Intelligent Networks

(IN)

Architecture, Protocol and Applications

Professor Aimé M. Mbobi, PhD., MSc., M.Eng.

https://aimembobi.com:8443/dashboard/home.jsp

Introduction into Intelligent Networks

History of Intelligent Networks

History of Intelligent Networks

- IN standards are defined by the European Telecommunications Standards Institute (ETSI) and the International Telecommunication Union - Telecommunication Standardization Sector (ITU-T).
- Also, in the USA, the work from Bellcore, deserves to be mentioned

History of Intelligent Networks

- 1980: Centralized databases (AT&T)
  - First calling card and 800-services
- 1984: Term 'Intelligent Network', From Bellcore
- 1985: Feature Node concept (Ameritech)
  - Services and switching are separated
  - Third party offers new economical services

History of Intelligent Networks

- 1986: Intelligent Network 2 (Expanded IN 1 Functionality)
  - No switch dependency
  - Prompt deployment of new services
- 1989: Advanced Intelligent Network (Centralized Architecture)
  - Co-operation with other organizations
  - CS (Capability Sets), ITU-T, ETSI
    - Define basic IN-services (e.g. freephone, premium rate)
    - Service Independent Building blocks, SIBs (basic IN-service functional entities e.g. digit collect and analyze, time and date functions)

History of Intelligent Networks

- 1993: Publication of Capability Set 1 (CS1)
- 1997: Publication of Capability Set 2 (CS2)
- 1999: Publication of Capability Set 3 (CS3)
- 2001: Publication of Capability Set 4 (CS4)

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Concerns leading to Intelligent Network: mid 1980s

- Integration of new services:
  - Carrier relied on vendors who were the only one able to modify program in the switch: Over billing.
- Some services require taking account of non-local information (common to all switches, e.g. toll free applications)
  - Long and expensive modification because of the variety and number of switches.
  - Translation table must be duplicated in all switches: impossible to ensure coherency,

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Concerns leading to Intelligent Network: mid 1980s

Mid 1980s:

Main Concern

HOW TO REALIZE SERVICES BY MODIFYING ONLY PROGRAMS RUNNING IN EACH NETWORK SWITCH ?

Intelligent Network Architecture Trials

Switch / Control Logic (Intelligence)

Four Concepts

Four Concepts

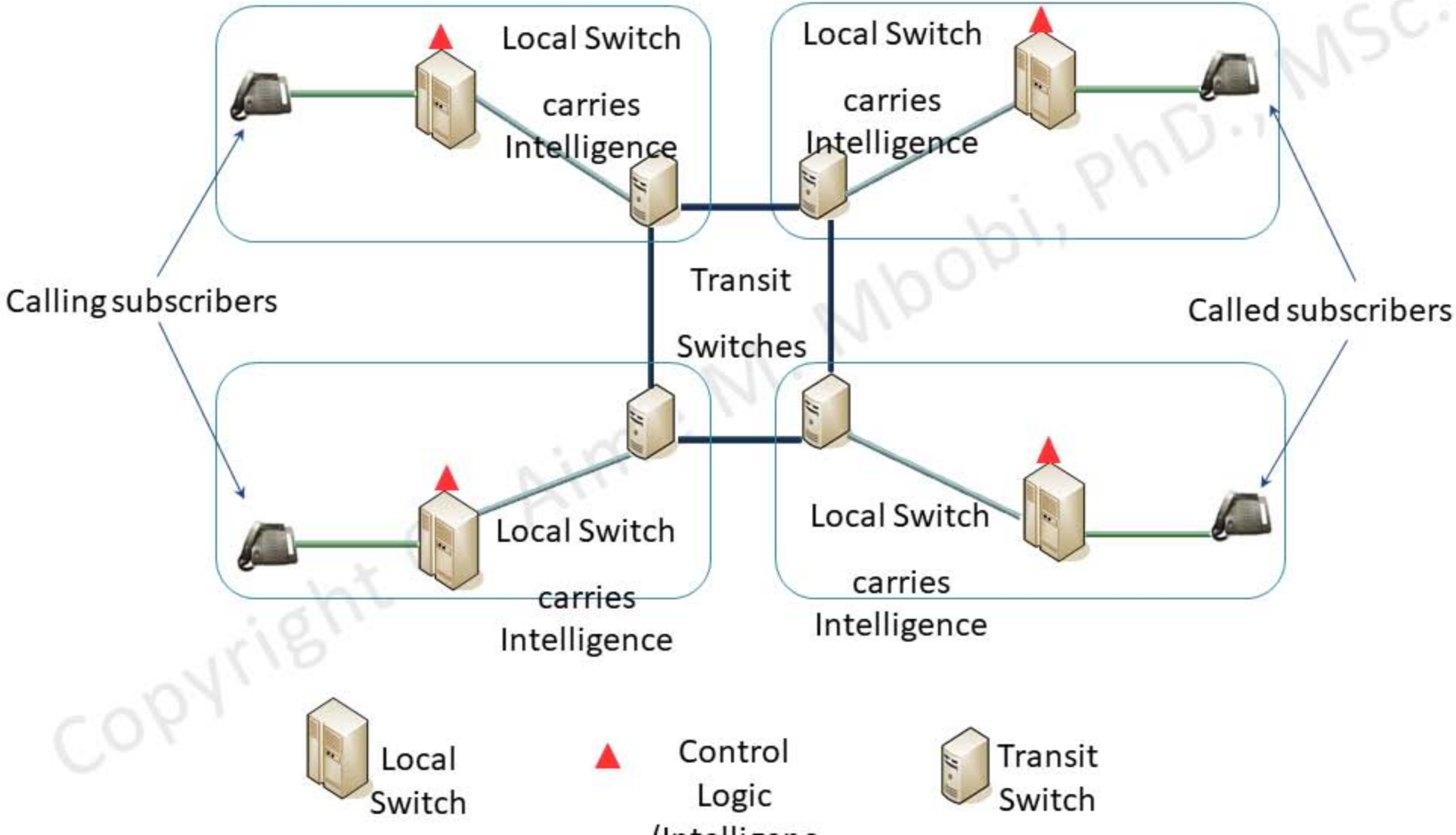
- Intelligence is carried by Local Switches
- Centralized intelligence in the network
- Intelligence allocated with flexibility in the network
- Intelligence distributed on demand

IN Architecture Trials

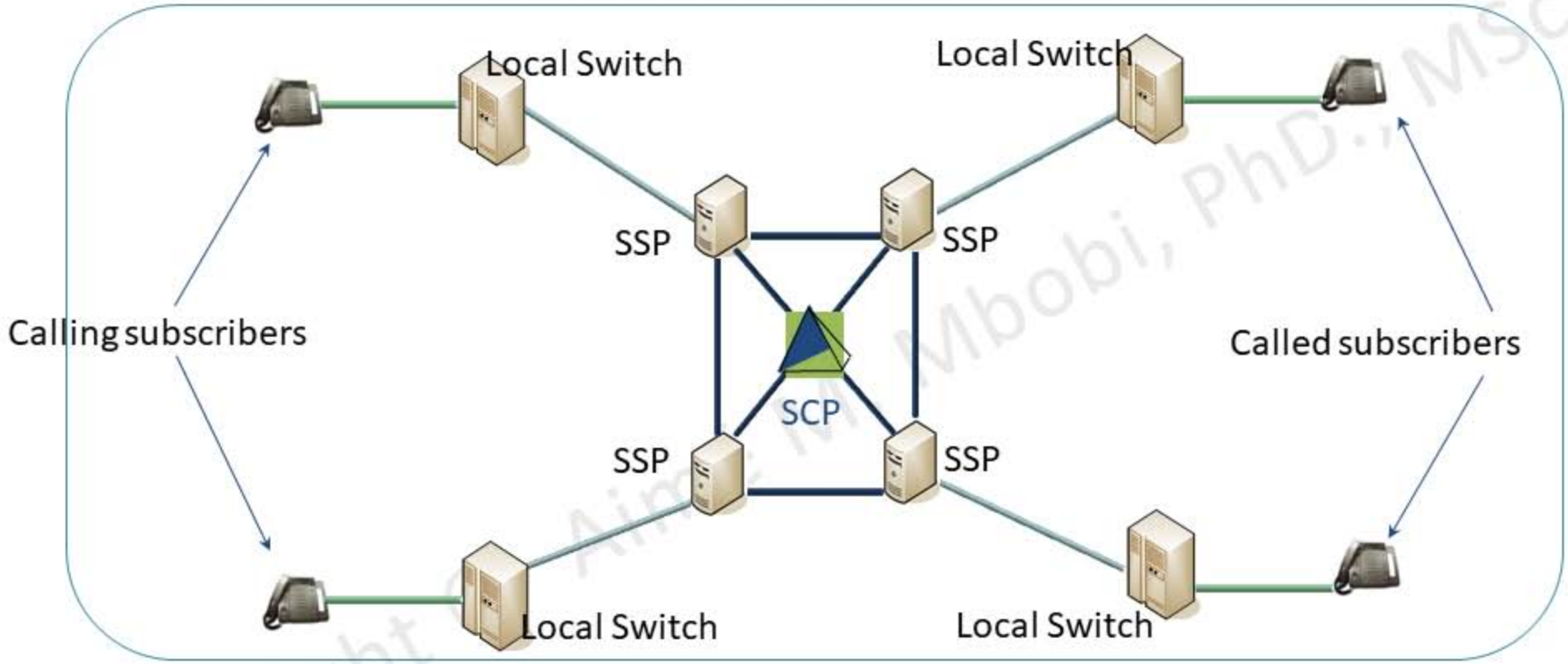
Intelligence (Control Logic) is carried by Local Switches

Intelligence (Control Logic) is carried by Local Switches

Intelligence (Control Logic) is carried by Local Switches



Centralized Intelligence in the Network

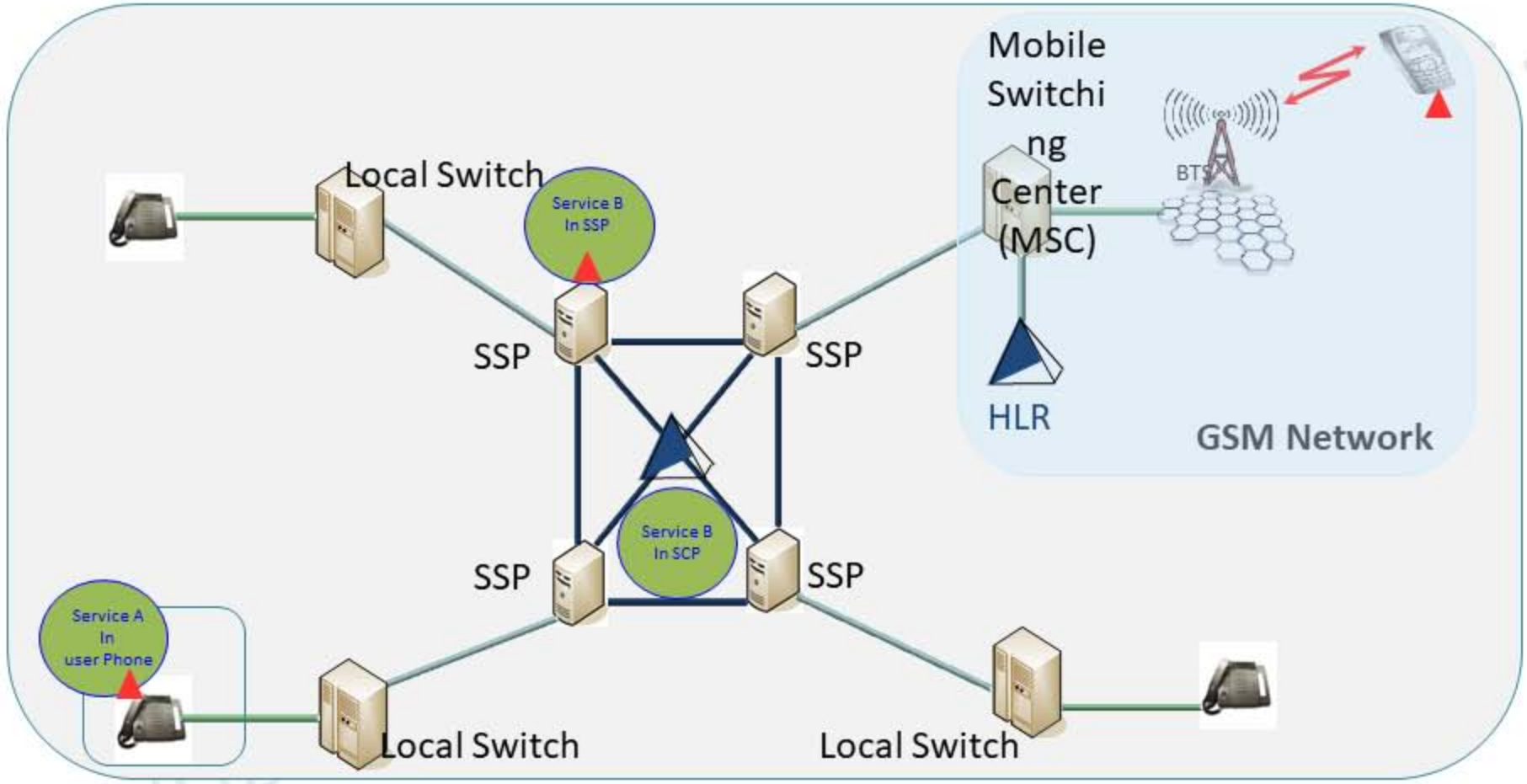


Local Switch

Service Control Point (SCP)

Service Switching Point (SSP)

Flexible Intelligence Allocation in the Network

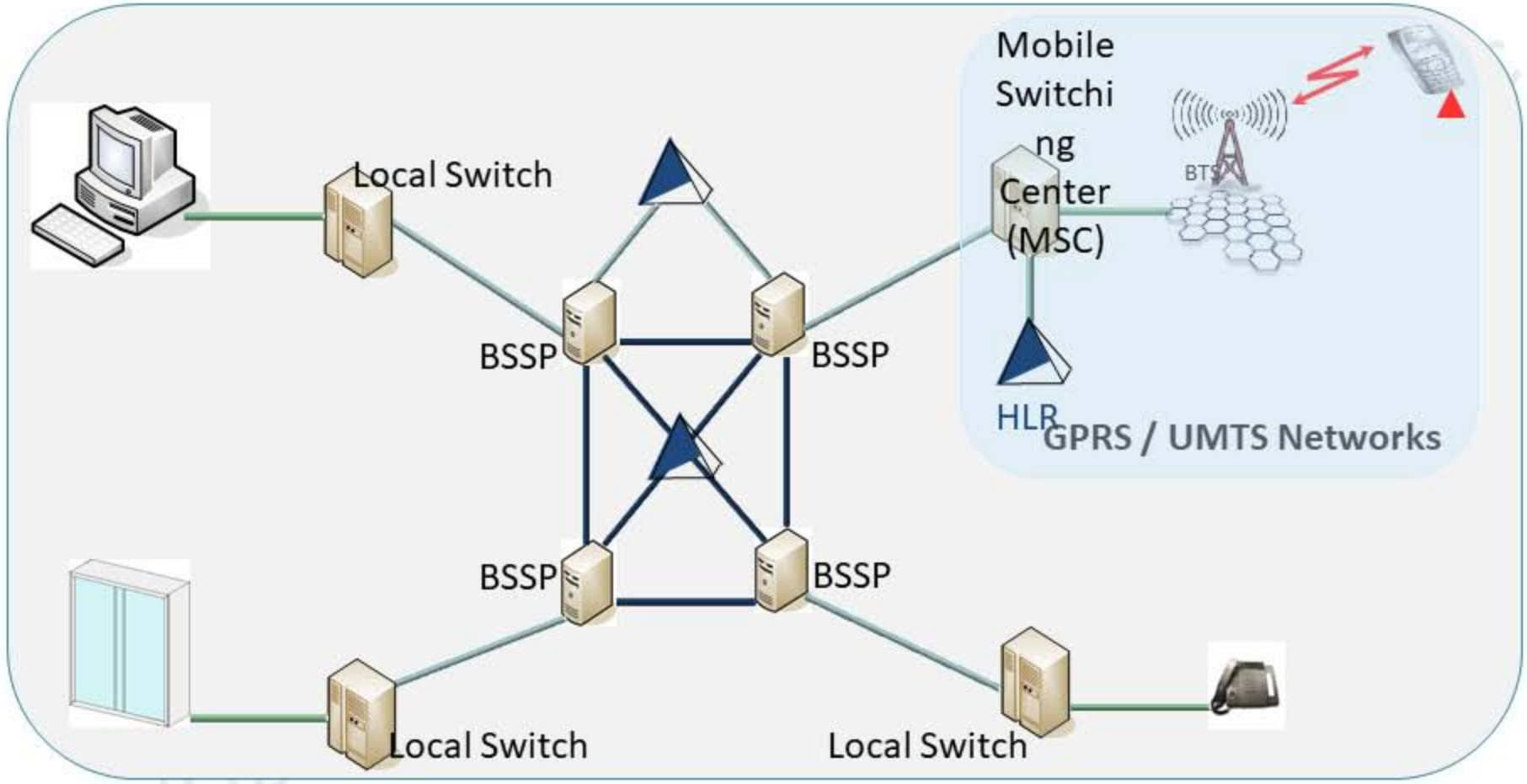


Local Switch

Control Logic

Service Switching Point (BSSP)

On Demand Intelligence Distribution



Local Switch

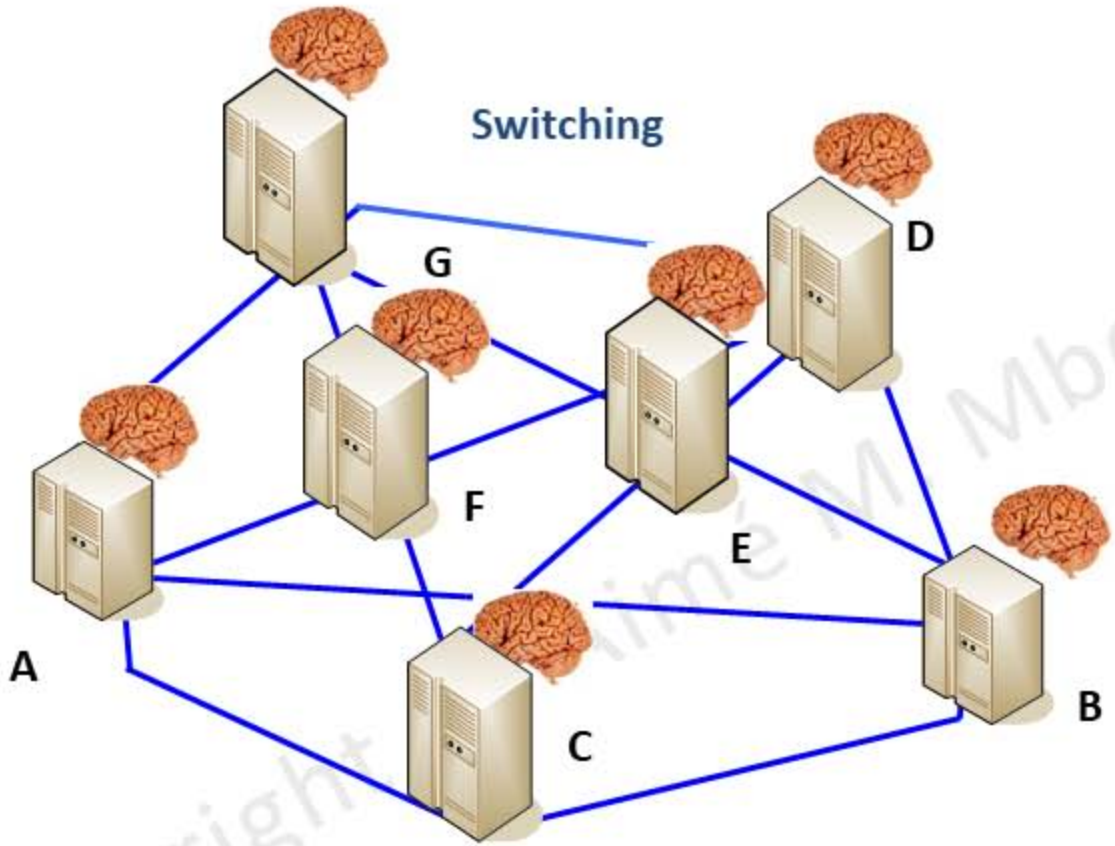
Control Logic

Broadband Service Switching Point

Essence of Intelligent Network

Projected Goal

Projected Goal



Intelligence
(Service Control Point)

INTELLIGENCE AND SWITCHING SPLIT

Projected Goal

- Dissociation of intelligence and switching in the network.
- Development of central nodes called Service Control Point (SCP) that stores all information and can be accessible to all switches.
- Thus, Network has became reach with new add-value services: Intelligent Network (NI).
- Intelligent Network is a network architecture meant for both fixed and mobile telecommunication networks where SCP is a Master and SSP are slaves

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Standardization Phases

Projected Goal

- To meet these goals and objectives, ITU-T has embarked on a phased standardization process toward the target IN architecture.
- ITU-T worked on defining a set of capabilities for each phase and simultaneously on evolving the view of the target INA.
- The IN capabilities are called Capability Sets (CS).

Projected Goal

- The IN capabilities are called Capability Sets (CS).
- The Capability Sets involve
  - Service creation
  - Management and interaction
  - Network management
  - Service processing
  - Network internetworking
- These CS's are backwards-compatible to previous CS's.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Added Value, Offers and Utilization

IN Added Value, Offers and Utilization

- Utilization
  - ISDN, PLMN and PSTN
- Offers
  - Open standards, vendor independence
  - Rapid service creation and deployment and centralized service management
  - Range of standard and customized services to users
  - Rapid adaptation to market needs and competition

Structure of IN Recommendations Q12XY

Structure of IN Recommendations Q12XY

- The basic standard that defines the framework of other IN standards is Q.1200.
- The standards have been numbered so that every new CSx will have a number that begins with 12x
- And the description of the CSx recommendation part y will be numbered also systematically such as 12xy.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Structure of IN Recommendations Q12XY

X	Y
00 - General	
10 - CS1	1 - Principles, Introduction
20 - CS2	2 - Service Plane (not included for CS1)
30 - CS3	3 - Global Functional Plane
40 - CS4	4 - Distributed Functional Plane
50 - CS5	5 - Physical Plane
60 - CS6	6 - For future use
70 - CS7	7 - For future use
80 - CS8	8 - Interface Recommendations
90 - Vocabulary	9 - Intelligent Network Users Guide

Structure of IN Recommendations Q12XY

[Q.1200] Rec. (09/97)	General series Intelligent Network Recommendation structure
[Q.1201/I.312] Rec. (10/92)	Principles of intelligent network architecture
[Q.1202/I.328] Rec. (09/97)	Intelligent network - Service plane architecture
[Q.1203/I.329] Rec. (09/97)	Intelligent network - Global functional plane architecture
[Q.1204] Rec. (03/93)	Intelligent network distributed functional plane architecture
[Q.1205] Rec. (03/93)	Intelligent network physical plane architecture
[Q.1208] Rec. (09/97)	General aspects of the Intelligent Network Application protocol

Intelligent Network Conceptual Model

Intelligent Network Conceptual Model (INCM)

Intelligent Network Conceptual Model (INCM)

- ITU defined the four-plan Intelligent Network Conceptual Model (INCM) to be used as a modeling environment for the Intelligent Network.
- INCM is defined in the ITU Recommendation Q.1201 and provides the way of describing various elements of Intelligent Network Architecture.
- Each plan corresponds to specific network abstraction:
  - Service plane
  - Global functional plane
  - Distributed functional plane
  - Physical plane

Intelligent Network Conceptual Model (INCM)

Triple objectives of INCM (Independence)

Intelligent Network Conceptual Model (INCM)

- The standards of Intelligent Networks define IN in an abstract point of view
- So it leaves the service providers the decisions on their own implementations
- INCM is the first comprehensive approach to modular telecom service development

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Intelligent Network Conceptual Model (INCM)

- It provides design guidelines for the IN architecture to meet the triple following objectives based on independence:
  - Service implementation independence
  - Network implementation independence
  - Vendor and technology independence

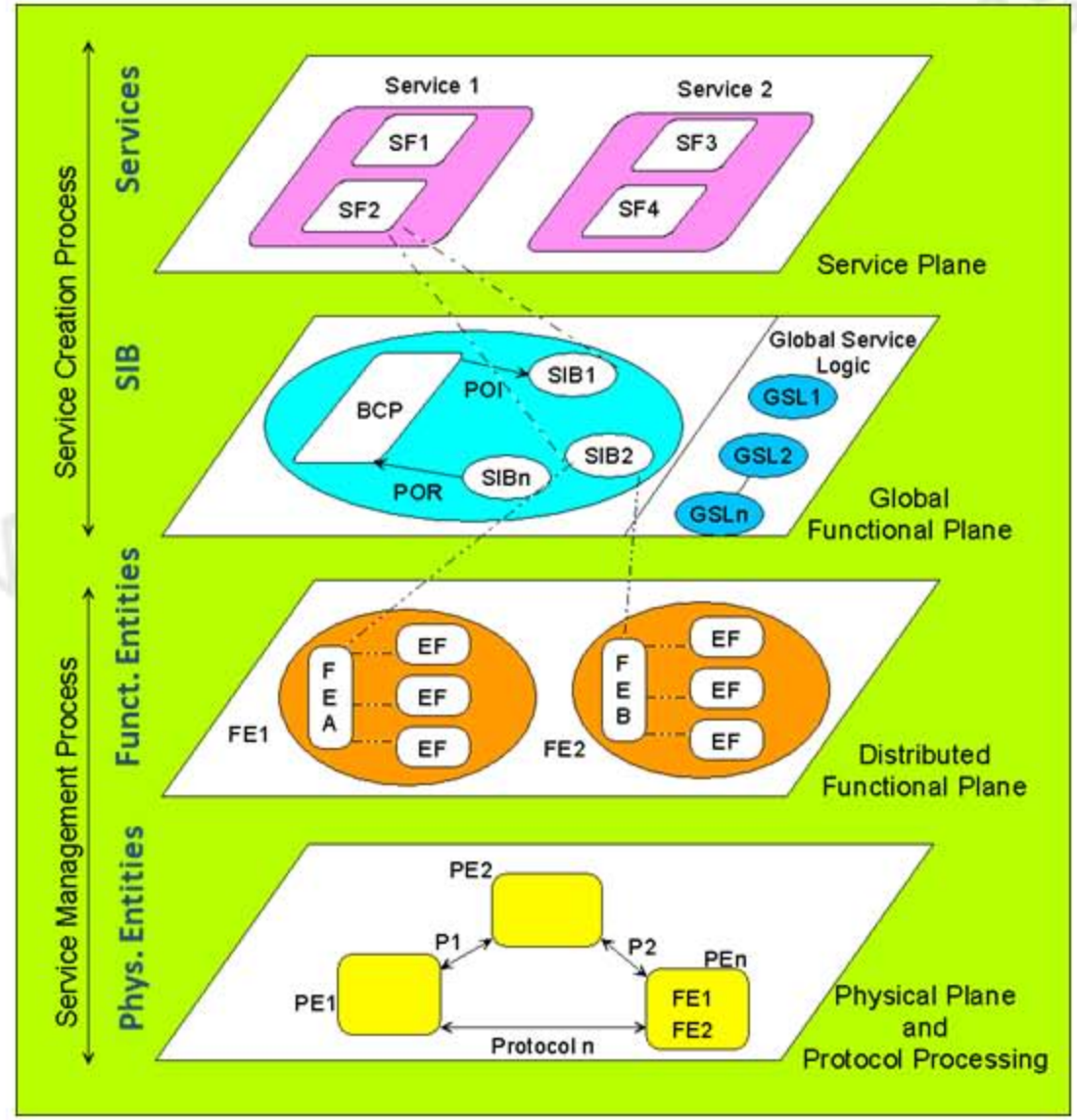
Intelligent Network Conceptual Model (INCM)

- Service Plane (SP) represents an exclusively service-oriented view. This view contains no information regarding the implementation of the services in the network

- Global Functional Plane (GFP) models the IN-structured network as a single entity. This view contains Basic Call Process (BCP) or Basic Call Function (BCF), Service Independent Building blocks SIB, Point of Initiation (POI) and Point of Return (POR) between the BCP and a chain of SIBs

- Distributed Functional Plane (DFP) models a distributed view of an IN-structured network by defining Functional Entities (FEs)

- Physical Plane models the physical aspects of IN-structured networks



Intelligent Network Conceptual Model (INCM)

Mapping IN Conceptual Model to Real Implementation

Mapping IN Conceptual Model to Real Implementation

IN Conceptual Model	Real Implementation
Service Plane	Services
Global Functional Plane	SIB
Distributive Functional Plane	Functional Entities
Physical	Physical Entities

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Intelligent Network Conceptual Model (INCM)

Operators and Service Providers

Operators and Service Providers

- A Network operator is the entity that owns and operates the network infrastructure.
- A service provider is an entity that offers services to the subscribers and is responsible for the management and development of the service.
- The service provider uses the network infrastructure of a network operator to deliver the service to the subscriber.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Intelligent Network Conceptual Model (INCM)

Service Plane (SP) Architecture (Q.1202)

Service Plane (SP) Architecture (Q.1202)

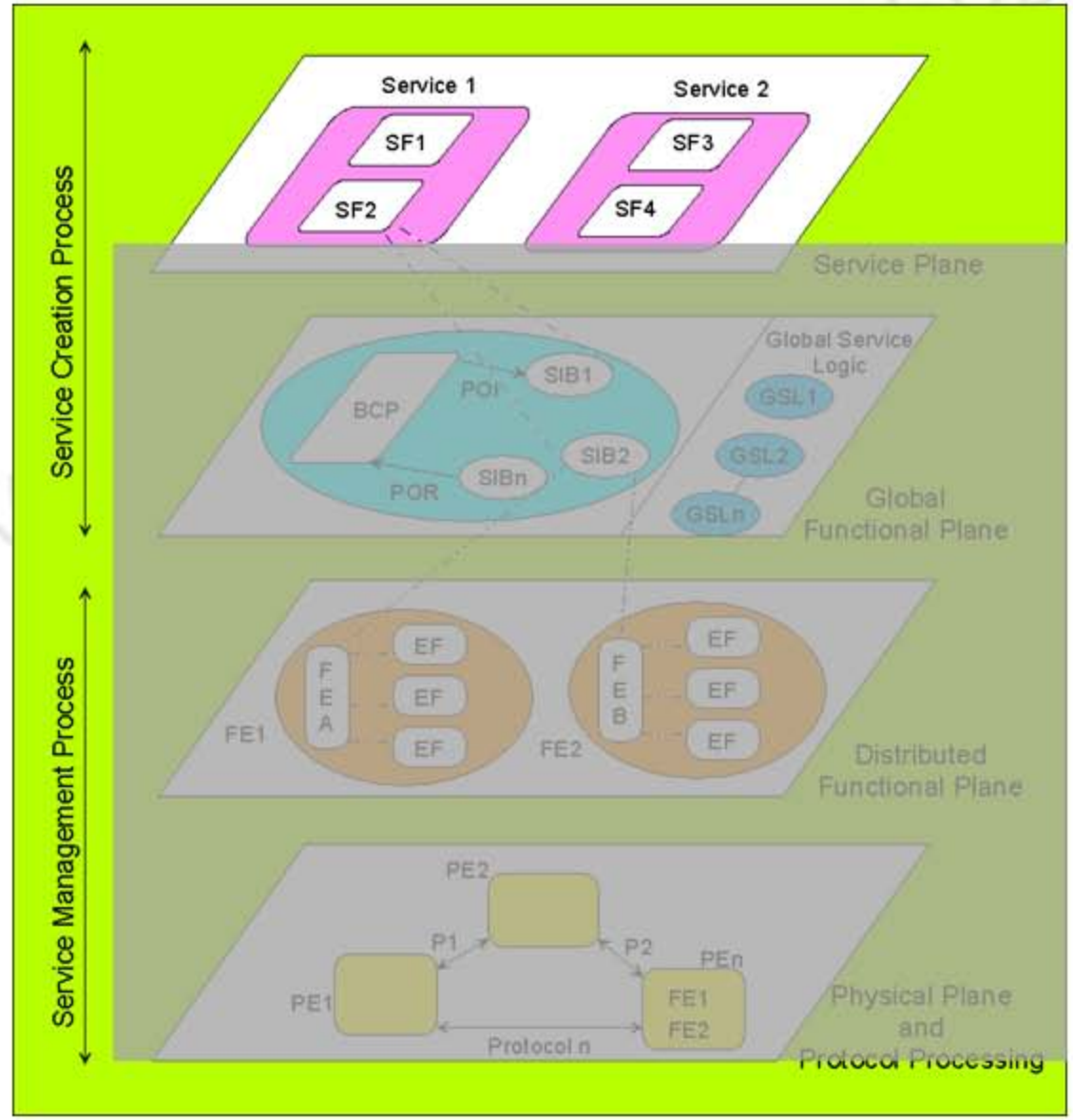
- The Service Plane is a solely service-oriented view.
- SP doesn't contain any information about the implementation of the services in the network.
- Only the network's service-related behavior is apprehended, i.e *"how the user perceives this service?" , "How the user can use USSD to top up or check its prepaid balance?"*

SERVICE PLANE COMES WITHIN THE COMPETENCE OF THE NETWORK SERVICE MARKETER

Service Plane (SP) Architecture (Q.1202)

Service

- A service is defined as a commercial offer from the Service Provider to the subscribers to satisfy an existing need in telecommunication.
- A service is described in Natural Language (eg. Call forwarding).
- It is made of one or more Service Elements or Service Features (SF).



Service Plane (SP) Architecture (Q.1202)

Service Features

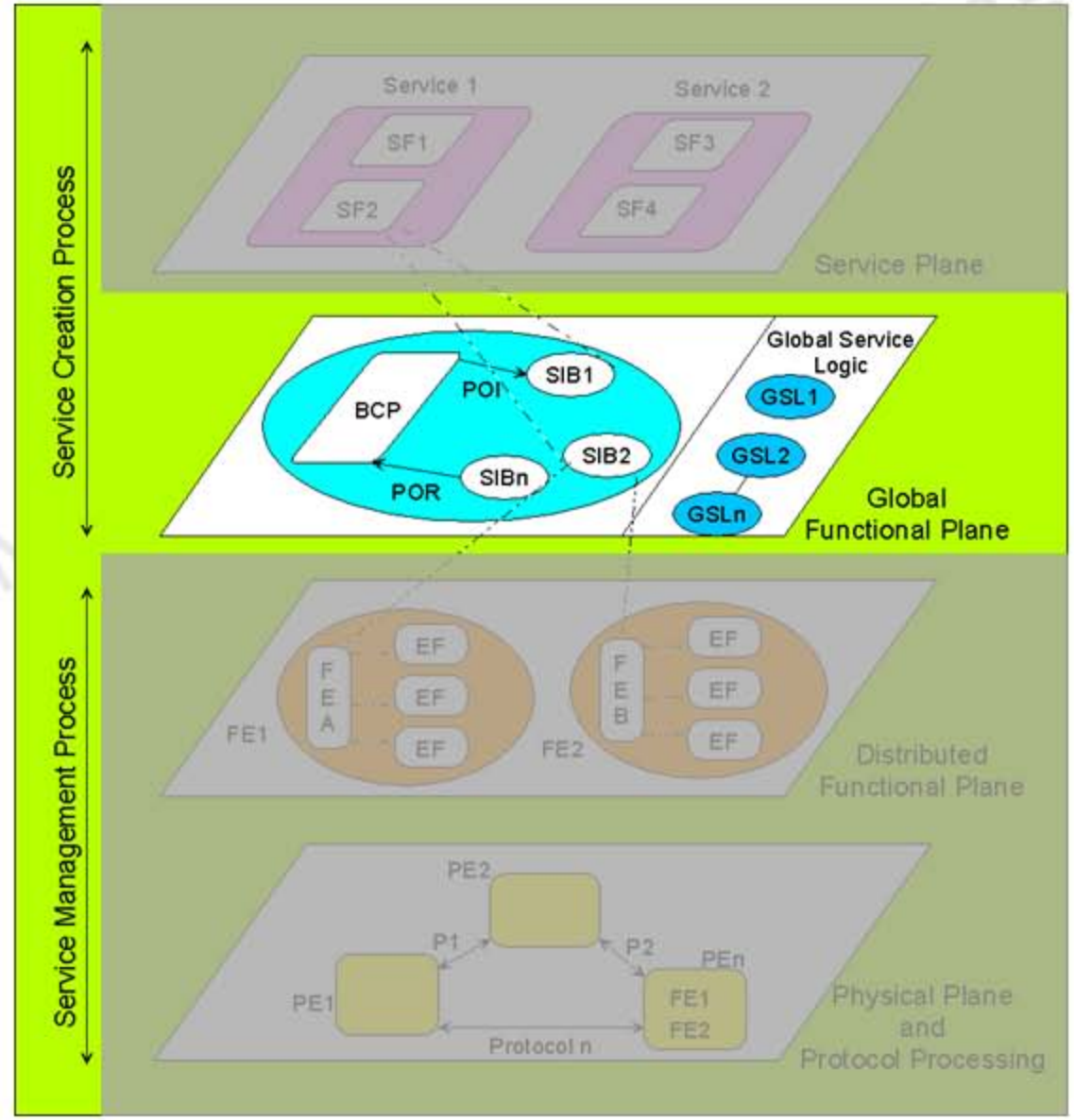
- A service feature or service element is the smallest unit used at this level.
- A SF corresponds to a part of the service or a service itself.
- So, a SF could also be a service i.e corresponding to a commercial offer.
- Generally a service element is independent to a given service.
- Example
  - Service element for “Authentication” or “Queuing” that could be reused to create various IN services

Intelligent Network Conceptual Model (INCM)

Global Functional Plane Architecture (Q.1203)

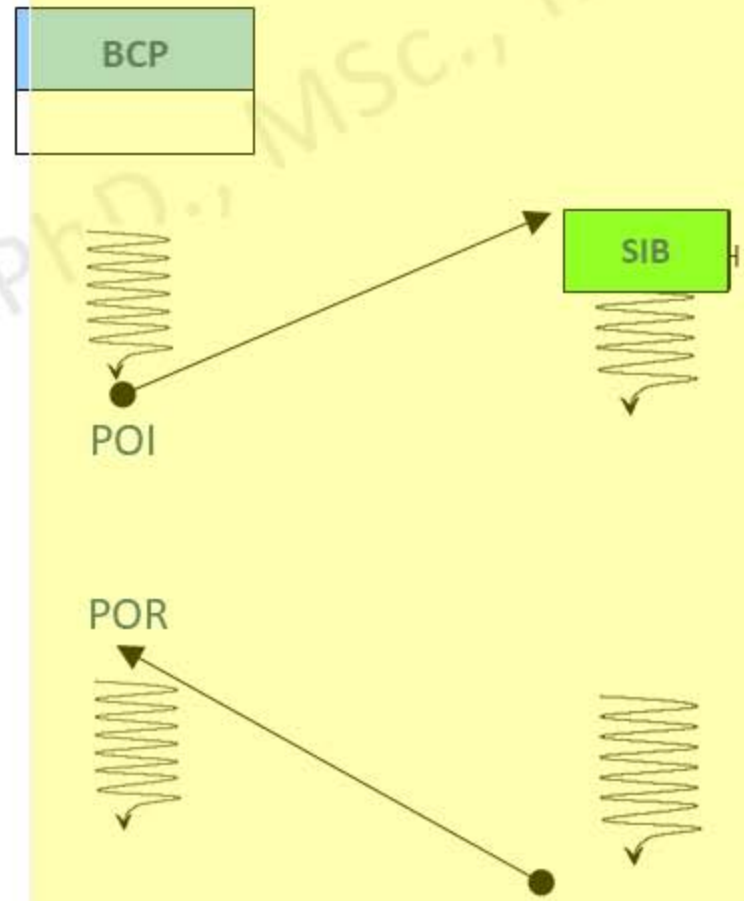
Global Functional Plane Architecture (Q.1203)

- Global Functional Plane (GFP) models the IN network as a single entity.
- This entity is capable of performing the functions represented by the Service Independent construction Blocks (SIB)
- It describes how service features are built using SIBs.
- In GFP, a service is chain of SIBs.
- E.g., the SIB that verifies that user supplied information conforms to a specified format



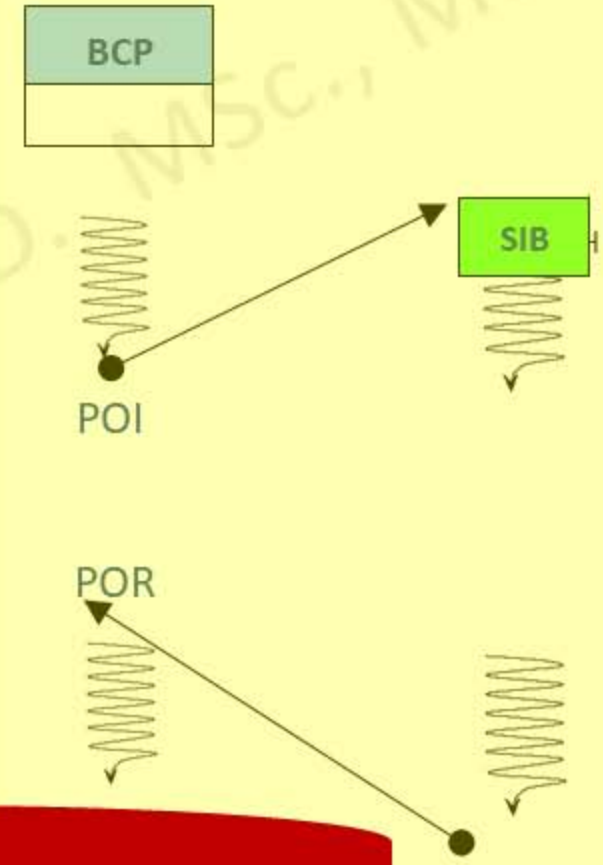
Global Functional Plane Architecture (Q.1203)

- The Chaining of SIBs starts from a particular point in the Basic Call Process (BCP) called Point Of Initiation (POI)
- For example
  - For the toll-free service, the POI corresponds to the detection of the prefix “1-800”
  - For USSD, the POI corresponds to the detection of the prefix *123#”
- After performing the SIBs sequence, the control is returned back to the BCP through a particular point called Point Of Return (POR)



Global Functional Plane Architecture (Q.1203)

- For a given service, a chain of SIBs associated to a POI and a POR constitute a "Global Service Logic"
- SIBs can be thought of as "off-the-shelf" components to be used for assembling services.
- In programming point of view, a GSL is a script



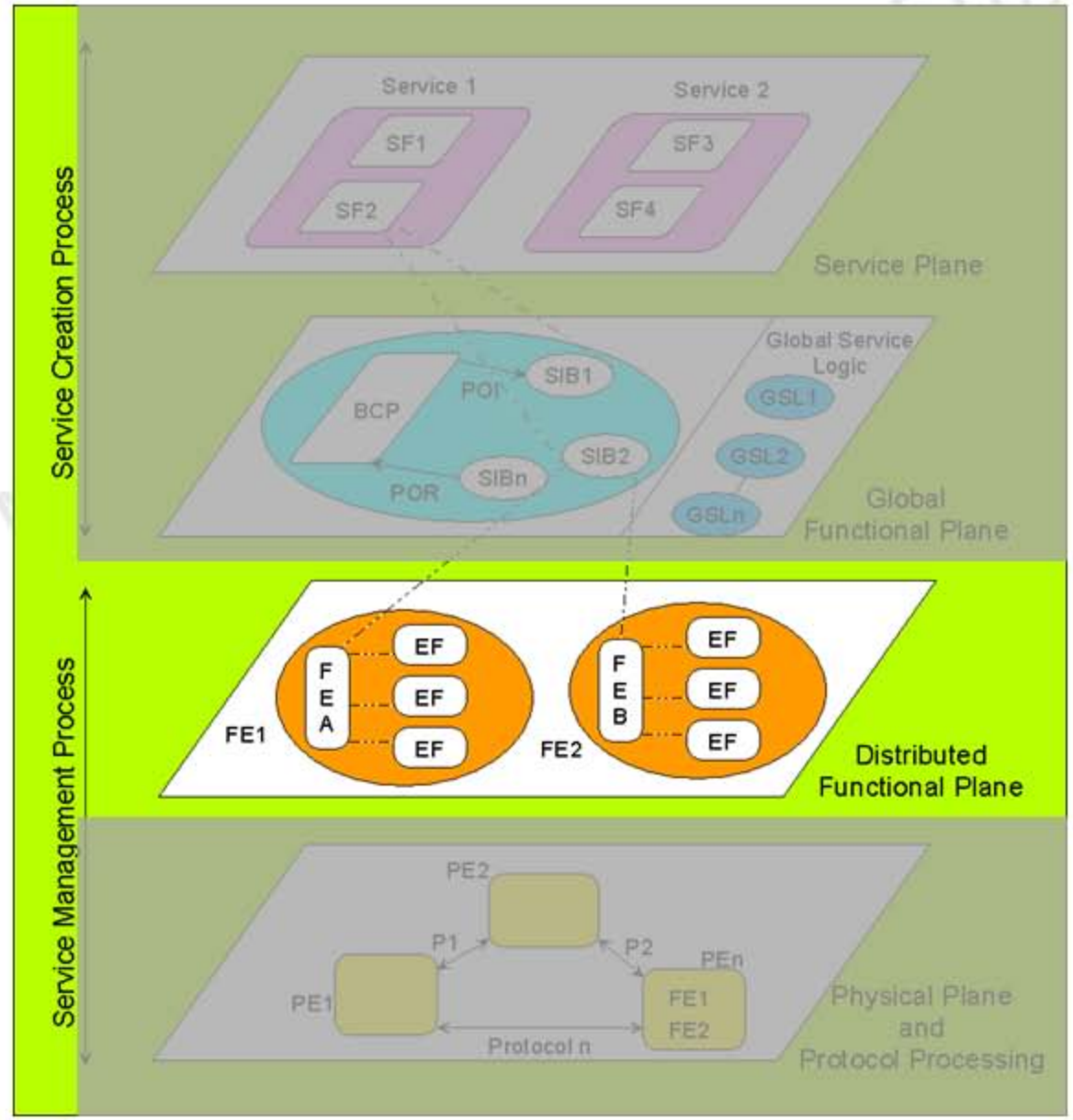
THE SYSTEM DESIGNER TAKES CHARGE OF THE GLOBAL FUNCTIONAL PLANE

Intelligent Network Conceptual Model (INCM)

Distributed Functional Plane Architecture (Q.1204)

Distributed Functional Plane Architecture (Q.1204)

- Distributed Function Plane (DFP) models the IN network as a set of distributed Functional Entities (FEs) where each FE may perform a variety of Functional Entity Actions (FEAs).
- E.g. the Service database function, which models system wide databases.



Distributed Functional Plane Architecture (Q.1204)

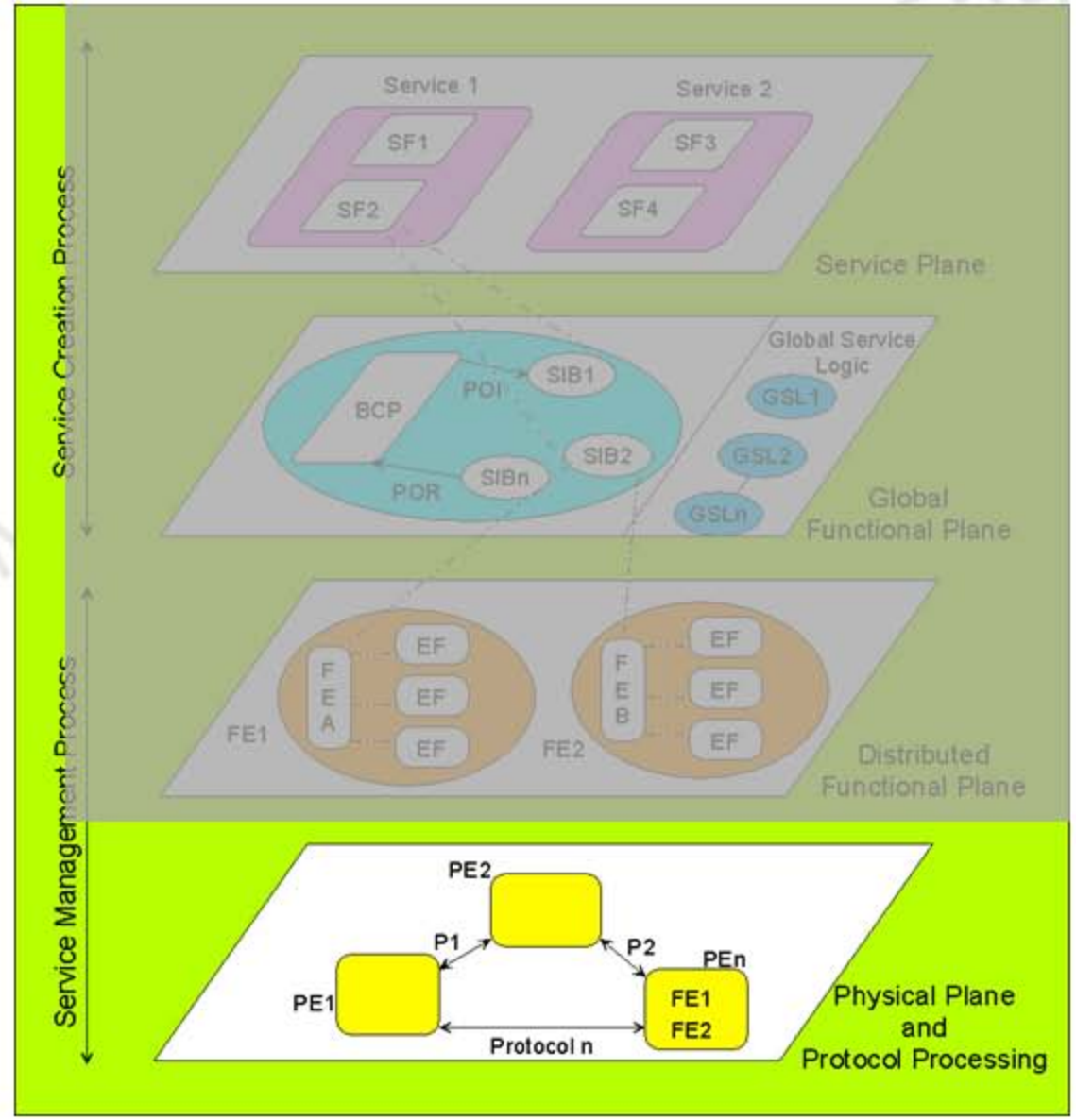
- In DFP, SIBs can be described by a sequence of actions performed in the Functional Entities
- It means that in DFP, SIBs can be then described by a collection of FEAs in different FE and information flows between FEAs.
- A given FEA may not be distributed across functional entities.

Intelligent Network Conceptual Model (INCM)

Physical Functional Plane Architecture (Q.1205)

Physical Functional Plane Architecture (Q.1205)

- Physical Plane (PP) models the physical aspects of IN network
- It identifies the physical entities and protocols that exist in real IN.
- However, it specifies, functional entities implemented in various physical entities



Physical Functional Plane Architecture (Q.1205)

- This implementation should respect the rule that a functional entity could be duplicated but should not be distributed in various physical entities.
- Generally, in DFP, the information flows are application protocols.
- In PN, information flows are the stack of protocol on which they will be functioning

THE NETWORK OPERATORS AND EQUIPMENT SUPPLIERS TAKES CHARGE OF THE PHYSICAL PLANE

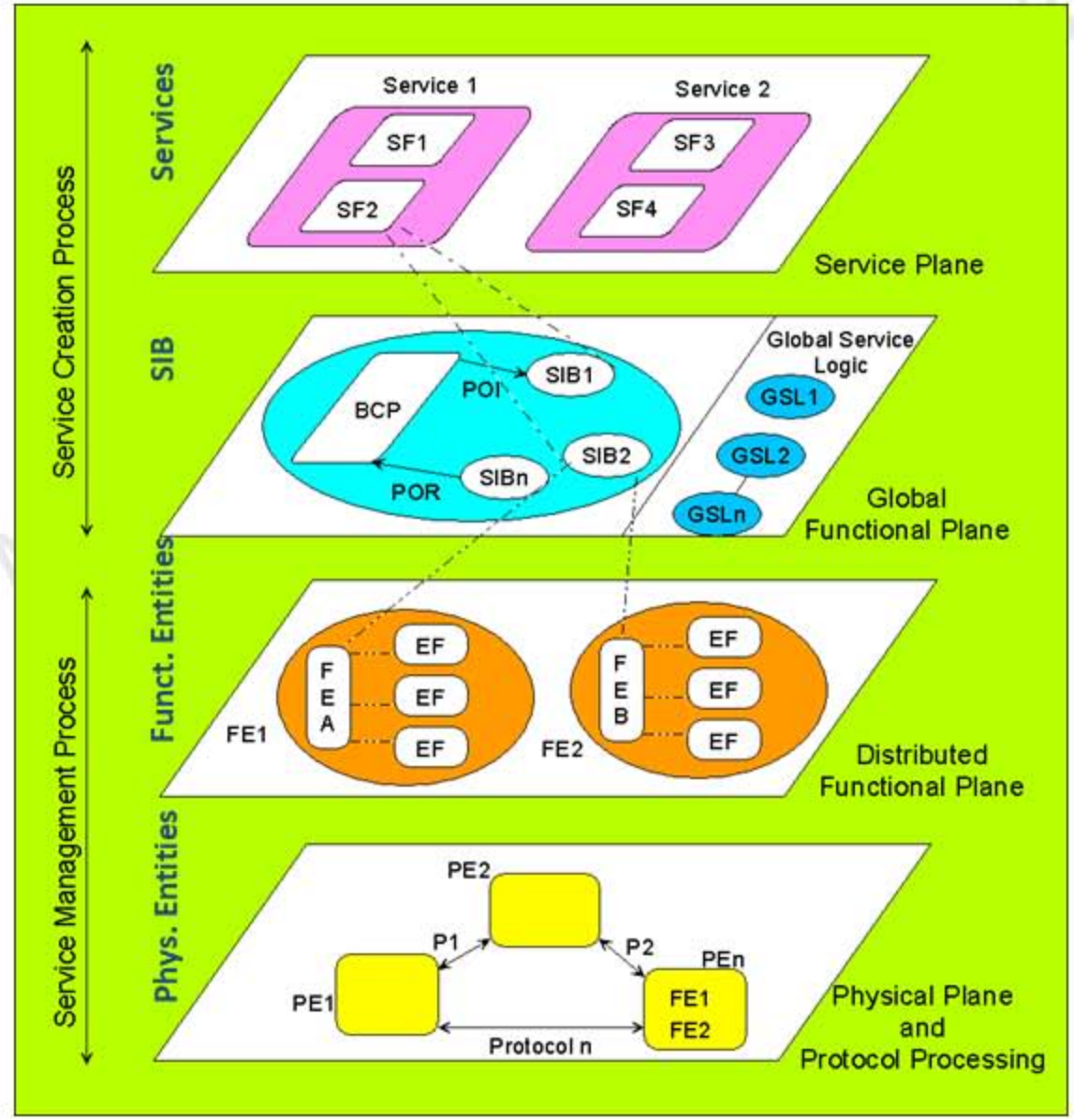
Intelligent Network Conceptual Model (INCM)

Relationship between Planes

Relationship between Planes

- SF described in SP are translated into GSL in GFP.
- A GSL is a grouping of one POI, a chaining of SIBs and one POR.
- A SIB of GFP is realized in the DFP by a sequence of FEAs performed in FEs
- FEs are translated into PE in PP.
- Groupings of FEs may occur before the translation into a given PE

SP=Service Plane
PE=Physical Entity
SF=Service Features
GSL= Global Service Logic
GFP=Global Functional Plane
FEA=Functional Entity Actions
DFP= Distributed Function Plane,
SIB=Service Independent construction Blocks



Intelligent Network Capability Sets

Physical Functional Plane Architecture (Q.1205)

- Capability sets refers to a set of services and service features that can be built using SIBs.
- All capability sets use the IN conceptual model.
- Each capability set is associated with a planned phase in the standards process.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Capability Set 1 (CS-1): Rec. Q.1210-1219 / 1993

- Services to be deployed over PSTN, ISDN and PLMNs.
- Included such services as:
  - Call forwarding
  - Credit card calling
  - Freephone

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Capability Set 2 (CS-2): Rec. Q.1220-1229 / 19997

- Services added: e.g.
  - Internetwork Freephone
  - Completion of call to busy subscriber
  - Conference calling
  - Call Hold, transfer and waiting
  - Message store and forward
  - International Telecommunication Charge Card

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Capability Set 3 (CS-3): Rec. Q.1230-1239 / 1999

- Contents e.g.
  - Number portability (e.g. GSM 2+ and 3 integration)
  - Interoperability of IN and other networks (e.g. CAMEL)
  - Initial interworking of IN and IP networks
  - Carrier selection handling
  - IN Calling Line presentation restriction
  - Inter-Network Service indicator
  - Triggering on Call Failure Condition
  - etc

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Capability Set 4 (CS-4): Rec. Q.1240-1249 / 2001

- Contents e.g.
  - Multiple points of control
  - Enhanced Number Portability
  - Inter-working with the services in Internet Protocol (IP) Networks
  - Operator determined barring
  - User defined barring
  - Call forwarding unconditional
  - Call forwarding on busy, no reply and not reachable
  - Closed user group, Advise of charge
  - Calling name identification presentation
  - etc.

Intelligent Network Capability Set 1 (CS-1)

IN Capability Set 1 (CS-1)

- It has been an international and European wide aim to define the first step of INA.
- These recommendations are gathered into a set called IN Capability Set 1 (CS1).
- Two standardization organizations worked on CS1
  - ITU-T
  - ETSI
- ITU-T has gathered these recommendations into the Q.120x -series.
- However, ITU-T's and ETSI's standards do not differ from each other in any way.

IN Capability Set 1 (CS-1)

- IN CS1 defines capabilities of direct use to both manufactures and network operators in support of circuit-switched voice/data services.
- The primary characteristic of the target set of IN CS1 services is that they apply during the setup phase of a call or during the release phase of a call.
- ITU chose this single-ended service characteristic to limit the operational, implementation, and control complexity for IN CS1.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Capability Set 1 (CS-1)

Intelligent Network Recommendations CS-1	
[Q.1210] Rec. (10/95)	Q.1210-Series intelligent network recommendation structure
[Q.1211] Rec. (03/93)	Introduction to intelligent network capability set 1
[Q.1213] Rec. (10/95)	Global functional plane for intelligent network CS-1
[Q.1214] Rec. (10/95)	Distributed functional plane for intelligent network CS-1
[Q.1215] Rec. (10/95)	Physical plane for intelligent network CS-1
[Q.1218] Rec. (10/95)	Interface recommendation for intelligent network CS-1
[Q.1218 Addendum 1 to Rec. (09/97)	Interface Recommendation for intelligent network CS-1: Definition for two new contexts in the SDF data model
[Q.1219] Rec. (04/94)	Intelligent network user's guide for capability set 1
[Q.1219 Supp.] Supplement (09/97) to Rec. Q.1219	Intelligent network user's guide: Supplement for in CS-1

IN Capability Set 1 (CS-1)

- Concerned by effectiveness ITU-T has limited its list of services.
- IN CS-1 enables only use of PSTN, PLMN and ISDN.
- CS-1 is intended to address services with high commercial value, focusing at addressing flexible routing, charging, and user interaction services.
- The characteristic of these services is to be technologically feasible and understandable, but do not significantly impact existing deployed technology
- So, in this context, ITU-T categorized two types of services
  - Type A Service
  - Type B Service

IN Capability Set 1 (CS-1) - Type A Services

- All type A services are invoked on behalf of and directly affect a single user.
- Most type A services can be invoked only during call setup of tear down and fall in the category of
  - Single-user, single ended (no requirements for representing end-to end messaging or control)
  - Single point-of-control (no requirement fro representing interaction points between multiple service logic programs)
  - Single-bearer capability (one media profile)
- Type A services may be used in conjunction with other services, switch-based or not, of any type, to form a more complete service package.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Capability Set 1 (CS-1) - Type B Services

- Type B services can be invoked at any point during the call.
- These services may be invoked on behalf of and directly impact one or more users.
- Feature interaction and arbitration, and topology manipulation are capabilities that need to be addressed to deploy these services.
- It is possible to use type A capabilities to enhance some existing type B services.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

IN Capability Set 1 (CS-1) and Types of Services

- The services addressed by CS1 fall under type A services.
- The type A category lead to a series of advantages in the context of CS1 standardization.
  - They represent a wide range of services of proven value.
  - They depend on well-understood control relationships between network components

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Service Plane (CS1 SP)

CS-1 Services Plane (SP)

- CS-1 covers type A services
- These services:
  - Are active only at one end (single ended): service concern only one of the two parties involved in this call and is independent from to all possible services at the other end.
  - Have only one control point (single point of control): at a given time, the same aspects of a call can be remotely controlled by only one entity SCF.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Services Classification

1. Number translation

- Abbreviated Dialing (ABD)
- Call Forwarding (CF)
- Call Rerouting Distribution (CRD)
- Call Distribution (CD)
- Destination Call Routing (DCR)
- Freephone (FPH)
- Follow-Me-Diversion (FMD)
- Premium Rate (PRM)
- Selective Call Forward on Busy/Don't Answer (SCF)
- Universal Access Number (UAN)
- User-Defined Routing (UDR)

CS-1 Services Classification

2. Alternate billing

- Account Card Calling (ACC)
- Credit Card Calling (CCC)
- Automatic Alternative Billing (AAB)
- Split Charging (SPL)

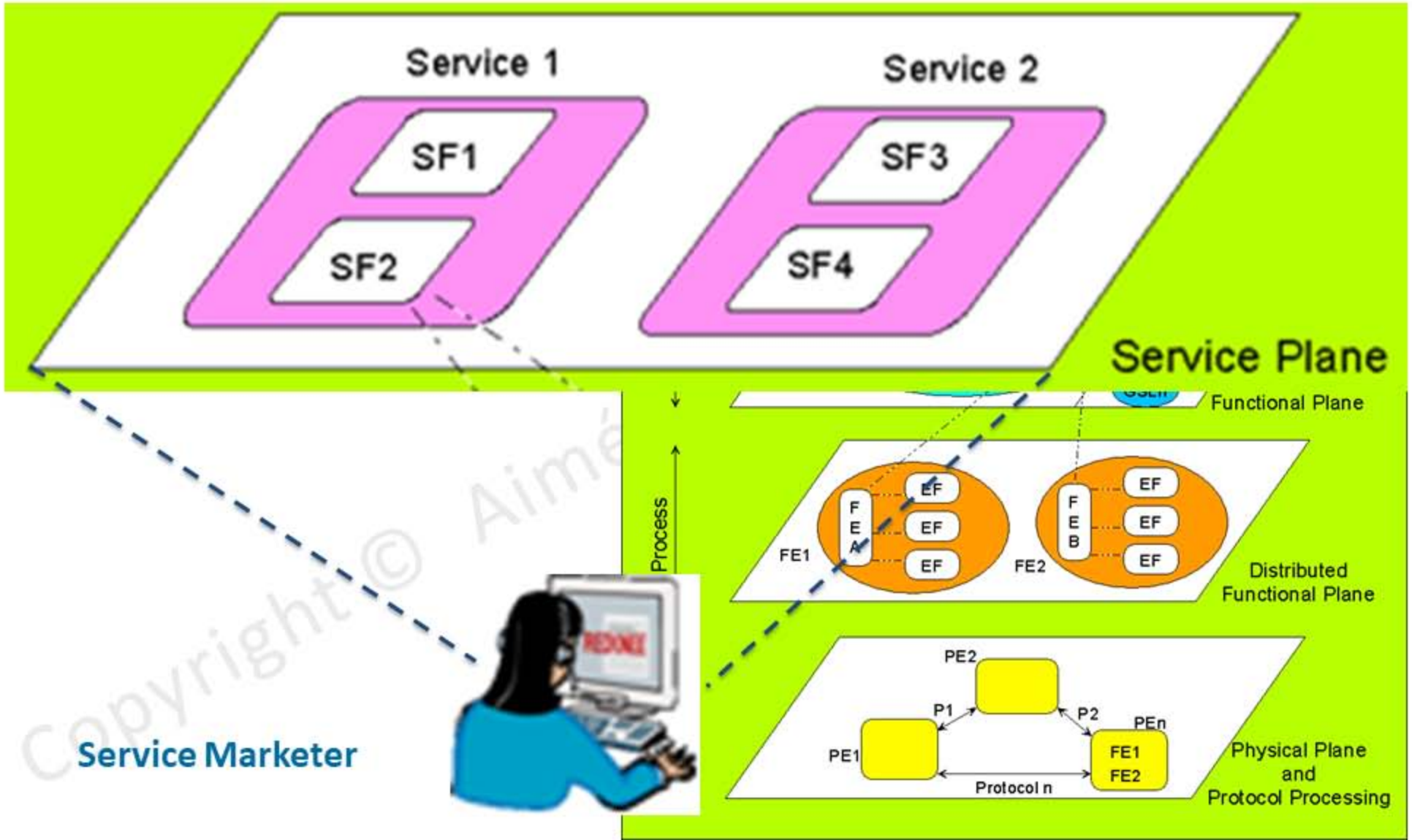
Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Services Classification

3. Screening
   - Originating Call Screening (OCS)
   - Security Screening (SEC)
   - Terminating Call Screening (TCS)

4. others
   - Conference Calling (CC)
   - Televoting (VOT)

CS-1 Services Plane Responsibility



CS-1 Global Functional Plane (CS1 GFP)

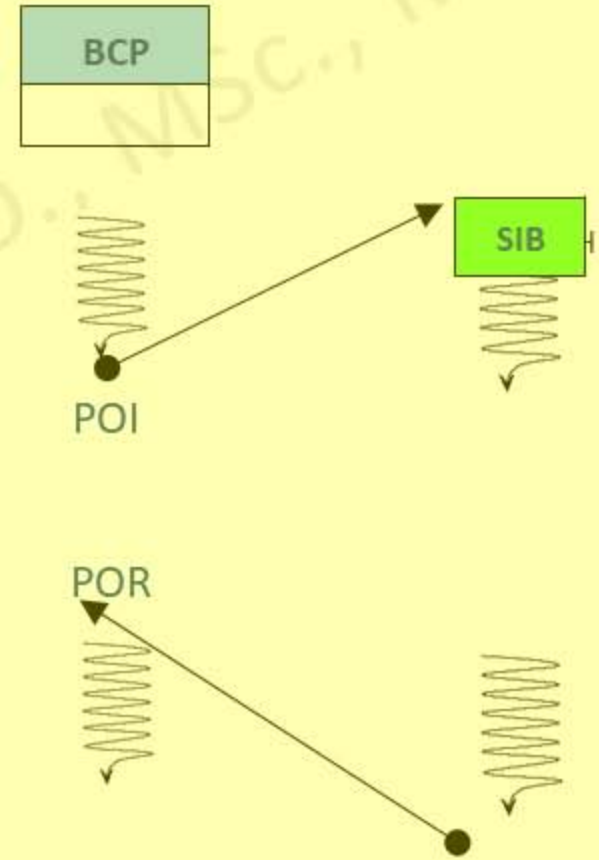
CS-1 Global Functional Plane (GFP)

- CS1 GFP models IN functionality in global point of view and could be viewed as a programming interface.
- In GFP, services from SP are break down into Service Elements (not specific to the implementation) and, then re-described in natural language in terms of network modular.
- These construction blocks standard and reusable are called Service Independent Building Blocks (SIB)

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

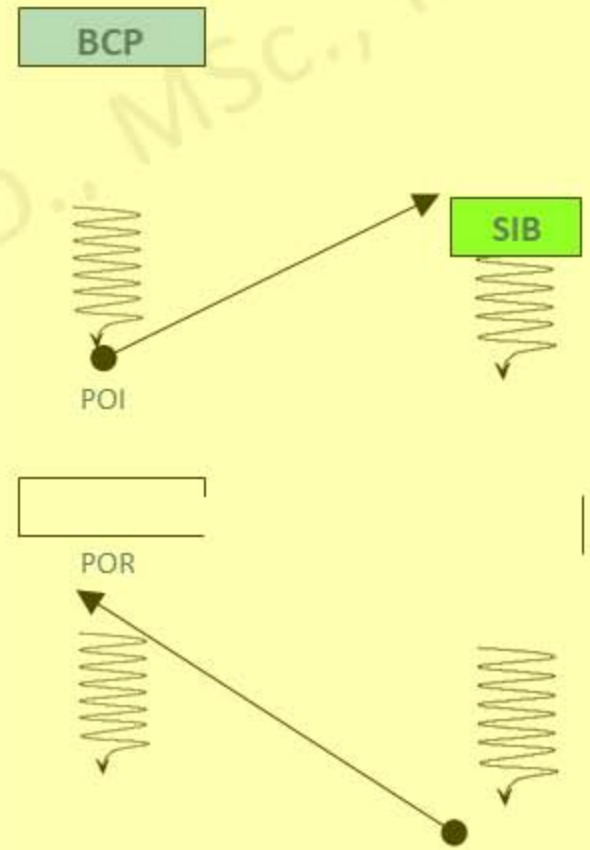
CS-1 GFP - Basic Call Process (BCP)

- Basic Call Process (BCP) could be viewed as a particular SIB that represents a basic call.
- BCP is described only by *"how it interacts with the IN service in the form of sequences of SIBs"*.
- This is accomplished by describing the interface between the BCP and the Global Service Logic (GSL).
- This interface consists of Points of initiation (POI) and Points of return (POR).



CS-1 GFP - Basic Call Process (BCP)

- The transfer of the control between the Call Processing (CP) and the Service is done at these points.
- The Global Service Logic (GSL) provides the way SIBs modules are linked together to describe the Service Elements that make it up.
- When a service should be invoked, its GSL is performed at a POI by a SIB BCF trigger
- At the end of the SIB chain, the control returns back to CP at a POR



CS-1 GFP - Points Of Initiation (POI)

- Call originated: this POI identifies that the user has made a service request without yet specifying a destination address.
- Address Collected: this POI identifies that the address input has been received from the user.
- Address analyzed: this POI identifies that the address input has been analyzed to determine characteristics of the address.
- Prepared to complete call: this POI identifies that the network is ready to attempt completion of the call to the terminating party.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 GFP - Points Of Initiation (POI)

- Busy: this POI identifies that the call is destined for a user who is currently busy.
- No Answer: this POI identifies that the call has been offered to a user who has not answered.
- Call acceptance: this POI identifies that the call is active but the connection between the calling and called parties is not established.
- Active state: this POI identifies that the call is active and the condition between the calling and called parties is established.
- End of call: this POI identifies that a call party has disconnected.

CS-1 GFP - Points Of Return (POR)

- Continue with existing data: this POR identifies that the BCP should continue call processing with no modification
- Proceed with new data: this POR identifies that the BCP should proceed with call processing with only a data modification
- Handle as transit: this POR identifies that the BCP should treat the call as if it had just arrived

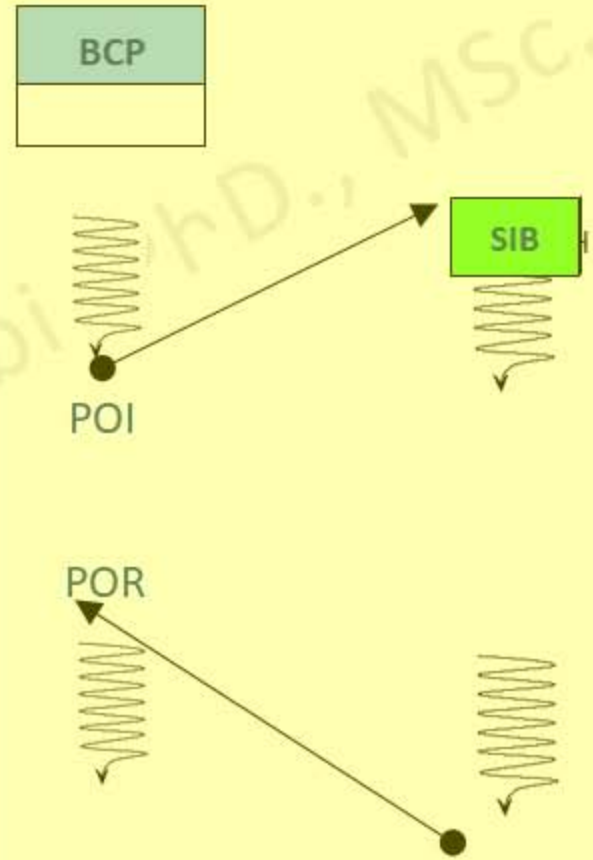
Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 GFP - Points Of Return (POR)

- Clear call: this POR identifies that the BCP should clear the call.
- Enable call party handling: this POR identifies that the BCP should perform functions to enable call control for individual parties.
- Initiate call: this POR identifies that a new call should be initiated. This may be independent of an existing call, or may be in the context of an existing call.

CS-1 GFP - Service Independent Building Blocks (SIB)

- Each SIB has:
  - Standardized Interfaces
  - One Logic Input
  - One or more Logic Output
  - Parameters for service performing



CS-1 GFP - Service Independent Building Blocks (SIB)

- The Parameters can be:
  - Dynamic Call Instance Data (CID)
    1. Data related to the call, describing the context of the service performing: i.e called and calling numbers
    2. These data can come from
       - SIB (calling and called identity)
       - Another SIB (Resulting from a number translation)
       - Keyed by the user (selected number, personal code)

CS-1 GFP - Service Independent Building Blocks (SIB)

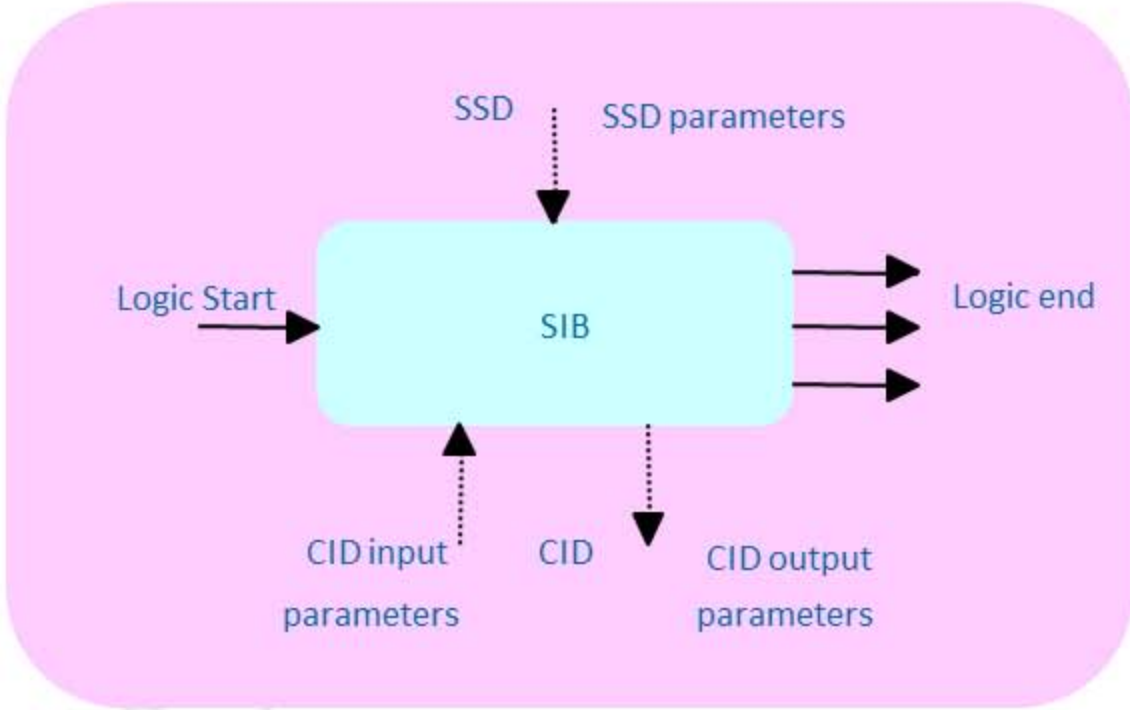
- The Parameters can also be:
  - Static: Service Support Data (SSD)
    1. Data related to the service, used for any context, i.e file containing subscriber's service profile
    2. There are two kinds of SSD
       - Fixed parameters (constant for all the service i.e the file name where to look up the translation table for the toll-free number or the list where to check if a number is present or absent)
       - CID Field Pointer (CIDFP: Call Instance Data Field Pointer tells the SIB what CID to use for its operations)

CS-1 GFP - Service Independent Building Blocks (SIB)

- Each SIB is specified through:
  - Description
  - Operation performed by this module
  - Its inputs that include Service Support Data (SSD) and Call Instance Data (CID)
  - Its outputs that include the description of logical ends and logical parameters from the performing of SIB
  - A graphical Representation

CS-1 GFP - Service Independent Building Blocks (SIB)

SIB graphical Representation



- Logical start (input)
- Service Support Data, SSD (input)
  - Fixed Parameters (depend on the SIB type)
  - CID Field Pointers (CIDFP)
- Call Instance Data, CID (input)
- Call Instance Data, CID (output)
  - Dynamic parameters (depend on call instance) Logical end (output)

CS-1 GFP - Service Independent Building Blocks (SIB)

The functionality of CS-1 can be achieved by using 14 SIBs

1. Algorithm: performs a mathematical operation (addition, subtraction)
2. Authenticate: provides the function for authentication (access right)
3. Screen: compares an identifier with a list to determine if it is present or not
4. Charge: used to apply a particular rate
5. Service Data Management: used to handle permanent data

CS-1 GFP - Service Independent Building Blocks (SIB)

6. Compare: perform a comparison between two parameters. (This SIB has four logical outputs “less than”, “greater than”, “equal”, “error”)
7. Status Notification: gives the state of network resources (i.e line state)
8. Distribution: distribute the calls to various outputs by using a define algorithm (i.e percentage allocated to each output)
9. Translate: translate an input parameter to an output parameter by using a file as a connection table

CS-1 GFP - Service Independent Building Blocks (SIB)

10. Limit: limit a number of calls that can reach a goal according to a configurable algorithm. It has three logical outputs “pass”, “don’t pass”, “error”. (i.e calls limited to a particular time slot)

11. User Interaction: used to dialogue with a user

12. Log Call Information: record in a file some information related to a call

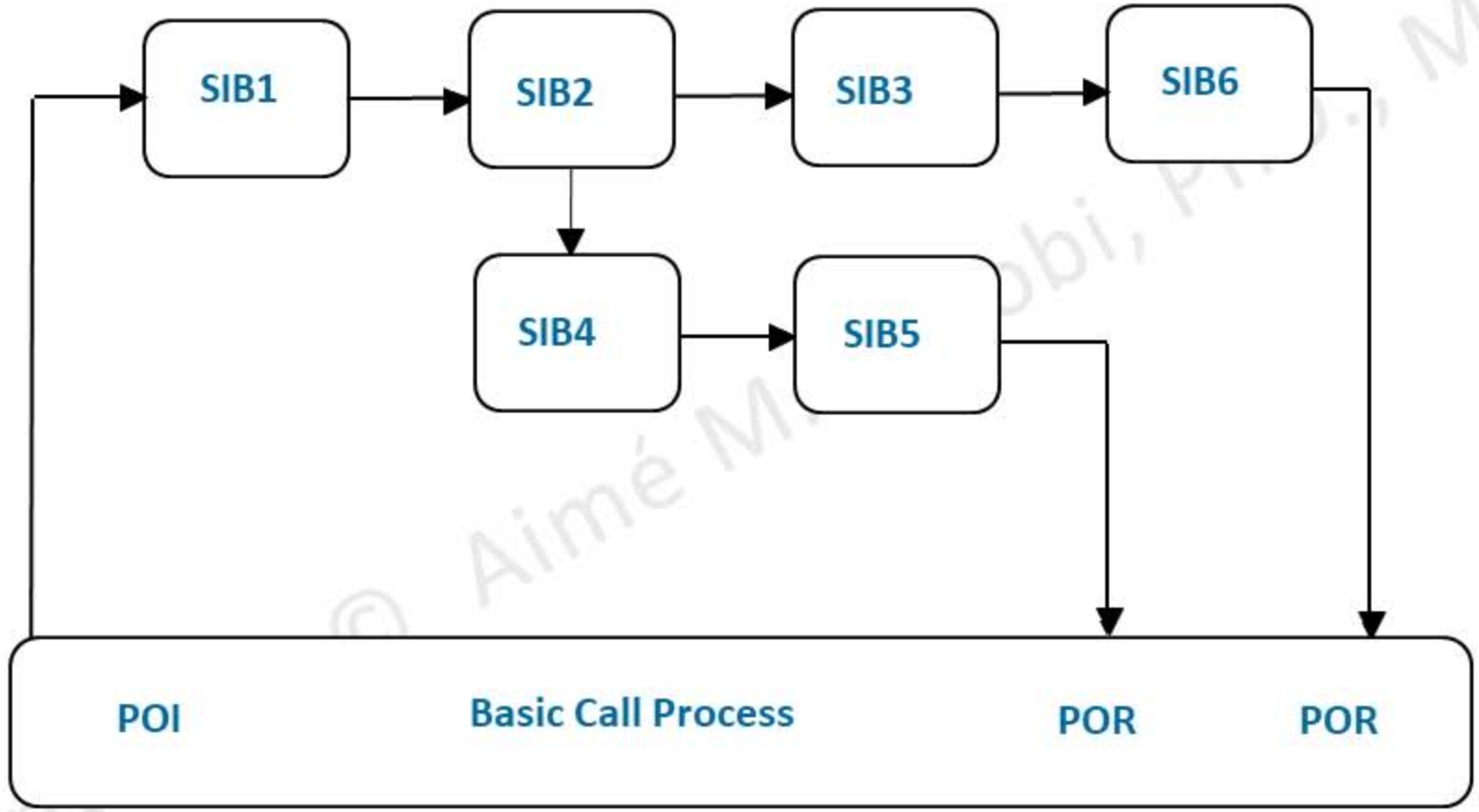
13. Queue: holds a call.

14. Verify: checks the syntax consistency of a received information

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 GFP - Service Independent Building Blocks (SIB)

SIB Chain in a Service



CS-1 GFP - Example: IN Automatic Alternative Billing (AAB) Service

- The AAB service enables a user to make a call from any telephone and the call charge to be billed to the user's account which is specific to this service, and which does not refer either to the calling line or to the called line.
- An account code and PIN are allocated to the service user by service management procedure.
- To invoke the service, the user dials an access code as a free call.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 GFP - Example: IN Automatic Alternative Billing (AAB) Service

- Different access codes could be used to identify the language to be used.

  The user then receives announcements asking him to dial his account code and PIN.

- The account code and PIN are validated, and a check could be made for expired credit limits.

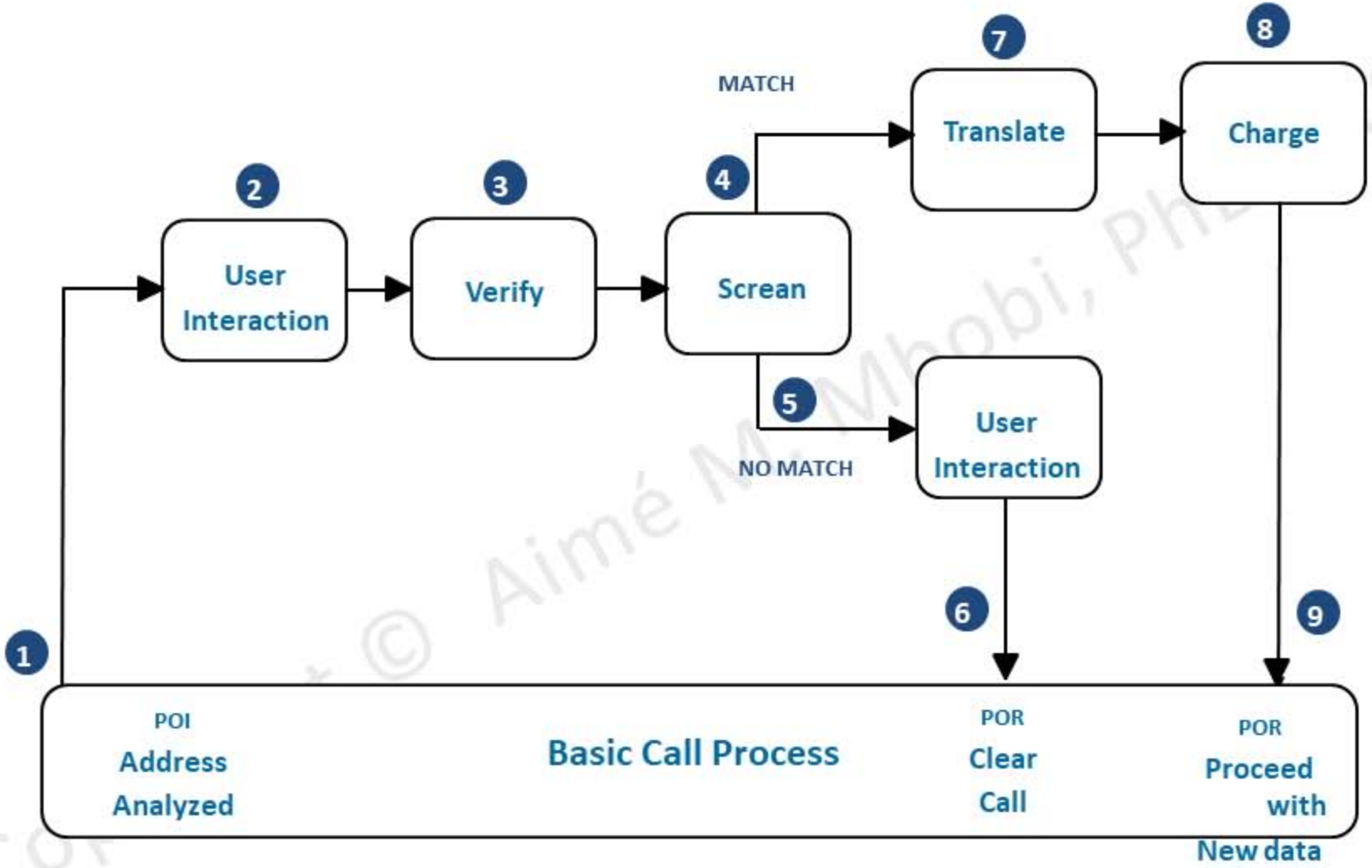
- NOTE: Account/credit card calling is similar, with the account number being supplied using a card wipe

CS-1 GFP - Example: IN Automatic Alternative Billing (AAB) Service

- The AAB service allows a user to call another user and ask him to receive the call at his expenses.
- Two steps may be defined:
  - The calling party is welcomed to record a brief message giving the caller's name and explaining the call reason,
  - The called party is alerted, receives the recorded message and is asked to accept to be charged for that call.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 GFP - Example: IN Automatic Alternative Billing (AAB) Service



CS-1 GFP - Example: IN Automatic Alternative Billing (AAB) Service

1. Basic Call Process		
Input	POI CID	Call Arrival 1) dialed number 2) calling line id
2. User Interaction SIB		
Input	SSD CID	1) announcement parameters 2) collected info calling line id
Output	CID End	Collected info OK
3. Verify SIB		
Input	SSD CID	1) min. and max. of numbers 2) Format collected info
Output	End	OK

CS-1 GFP - Example: IN Automatic Alternative Billing (AAB) Service

4. Screen SIB		
Input	SSD CID	screenlist indicator collected info
Output	END	1) Match 2) No Match
NO MATCH		
5. User Interaction SIB		
Input	SSD CID	announcement parameters calling line id
Output	End	OK
6. Basic Call Process		
Input	POR	Clear Call
Output	CID	calling line id

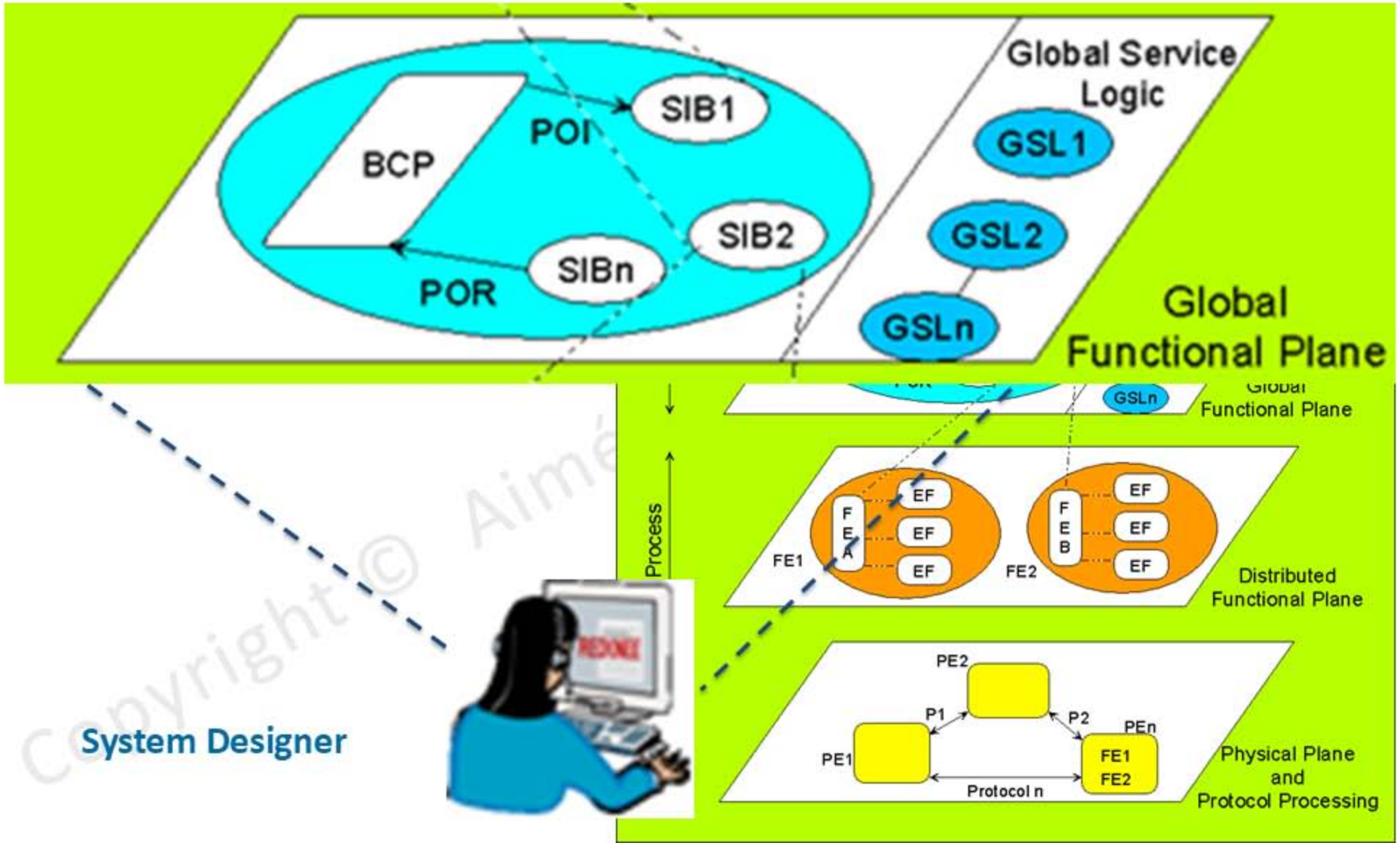
Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 GFP - Example: IN Automatic Alternative Billing (AAB) Service

MATCH		
7. Translate SIB		
Input	SSD	Type
		Filename
	CID	dialed number
Output	CID	called number
	END	Ok
8. Charge SIB		
Input	SSD	Account CodeList
	CID	Account Code
Output	End	OK
9. Basic Call Process		
Input	POR	Proceed with New Data
Output	CID	called number

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 GFP - Global Functional Plane responsibility



CS-1 Distributive Functional Plane (CS1 DFP)

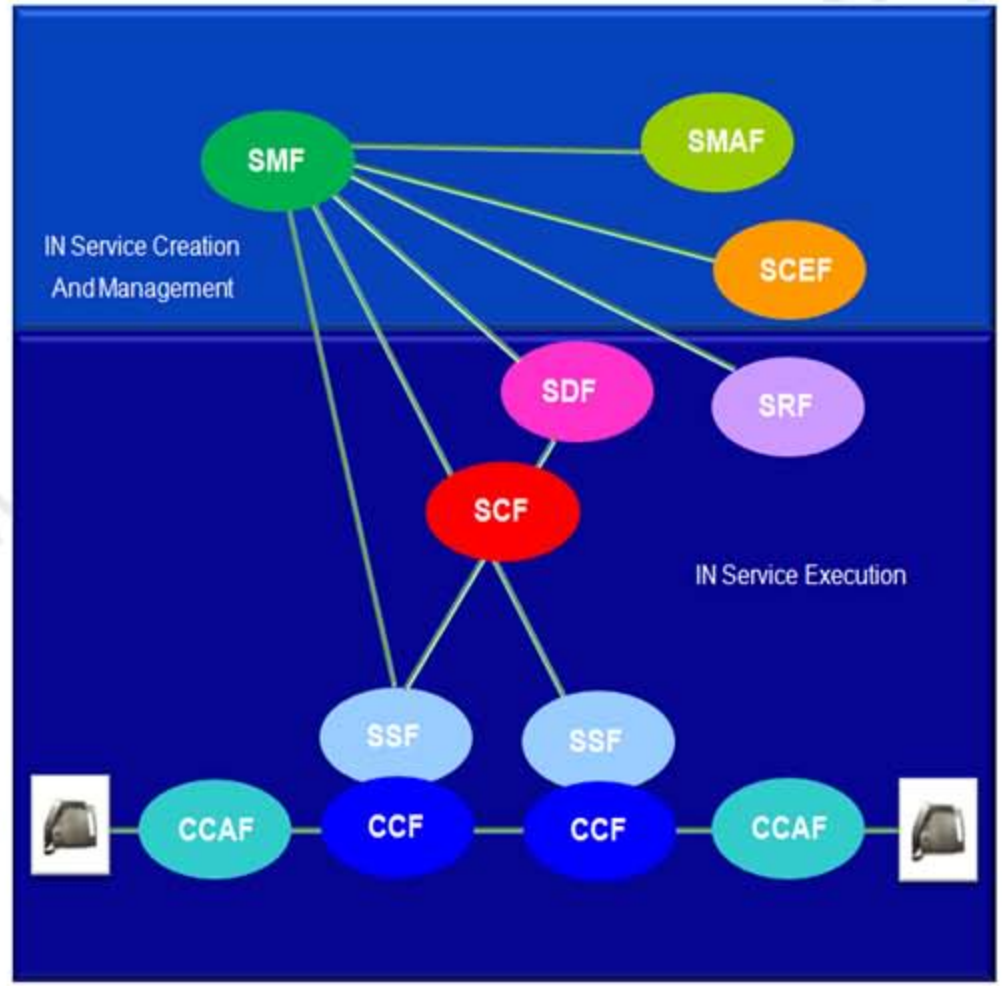
CS-1 Distributive Functional Plane (DFP)

- Global Functional Plane deals with "What?" SIB constitute the service
- Distributive Functional Plane deals with "How?" SIBs or service functions are created.
- At this level, IN is viewed as a set of functional entities (FEs) or functions interacting through Information Flows (IFs) via abstract communication supports called Relationships

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 DFP Functional Entities

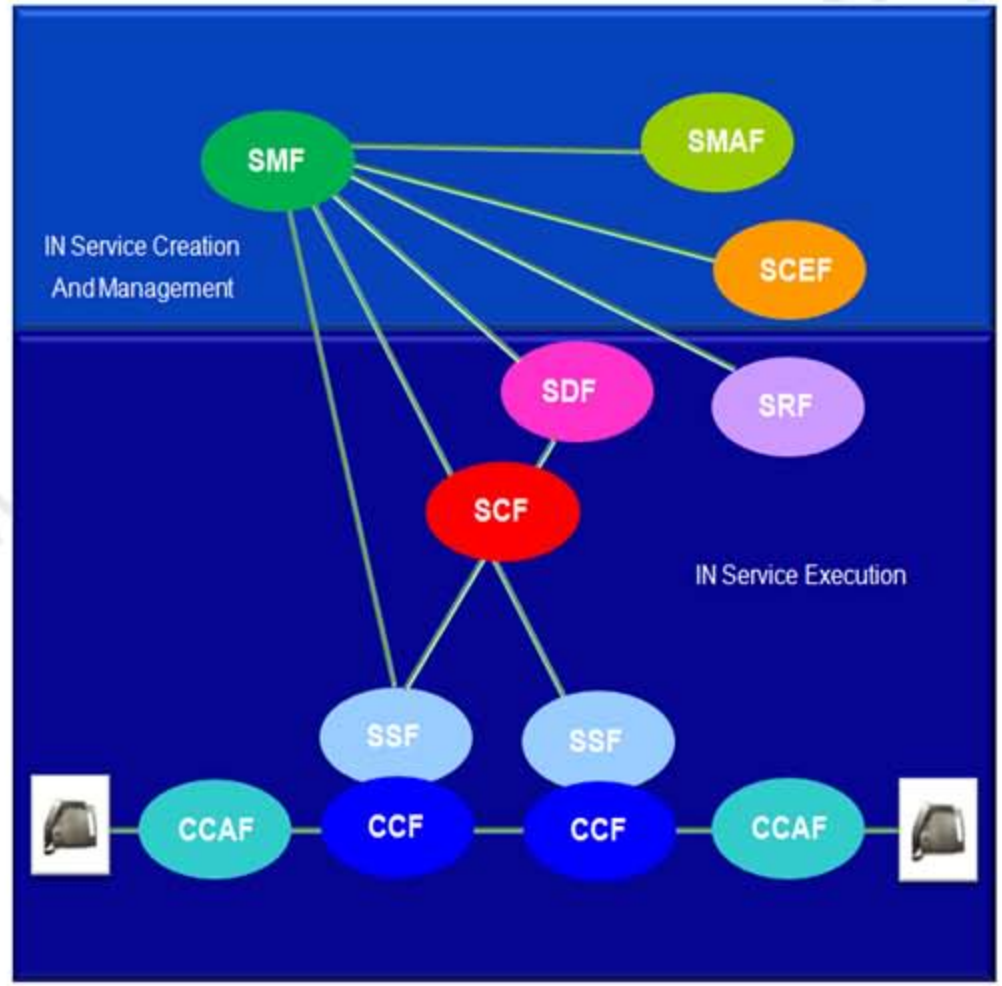
- Call Processing related Functions
  - Call Control Function (CCF)
  - Call Control Agent Function (CCAF)
  - Specialized Resource Function (SRF)
  - Service Switching Function (SSF)
- Services Related Functions
  - Service Control Function (SCF)
  - Service Data Function (SDF)
- Management related Functions
  - Service Management Function (SMF)
  - Service Management Agent Function (SMAF)
  - Service Creation Environment Function (SCEF)



CS-1 Call Processing related Functions

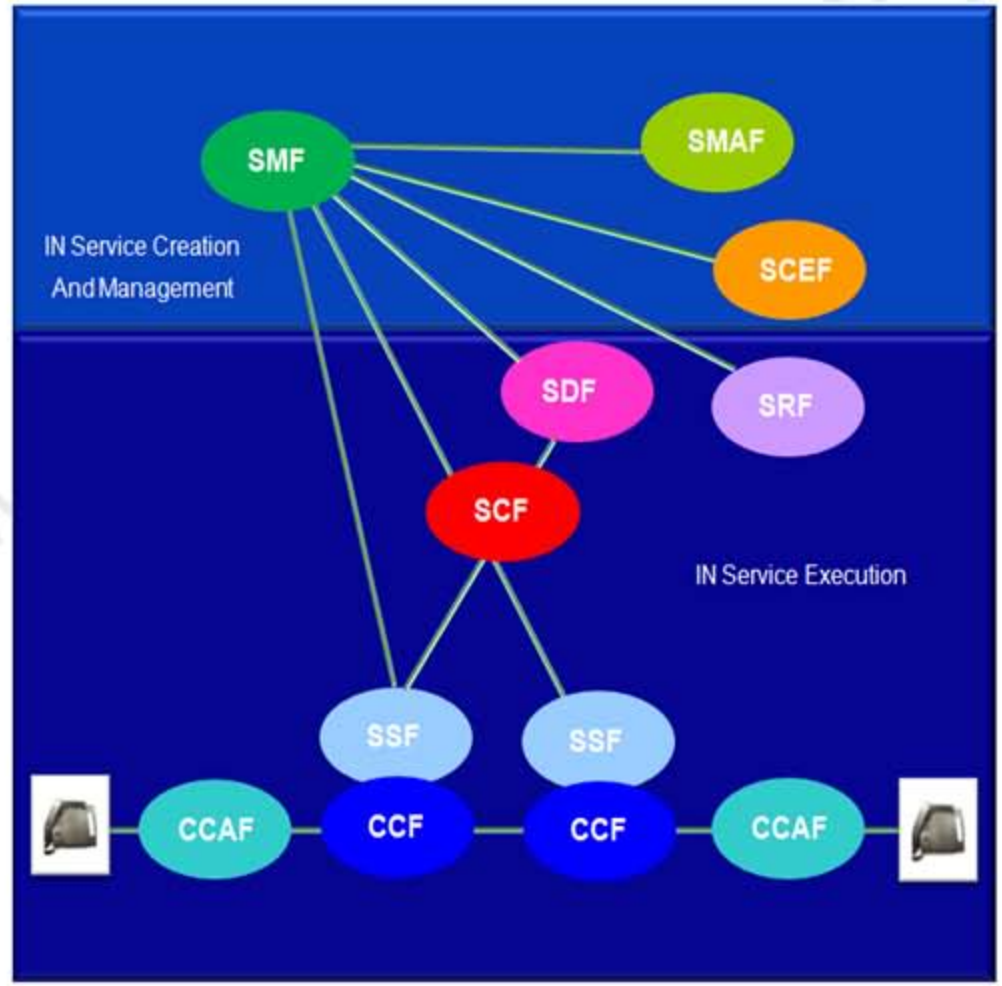
CS-1 Call Processing Related Functions

- Call Control Function (CCF)
  - Provides trigger mechanism to access IN functionality (e.g. passes events to the SSF)
  - Establishes, manipulates and releases call / connection instances as "requested" by the CCAF
  - Provides the capability to associate and relate CCAF functional entities that are involved in a particular call and/or connection instance



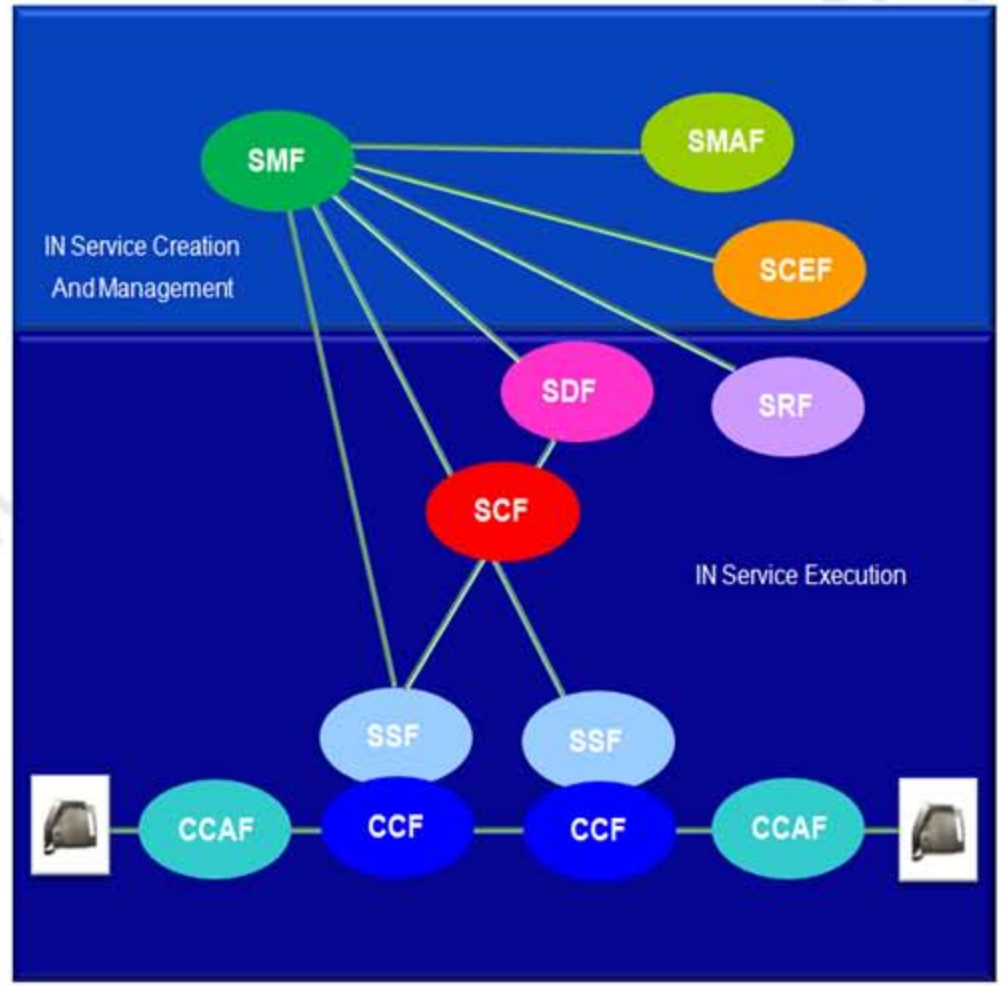
CS-1 Call Processing Related Functions

- Call Control Function (CCF)
  - Manages the relationship between CCAF functional entities involved in a call (e.g. supervises the overall perspective of the call and/or connection instance)
- Concretely, this function is implemented in the switch.



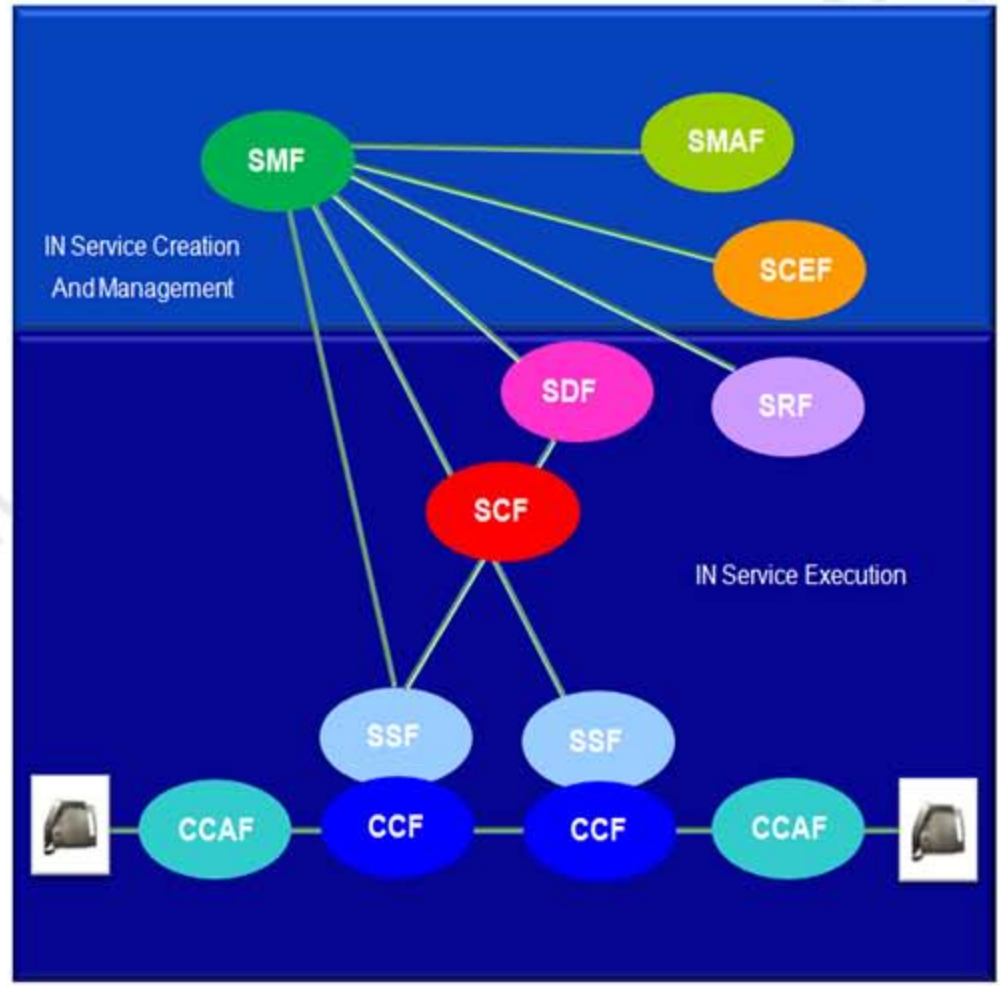
CS-1 Call Processing Related Functions

- Call Control Agent Function (CCAF)
  - Provides for user access, interacting with the user to establish, maintain, modify and release, as required, a call or instance of service
  - Accesses the service-providing capabilities of the Call Control Function, using service requests (e.g. setup, transfer, hold, etc.) for the establishment, manipulation and release of a call or instance of service



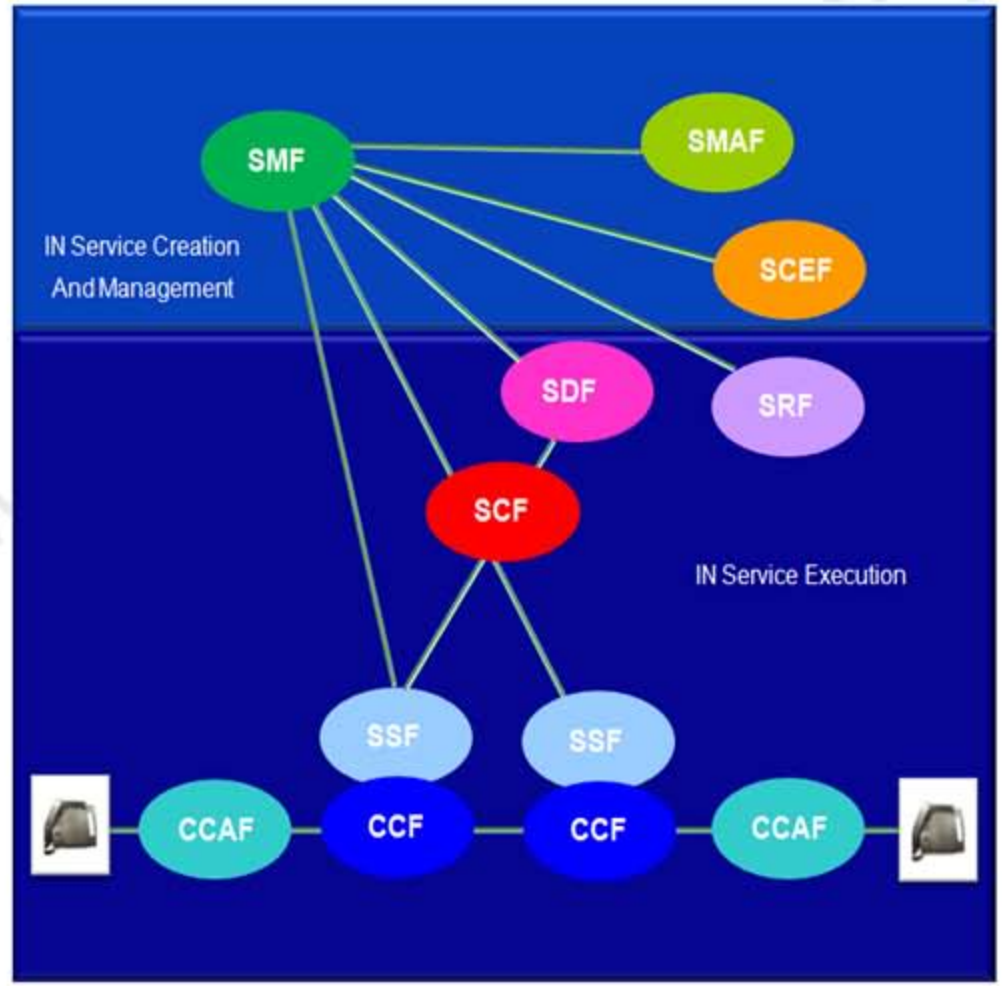
CS-1 Call Processing Related Functions

- Call Control Agent Function (CCAF)
  - Receives indications relating to the call or service from the CCF and relays them to the user as required
  - Maintains call/service state information as perceived by this functional entity
- Concretely, this function is implemented in the terminal/switch



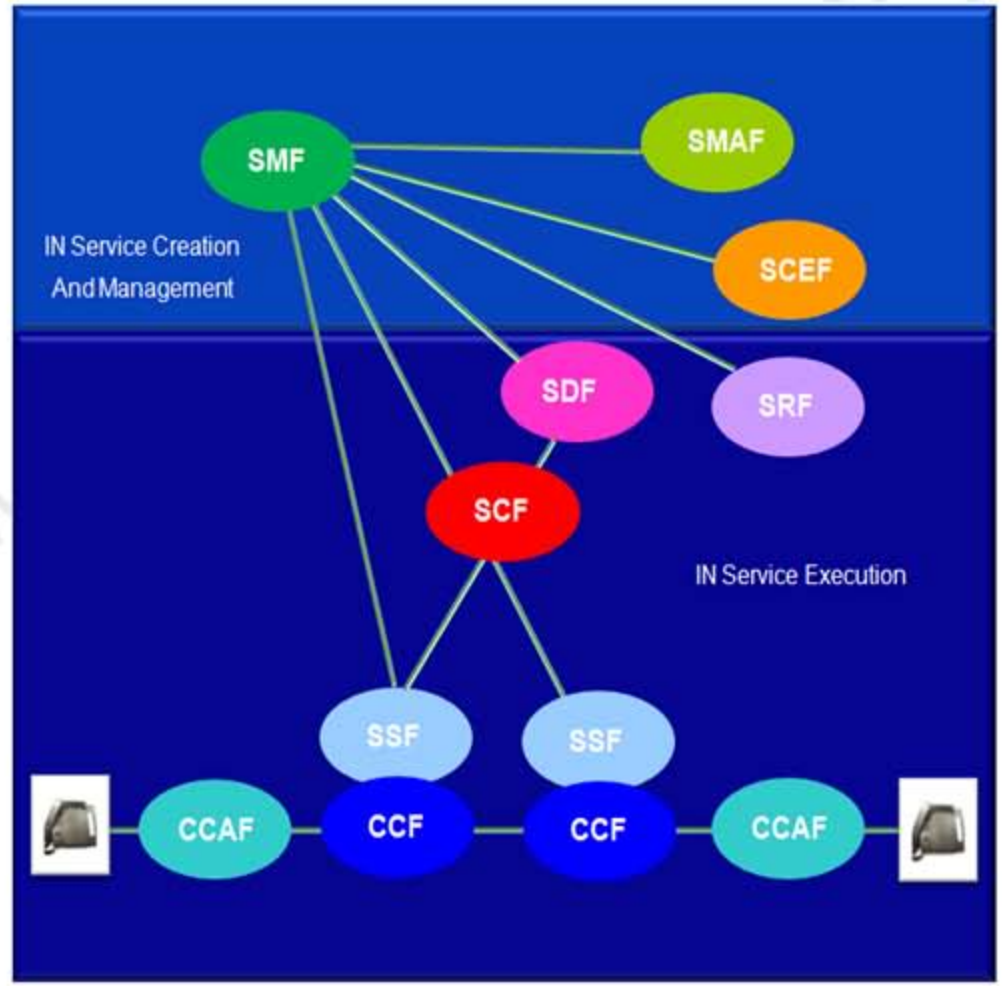
CS-1 Call Processing Related Functions

- Specialized Resource Function (SRF)
  - Provides specialized resource to be used by others entities in the network.
  - These resources are used to establish a dialogue with the user.
- Concretely, this is the transmitter-receiver DTMF for protocol conversion, vocal synthesis, vocal analysis



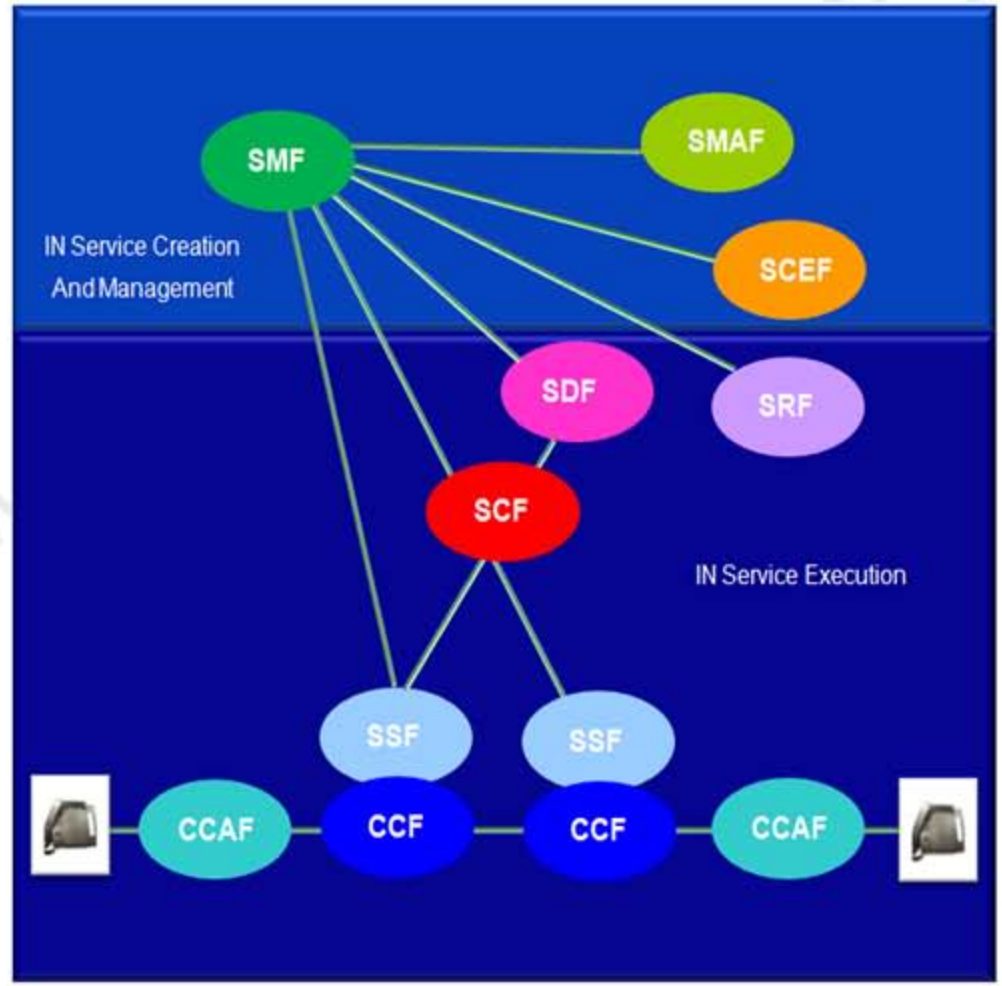
CS-1 Call Processing Related Functions

- Service Switching Function (SSF)
  - Acts as interface SCF-CCF and enables the CCF to be controlled by the SCF.
  - Actually, it copies information elements from the ISUP or DTAP on to the INAP message that is used to invoke the IN service, and vice versa.
  - Extends the logic of the CCF to include recognition of service control triggers and to interact with the SCF



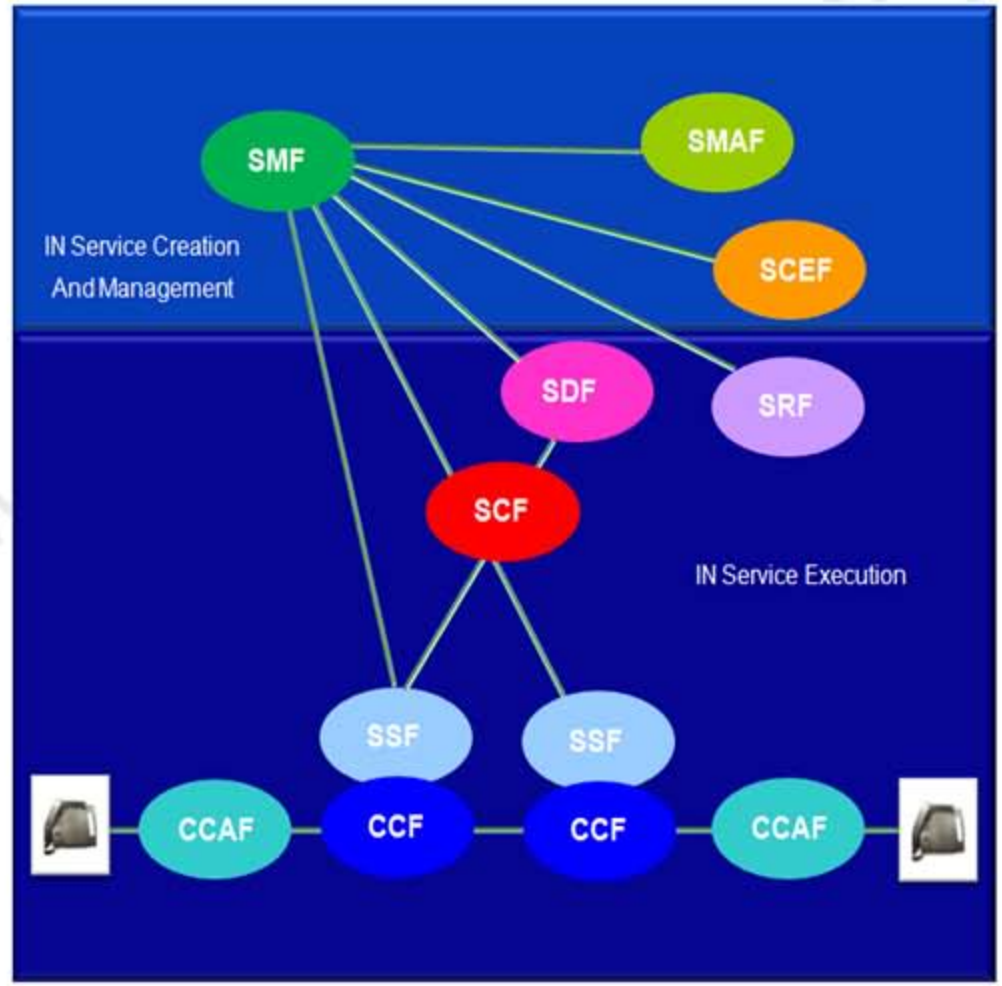
CS-1 Call Processing Related Functions

- Service Switching Function (SSF)
- An example of its role is the suspension of the call processing to allow the SCF to translate a toll free number to a real number.
- CCF and SSF are inseparable, a network element that has CCF function must also have SSF function: (SSF/CCF)



CS-1 Call Processing Related Functions

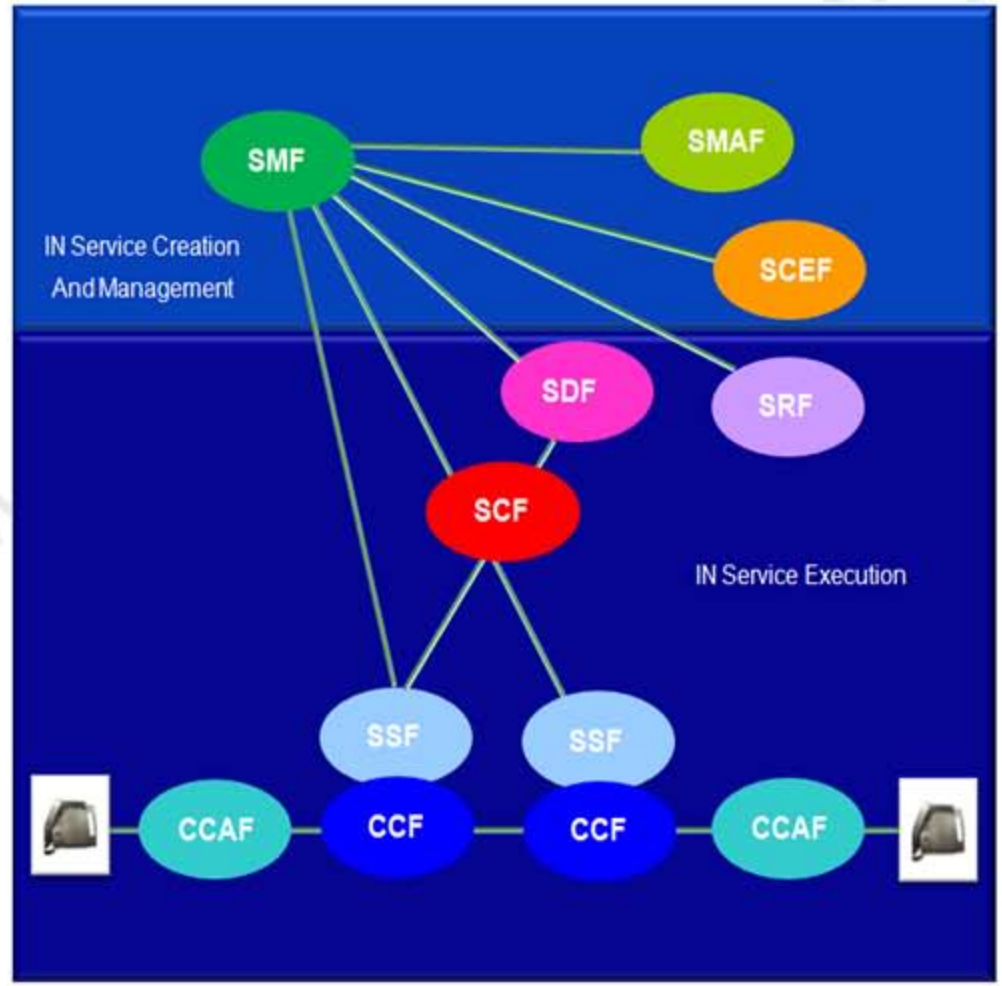
- Service Control Function (SCF)
  - Contains the service logic and controls their execution.
  - SCF may interact with other functional entities to access additional service logic or obtain information (service or user data) required to process a call or service logic instance
  - Interfaces and interacts with SSF/CCF, SRF and SDF functional entities, and with other SCFs, if necessary



CS-1 Data Related Function

CS-1 Data Related Function

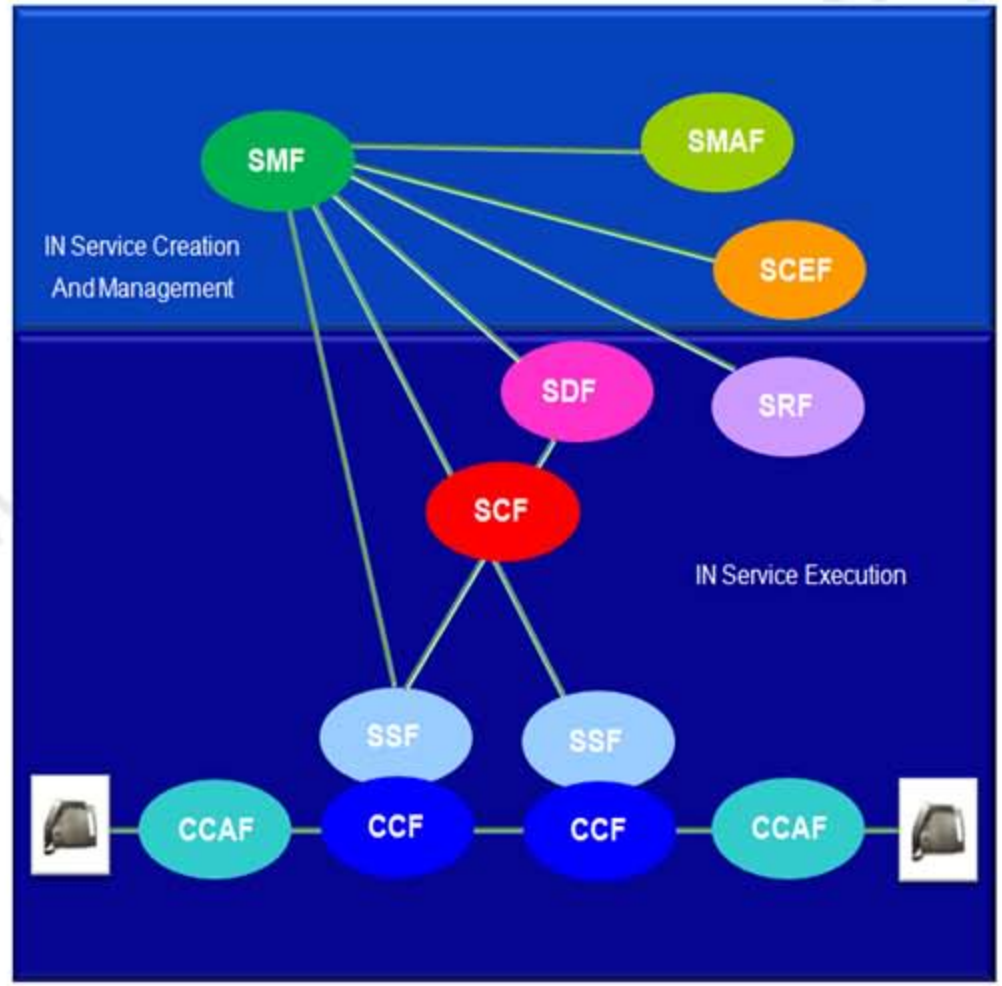
- Service Data Function (SDF)
  - Contains customer and network data for real time access by the SCF in the execution of IN provided services.
  - Interfaces and interacts with SCF as required and with other SDFs, if necessary;
  - Provides the SCF with an abstract view of these data hiding their implementation



CS-1 Management Related Functions

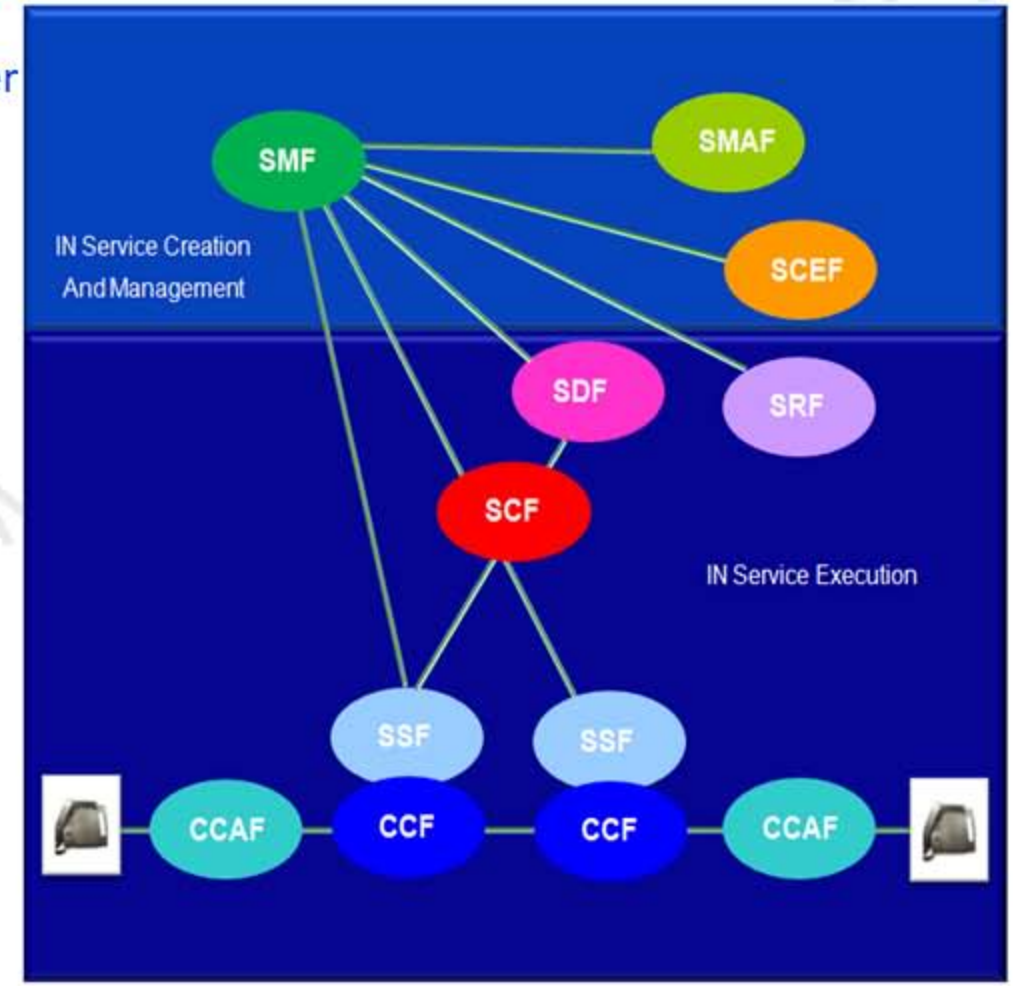
CS-1 Management Related Functions

- Service Management Function (SMF)
  - Takes care of deployment of service logic developed initially in the environment of service creation, configuration, and service management.



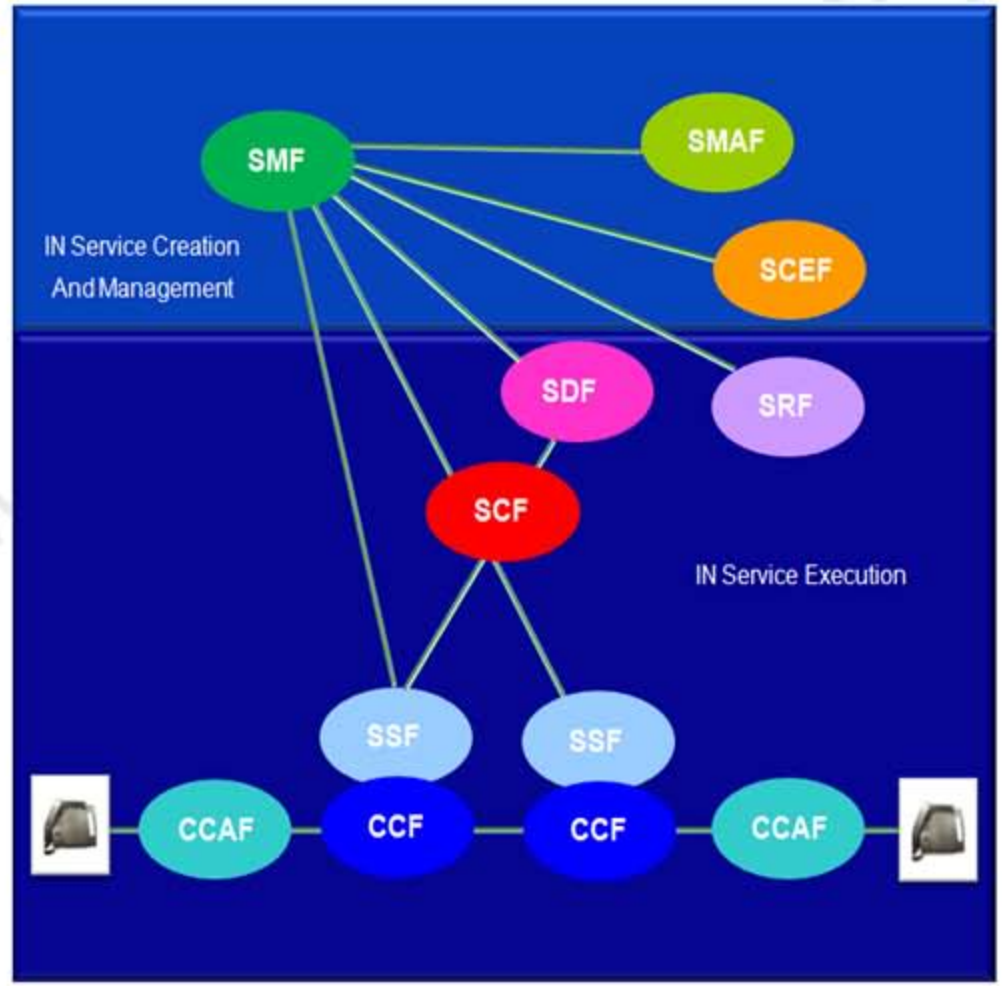
CS-1 Management Related Functions

- Service Management Agent Function (SMAF)
  - Plays the role of terminal that provides the user interface to access to SMF



CS-1 Management Related Functions

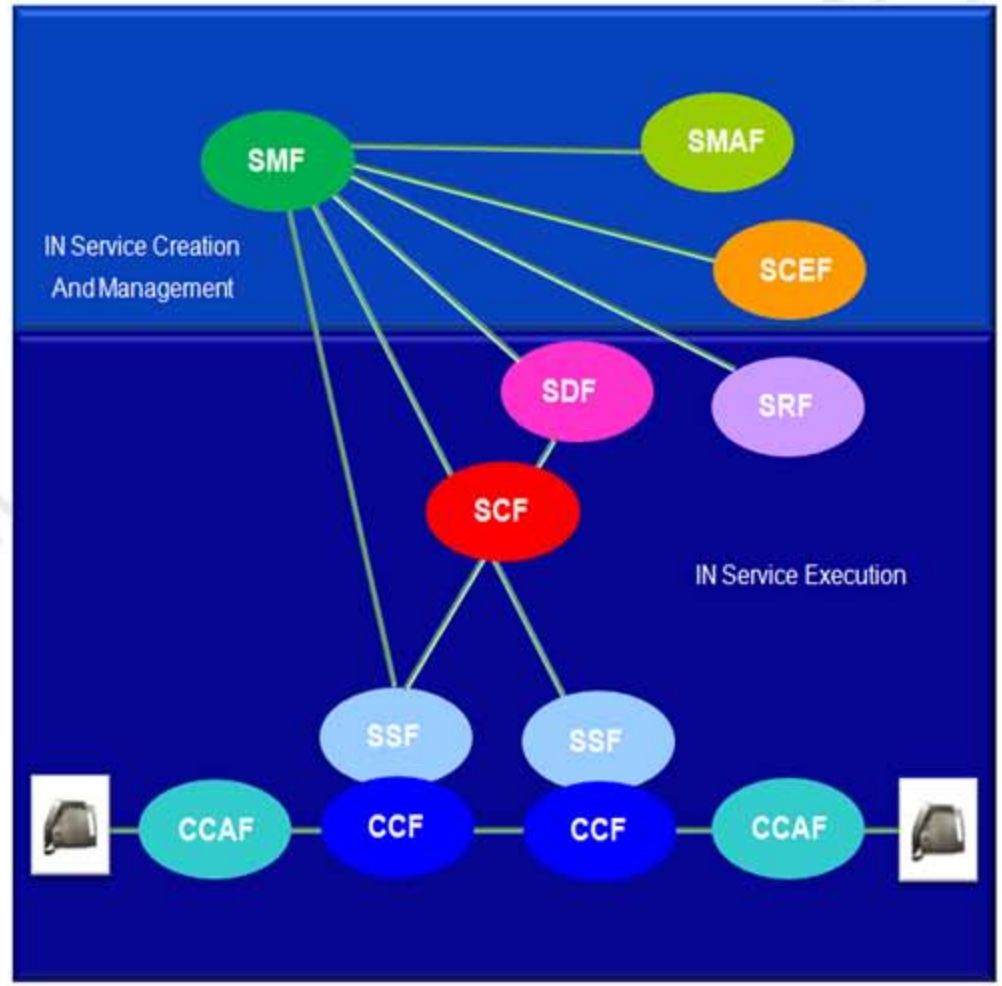
- Service Creation Environment Function (SCEF)
  - Used to specify, develop, test an IN service and to transfer it in SMF
  - SCEF is used to develop the service logic, data structures and information associated to the trigger criteria in the switch



CS-1 SSF/CCF Structure

CS-1 SSF/CCF Structure

- SSF/CCF is made of various entities such as the Basic Call Manager (BCM)
- BCM manages calls and controls connections by detecting events susceptible of leading to service instantiation in the call processing.
- Outside this function, BCM presents a model in the form of Call processing State Machine called Basic Call State Model (BCSM)

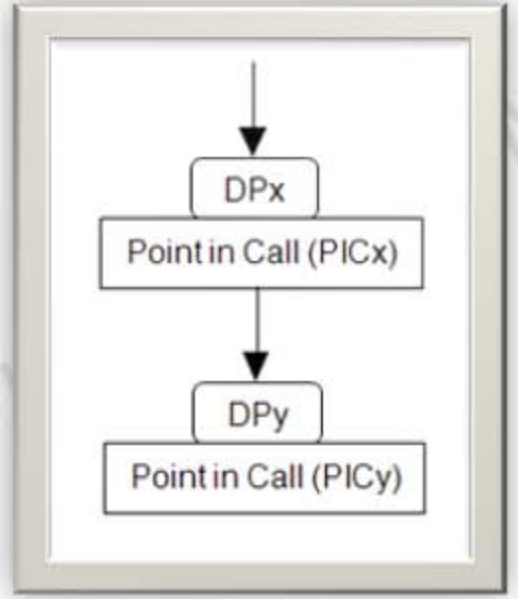


Basic Call State Model (BCSM)

CS-1 Basic Call State Model (BCSM)

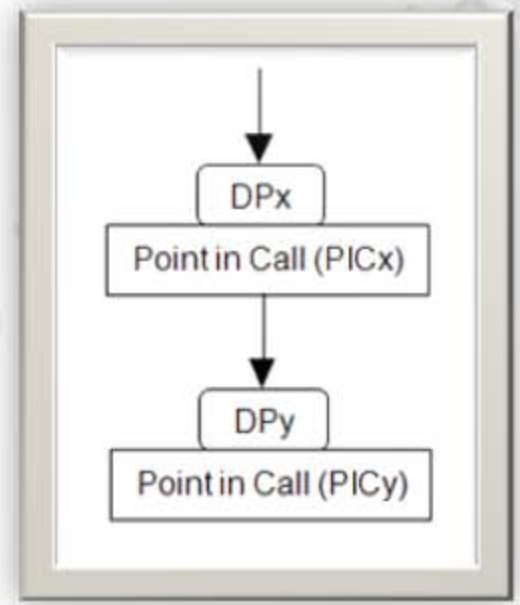
- BCSM is an abstract view that represents the activities of CCF
- BCSM identifies precise points in the call processing where IN service is allowed to interact with the call processing.
- Thus, BCSM provides an environment to specify when the transfer of the control between the Basic Call Process (BCP) in the CCF and the logic of the service in the SCF can occur

CS-1 BCSM Description



- BCSM has two major elements
  - Point in Call (PIC): rectangular boxes, identify CCF activities essential to a call processing state. indicates the state of the call, such as Analysis, Alerting and Active. It reflects normal call handling.
  - Detection Point (DP): smaller squares, indicates points where the need for IN functionality can be identified and the basic call handling suspended while the call control is transferred from basic call logic to the IN functionality in question.

CS-1 BCSM Description



- PIC indicates the state of the call (Alerting and Active)
- DP is associated with a state transition.
- When the call reaches a certain PIC, the BCSM first processes the DP associated with the transition to that reached PIC.
- Example, when the call is in the Alerting phase and an Answer event is received over ISUP, the BCSM processes the DP that is associated with the Answer event.
- After the processing of the DP is complete, the BCSM transits to the Active PIC.
- When PICx is reached, BCSM executes DPY. At the end of DPY BCSM transits to PICy

CS-1 Some DP Related POIs

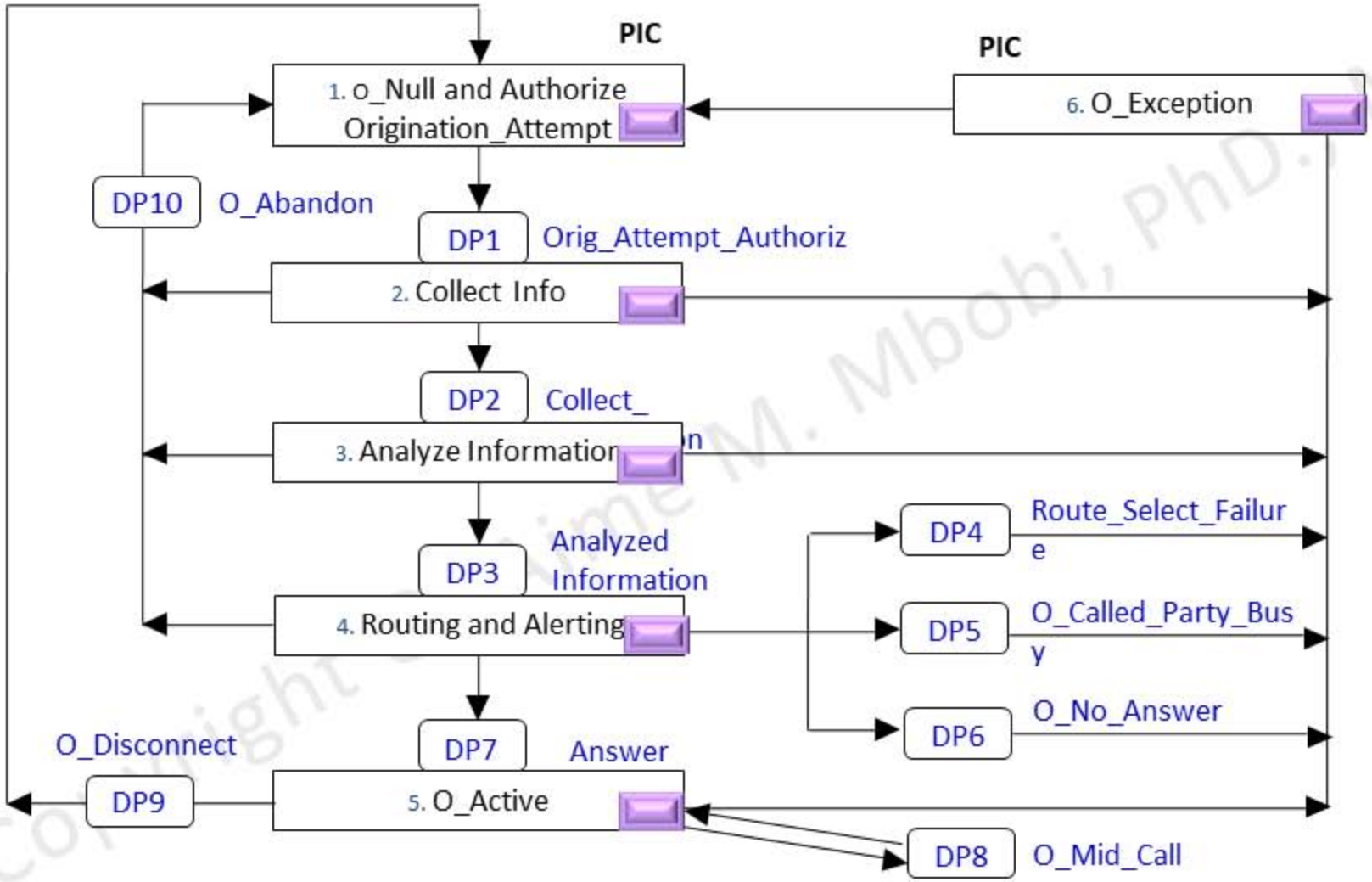
Point of Initiation	Originating BCSM DP	Terminating BCSM DP
Call originated	Orig.Attempt _Authorized	
Address collected	Collected_Info	
Address analysed	Analysed_Info	
Prepare to complete call		Term.Attempt_Authorized
Busy	O_Call_Party_Busy	T Call_Party_Busy
No answer	O_No_Answer	T_No_Answer
Call acceptance	O_Answer	T_Answer
Active state	O_Mid_Call	T_Mid_Call
End of call	O_Disconnect	T_Disconnect

O-BCSM

T-BCSM

CS-1 Originating BCSM (O-BCSM)

CS-1 Originating BCSM (O-BCSM)



CS-1 Originating BCSM (O-BCSM)

- O_Null and Authorize Origination_Attempt: State in which the BCSM model is when a user request a connection to the network (Pick up the phone)
- Checks user authorization to perform this operation
- This request could be refused based on certain condition such as line restriction in certain hours
- PIC output occurs when the call is initiated or refused

O-BCSM

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Originating BCSM (O-BCSM)

- Collect Info: In this state, user information (number dialed) are collected to establish a connection
- This information is analyzed according to the numbering plane to determine the end of this collect.
- PIC output occurs when the complete information is received, user drops off or an error from numbering (incorrect number of digits)

O-BCSM

CS-1 Originating BCSM (O-BCSM)

- Analyze Information: the previous information provided by the user are analyzed to establish the call routing and type (call from local, transit or international switch)
- PIC output occurs when the information is analyzed, user drops off or if there is incident in the phase of analyze

CS-1 Originating BCSM (O-BCSM)

- Routing and Alerting: at this PIC, the physical route must be selected and the request must be conveyed to the terminating party (T-BCSM).
- The call connection processing continues (i.e. ringing)
- PIC output occurs the user drops off or if there is incident (i.e. network congestion or route unavailable)

O-BCSM

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Distributive Functional Plane (DFP)

- O_Active: the call is in active phase, the two parties can now communicate.
- Call rating and supervision are ensured
- PIC output occurs at the reception of a disconnecting indication from the calling party, a service request from the calling party or if an incident occurs.

O-BCSM

CS-1 Originating BCSM (O-BCSM)

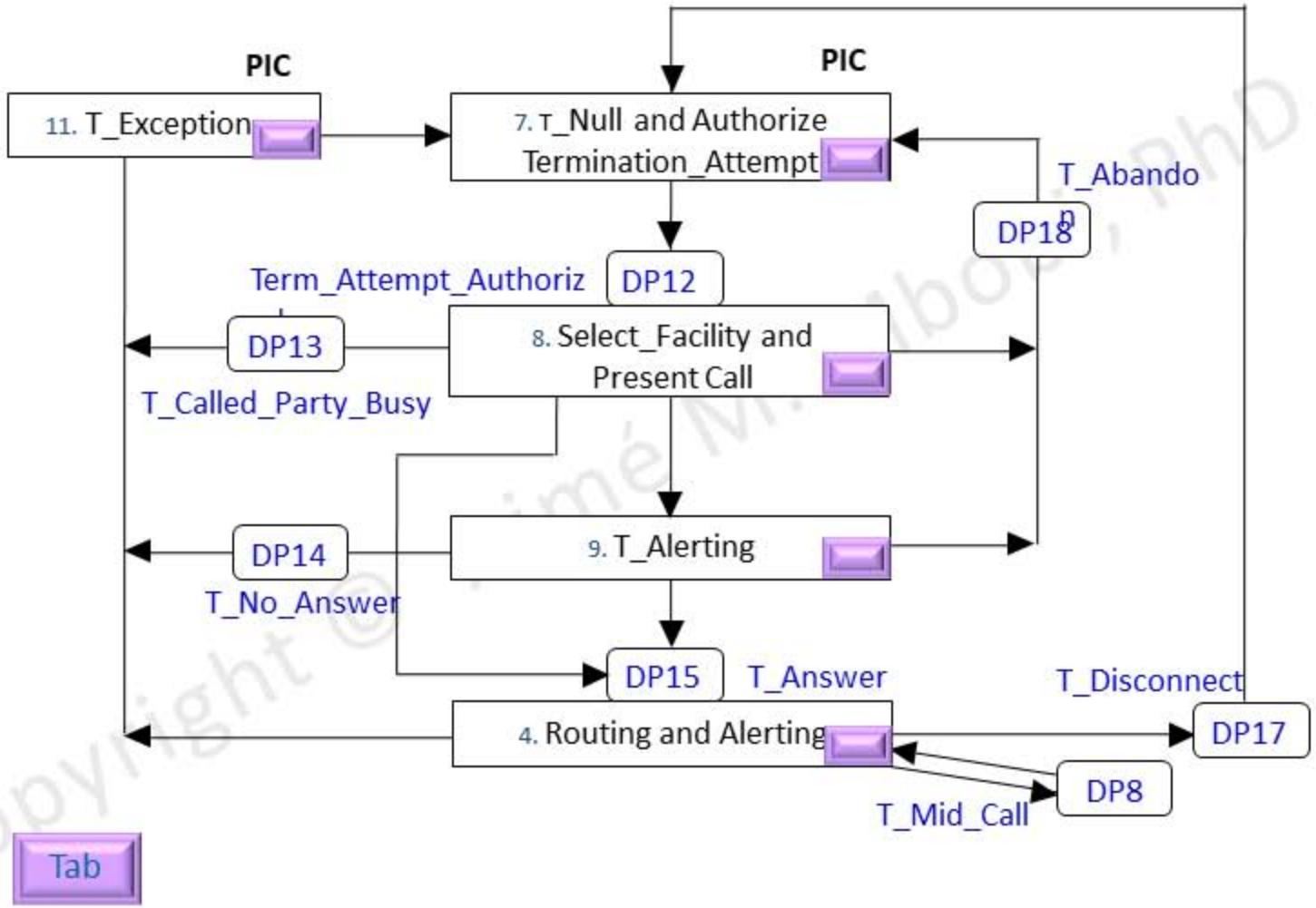
- O_Exception: an exception occurred in one of the PICs
- PIC output occurs at the end of the process

O-BCSM

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Terminating BCSM (T-BCSM)

CS-1 Terminating BCSM (T-BCSM)



CS-1 Terminating BCSM (T-BCSM)

- T_Null and Authorize Origination_Attempt: When an incoming call from O-BCSM occurs, some access right are checked (incoming access restriction to the line, media compatibility)
- PIC output occurs when the checking is done (authorization accepted or refused)

T-BCSM

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Terminating BCSM (T-BCSM)

- Select_Facility and Present Call: One of the termination resources is selected.
- The terminal is informed of the incoming call
- PIC output occurs when there is alert or occupation of the called party, drop off of the calling party or impossibility to present the call
- Based on the type of this resources (answer machine), a possible PIC output PIC could be “call establishment”, what brings through point 10

T-BCSM

CS-1 Terminating BCSM (T-BCSM)

- Alerting: At this point, the called party is notified of the incoming call (i.e. ringing)
- To preserve network resources, a timer is used
- PIC output occurs when the called party answer and the call is set up, timer expiration, calling party drops off

T-BCSM

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Terminating BCSM (T-BCSM)

- Active: the call is in active phase, the two parties can now communicate.
- To preserve network resources, a timer is used
- PIC output occurs at the reception of a disconnecting indication from the called party, or disconnecting indication from the calling party via O_BCSM, service request from the called party or if an incident occurs.

T-BCSM

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Terminating BCSM (T-BCSM)

- O_Exception: an exception occurred in one of the PICs
- PIC output occurs at the end of the process

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Armed Detection Points (DP)

CS-1 Distributive Functional Plane (DFP)

- During call processing, some events can be visible for the IN
- Detection Points (DPs) exception are placed where these events are detected during call processing
- A DP can be armed to inform an instance of a service that this DP is met
- The service logic can now decide whether it influence the rest of the call processing or not

CS-1 Distributive Functional Plane (DFP)

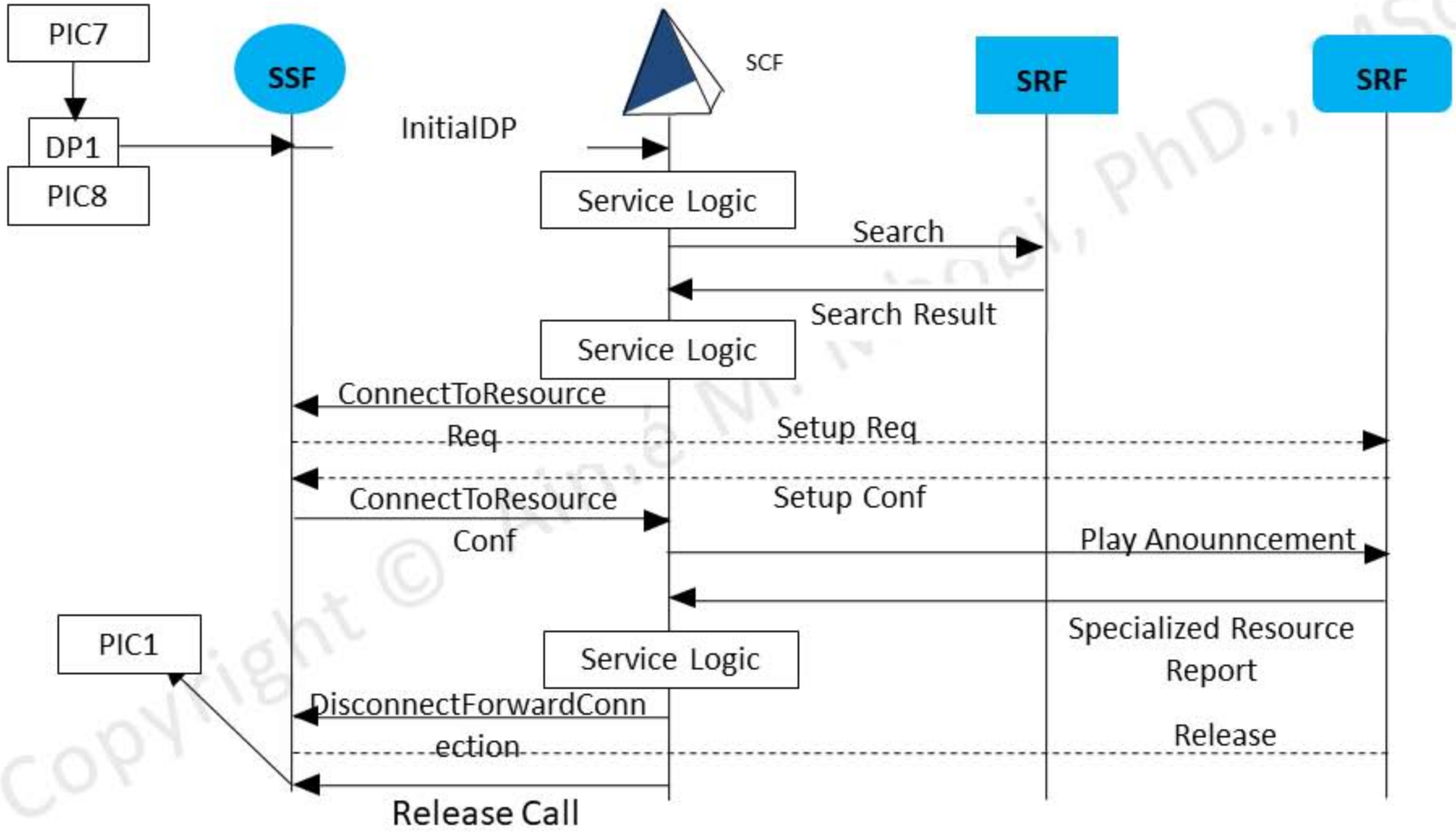
- To an armed DP is associates a serial of criteria that must be satisfied so that SCF is informed of the event corresponding to the DP
- By considering the example of toll free number, DP3, Analyzed_Information is armed with the criteria "PREFIXE = 1800"

CS-1 Distributive Functional Plane (DFP)

- The Global Functional Plane (GFP) contains the Global Service Logics
- Each of them is made of a chain of SIBs containing the Call Processing SIB (BCP), POIs, and PORs
- BCP is models in the DFP by two automata O-BCSM and T-BCSM
- In DFP, a SIB is realized by the actions of functional entities (FEs) even if these actions are in different FEs.
- If these actions are in different FEs, you need to list the Information Flows (IFs) between FEs in order to get the complete representation of a SIB

CS-1 Example of Terminating Call Screen

CS-1 Example of Terminating Call Screen



CS-1 Example of Terminating Call Screen

- The Call Processing is based on the T-BCSM
- DP12 (Term_Attempt_Authorized in the Call Processing is the DP that triggers the Service Logic in SCF
- By the Information Flow (IF) *InitialDP*, the CP is then suspended, and SSF tells the SCF that a DP is met
- Initial DP contains a parameter Service key i.e. TCS service identifier

CS-1 Example of Terminating Call Screen

- SCF starts the Service Logic by first checking whether the calling number is in the filtering list associated to the service through the realization of FEAs and IF corresponding to Screen SIB
- If the number is not in the list then SCF request to SSF to recommence the Calling Process normally
- We know that in GFP, the POR is continued with existing data
- In DFP, the Service Logic orders the SSF to recommence the call Processing from the DP where it was suspended

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Example of Terminating Call Screen

- If the number is in the list, plays the vocal message for example to inform that the called number is unavailable through the realization of FEAs and FI corresponding to User Interaction SIB
- Then, the service logic asks the SSF to release the line
- The POR clear from GFP becomes the *Release Call* information Flow in the DFP

Example of Credit Card Calling (CCC)

Example of Credit Card Calling (CCC)

- The CCC service allows subscribers to place calls from any normal access interface to any destination number and have the cost of those calls charged to the account specified by the CCC number.
- The service allows the caller to be automatically charged on a bank card account, for any type of outgoing call. The caller has to dial his card number and a PIN (Personal Identification Number), then the called number. As an option forward calls may be allowed, without dialing again card number and PIN

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Example of Credit Card Calling (CCC)

CS-1 Example of VPN Service

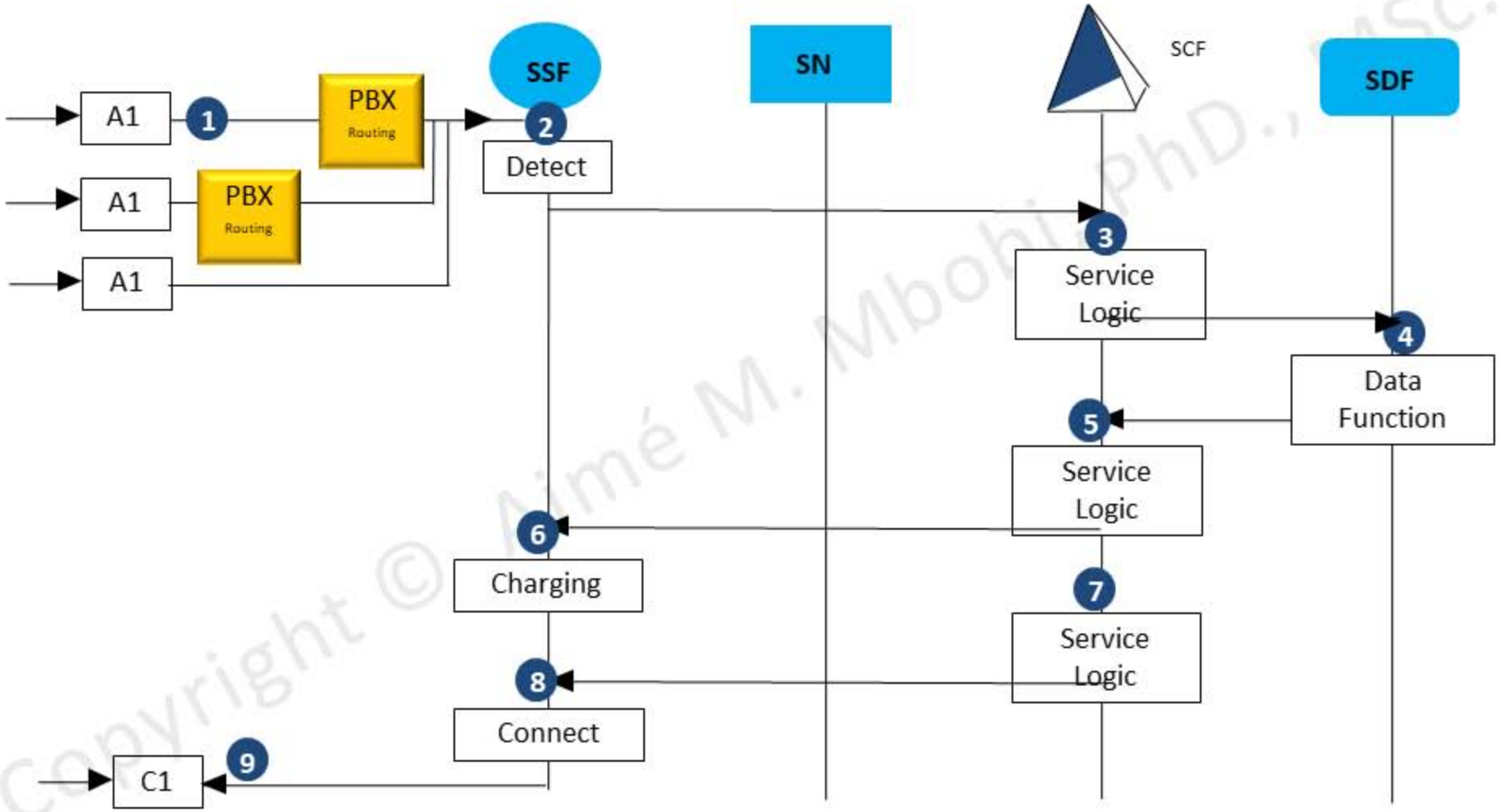
- VPN permits to build a private network by using the public network resources.
- The subscriber's lines, connected on different network switches, constitute a virtual PABX, including a number of PABX capabilities, such as Private Numbering Plan, call transfer, call hold, and so on.
- As an option, to each private user, either a class of service or specific rights and privileges may be attributed.

CS-1 Example of VPN Service

- Another option could be the Private Numbering Plan (PNP), hold, call transfer, and so on.
- A PNP may provide a group of users the capability to place call by using digit sequences having different structures and meaning than provided by the public numbering plan, or PNP may utilize the public numbering plan's digit sequences, structures and meaning.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Example of VPN Service



CS-1 Example of VPN Service

1. Dialling short number (fromVPN to VPN) or company number with subnumber (to VPN)
2. IN-Call Detection from B-number
3. SCP sends message to SDP (db query)
4. SDP returns “Calling Plan etc.”
5. SCP sends INAP message to switch (including charging information)
6. Switch saves charging information
7. SCP sends message to switch (Connet line to VPN number)
8. Switch connects line

Example

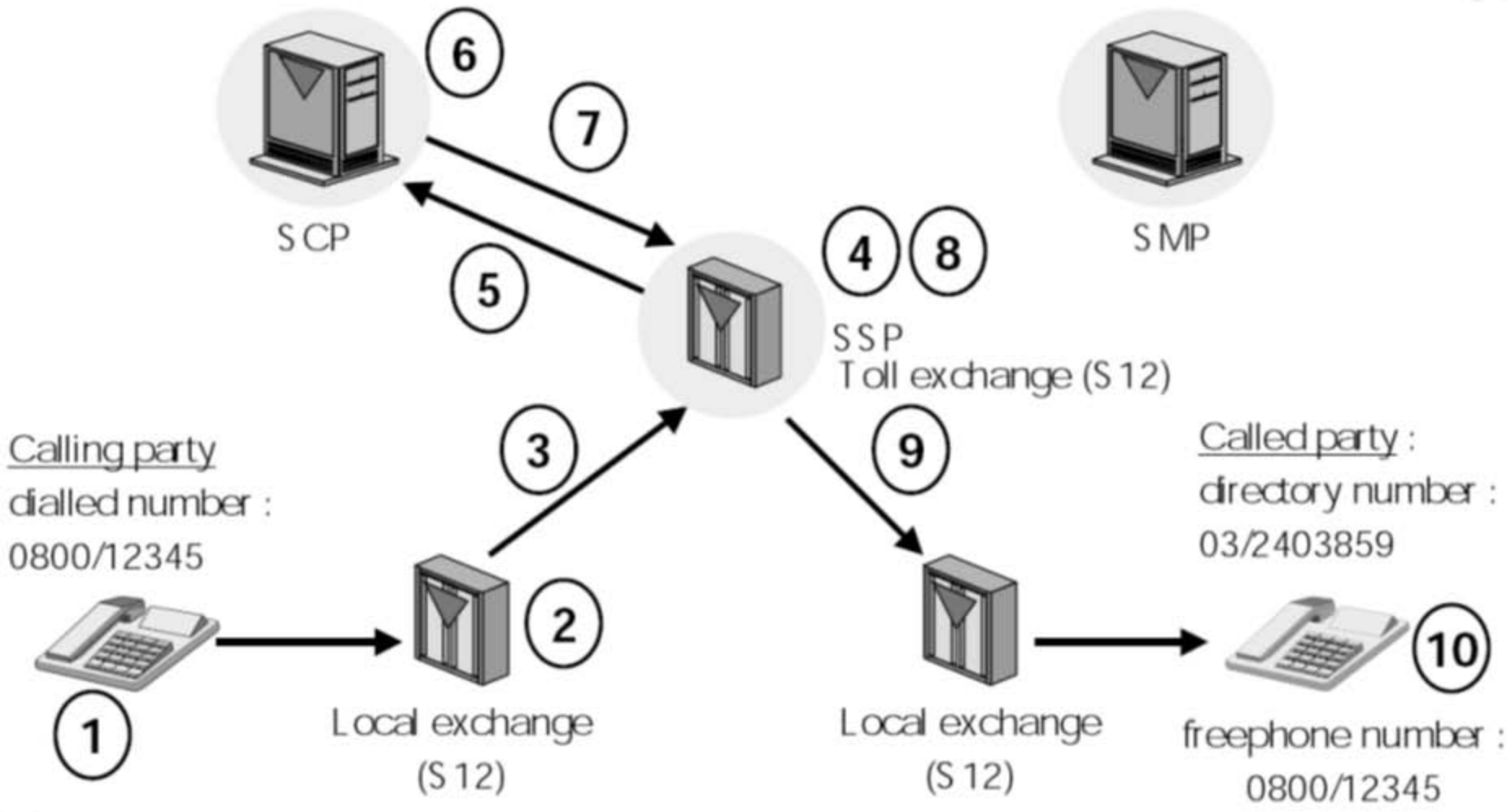
Example of FreePhone Service

CS-1 Example of FreePhone Service

- FreePhone allows reverse charging, the subscriber accepting to receive calls at its expenses and being charged for the whole cost of the call
- Moreover, FreePhone allows the served user having one or several installations to be reached from all part of the country, or internationally as appropriate, with a freephone number and to be charged for this kind of call

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Example of FreePhone Service



CS-1 Example of FreePhone Service

1. The service user picks up the telephone and dials the number 0800/12345.
2. The digits 080012345 are collected in the local exchange.
3. The local exchange forwards the number to SSP. This is because the free-phone number can't be treated by the local exchange.
4. The digits 080012345 enter the SSP via the DTM (Digital Trunk Module).
5. The SSP detects that it is an IN based service therefore it contacts the SCP by sending an INAP operation *InitialDP (IDP)*. This operation contains a number of parameters (called number, calling number etc.)

Example

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Example of FreePhone Service

6. In SCP, Inintial DP will be analyzed and the search for the requested service (SLP = service logic program) begins:
   - if not found: the SCP indicates this to the SSP
   - If found: the service logic is executed step by step
   - execution of the service script:
     1. - look for the dialed free-phone number in the service database (in SCP)
     2. - if the free-phone number is found it will be translated, depending on different criteria, to an existing directory number

Example

CS-1 Example of FreePhone Service

3. -If the free-phone number is not found in the database, then SCP will send an operation for an announcement and the call is usually terminated.

7. Once the SCP has translated the free-phone number, it will send some INAP operations to the SSP:

- applycharging: tell the SSP how to do the charging
- requestreportBCSME event: tell the SSP how to react to events that occur in the access network
- connect: order the SSP to establish a connection to the called party

Example

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Example of FreePhone Service

8. The SSP will execute the INAP operations coming from the SCP. For the connect operation, which includes the directory number, the digits are analyzed. The result of this analysis is:
   - destination for access: outgoing
   - route code: DPC (Destination Point Code) of local exchange
9. The call is forwarded to the local exchange and a connection is established to the number 098765432
10. The called party picks up and a connection is established with the service user.

Example

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Example of FreePhone Service

- During the conversation, the SCP will:
  1. check at regular time intervals if the call is still active by using the INAP-operation ActivityTest
  2. record all service related data (e.g. in a calling card service the change of PIN code)

11. When one of the parties disconnects the call, this event is seen by the SSP

12. The following actions will occur

- The SSP notifies the SCP that the call is over
- The SSP closes the charge record files and sends them to the SCP

Example

CS-1 Example of FreePhone Service

1. The SCP hands the call back to the SSP. The SSP will free the resources (speech paths) of the call.

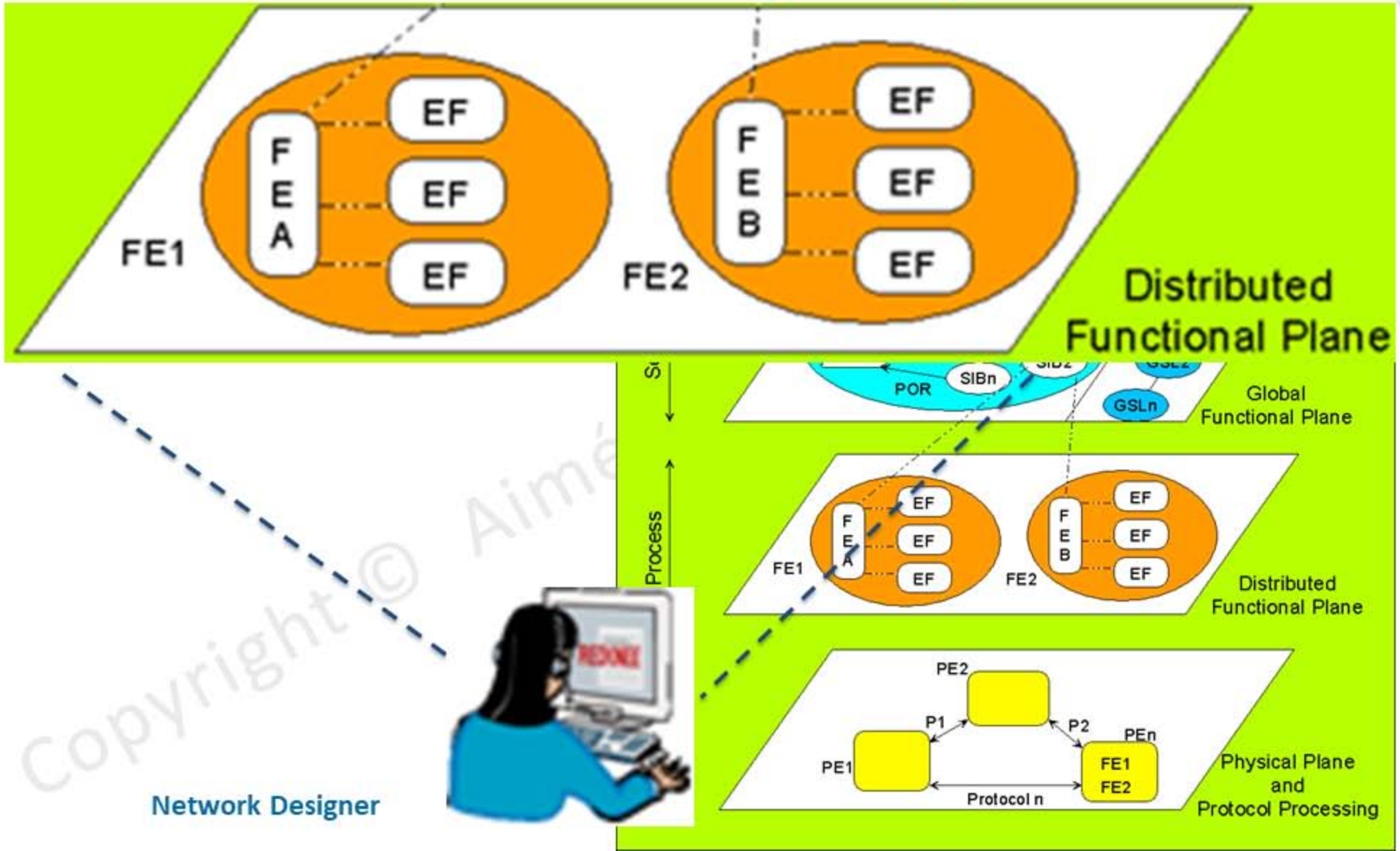
2. The SCP collects all relevant information for the call and stores this in a statistical call ticket (CDR) which is then sent to the SMP. This information can then be accessed by the SMP-operators , for statistical or billing purposes .

Example

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Distributive Functional Plane (DFP)

CS-1 Distributed Functional Plane responsibility



CS-1 Physical Plane (CS1 PP)

CS-1 Physical Plane (PP)

- Physical Plane deals with two aspects:
  - Affectation of functional entities in physical entities
  - Specification of the Intelligent Network Application Protocol

CS-1 Physical Entities

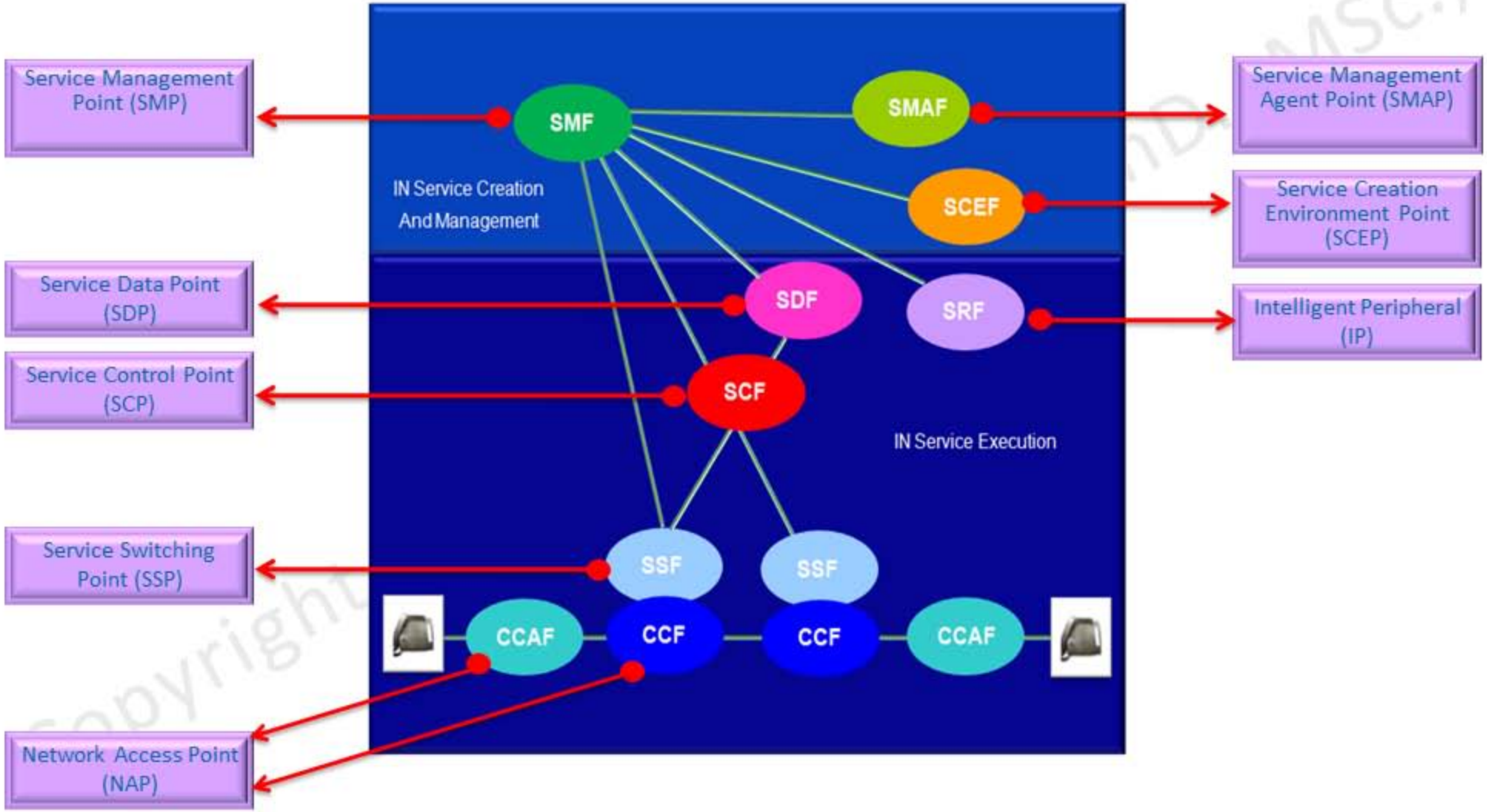
- Most Functional Entities can be mapped to the same physical entity
- But a Functional Entity cannot be distributed into several Physical Entities
- The principal Physical Entities are
  - Service Switching Point (SSP)
  - Service Control Point (SCP)
  - Service Data Point (SDP)
  - Intelligent Peripheral (IP)
  - Service Management Point (SMP)
  - Service Creation Environment Point (SCEP)
  - Service Node (SN)

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) DFP to PP Mapping

Service Switching Function (SSF)	Service Switching Point (SSP)
Service Control Function (SCF)	Service Control Point (SCP)
Service Data Function (SDF)	Service Data Point (SDP)
Specialized Resource Function (SRF)	Service Resource Point (SRP) or Intelligent Peripheral (IP)
Service Management Function (SMF)	Service Management Point (SMP)
Service Creation Environment Function (SCEF)	Service Creation Environment Point (SCEP)
Service Management Agent Function (SMAF)	Service Management Agent Point(SMAP)
Call Control Function (CCF) + Call Control Agent Function (CCAF)	Network Access Point (NAP)

CS-1 (Physical Plane) DFP to PP Mapping



CS-1 (Physical Plane) Service Switching Point (SSP)

- PSTN switch modified to recognize IN-services
- Can have dialogues with different SCPs
  - Trigger point defines required service in calls
  - Interconnections via Signaling Transfer Points
- Dialogues with SCPs based on SS7 signaling. No actual payload is transmitted
- Optionaly,
  - "SSP"+"SCF"+"SDF" = SSCP (Service Switching and Control Point)

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) Network Access Point (NAP)

- Physical Entity that includes only the CCAF and CCF functional entities
- Has the ability to determine when IN processing is required.
- It must send calls requiring IN processing to an SSP.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) Service Control Point (SCP)

- Service logic is controlled by Service Logic Processing Program (SLP)
- Services are run in Service Logic Execution Environment e.g. OS, runtime modules, management procedures etc.
- Service data can be located in Service Data Point ie. (relational) database
  - Usually integrated to SCP
  - Can be a commercial product (Oracle,Sybase)
- Service interfaces to SSP abstracted with SS7 TCAP and INAP (OSI application layer)
- SCP is connected to SSP and IP through the SS7 network

CS-1 (Physical Plane) Service Data Point (SDP)

- SDP contains subscribers and network's data acceded during service performing.
- SDP can be in the same network that contains SCP

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Service Resource Point (SRP) or Intelligent Peripheral (IP)

- Connected to SSP over a high speed bus
- Manages resources such as
  - announcements
  - speech recognition
  - digit collection
  - protocol conversions
- Controlled by SSP or SCP
- Interface to SSP including both signaling and data, but to SCP only signaling

CS-1 (Physical Plane) Service Management Point (SMP)

- Supports both commercial and technical IN service management
  - Service users can e.g. change PIN
  - service subscriber to an 800-service can configure call routing
  - operator can load new services to the SCP
  - operator can gather statistics and billing data to the OSS (Operations Support System)
- Handles service management in the distributed IN systems data consistency in SCPs' databases (SDPs)
- Usually closely coupled with the SCP

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 Service Creation Environment Point (SCEP)

- Framework for defining, developing and testing Service Logic Processing Program (SLP). e.g.
  - Graphical SIB-based 'drag and drop'
  - Graphical SDL-based
  - High level, 4GL language based
  - Low level C-language based with special resources e.g. libraries and runtimes
  - Proprietary graphic and/or text based

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) Service Node (SN)

- Complete set of resources and services for advanced IN services
  - Can have the functionality of both SCP and IP
  - Point-to-point connection to SSPs (via STPs)
- Can communicate to several SSP through SS7
- SN contains SCF, SDF, SSF/CCF, SRF

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) Interfaces between PEs

- In CS-1, (Q1215), various standardized interfaces are stated in the Physical Plane Architecture.
- These interfaces are:
  - SCP-SSP
  - SCPSDP
  - SCP-IP
  - AD-SSP
  - IP-SSP
  - SN-SSP
  - AD-IP

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) Interfaces between PEs: SCP-SSP

- In CS-1, the interface between an SCP and an SSP is Transaction Capabilities Application Part (TCAP) on Signaling Connection Control Part (SCCP) on Message Transfer Part (MTP) of SS7
- At the lowest layer protocols of the SS7, this interface could also be something else in order to achieve, for example, high-speed Signaling between these PEs.
- That is why, the IN standardization is mainly focused on the application layer protocols.

CS-1 (Physical Plane) Interfaces between PEs: SCP-SDP

- In CS-1, the interface between an SCP and an SDP is Transaction Capabilities Application Part (TCAP) on Signaling Connection Control Part (SCCP) on Message Transfer Part (MTP) of SS7.
- For SDPs outside the network (e.g. Credit Card validation data base at Credit Card company) an interworking unit can be used which is inside the network and performs translation of SS7 TCAP to a public or private data transfer protocol (e.g. X25). Q1215

CS-1 (Physical Plane) Interfaces between PEs: SCP-IP

- In CS-1, the interface between an SCP and an IP is Transaction Capabilities Application Part (TCAP) on Signaling Connection Control Part (SCCP) on Message Transfer Part (MTP) of SS7. Q1215

CS-1 (Physical Plane) Interfaces between PEs: SSP-SN

- In CS-1, the interface between an SSP and an SN is ISDN Basic Rate Interface (BRI), Primary Rate Interface (PRI) (or both)
- An SN and an SSP exchange application layer messages over an ISDN D-channel using common element procedures of ITU-T Recommendations Q.932. Q1215

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) Interfaces between PEs: SSP- IP

- In CS-1, the interface between an SSP and an IP is ISDN Basic Rate Interface (BRI), Primary Rate Interface (PRI) (or both), or SS7. Q1215
- If a BRI or PRI is used, the ISDN D-channel connecting an IP to an SSP carries application layer information between an SCF and an SRF, and supports the setup of B-channel connections to the IP.

CS-1 (Physical Plane) Interfaces between PEs: SSP- IP

- Information is passed from an SCF to an SRF (e.g. collected information and billing measurements) is embedded in the Facility Information Element (FIE). The FIE can be carried by a number of Q.931 messages, like SETUP and DISCONNECT.
- The FIE can also be carried by the FACILITY message in Q.931. This possibility provides for the flexibility to convey application layer information without affecting the connection state of the call. Q1215

CS-1 (Physical Plane) Interfaces between PEs: SSP- AD

- In CS-1, the interface between an SSP and an AD is Transaction Capabilities Application Part (TCAP) on Signaling Connection Control Part (SCCP) on Message Transfer Part (MTP) of SS7.
- Number of alternative standard protocols could also be used.

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

CS-1 (Physical Plane) Physical Plane -User Interfaces

- A user is an entity external to the IN that uses IN capabilities.
- Users use existing network interfaces. Q1215
  - Analogue interface Signaling
  - ISDN access Signaling arrangements.
- IN user-network interactions include providing stimuli which determine further IN action
  - DTMF digit Signaling

Copyright © Aimé M. Mbobi, PhD., MSc., MEng.

Intelligent Network Application Protocol (INAP)

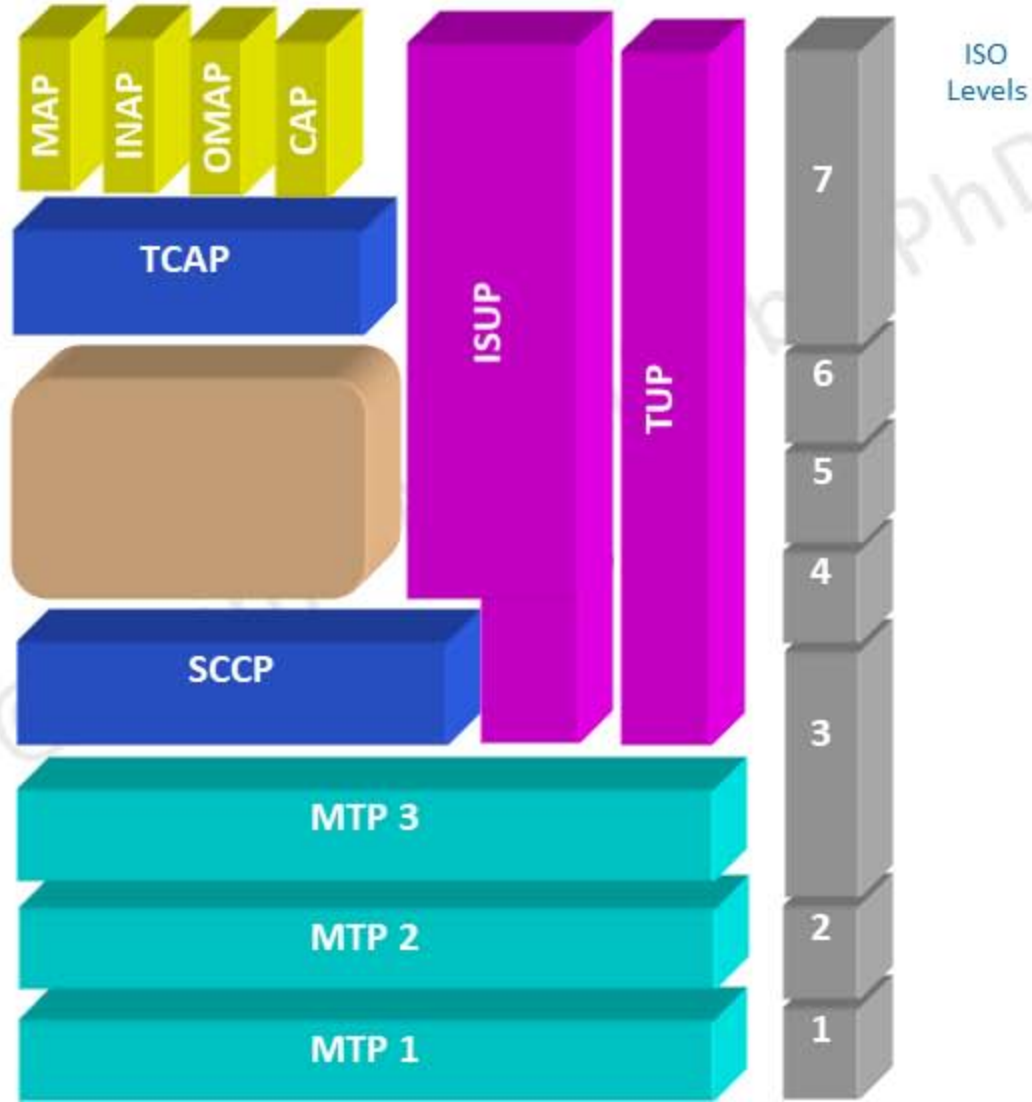
Intelligent Network Application Protocol (INAP)

- IN Application Part (INAP) is often used as generic term to denote the IN control protocol between SCP and core network.
- INAP is application layer protocol sitting over TCAP It controls call processing through various operations which are sent to IN application.
- The core elements described above use standard protocols to communicate with each other.

Intelligent Network Application Protocol (INAP)

- In fact, the SS7 protocols implement much of the OSI seven-layer model.
- This means that the IN standards only had to define the application layer which was called the Intelligent Networks Application Part or INAP.
- The INAP messages are encoded using ASN.1.

Intelligent Network Application Protocol (INAP)



INAP Operations

INAP Operations (1)

OPERATION	Acr	DIRECTION	COMMENT
Initial DP	IDP	SSF ⇨ SCF	Operation sent by the SSF after detection of a TDP-R in the BCSM to request SCF instruction for call completion.
Continue	CUE	SCF ⇨ SSF	Used to request the SSF to proceed with call processing (without new data) at the DP call processing is suspended.
Release Call	RC	SCF ⇨ SSF	Used to tear down existing call at any phase of the call and for all parties involved.
Connect	CON	SCF ⇨ SSF	Used to request the SSF to perform the call processing actions to route the call to a specific (SCF provided) destination.
ConnectToResource	CTR	SCF ⇨ SSF	Used to create a connection between a controlling/passive leg and the SRF (after successful connection, user interaction can take place).
DisconnectForwardConnection	DFC	SCF ⇨ SSF	Used to disconnect a connection to a (SRF) resource established previously by a "ConnectToResource" operation.

INAP Operations

OPERATION	Acr	DIRECTION	COMMENT
PlayAnnouncement	PA	SCF ⇨ (SSF) ⇨ SRF	Used to send inband information to a user.
PromptAndCollectUserInformation	PCUI	SCF ⇨ (SSF) ⇨ SRF	Used to send inband information to a user in order to collect information from that user. (The result of the prompt (i.e. the collected digits) is sent to the SCF using the TCAP "ReturnResult" component).
Cancel	CAN	SCF ⇨ (SSF) ⇨ SRF	Used to cancel previous "PlayAnnouncement" or "PromptAndCollectUserInformation" operations.
SpecializedResourceReport	SRR	SRF ⇨ (SSF) ⇨ SCF	Used as a response to the "PlayAnnouncement" operation when the announcement is completed.

INAP Operations

OPERATION	Acr	DIRECTION	COMMENT
CallInformationRequest	CIRQ	SCF ⇨ SSF	Used to request the SSF to record specific information about a call (CallAttemptTime, CallStopTime, Call ConnectTime, ReleaseCause, ...).
CallInformationReport	CIRP	SSF ⇨ SCF	Used to send to the SCF information as requested by previous "CallInformationRequest" operation.
RequestReportBCSMEvent	RRB	SCF ⇨ SSF	Used to request the SSF to monitor for a call-related event.
EventReportBCSM	ERB	SSF ⇨ SCF	Used to indicate the SCF of a call related event previously requested by the "RequestReportBCSM Event" operation.
ResetTimer	RT	SCF ⇨ SSF	Used to refresh TSSF application timer.

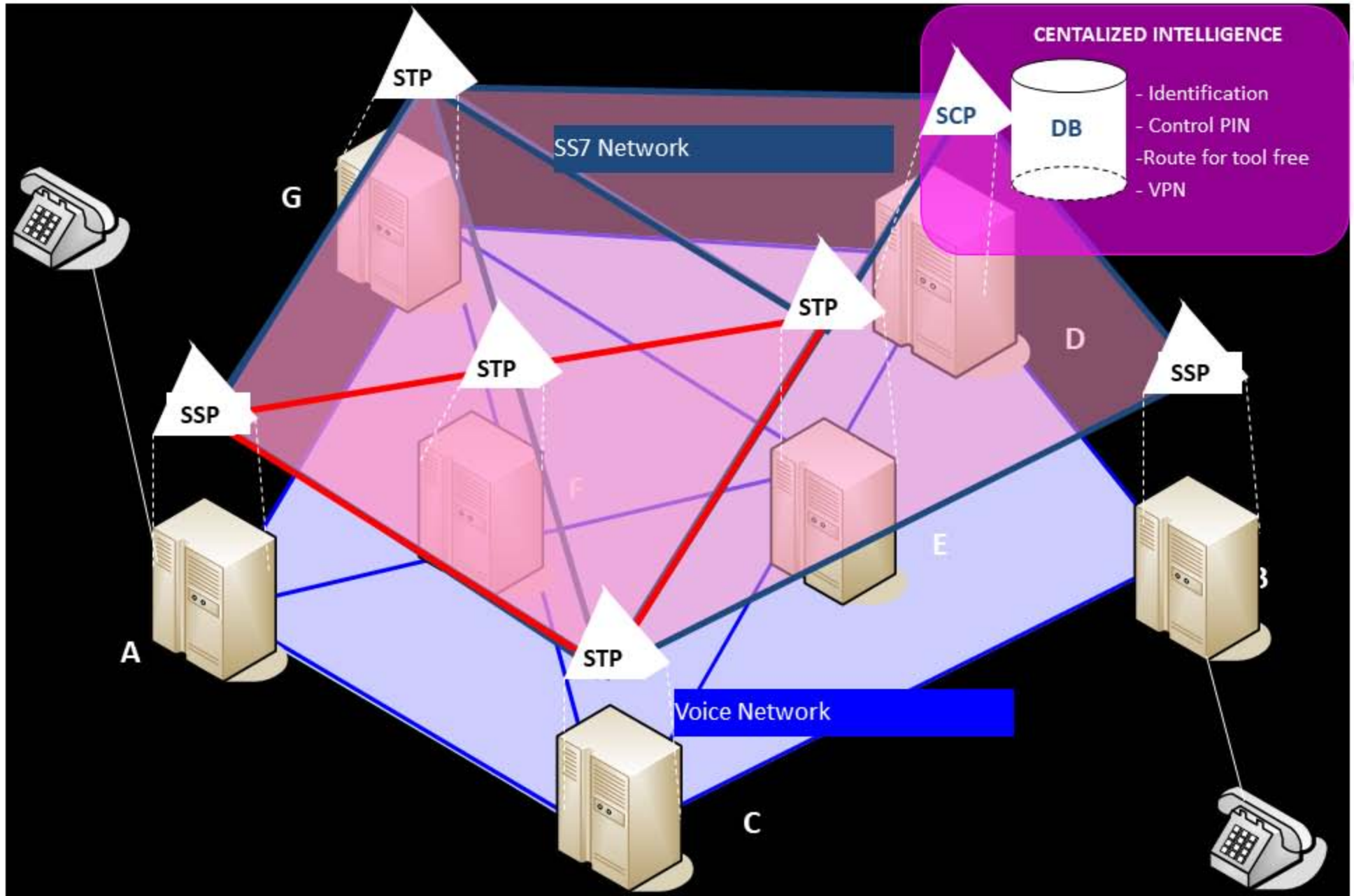
INAP Operations

OPERATION	Acr	DIRECTION	COMMENT
ApplyCharging	AC	SCF ⇨ SSF	Used to request the SSF to execute charging procedures relating to the IN service, or to initialize a call supervision.
ApplyChargingReport	ACR	SSF ⇨ SCF	Used to report IN service charging related information or call supervision information to the SCF as requested by the "ApplyCharging" operation.
FurnishChargingInformation	FCI	SCF ⇨ SSF	Used to request the SSF to generate a call record including SCF provided charge record information (off-line charging of IN service).
SendChargingInformation	SCI	SCF ⇨ SSF	Used to request interactions with the basic network charging.
RequestNotificationChargingEvent	RNC	SCF ⇨ SSF	Used to instruct the SSF how to manage charging events.
EventNotificationCharging	ENC	SSF ⇨ SCF	Used to report to the SCF the occurrence of a specific charging event as requested by previous "RequestNotificationChargingEvent" operation.

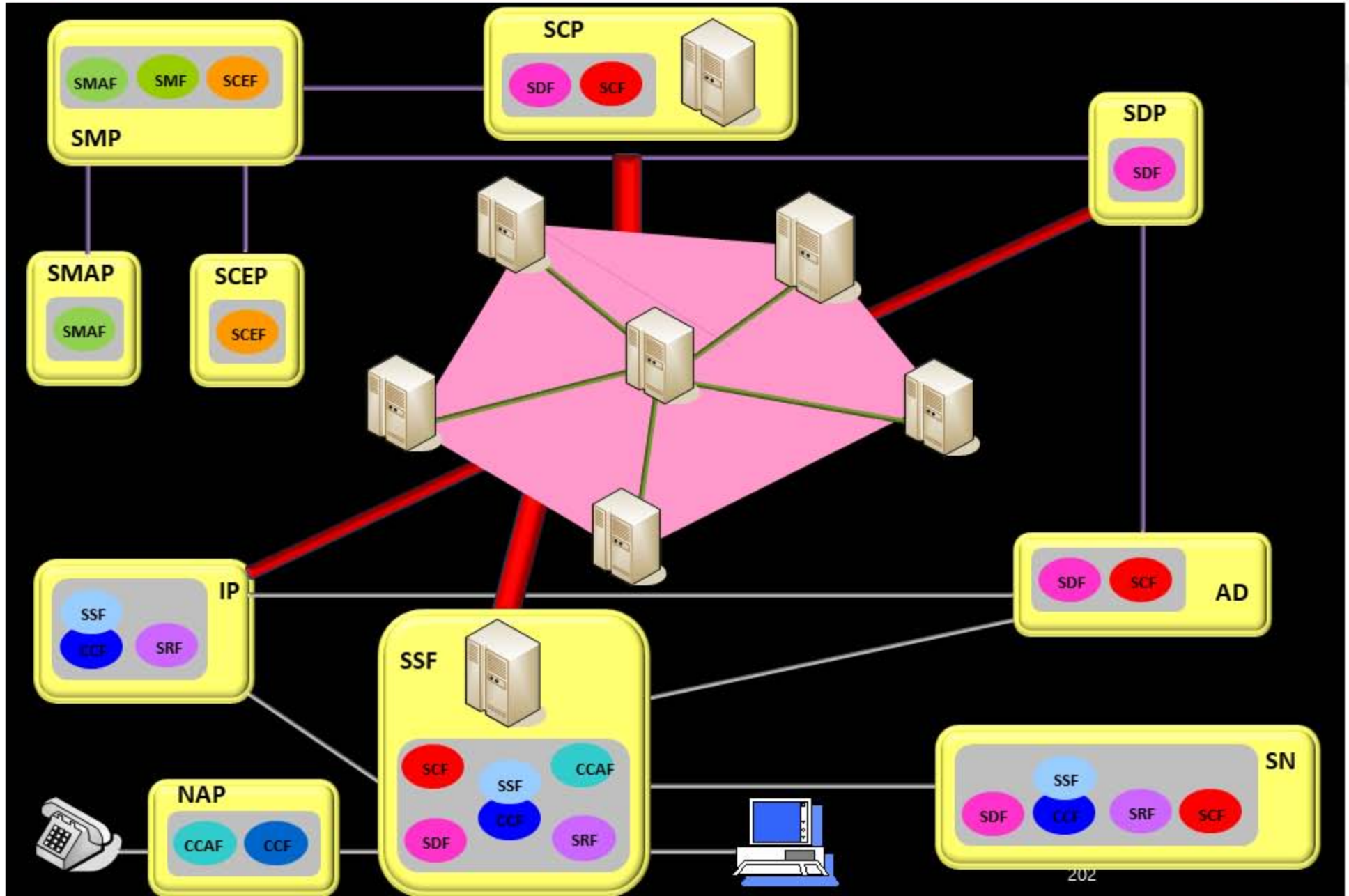
INAP Operations

OPERATION	Acr	DIRECTION	COMMENT
CallGap	CG	SCF ⇨ SSF	Used to request the SSF to reduce the rate at which requests for IN services are sent to the SCF.
ActivateServiceFiltering	ASF	SCF ⇨ SSF	Used to request the SSF to handle calls in a specified manner without request for instructions to the SCF.
ServiceFilteringResponse	SFR	SSF ⇨ SCF	Used to report to the SCF the result of service filtering algorithm executions (e.g. value of counters) specified in a previous "ActivateServiceFiltering" operation.
Activity Test	AT	SCF ⇨ SSF	Used to check for the continued existence of the SSF-SCF relationship (if the relationship is still in existence a ReturnResult "ActivityTest" component is sent to the SCF).

IN Philosophical Concept



IN Phisical Plane



CS-1 Physical Plane (PP)

CS-1 Physical Plane -Physical Plane responsibility