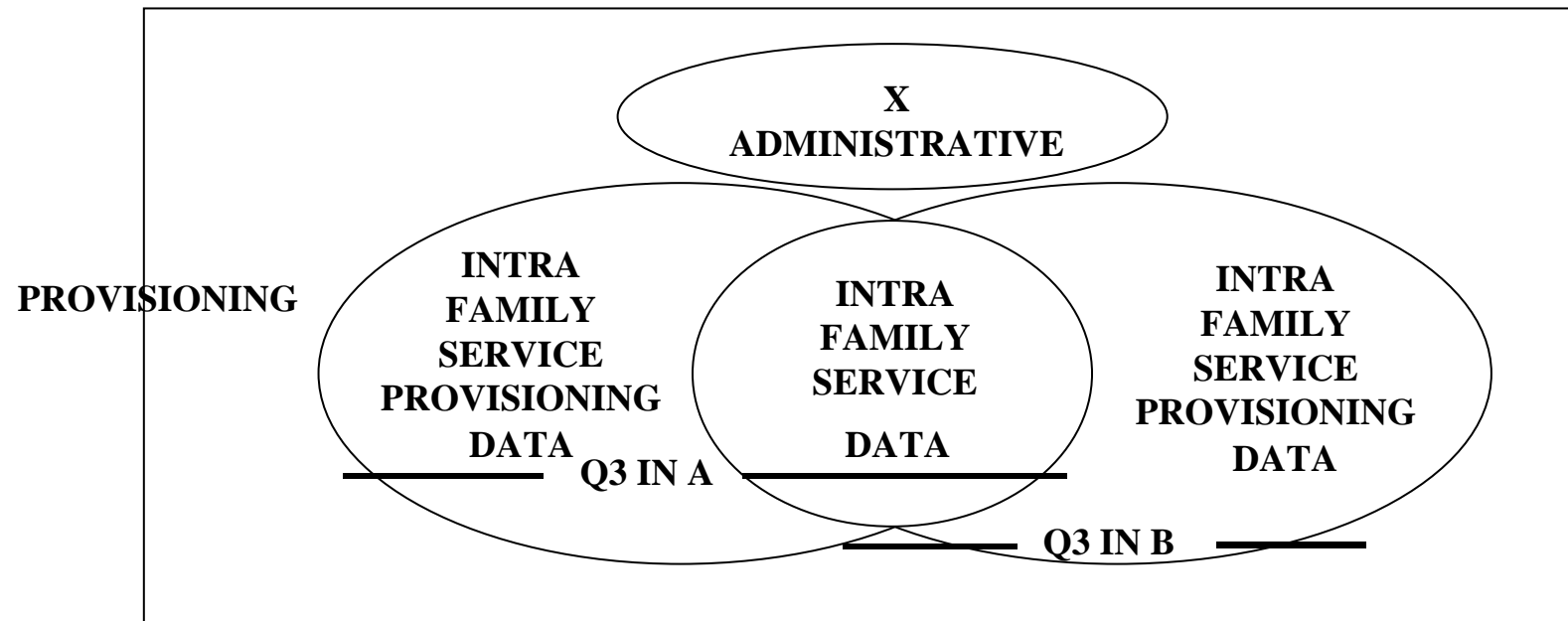
SERVICE PROVISIONING FUNCTIONALITY

□ “Q3A” and “Q3B”

- Represent the service provisioning data pertaining to OS “A” and OS “B”.

□ “X ADMINISTRATIVE”

- Represents that information which is needed to allow for communication over the “X” interface

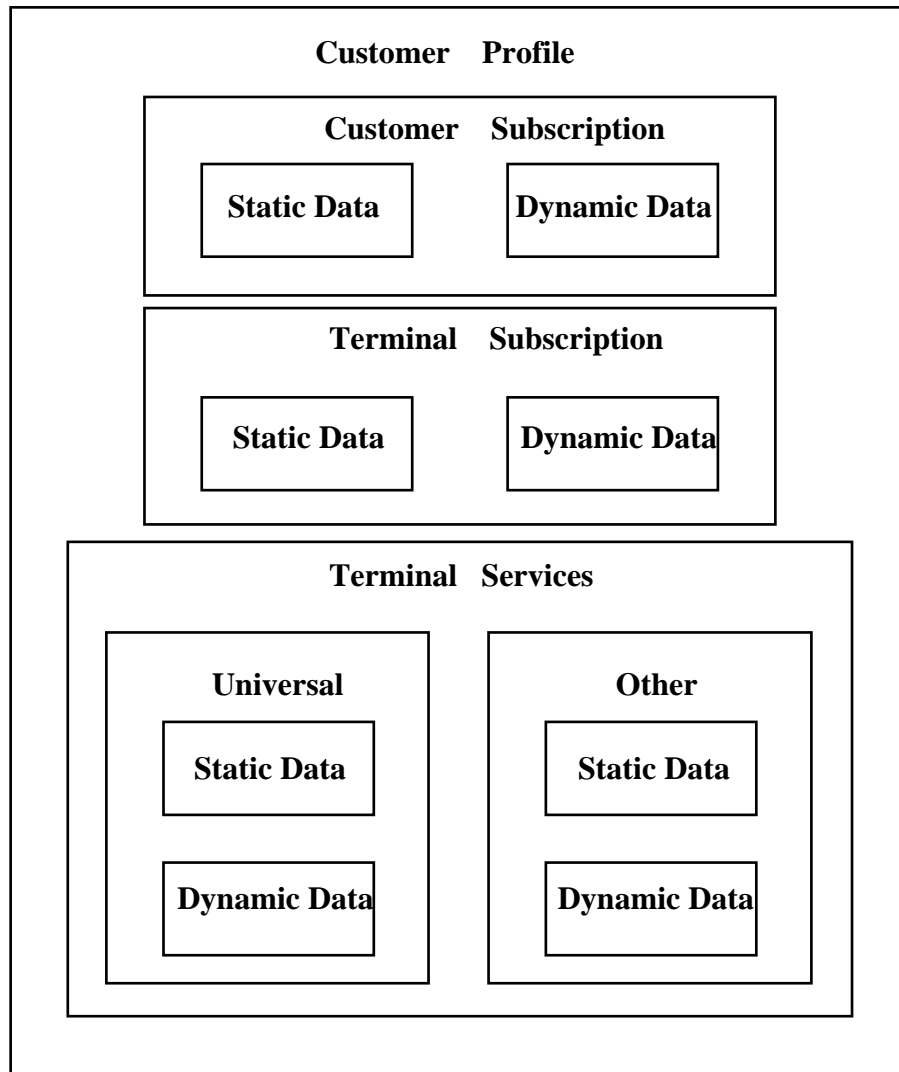


Service Provisioning Data Sets

SERVICE PROVISIONING REQUIREMENTS

- Customer data
 - To identify an end customer
- Customer correlated data
 - That identifies the customer's authorised mobile terminal
- Static Data
 - Provisions the customer contracted services
- Dynamic Data
 - Effecting multiple calls (not per call data) that permit customer/system modification
- Service classification
 - Defines the provisioning parameters for each service type
 - Contains proprietary, regional, and future service types

SERVICE PROVISIONING INFORMATION SPECIFICATIONS



□ Three major categories

- **Customer Subscription provisioning :**
Information specifications for service provisioning
 - Static Data
 - Dynamic Data
- **Terminal Subscription provisioning :**
Common pointers are needed to correlate a customer to the subscribed terminals
 - Static Data
 - Dynamic Data
- **Terminal Services provisioning :**
Common pointers are needed to correlate Terminal services with a customer subscription and the subscribed terminals
 - Universal Services
 - Other Services

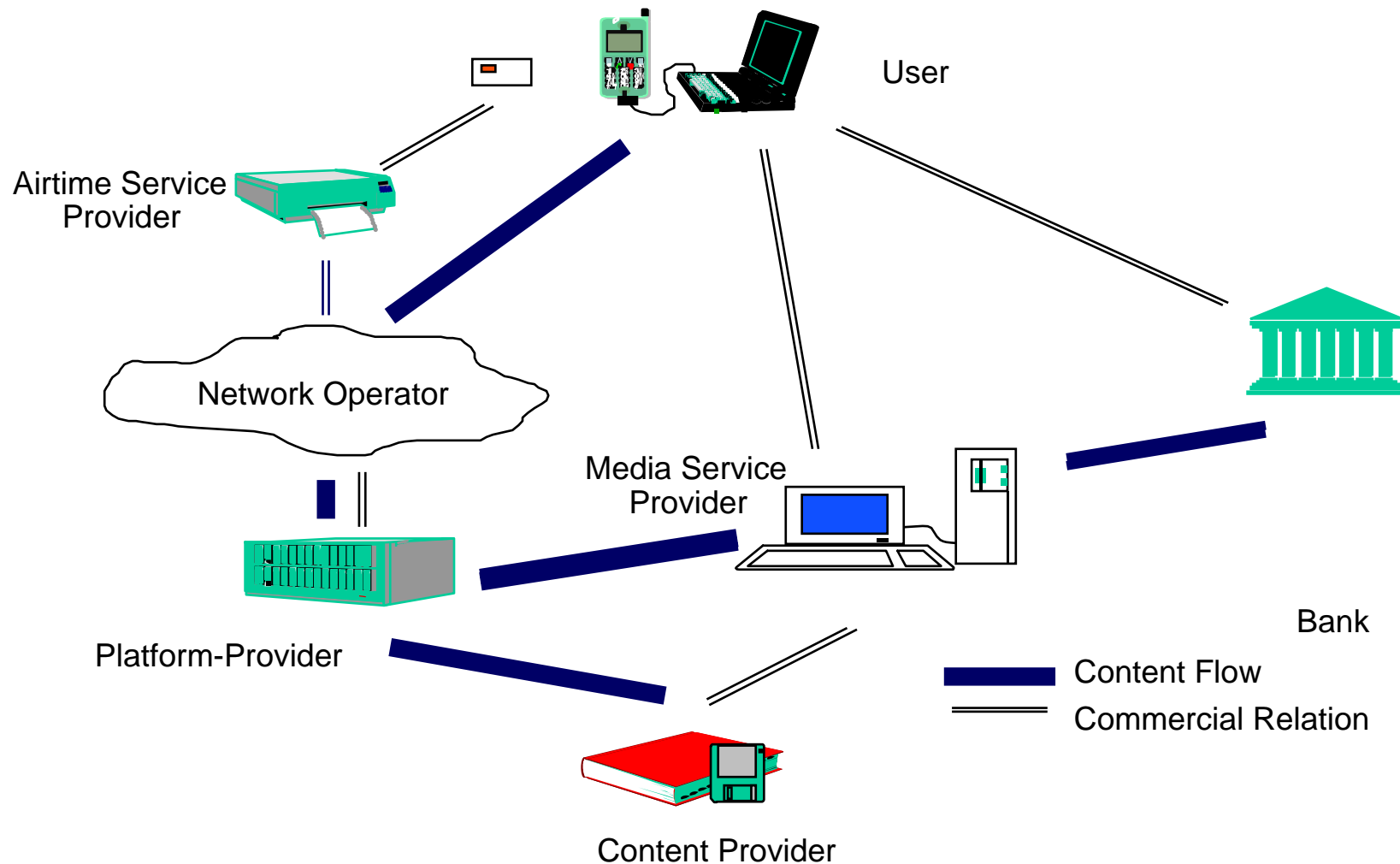
SERVICE PROVISIONING RESULTS

- ❑ Initial work on the service provisioning aspect of the IMT-2000 management functional requirements
- ❑ Identification of key informational requirements needed to achieve service provisioning
- ❑ An association between the key informational requirements and M.3400 functional sets were determined
- ❑ Major remaining effort:
 - Associate M.3400 functional sets with parameters
 - Determine new functional sets, if needed,
 - Associate the new functional sets with parameters
 - Determine parameters which apply to the “X” interface
 - Complete the parameter list for “universal” services and “other” services

CONSIDERATION FOR GLOBAL ROAMING

- ❑ Consideration of defining the roles and responsibility of the X Interface for IMT-2000
 - Roaming between two different service providers within a single family member
 - Roaming between two different service providers between different family members
- ❑ Accounting Management
 - Exchange of accounting management information
- ❑ Configuration Management
 - Management information exchange for the establishment and update of roaming agreements
 - Management information exchange to facilitate subscriber roaming
- ❑ Fault Management
 - Management information exchange to facilitate the rapid detection and correction of subscriber roaming anomalies

MANAGEMENT OF SERVICE WITH MOBILITY



**MANAGEMENT SYSTEM
ARCHITECTURE AND SUPPORTING
TECHNOLOGIES FOR UMTS**

MANAGEMENT APPROACH FOR UMTS

- ❑ New approach to standardise an O&M interface
 - Rapid specification of a standard framework which demonstrates the conceptual principles
 - Different levels of abstraction to reduce complexity
 - Use of common and proven methods and tools to specify the standard for easy implementation
 - Choosing an approach that gives the network element supplier the opportunity for bespoke design but allows the operator open access to all data
- ❑ The object oriented approach incorporated in CORBA is one of the most modern and powerful methods to describe and implement distributed systems.

THE FRAMEWORK UML'S MANAGEMENT (1/2)

□ Using the object oriented method (UML)

– Pro :

- Object oriented modelling is a state of the art modelling technique
- UML is a frequently used syntax to describe object oriented models
- Tools available
- Compiler from UML into program skeletons for C++ or Java are part of software engineering environments
- UML has been submitted to the OMG for standardisation in January 1997

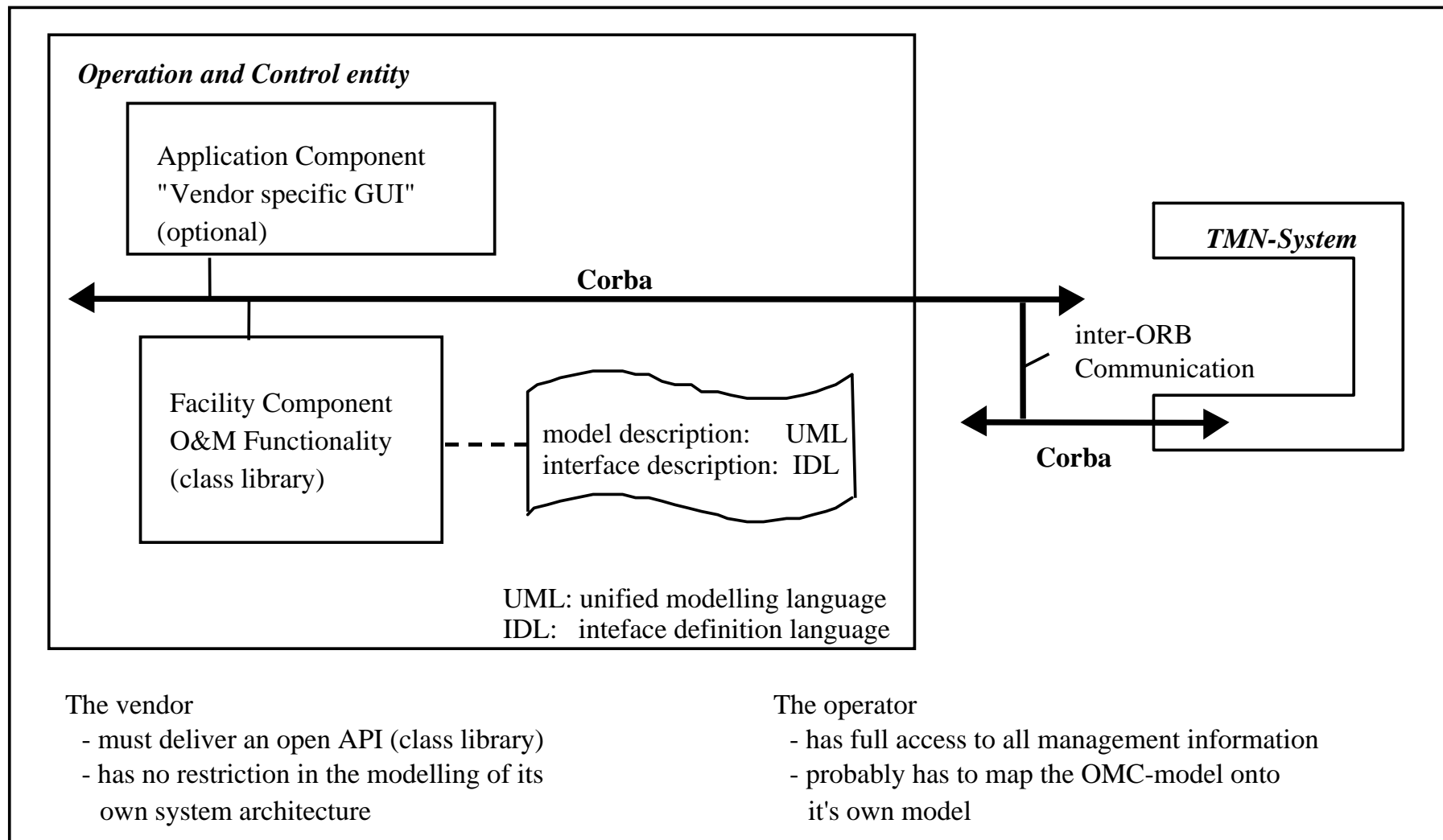
– Contra :

- No implicit mechanism for notification handling by comparison with GDMO
- May be extra time required for UML specifications

THE FRAMEWORK UMTS MANAGEMENT (2/2)

- ❑ Using CORBA for object distribution and communication
 - Standardised in OMG
 - Many implementations available
 - Wide utilisation in different domains
 - Many components specified or implemented
 - Service component for notifications under standardisation
- ❑ Strict delineation between service components and applications
 - Pro :
 - Open interface (API) for the Service Component “O&M Functionality” in a standardised environment
 - No constraints on realising the management model except the use of UML and IDL
 - Open access to all data
 - Contra :
 - Possible mediation between an operator specific view and the vendors object model has to be initiated by the operator
 - The vendor has to follow constraints of the design pattern

PRINCIPLES OF THE REQUIRED ARCH. OF A NEW O&M INTERFACE FOR UMTS



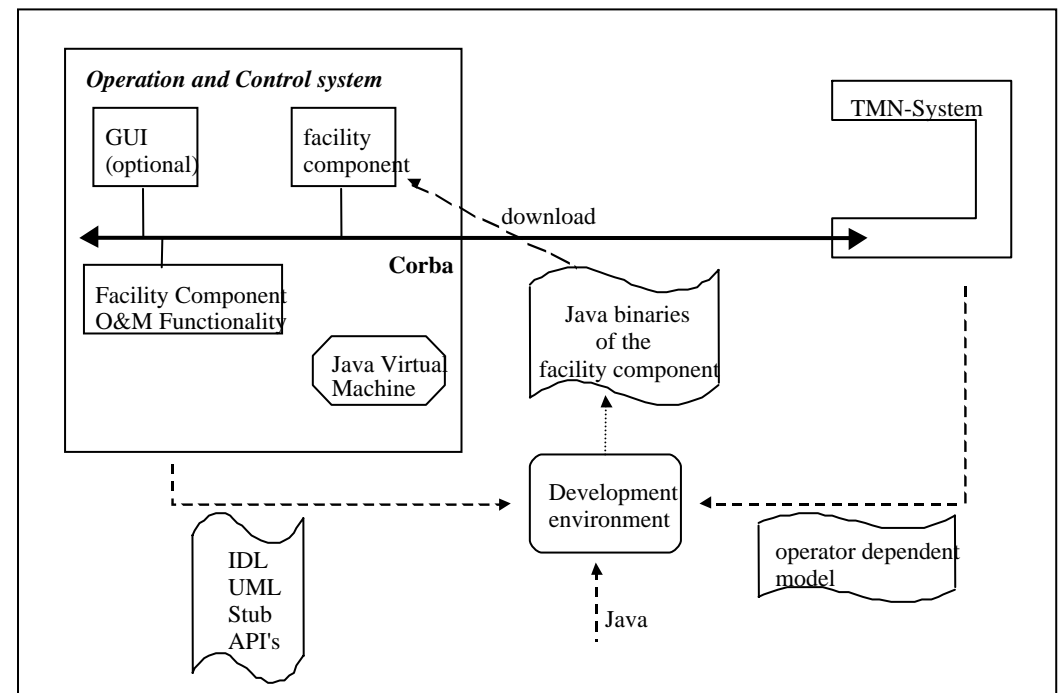
USE OF JAVA TO IMPLEMENT A MEDIATION DEVICE

- ❑ In most cases the vendor specific model would not match the operator's view of the Network
- ❑ The operator has to model and implement such a mediation device as a facility component of the CORBA bus.
- ❑ Security requirements from the provider of the operation and control system.
- ❑ Each operation and control system is required to support a JVM and the necessary API's

USE OF JAVA TO IMPLEMENT A DEDIATION DEVICE

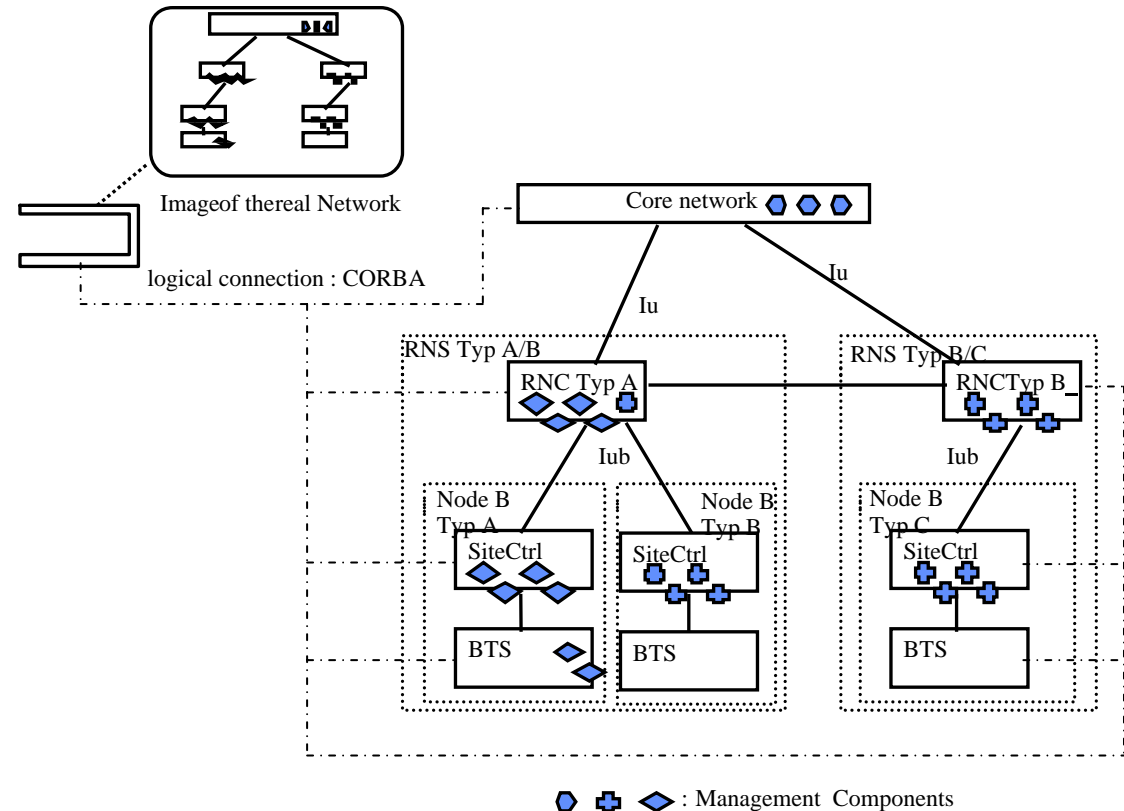
- ❑ The operator gets the IDL
- ❑ CORBA Stub to access the service component “O&M Functionality”
- ❑ The operator knows his own internal model and requirement of the O&M-Functionality

- ❑ UMTS management system can communicate with the facility component, after downloading the Operation and Control System,
- ❑ Proper definitions will need to be made relating to resource and performance requirements to ensure the facility component and core functions of the NE operate satisfactorily



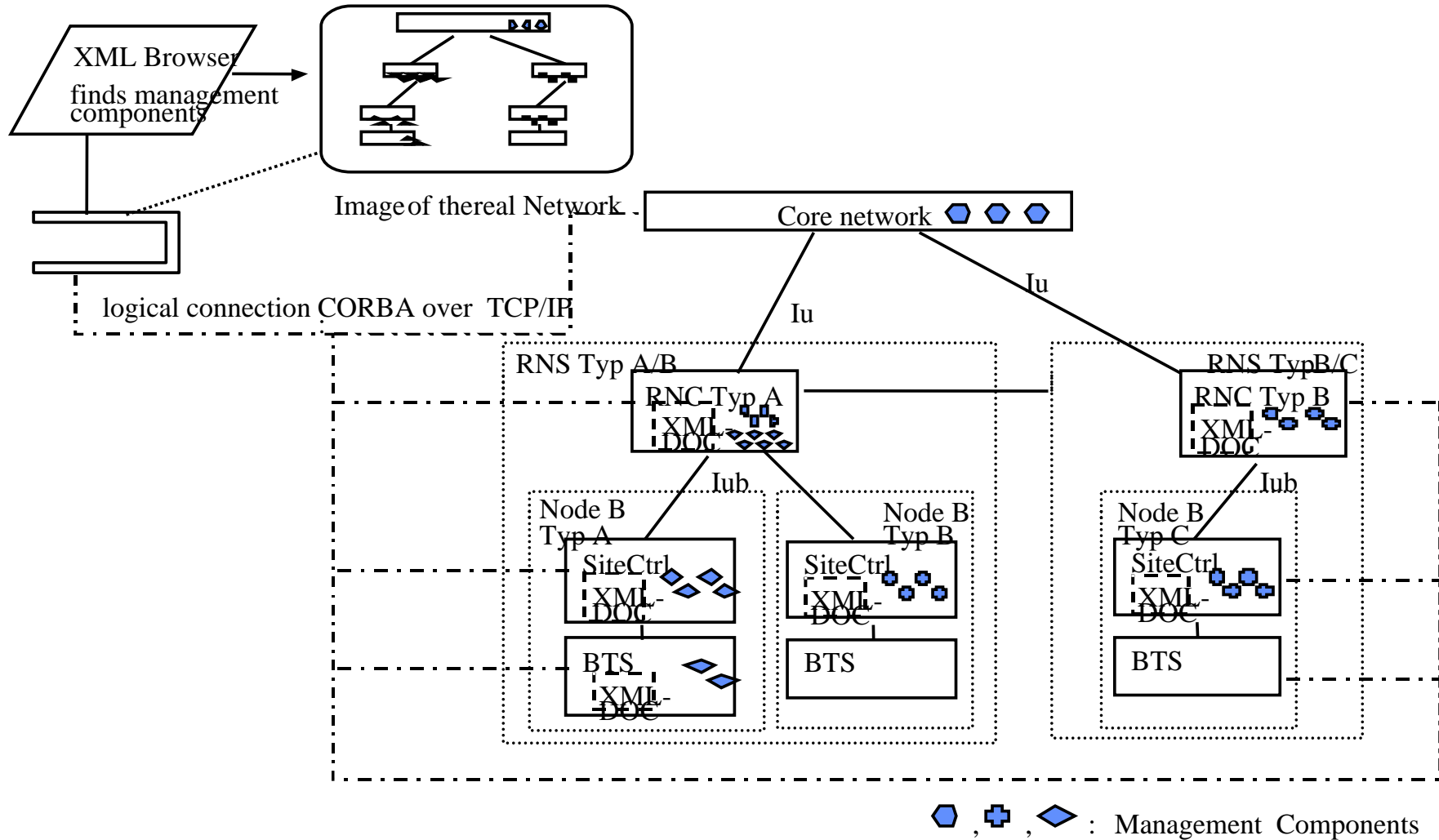
USE OF JAVA TO REALISE A FLEXIBLE DISTRIBUTION OF MANAGEMENT CAPABILITY

- ❑ All the management functionality must be distributed to the network elements themselves by using CORBA
- ❑ If some of the management functions are more management applications it could be valuable to download them onto the UMTS management system

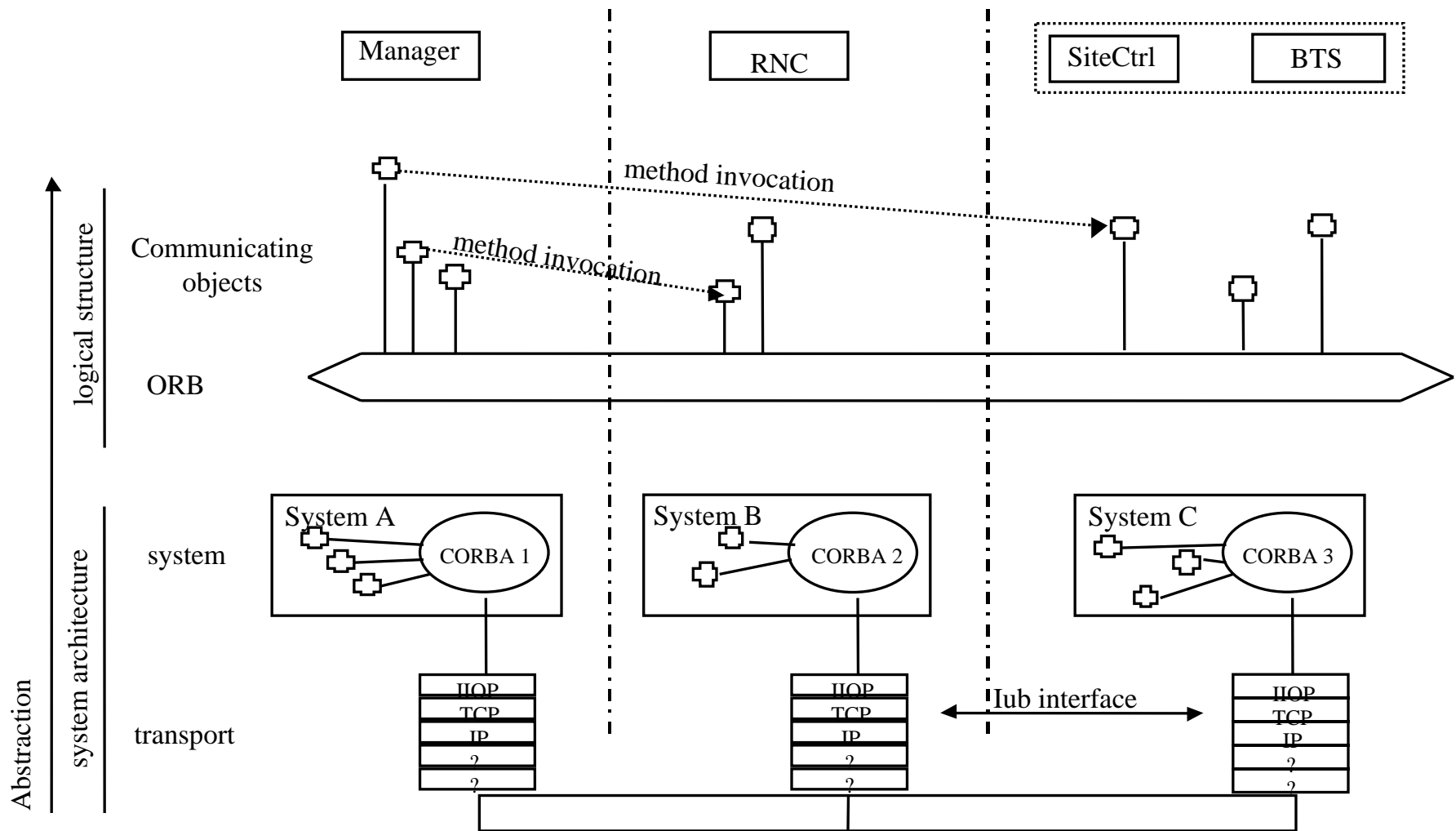


- ❑ The network element supplier will probably support the operator only with raw data access components.
- ❑ This approach will allow the realisation of a “tool box”.

USE OF JAVA TO REALISE A FLEXIBLE DISTRIBUTION OF MANAGEMENT CAPABILITY



REQUIREMENTS ON THE Iu AND Iub INTERFACES FROM A MANAGEMENT PERSPECTIVE



Iub FACILITY COMPONENTS

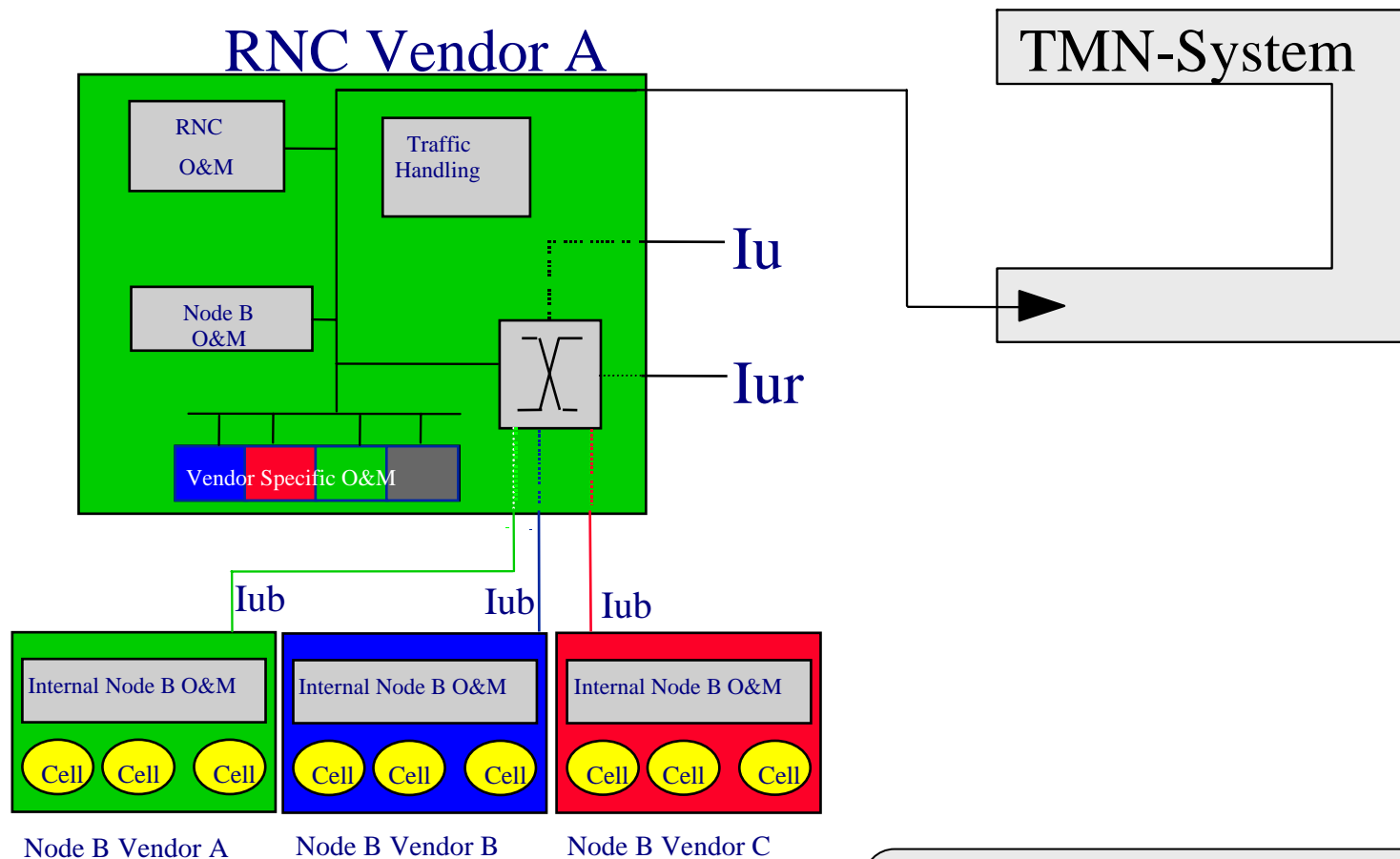
- ❑ The O&M facility components must be defined to allow the architecture of the UTRAN to be determined.
- ❑ High level functional model for the facility components
 - Signalling Link Management, Timing and Synchronisation
 - Cell Configuration, Dedicated Resource Management
 - Common Channel Management, Radio System Management
 - Software Management, Node B Initialisation
 - Node B Hardware Configuration, Performance Monitoring
 - Site Maintenance, Security and Access Control
 - External Interface Management
- ❑ When establishing a suitable architecture an appreciation should be given to the functions described above and their dependency and impact on each other.

REQUIREMENTS FOR UTRAN MANAGEMENT ARCHITECTURE

- ❑ High level architectural requirements
 - The chosen management architecture must ensure the RNC performs an integral role in O&M procedures
 - The architecture must support multiple vendor implementations which support a multi-vendor Node B environment
 - The chosen architecture must provide a robust and distributed management system
 - The hardware platform requirements of the management system must be minimised
- ❑ Many O&M processes will have a direct impact on the traffic handling ability of the Node B radio site
- ❑ The management architecture must also be capable of supporting multiple vendor implementations

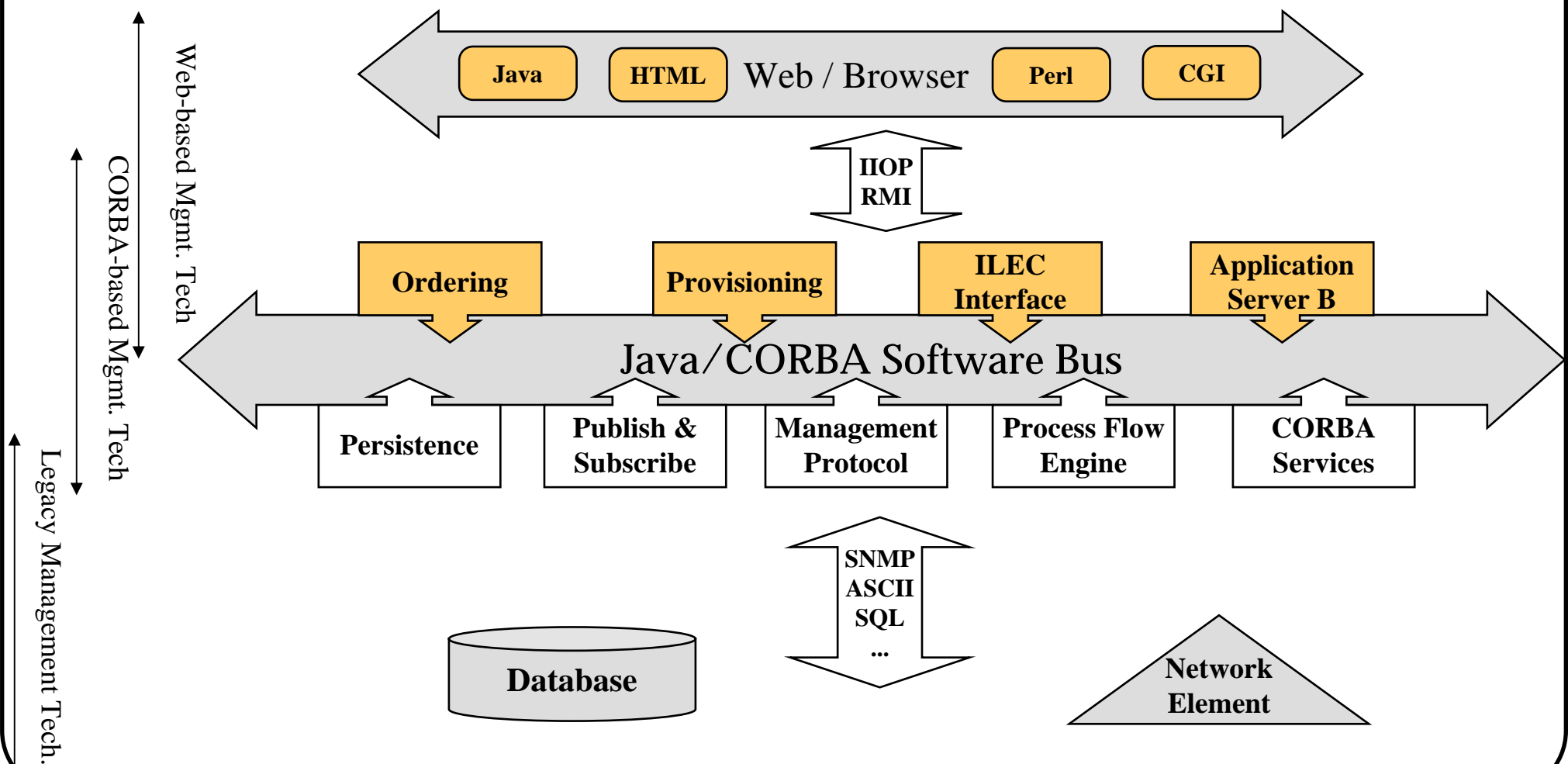
REQUIREMENTS FOR UTRAN MANAGEMENT ARCHITECTURE

- The third architectural requirement above indicates the need to maximise the integrity of the UTRAN O&M management system



IMPLEMENTATION OF IMT-2000 MANAGEMENT SERVICE

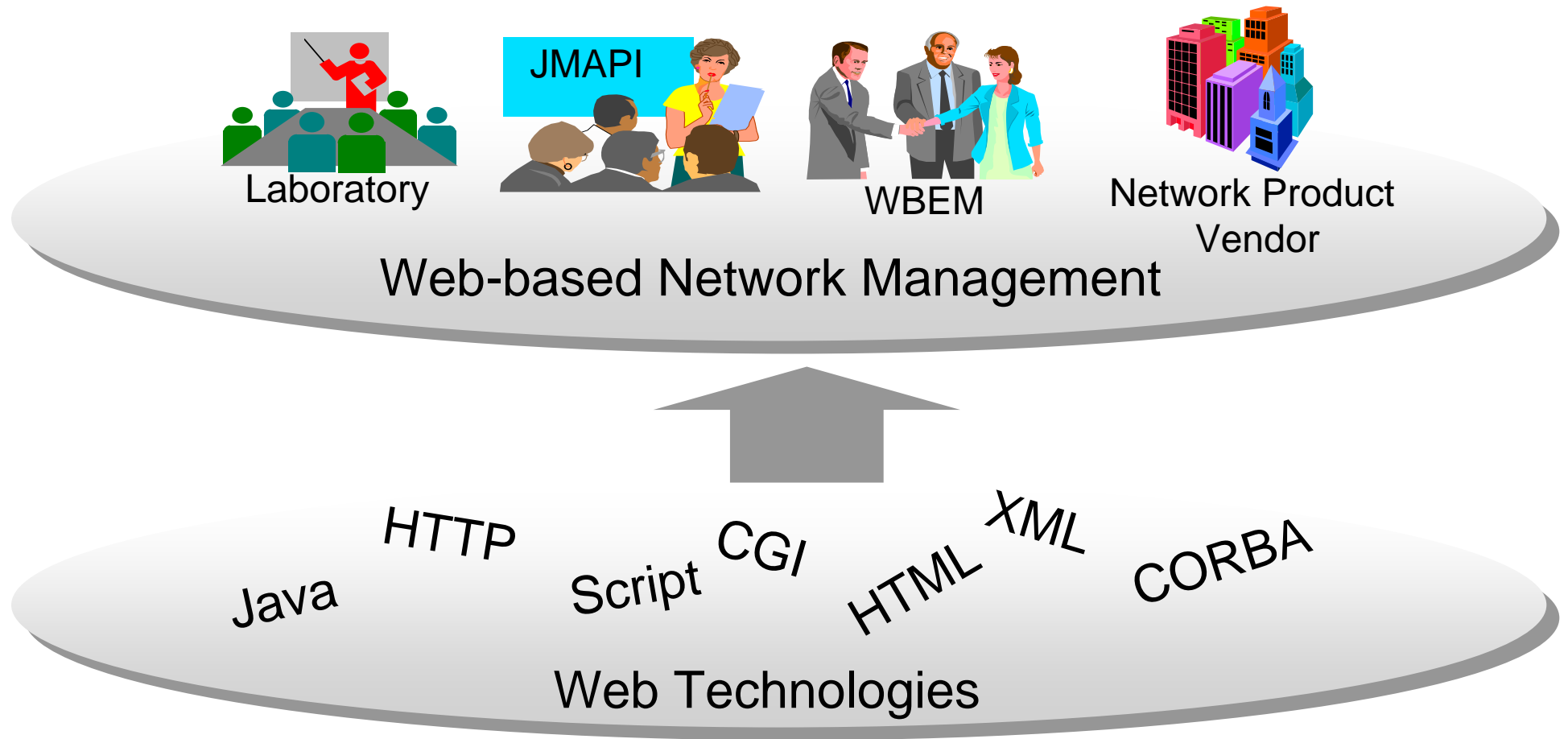
SOFTWARE FRAMEWORK



A HIGH-LEVEL VIEW OF TECHNOLOGY SELECTION

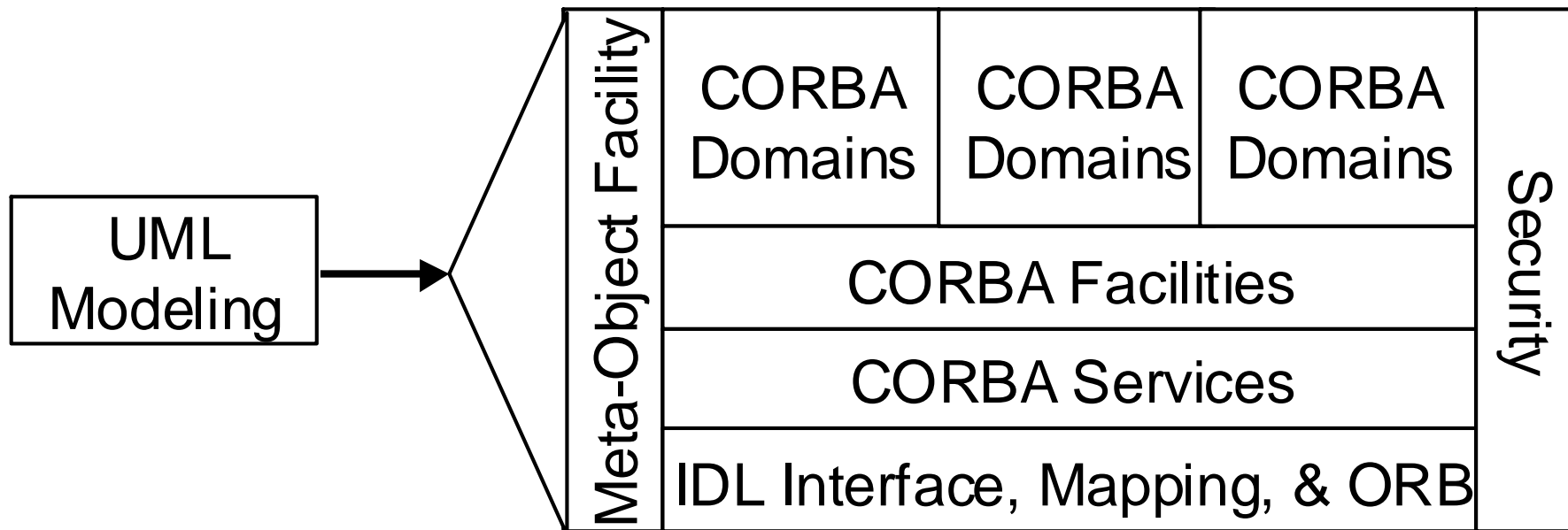
Item	System Role	Technology
1	Customer/Operational Staff access	Web browser / JAVA
2	Business process interaction / backbone distribution	CORBA (+ Workflow?)
3	Business process control of network resources	CMIP/GDMO SNMP/MIBs
4	Business process access to operational data (not discussed)	SQL, SQL-Net, ODBC, Data Distribution?

WEB-BASED MANAGEMENT TECHNOLOGY



CORBA-BASED MANAGEMENT TECHNOLOGY

- ❑ OMG CORBA Telcom
- ❑ Developing Procedure



TECHNOLOGIES INTEGRATION

- ❑ CORBA/IDL ↔ CMIP/GDMO
 - JIDM Specification Translation developed by the Joint Inter-Domain Management (JIDM) team consisting of members from TM Forum and Open Group (previous X-Open representatives)
- ❑ CORBA Services ↔ CMIP Services
 - JIDM Interaction Translation
- ❑ CORBA Objects ↔ HTTP/HTML based Browser Services
 - No defined specification as such, but some individual product implementations (e.g. via IIOP/HTTP tunneling)
- ❑ Java Objects ↔ CORBA Objects
 - Use of Java as a Programming Language binding to CORBA
 - Use of Internet Inter-Orb Protocol (IIOP) to provide object linkage between Java objects and CORBA objects
 - Ability to download CORBA components written as Java applets into client environment using the principles of code
- ❑ TMN Manager/Agent Programming Interface
 - TM Forum TMN C++ APIs
 - Developed for: Overall Architecture, GDMO (Architecture, Class References, Specific Aspects
 - CMIS ASN.1 (Base Classes and Specific Interface, Generic Interface)

CONCLUSION

- IMT-2000 Standardization**
- IMT-2000 Network Management Using TMN**
- IMT-2000 Service Management**
- UMTS Management**
- Technologies and Integration for the Implementation of IMT-2000 Management Service**