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Next Generation Networks – Frameworks and functional architecture models

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Converged services framework functional requirements and architecture

ITU-T Recommendation Y.2013

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GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

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ITU-T Recommendation Y.2013

Converged services framework functional requirements and architecture

Summary

This Recommendation provides the high-level requirements and functional architecture for the converged services framework (CSF). The CSF defines an architectural framework to provide a seamless user experience across multiple networks.

Source

ITU-T Recommendation Y.2013 was approved on 14 December 2006 by ITU-T Study Group 13 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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1 Scope

One objective of NGN is to enable seamless delivery of services across users' multiple devices served across different environments (home, cellular, enterprise, etc.) that are connected across multiple access networks in one operator domain or different operator domains. As users move across different environments, their services are managed and delivered to them seamlessly and with ease. The converged services framework (CSF) is designed to provide a common point of coordination for services, mobility, preferences, resources and the state of users on a per-user basis.

This Recommendation defines the high-level requirements and functional architecture for the CSF. In addition, this Recommendation provides example use case scenarios (see Appendix I) to highlight the functionality of the CSF.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T M.60] ITU-T Recommendation M.60 (1993), *Maintenance terminology and definitions*.

[ITU-T Y.2012] ITU-T Recommendation Y.2012 (2006), *Functional requirements and architecture of the NGN release 1*.

[ITU-T Y.2021] ITU-T Recommendation Y.2021 (2006), *IMS for Next Generation Networks*.

[ITU-T Y.2091] ITU-T Recommendation Y.2091 (2007), *Terms and definitions for Next Generation Networks*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 service: [ITU-T Y.2091] A set of functions and facilities offered to a user by a provider.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 application: A software entity residing on an application server that contributes to the delivery of an end user service.

3.2.2 application server: A physical network element that provides computing resources that are applied to the delivery of services to end users through the execution of applications.

3.2.3 policy: An ordered combination of policy rules that defines how to administer, manage and control access to resources. This function is responsible for policy access, policy condition matching and corresponding policy decisions according to matched conditions.

3.2.4 policy management: This provides the functions for describing, creating, updating, deleting, provisioning and viewing of policies.

3.2.5 service convergence: The coordination of a set of services such that the end user's view is that of a single service. The component services may have different providers.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

a.k.a.	also known as
AAA	Authentication, Authorization and Accounting
AM	(PCMM) Application Manager
AS	(IMS) Application Server
AS-FE	Application Support Functional Entity
CSF	Converged Services Framework
CC-FE	Convergence Coordination Functional Entity
CLS-FE	Client Support Functional Entity
CP-FE	Convergence Policy Functional Entity
DRM	Digital Rights Management
ES-FE	Edge Support Functional Entity
FE	Functional Entity
GPS	Global Positioning System
HSS	(IMS) Home Subscriber Server
iFC	initial Filter Criteria
IMS	IP Multimedia Subsystem
ISC	IMS Service Control
ISDN	Integrated Services Digital Network
NGN	Next Generation Network
NS-FE	Network Support Functional Entity
OSA	Open Service Access
OSE	OMA Service Environment
OSI	Open Systems Interconnection
PCMM	PacketCable Multimedia
PIEA	PSTN/ISDN Emulation Architecture
POD	Point Of Display
PS	(PCMM) Policy Server
PSTN	Public Switched Telephone Network

RKS	(PacketCable) Record Keeping Server
SCP	Service Control Point
SIP	Session Initiation Protocol
SLF	(IMS) Subscription Locator Function
SPT	(IMS) Service Point Trigger
SSP	Service Switching Point
STB	Set Top Box
STP	Signalling Transfer Point
SUP-FE	Subscriber User Profile Functional Entity
UE	User Equipment
UPnP	Universal Plug and Play
VoD	Video on Demand
WMAN	Wireless Metropolitan Area Network

5 Overview and high-level requirements

5.1 Introduction

The main goal of the 'converged services framework' (CSF) is to provide the experience of a service that operates smoothly and consistently when crossing the boundaries of multiple access and core networks, or when service interaction events occur. To enable this, the framework should support features common to many applications. These include tracking the user state and profile, device identity, state and profile, session state and location across multiple NGN and non-NGN networks.

Another key element of the CSF is that it will allow advanced services to be made available to legacy terminals.

5.2 High-level requirements

The CSF is required to support the following high-level requirements:

1) Function across various transport and control networks.
2) Integrate user preferences and current state for each active user identifier such that the user is not required to explicitly initiate session mobility.
3) Collect user-related information from services, core networks, access networks, devices and applications, subject to privacy and security considerations.
4) Process user- and service-related information about a particular user across multiple networks, devices and applications.
5) Distribute processed user-related information to services, core networks, access networks, devices and applications, subject to privacy and security considerations.
6) Respond to service requests by end users or applications with responses that consider the processed information about a user and his/her state (for example, multiple networks, devices, applications).
7) Provide network-specific, application-specific or device-specific translated service requests on behalf of a received service request to allow an end user or network-agnostic application to achieve consistent behaviour across service provider domains.

8) Integrate end user identifiers and preferences to create appropriate services' behaviour for the currently "in use" identifier.

9) Enable services that allow an end user to cause their current session to be transferred from one device to another, by user profile preference or user action.

10) Enable services to be converged across various transport and control networks.

11) Support both network-operator-specific and third-party services.

12) Support management of user profile, location, presence, availability, preference and service subscription information that spans different networks and devices, subject to privacy and security considerations.

13) Provide controlled access to information from services enablers (such as presence, availability, location, registration status, QoS options, media resources, billing) irrespective of the access network, application server and device to create enhanced integrated services on a per-user basis.

14) Be compliant with policy-based service management.

15) Support policy management of service convergence that is independent of the implementation method of the service.

16) Support digital rights management (DRM) and allow service providers to enable DRM when sharing content across multiple devices owned by the same user, across multiple access networks and across multiple identities of the same user.

17) Support the use of network adapters which allow information to be successfully delivered across an interface between systems using different data formats and protocols.

18) Support a flexible trace mechanism in order to locate service faults effectively.

19) Coordinate between services provided to a user, possibly by different service providers, such that their delivery to the user is in compliance with service provider policies and user preferences.

Additionally, the CSF:

1) should operate over access networks and NGN domains that are not controlled or managed by the CSF; and

2) should provide controlled access to network resources when the business agreement permits, regardless of which network the resource resides within.

6 CSF functional architecture and functional entities

Figure 6-1 shows the CSF functional architecture, comprised of the CSF functional entities, reference points among the CSF functional entities and between CSF and the converged services/applications that rely upon CSF.

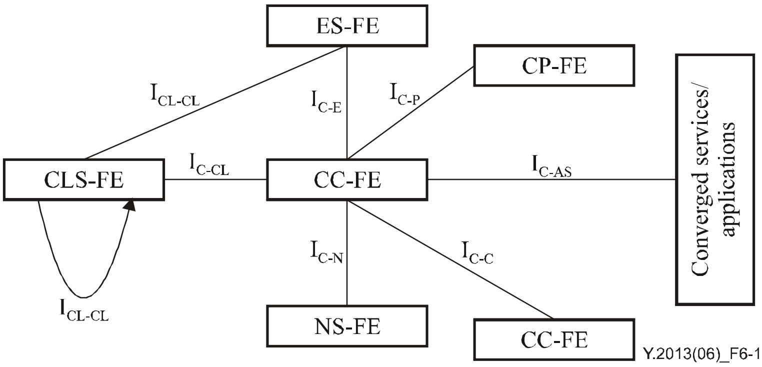


Figure 6-1 – CSF functional architecture

NOTE 1 – The "converged services/applications" box is representing the collection of FEs in support of services and applications provided to the end user. Typically, these would correspond in an NGN environment to the FEs defined in clause 9.3.4 of [ITU-T Y.2012] ("Application support functions and Service support functions").

NOTE 2 – The I_{C-AS} reference point is meant to represent the individual reference points between the CC-FE and any of the FEs pertaining to the "converged services/applications" box (also referred to as the "AS-FE (and similar FEs)" in this Recommendation).

The CSF functional entities identified in Figure 6-1 are individually described in the following sub-clauses in terms of supported functions, supported reference points, actions performed as well as supported information.

6.1 Convergence coordination functional entity (CC-FE)

The convergence coordination functional entity (CC-FE) provides coordination of information about: users, devices, service subscriptions, session management and resource capabilities. The CC-FE takes input from service provider application servers/databases, profile information and/or from the network, edge, client and policy support functional entities in a single network domain or over multiple network domains.

6.1.1 Reference points

The CC-FE supports the following CSF reference points:

– I_{C-AS}, with respect to the AS-FE (and similar FEs). This reference point provides a communication path between the application server and the CSF. Some candidate protocols for this reference point are, for instance, Parlay X and SIP. If I_{C-AS} is based on the IMS services control (ISC) SIP messaging set, SIP messages arriving from the AS-FE (and similar FEs) or the NS-FE are evaluated against the CC-FE user preferences for possible action.

– I_{C-CL}, with respect to the CSF client support function (CLS-FE). This reference point should provide a communication path between the end user device and the CC-FE. I_{C-CL} may transfer client environment information to CC-FE, such as the location of the device. In addition, other CSF-enabled devices with which the client device has communications, and other sessions the client device is participating in, may effect the CC-FE's service coordination decisions. For example, multi-interface devices may be participating in more than one session at a time, so there may be separate CC-FEs (or equivalents) for each session, see I_{C-C} below.

– I_{C-N}, with respect to the CSF NS-FE. This reference point should provide a communication path between a supporting underlying network and the CC-FE. I_{C-N} is the main connection to the "enabling" services of the network, for example location, session control and user data (as stored in the HSS). I_{C-N} will be implemented over several existing interfaces to existing "enablers" such as ISC to the session control.

– I_{C-E}, with respect to the CSF ES-FE. This reference point provides a communication path between a supporting edge device or network and the CC-FE. Edge devices are those network components between a customer premise and an access network.

– I_{C-C}, the reference point between CC-FEs in different domains. This reference point provides a communication path between CC-FEs, each of which covers and coordinates different service providers or administration domains, etc. With this reference point, it is possible to provide coordination of multiple services of various integration types, such as hierarchical, master-slave and peer-to-peer coordination models. The examples for each model are described in Appendix IV.

– I_{C-P}, with respect to the CP-FE. This reference point provides a communication path between policy functionality and the CC-FE to enable describing, creating, updating, deleting and provisioning.

6.1.2 Actions

CC-FE's actions on receipt of stimulus across one of the reference points that it terminates can be complex and extensive. CC-FE's response to stimulus is related to the following areas of concern:

– Active-sessions-related change.

– Client location change.

– Network equipment state or informational change.

– Session initiation or termination change.

– User preference change.

– Policy change.

Actions associated with active sessions are signalled to the CC-FE from the serving network through the NS-FE over I_{C-N} or from the AS-FE (or similar FEs) over I_{C-AS}. In response to stimulus, the CC-FE will adapt the arriving information to the appropriate form, add or remove information as required of the recipient and forward the information along another of its reference points.

Client location changes will be detected by enablers (such as a location server) in the NS-FE set or by reports from CLS-FE or ES-FE that the end user's device is present within a well known network. If there are any registered applications for location changes of the type reported, those applications will be notified. The user's presently reported location will also be updated.

Network equipment state or informational change would be reported to CC-FE over the I_{C-N} reference point. These might represent user-initiated session-related signalling (i.e., SIP session control to S-CSC-FE) or a user registration with the HSS. The CC-FE would evaluate the report based on the user's preferences for actions, and the network's rules as expressed by network policies. An end result would be appropriate messaging to applications to report session or user registration changes.

In all cases, the CC-FE complies with both user preferences as recorded in the CC-FE user profile and operator policies as directed by CP-FE.

The CC-FE takes simple actions when stimulated. Examples include:

– Notify application of actions (under policies).

– Inform applications of environmental changes.

– Adapt "next application" selection based on information returned by prior application.

For example, on receipt of "new node in local environment" information from an ES-FE (resident within a subnetwork, such as a household wireless network) the CC-FE would consult the user-preferred response, note the transfer of voice call services to the household fixed network and send a "location update" information to a "call forward" application to place the necessary subscriptions to the user's cellphone to activate the services.

6.1.3 Information

The CC-FE's information contains application, network, device and user-specific entries.

The CC-FE application information model (see [ITU-T M.60]) contains at least the following information for each application that is registered with the CC-FE:

– Identity – how to refer to the application.
– Address – how to contact the application.
– Security – how to verify the application.
– Signalling type (some applications may be non-ISC).
– Priority/sequence within applications using the same ISC message type.
– Required information to be passed to application.
– Allowed actions by the application.

The CC-FE network information model contains at least the following information for each network that CC-FE interacts with (represented by another CC-FE):

– Identity – how to refer to the network.
– Address – how to contact the network's CC-FE.
– Security – information and methods to authenticate this network to the network's CC-FE.
– Signalling type.
– Network allowable requests of this network.
– Network allowable requests of the other service provider networks.

The CC-FE user information model contains the following user profile information:

– Identities – user's identifiers or pseudonyms in all known service provider networks.
– Devices – the users devices and the network(s) providing access ability.
– Access preferences by service type – what device or service provider network is preferred for which type of service.
– Transfer preferences – which service-initiated transfers of session types the network should make for the user (by well known location).
– Well known locations – physical locations that have special meaning to the end user (e.g., their place of residence (home), their place of employment (work), others may be added by the system or end user, as needed).

The CC-FE device information model contains the following information for devices:

– The devices capabilities (a device may be an assembly of several attached devices, each with different capabilities, so device capability may be nested down to non-expandable devices).
– User identifiers associated/registered to this device. The device may be shared between multiple users (e.g., household land line phone and number, TV screen, etc.).

6.2 Network support functional entity (NS-FE)

The network support functional entity (NS-FE) provides session, access and rights information to the CC-FE.

6.2.1 Reference points

The NS-FE supports the following CSF reference point:

– I_{C-N} (see clause 6.1.1)

I_{C-N} is the CC-FE to NS-FE reference point, allowing the CC-FE to interface with the network in which the NS-FE is embedded. Examples of such reference points may include ISC to IMS S-CSCF and Sh to HSS reference points in [ITU-T Y.2021].

NS-FE to network reference points

The NS-FE supports interfaces with the network in which the NS-FE is embedded. Interface candidates include ISC to IMS S-CSCF and Sh to HSS reference points in [ITU-T Y.2021].

6.2.2 Actions

The NS-FE is viewed as a transparent intermediary along the existing reference points available from the service control functions. NS-FE is an architecturally necessary function only when the underlying services layer/functions are not compatible with the CC-FE expectations of I_{C-N}.

6.2.3 Information

The NS-FE retains only the information necessary to connect with the CC-FE and the underlying services entities.

The NS-FE information model contains at least the following information for each network element that NS-FE interacts with:

– Identity – how to refer to the network element.

– Address – where to contact the network elements.

– Security – information and methods to authenticate with the underlying network elements.

– Signalling type.

6.3 Edge support functional entity (ES-FE)

The Edge Support Functional Entity (ES-FE) provides session, access, and rights information about itself and subtending devices to the CC-FE.

The ES-FE interfaces to some combination of the access networks and the customer local networks. It provides session, resource, and identity information about itself and subtending devices to the CC-FE.

The ES-FE is the CSF client in a set top box or similar device, non-mobile edge of an access network device.

6.3.1 Reference points

The ES-FE supports the following CSF reference points:

– I_{C-E} (see clause 6.1.1).

I_{C-E} is the CC-FE to ES-FE reference point, providing ES-FE a means to forward information about the "edge" of the access network to the CC-FE. The CC-FE may also use I_{C-E} to forward commands to the edge device related to CSF functionality.

– I_{CL-CL}.

I_{CL-CL} is a CLS-FE to CLS-FE or ES-FE reference point. I_{CL-CL} provides a means for a CLS-FE in one network domain (e.g., a mobile device) to determine the presence of another network endpoint in its local vicinity (e.g., a home set top box or an office WLAN-based VoIP system). This link might be implemented by a DLNA/UPnP interface across a WLAN or Bluetooth. The two endpoints may be serviced by the same network provider or by different network providers. The reference point allows for the transfer of appropriate information to enable the two clients to notify their respective CC-FE of the other client's presence.

ES-FE to edge device reference point

The ES-FE interfaces with the edge device in which the ES-FE-enabled device is resident. Most commonly, it corresponds to an edge device API defined by the edge device vendor. The purpose of the reference point is to allow the ES-FE to interact with the underlying device.

In addition, the ES-FE may be given access to APIs that enable "out of box" experiences, allowing the ES-FE to monitor and report on changes to the "local environment" such as the entry or exit of a mobile device (laptop, handset, etc.). This API would be similar in structure and content to UPnP defined for discovery and communications between LAN resident functions.

6.3.2 Actions

The majority of ES-FE actions originate when a ES-FE experiences environment changes, such as detection of new CSF functions within its local environment (nominally wireless access is assumed).

ES-FE primarily reports on changes in the information it stores, for example it will:

– Establish communications with CLS-FEs in the local environment (interface restricted to short range RF) to determine their identity, capability and security authorizations.

– Initial report on entities and/or services available in the local environment or changes in the devices or capabilities in the local environment.

– It is likely that ES-FE will be required to somehow report on alternate paths to the entities in the local environment (or to itself in cases where one end user device can connect to more than one access network, such as cellular and WLAN).

6.3.3 Information

ES-FE stores information regarding:

– The local environment in terms of what networks and/or devices it can correspond with and the services available from them.

– The client's current location expressed as both a network address and (optionally) a physical location (the latter as an aid in emergency services dispatch, although this may be retrieved from the business management system (BSS) instead).

– The devices that are "resident" within the environment (loss of communications usually means that the devices have been moved out of range, powered off or failed).

– The devices that are transient within the environment (loss of communications indicates mobility, a normal event with respect to these devices).

– The current active session of the edge device.

6.4 Client support functional entity (CLS-FE)

The CLS-FE provides session and resource information about the client and the user to the CC-FE.

CLS-FE represents CSF within an end user device. Its role is twofold:

– End user interaction – prompts end users for information and collects their response (if necessary, the users will be prompted for additional information if their original preferences were not absolutely clear).

– End user device interactions – allows for the push or pull of information to and from the end user device (e.g., the cellphone). For example, CLS-FE might update the user's handset-based address book if one of their contacts adds a new contact mechanism to their global set.

CLS-FE generates I_{C-CL} messages when there are changes of specific information (e.g., the end user places the device in a docking cradle, which may imply absence of the end user from the device's immediate vicinity and may cause CC-FE to change services for the user under user profile control).

CLS-FE receives messages mainly relating to stored information on the device. The address book is the most obvious example. Calendar items being offered, accepted, updated are other examples. CLS-FE messaging from CC-FE would also be appropriate to advise the end user device that the device is in a "no ring zone" (a theatre) and that it must "vibrate" to "ring" instead of play some wonderfully confusing ring tone.

6.4.1 Reference points

The CLS-FE supports the following CSF reference points:

– I_{C-CL} (see clause 6.1.1).

I_{C-CL} is the CLS-FE to CC-FE communications link. This link is used to update CC-FE's knowledge of the local client environment, to change information on the end user device or to interact with the user to resolve decision ambiguities in services automation.

– I_{CL-CL}

I_{CL-CL} is a CLS-FE to CLS-FE or ES-FE reference point. I_{CL-CL} provides a means for a CLS-FE in one network domain (e.g., a mobile phone) to determine the presence of another network endpoint in its local vicinity (e.g., a home set top box or an office WLAN-based VoIP system).

CLS-FE to host reference point

Client to host reference points take many forms. The simplest to conceive is an API between the normal local application and the local operating system style. For example, APIs provided to access operating system managed resources. More specialized host interfaces are present in devices with specialized functions, such as mobile phones, or applications resident on the host device, such as an API to a calendar or address book application/service.

6.4.2 Actions

The majority of CLS-FE actions originate when CLS-FE is hosted on a mobile device, which can therefore experience environment changes. Most fixed-location devices are assumed to implement ES-FE rather than CLS-FE.

CLS-FE primarily reports on changes in the information it stores, for example it will:

– Provide information resident on the device to CC-FE on demand or in response to a locally generated trigger (e.g., a change to the local address book on a cellphone).
– Notify CC-FE when its current location matches a "well known location". This may be determined by use of GPS or by recognizing the SSID of a local RF signal or some combination of attributes.
– Establish communications with CLS-FEs or ES-FEs in the local environment (interface restricted to short range RF) to determine their identity, capability and degree of cooperativeness.
– Initial report on entities and/or services available in the local environment or changes in the devices or capabilities in the local environment.
– It is likely that CLS-FE will be required to somehow report on alternate paths to the entities in the local environment (or to itself in cases where one end user device can connect to more than one access network such as cellular and WLAN).

6.4.3 Information

CLS-FE stores information regarding:

– The local environment in terms of what networks it can correspond with and the services available from them.

– The client's current location (as an aid to recognizing the clients "well known locations").

– The client's well known locations.

– The current active session of the client.

– The client's information resident on the local device, or changes to stored information.

6.5 Convergence policy functional entity (CP-FE)

The CP-FE provides policy management and enforcement information to the CC-FE. It acts as a policy decision point within the CSF and then acts as a policy enforcement point in executing the policy guidance received.

The CP-FE may update policy guidance to the CC-FE at any time.

The CP-FE does not directly communicate with any CSF functions below CC-FE (e.g., CLS-FE, ES-FE or NS-FE). The network elements that NS-FE interacts with access the policy services through non-CSF-related channels.

The CP-FE is capable of managing one or more than one CC-FE.

Figure 6-2 provides a high-level view of the policy mechanism.

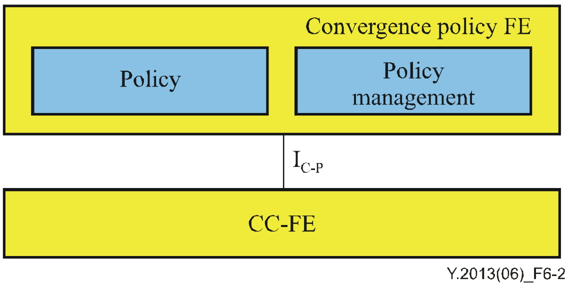


Figure 6-2 – CSF policy mechanism

6.5.1 Reference points

The CP-FE supports the following CSF reference point:

– I_{C-P} (see clause 6.1.1)

The I_{C-P} reference point is responsible for interaction between CP-FE and CC-FE. CC-FE uses this reference point to receive policies from CP-FE and to return a result to it.

The I_{C-P} reference point can be viewed as being similar to the "Go" interface defined within IMS [ITU-T Y.2021] for policy distribution.

6.5.2 Actions

CP-FE's actions are all driven by policy distribution needs. Thus CP-FE will provide policy guidance to the CC-FE on CC-FE start-up or when the policy stored within CP-FE is changed by the network operator.

6.5.3 Information

As a minimum IMS policy decision functionality to the CP-FE would be expected to provide information for the connected access networks. Additional information may be required to support CSF specifically, but this is for further study.

7 Context of CSF within NGN

7.1 Relationship to NGN functional architecture

7.1.1 Introduction

The converged service framework can be considered as an 'overlay' approach, amenable to interworking with existing end-to-end solutions, whether they are legacy ones (cellular, packet cable, etc.) or NGN (including IMS-based ones). See Appendix V for examples of CSF configuration models.

The objective of this clause is to look more closely at the case where CSF operates in conjunction with NGN to better understand the positioning of the CSF functional architecture described in clause 6 within the NGN functional architecture as described in [ITU-T Y.2012].

Figure 7-1 shows the NGN architectural overview [ITU-T Y.2012]. The CSF relationships to existing standards such as OSA/Parlay, OMA open service environment (OSE) and underlying networks (e.g., IMS-style networks, wireline-style networks) are briefly covered in Appendix II.

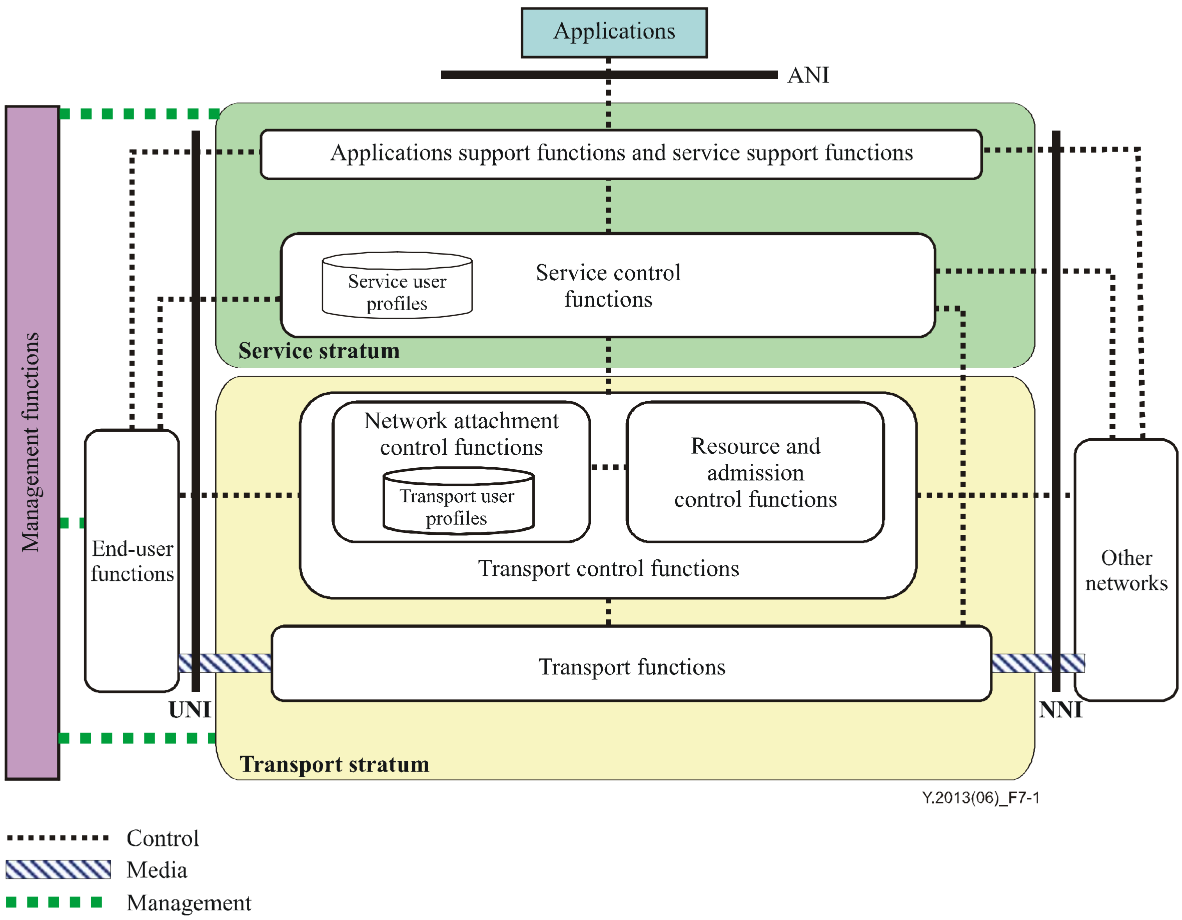


Figure 7-1 – The NGN architecture overview

When operating in conjunction with NGN, the CSF functional entities are largely located in the NGN service stratum with some support functional entities reaching into the transport stratum and end-user functions in certain cases.

7.1.2 CSF and the NGN functional architecture

As described in clause 6, the CSF is made up of one or more convergence coordination functional entities (CC-FE), as well as supporting functional entities in the network support functional entity (NS-FE), edge support functional entity (ES-FE), the end devices for client support functional entity (CLS-FE) and policy management and enforcement support functional entity (CP-FE). Figure 7-2 illustrates the corresponding positioning of the CSF FEs in the context of the NGN generalized functional architecture.

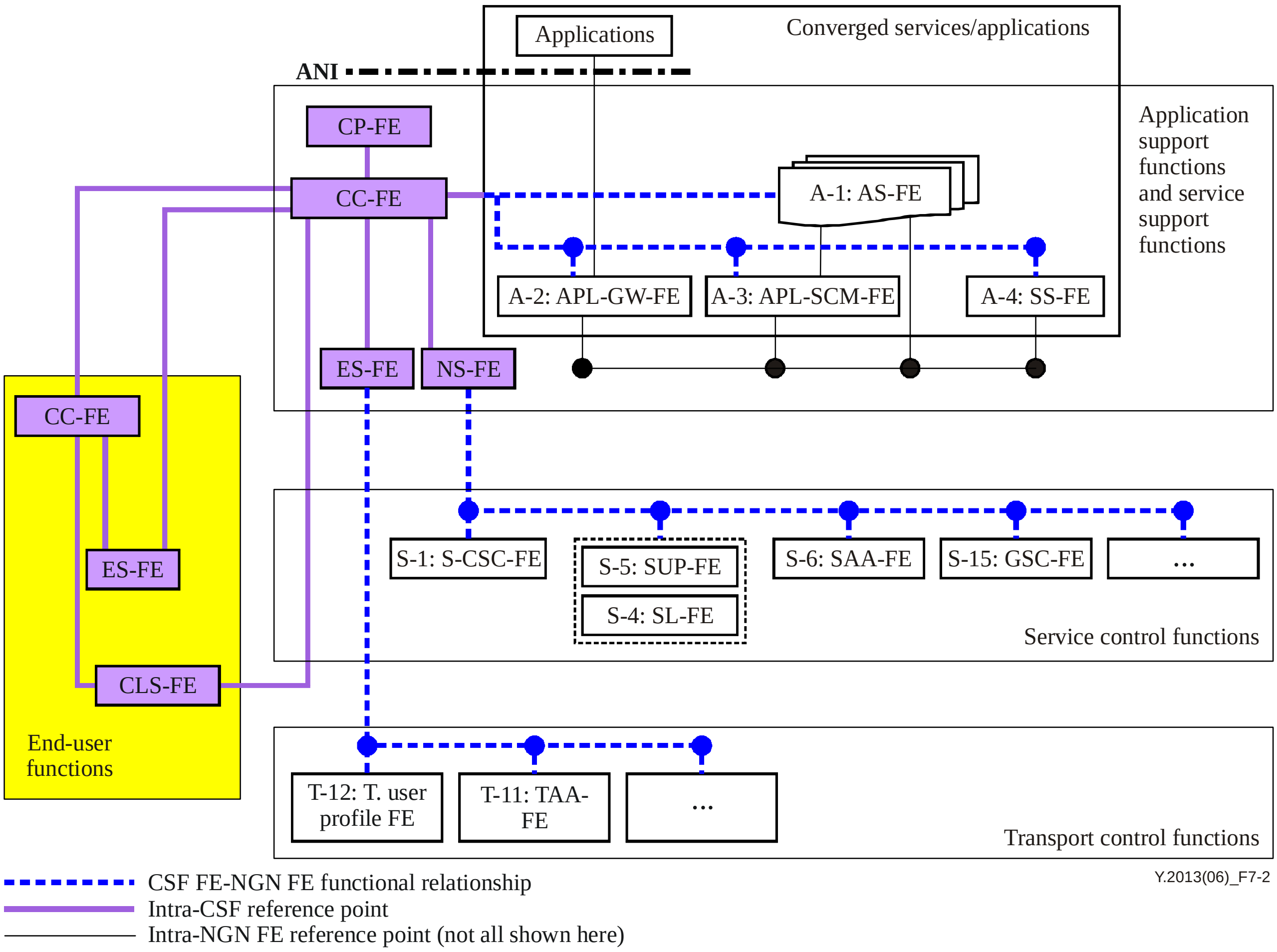


Figure 7-2 – The CSF relationship to the NGN functional architecture

Figure 7-2 identifies three types of reference points. The thick grey line represents the reference points between CSF FEs (intra-CSF) (see clause 6 for further details). The dotted line shows reference points (or functional relationships) between CSF and NGN functional architecture FEs. The solid lines are reference points between NGN functional architecture FEs, which are not all shown here (see [ITU-T Y.2012] for further information).

It should be noted that the CC-FE may be collocated with a CSF support functional entity, such as the NS-FE, ES-FE or CLS-FE. It should further be noted that other than the CC-FE and CP-FE, not all FEs need be present for operation. For example, the CSF may be implemented entirely in an operator's infrastructure through the use of CC-FEs, CP-FEs and NS-FEs, and without ES-FEs or CLS-FEs.

In certain configurations, a CC-FE can be located in the end-user functions. In such a configuration the CC-FE coordinates the services in the local end-user environment and interacts with the peer CC-FE in the service stratum when service coordination is needed across network domains.

7.1.2.1 CSF and the application support functions and service support functions

The CC-FE resides within the application support and service support functions of the NGN architecture.

The CC-FE should support coordination control for multiple invocations of services in single or multiple service component(s) within the NGN service stratum (see Figure 7-3, clause 7.2).

The CC-FE interacts with the following functional entities within the application support and service support functions (see Figure 7-2):

– A-1 – Application support FE (AS-FE): An AS-FE is a functional entity that provides the intelligence for a user-level service. An AS-FE communicates with a CC-FE in a manner similar to how an application communicates with an application gateway functional entity (APL-GW-FE). An AS-FE contacts a CC-FE when enacting a service on behalf of a user to determine the user capability and state across (and independently of) the multiple access networks or devices available to the user.

– A-2 – Application gateway FE (APL-GW-FE): The APL-GW-FE is an intermediary between the applications and functional entities in the service control function. The APL-GW-FE is analogous in some respects to the CC-FE. In particular, it may sit logically between an application and an S-CSC-FE or MRC-FE and communicate to applications over ANI. The CC-FE interacts with the APL-GW-FE in its communications with the "third party" applications for obtaining input from service provider databases.

– A-3 – Application service coordination manager FE (APL-SCM-FE): The APL-SCM-FE manages service interactions between multiple application services in NGN. By doing so, it might provide convergent services in NGN. But APL-SCM-FE is limited to the capabilities provided with the service control function, and the CC-FE has more global coordination capabilities across multiple domains. The CC-FE may interact with APL-SCM-FE to obtain service coordination information in its communication with application services in NGN.

– A-4 – Service switching FE (SS-FE): The SS-FE provides access and interworking to a legacy intelligent network (IN) service control point (SCP). The CC-FE may interwork with SS-FE to obtain service trigger information in its communication with legacy IN services.

The CC-FE also interacts with the service control functions in the service stratum via the network support functional entity (NS-FE). In addition, the CC-FE interacts with the transport stratum via the edge support functional entity (ES-FE) and it also interacts with components within the end-user functions.

The convergence policy functional entity (CP-FE) also resides within the application support and service support functions of the NGN architecture.

NOTE – Interactions between CP-FE and additional FEs within the service stratum are for further study.

7.1.2.2 CSF and the service control functions

The NS-FE resides within the application support and service support functions of the NGN architecture. The NS-FE should support media service control for multiple invocations of media resources in single or multiple service component(s) within the NGN service stratum (see Figure 7-3).

The NS-FE interacts with the functional entities located within the service control functions of the NGN architecture (see Figure 7-2):

– S-1 – Serving call session control FE (S-CSC-FE): The S-CSC-FE is responsible for enabling access of end devices to application servers. The S-CSC-FE should include NS-FE behaviour to push information/respond to requests for information to a CC-FE. In particular, the S-CSC-FE/NS-FE should provide the following categories of information to a trusted CC-FE:
  - Notification of triggers related to previously specified users or devices.
  - Parameters related to sessions that are in progress.
  - Notification of user/device registration status.
  - Addressing, location information for devices known to be associated with a specified user.
– S-5 – Service user profile FE (SUP-FE): The SUP-FE is a database function that maintains user profile, device profile, presence, subscription and location information for an administrative domain. The SUP-FE should include NS-FE behaviour responsive to a CC-FE, providing access to its content according to its own rules of access privileges/trust. The NS-FE should filter its data prior to transmission to the CC-FE according to these rules. Conditioned upon establishment of trust, the NS-FE should also accept and store SUP-FE-related information from a CC-FE as a proxy for a user or user device.
– S-6 – Service authentication and authorization FE (SAA-FE): The SAA-FE provides authentication and authorization in the service stratum.
– S-15 – General services control FE (GSC-FE): The general services control functional entity (GSC-FE) acts as a contact point for application support and service support functional entities, as well as end-user functions. The GSC-FE maintains session-related state as needed to assist in policy actions. It should include NS-FE behaviour accordingly.

It is expected that a CSF component may need to establish its identity and authority to access or provide information when communicating with an administrative domain operated by a different service/network provider.

NOTE – Interactions between NS-FE and additional FEs within the service control functions are also envisioned and are for further study.

7.1.2.3 CSF and the transport control functions

The ES-FE resides within the application support and service support functions of the NGN architecture and interacts with the following functional entities located within the transport stratum:

– T-12 – Transport user profile FE (TUP-FE): The TUP-FE is responsible for storing user profiles related to the transport stratum. The TUP-FE includes NS-FE behaviour responsive to a CC-FE, providing access to its content according to its own rules of access privileges/trust. The NS-FE should filter its data prior to transmission to the CC-FE according to these rules. Conditioned upon establishment of trust, the ES-FE should also accept and store TUP-FE-related information from a CC-FE as a proxy for a user or user device.
– T-11 – Transport authentication and authorization FE (TAA-FE): TAA-FE provides authentication and authorization functions in the transport stratum. It is expected that a CSF component may need to establish its identity and authority to access or provide information when communicating with an administrative domain operated by a different service/network provider.

NOTE – Interactions between ES-FE and additional FEs within the transport control functions are also envisioned and are for further study.

7.1.2.4 CSF and the end-user functions

The client support functional entity (CLS-FE) resides in the end-user functions as shown in Figure 7-2. The CLS-FE interacts with components of the end-user functions of the NGN architecture. The CLS-FE should support priority-based service execution when multiple services are invoked in parallel, and support multiple interfaces with multiple services in single or multiple service component(s). See Figure 7-3.

The CC-FE and ES-FE may be used in the end-user functions (see Figure 7-2).

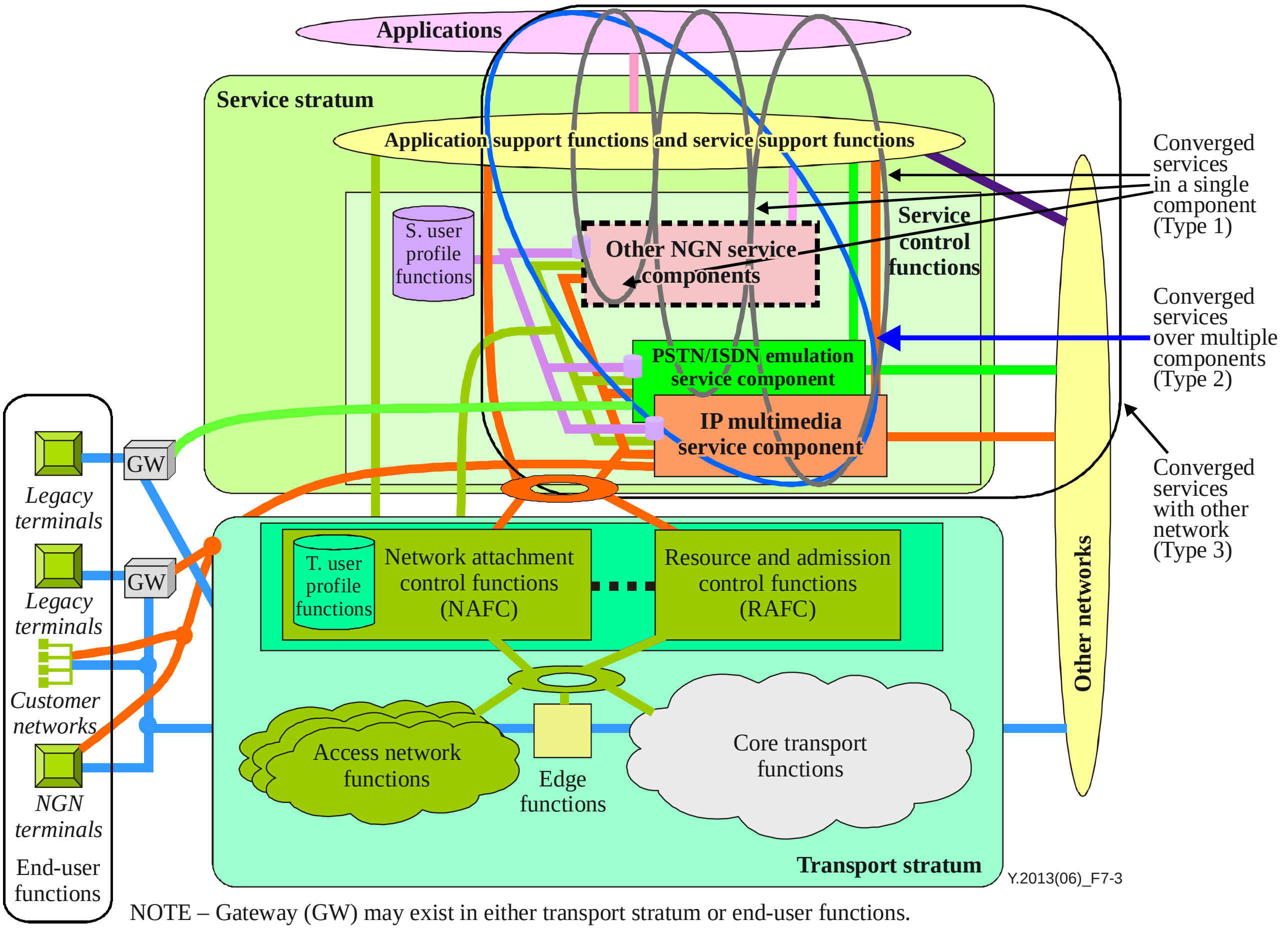
7.2 Service convergence types

Service convergence can be described as a set of services presented to the user by interworking or integrating component services, in single or multiple service component(s) of the NGN functional architecture [ITU-T Y.2012], to various types of terminals attached to various types of access networks, each with its own restrictions and capabilities.

In the context of CSF, service convergence can be described in several ways. Within this Recommendation, a classification based on the functional architecture point of view has been chosen leading to the following architectural types:

– Type 1: Converged service in a single service component (e.g., IP multimedia service component).
– Type 2: Converged service over multiple service components (e.g., IP multimedia service component + PSTN/ISDN emulation service component).
– Type 3: Converged service over multiple service components and other networks (e.g., IP multimedia service component + Internet service).

Figure 7-3 shows the three different types considered in this Recommendation for realizing converged services.



NOTE – Gateway (GW) may exist in either transport stratum or end-user functions.

Figure 7-3 – Converged services types

In order to illustrate the different types shown in Figure 7-3, scenario examples for type 1, type 2 and type 3 are described in clauses III.1, III.2 and III.3, respectively.

Appendix I

CSF use cases

(This appendix does not form an integral part of this Recommendation)

This appendix includes example use cases to highlight the functionality of the CSF.

I.1 Voice and presence service converged service

This use case describes the role that CC-FE plays in tracking user state (and location), recognizing the services that need to be executed when a user state changes and distributing that information when appropriate. It takes a core-network-centric implementation of CSF. It handles brokering of two services: presence (SIP-based service) and voice telephony (non-SIP-based service).

The dotted lines in Figure I.1 are CSF-internal flows.

Assumptions:

1) This flow only captures the interactions with the CSF system. The other interactions are only there for completeness of the use case.
2) The call flows shown are high level and not meant to show the actual protocol exchanges.
3) The NS-FE/legacy CN shown is merged together to simplify the use case scenario. The NS-FE keeps the state change information about the user and informs the CC-FE about it. Not all flows shown involve NS-FE but they do always involve some entities in the core network (CN).

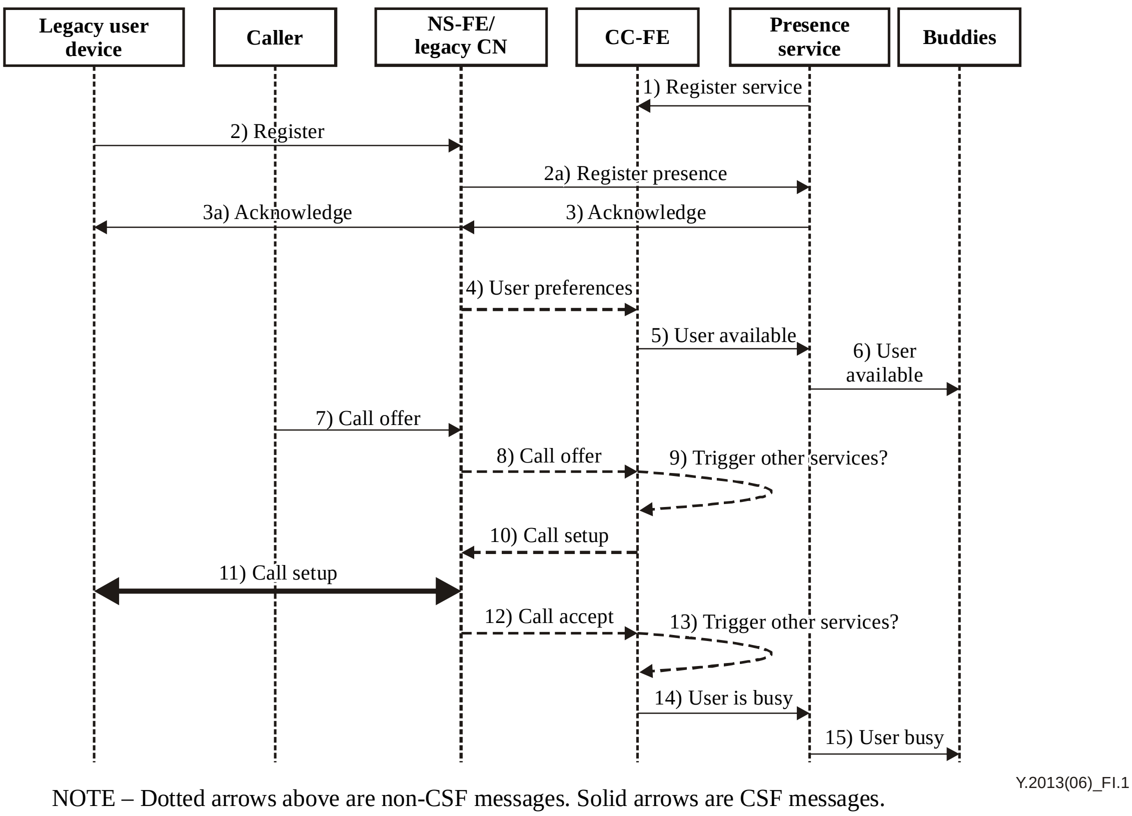


Figure I.1 – Voice and presence service converged service use case

Call flow description:

1) The presence service registers with CC-FE.
2) User device registers with the service provider.
3) Service provider network acknowledges the registration.
4) The NS-FE notifies CC-FE of user registration.
5) CC-FE notifies the presence service that the user device is registered and available for instant messaging.
6) Presence service notifies the users on the buddies list that the user is available.
7) A call is offered to the legacy CN for the user.
8) NS-FE relays the request to the CC-FE for the user.
9) The CC-FE determines that there are no terminating triggers registered for the device and that the user is available to take the call.
10) CC-FE informs the NS-FE in the CN to proceed with call setup.
11) Call setup takes place.
12) NS-FE notifies CC-FE that the call is accepted.
13) CC-FE reviews the users "subscribed services", identifies presence as a subscribed service, requiring a "presence" update when the user changes state and user preference for "do not disturb while on a call".
14) CC-FE forwards the user's "busy" state to the presence service.
15) The presence service forwards "not available' to the user's "buddies".

NOTE – The presence service retrieving the users buddy list from the HSS through the NS-FE is not shown in this example.

I.2 Call forwarding – Video conferencing converged service

This use case shows a service which coordinates a call forwarding service and a video conferencing service. When the user starts the video conferencing service, her/his terminal state changes to busy which causes the network to change its behaviour in reaction to future calls. At this time, if there are other incoming calls, they need to be automatically forwarded to an alternate terminal, and Figure I.2 shows the case.

The dotted lines in Figure I.2 are CSF-internal flows.

Assumptions:

1) This flow captures the interactions with the CSF system. The other interactions are only there for completeness of the use case.
2) The call flows shown are high level and not meant to show the actual protocol exchanges.
3) The NS-FE/CN shown is merged together to simplify the use case scenario. The NS-FE keeps the state change information about the user and informs the CC-FE about it. Not all flows shown involve NS-FE but they do always involve some entities in the core network.

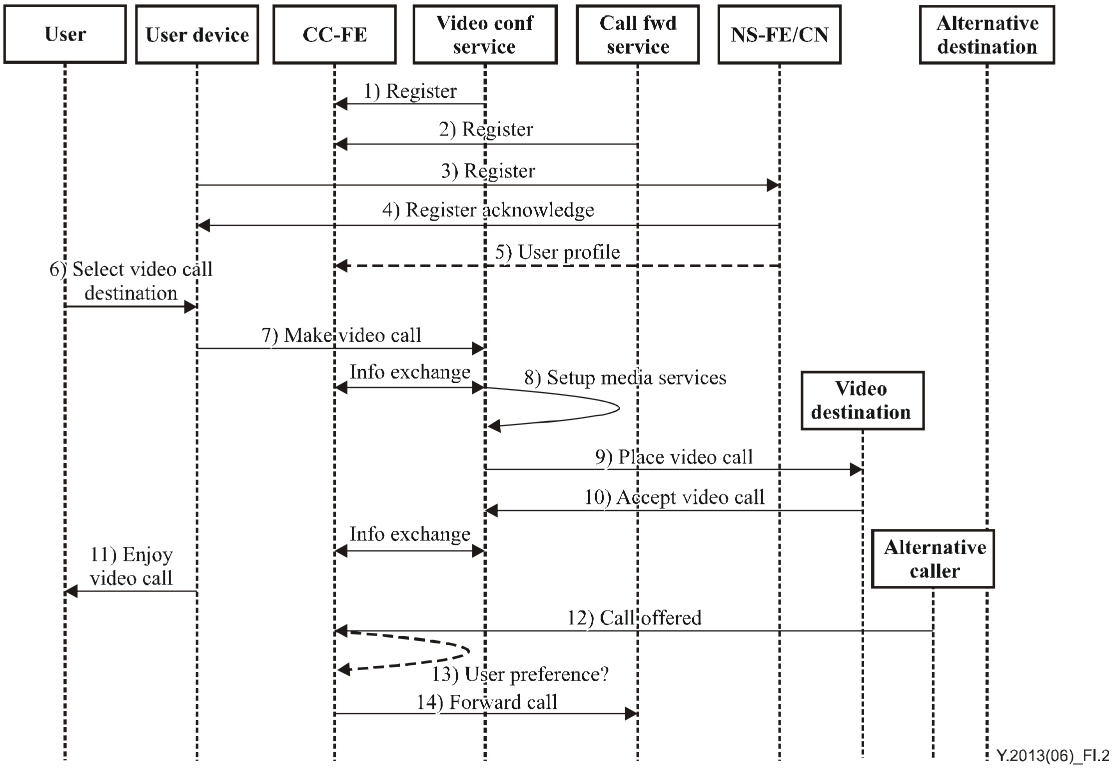


Figure I.2 – Call forwarding: Video conferencing converged service use case

Call flow description:

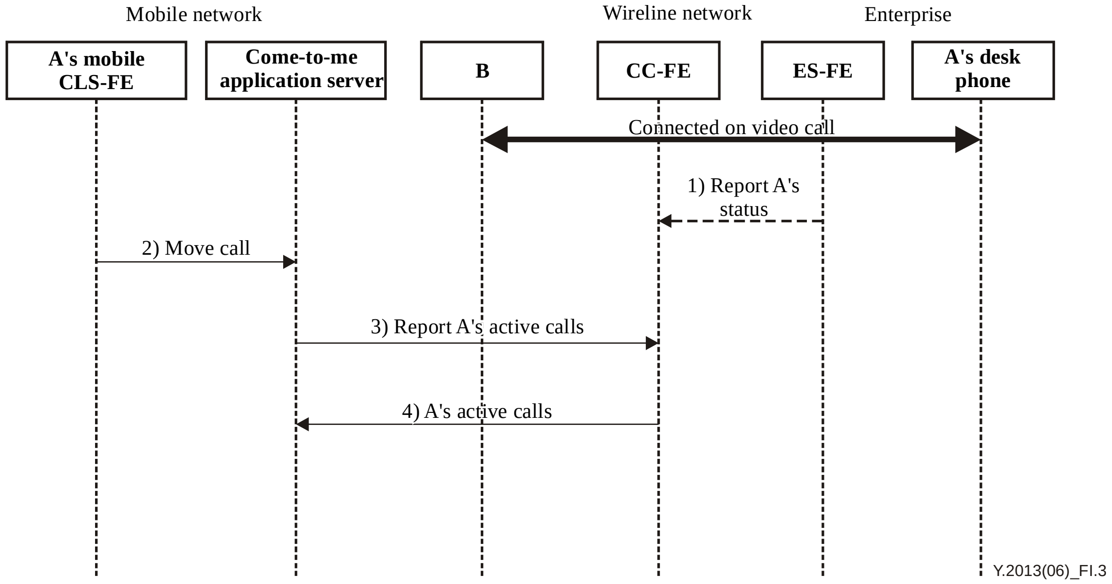
1) Register the video conferencing service with CC-FE.
2) Register call forwarding service with CC-FE.
3) The user device registers with the HSS through the NS-FE.
4) The HSS acknowledges the registration through the NS-FE.
5) The HSS sends CC-FE user profile information through the NS-FE.
6) The user initiates a video conference by selecting a group.
7) User device requests a video conference.
8) The video conference call service initiates the requisite media bridge services (reported to CC-FE).
9) Video conference service initiates legs of the conference call to each of the call recipients based on user and device state information provided by the CC-FE.
10) Recipients accept calls (reported to CC-FE).
11) Users enjoy their video conference.
12) The CC-FE is notified of another call addressed to the user through the NS-FE.
13) The CC-FE determines the user is busy and has a preference to forward calls while busy to an alternate device (may be voice mail, may be another user device).
14) CC-FE has call forwarding initiate a call to the destination designated in the user's profile.

NOTE – HSS is omitted due to space limitations.

I.3 Movement of conference call from a fixed client to mobile client

To provide service continuity across administrative domains it is necessary to provide a service coordination network entity (e.g., a CC-FE) that is aware of the user's state and can facilitate the join operation of a user's session across these administrative boundaries. Service elements in need of coordination are the user's available resources and device states on both sides of the two, or more, administrative domains. The service coordination network entity is responsive to service requests from either the fixed network or mobile network.

Figure I.3 presents a use case scenario in which "A" is in a video conference call with "B." "A" decides to leave his/her location but wishes to continue the conversation on a mobile device without interruption. "A" is able to push a button on the mobile phone and have the audio portion of the call move to the mobile phone automatically.



NOTE – Dotted arrows above are non-CSF messages. Solid arrows are CSF messages.

Figure I.3 – Movement of a conference call from a fixed client to a mobile client

NOTE – Dotted arrows above are non-CSF messages. Solid arrows are CSF messages.

Call flow description:

1) A's desk terminal is connected to B's phone on video call. An ES-FE in A's enterprise network notifies A's CC-FE about A's status. User A needs to walk out of office and continue with the voice part of the video call.

2) A's mobile device requests its "come to me" application to find its calls and move them to the mobile device.

3) The "come to me" application queries the CC-FE to gather the active calls associated with user A.

4) The CC-FE responds with the list of active calls compatible with A's devices, in this case a single video call between A's desk phone and B's phone.

NOTE – The transfer of the voice call from A's desk phone to A's mobile device is done by the networks and does not involve CSF functional entities and hence it is not shown.

I.4 Hybrid solution for a cross-network video + phone converged service (video on demand point of sale service using the CSF support and coordination functional entities)

The use case presented in this clause highlights some of the key features of the CSF with respect to media, mobility of content rights and transaction-based services. Additionally, it shows a flexible set of coordination models (third party, loosely-coupled operators).

I.4.1 VoD point of sale use case description

"User" is at hotel and has subscribed to high-speed wireless provided by "Operator 1". User also subscribes to a video service at home from "Operator 2" (also known as "MSO"). Operator 2 broadcasts its pay-per-view movie trailers over broadband wireless as a third party to Operator 1. User can buy these movies while watching the advertisement on the mobile device. The licence to view the movie can be obtained for viewing either:

i) only by the mobile device;

ii) for some default point of display (such as through a home set top box); or

iii) for multiple devices belonging to User (such as a laptop, a home HDTV, etc.).

If User were to choose an option including rights to view on the mobile device (such as option i), then this capability could be arranged between Operators 1 and 2 via Operator 2's CC-FE. This use case assumes that User buys a licence such that the movie can be viewed in all of his devices. User then chooses to watch it while at the hotel. While watching the movie, User gets a call and chooses to answer it. The movie pauses automatically or via an interface in the mobile phone. It resumes when User is done with the call.

I.4.2 Assumptions

1) User's mobile device has an application (referred to as client app in the following discussion) which is used to view the advertisements and order movies. It may be in the form of a web browser using a video viewer as a plug-in, and widgets for user directives (such as "buy movie") and preferences (such as "always buy a copy for my laptop").

2) There is a CLS-FE in User's laptop. The CLS-FE supports the interfaces and procedures that enable the CC-FE to access information about the point of display (POD), i.e., device capabilities such as display capability, availability of high-speed interface, etc.

3) There is a CC-FE that can identify and interact with all the CLS-FEs corresponding to User. Specifically the laptop in this case.

4) There is an application server (termed "VoD AS"), presumably provided by Operator 2, that has the information about the movies and can also identify and interact with the CC-FE.

I.4.3 Instantiation using a single CC-FE

The sequence of messages in Figures I.4.1 and I.4.2 provide an overview of one instantiation of the use case in the context of CSF.

Steps 1, 2 and 3 are application-specific and do not bear on the CSF description. As such, they are not described in detail.

Dotted arrows in Figures I.4.1 and I.4.2 are non-CSF messages. Solid arrows are CSF messages.

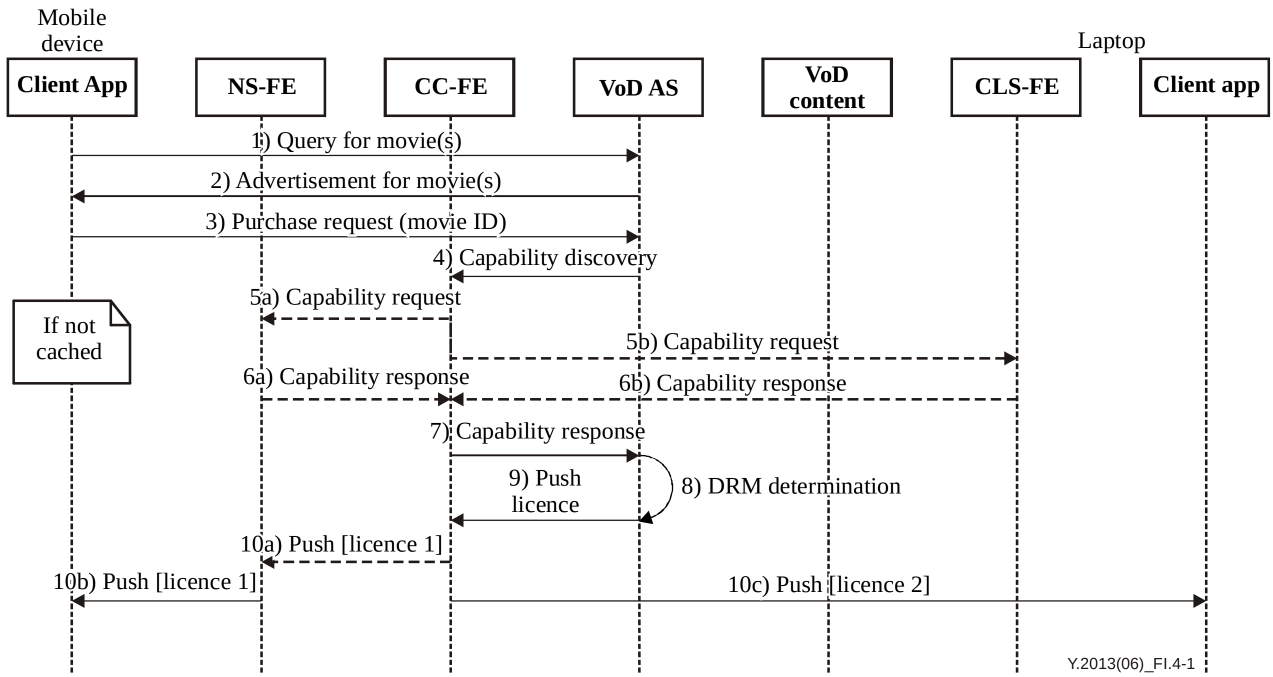


Figure I.4.1 – CSF use case: Video on demand point of sale

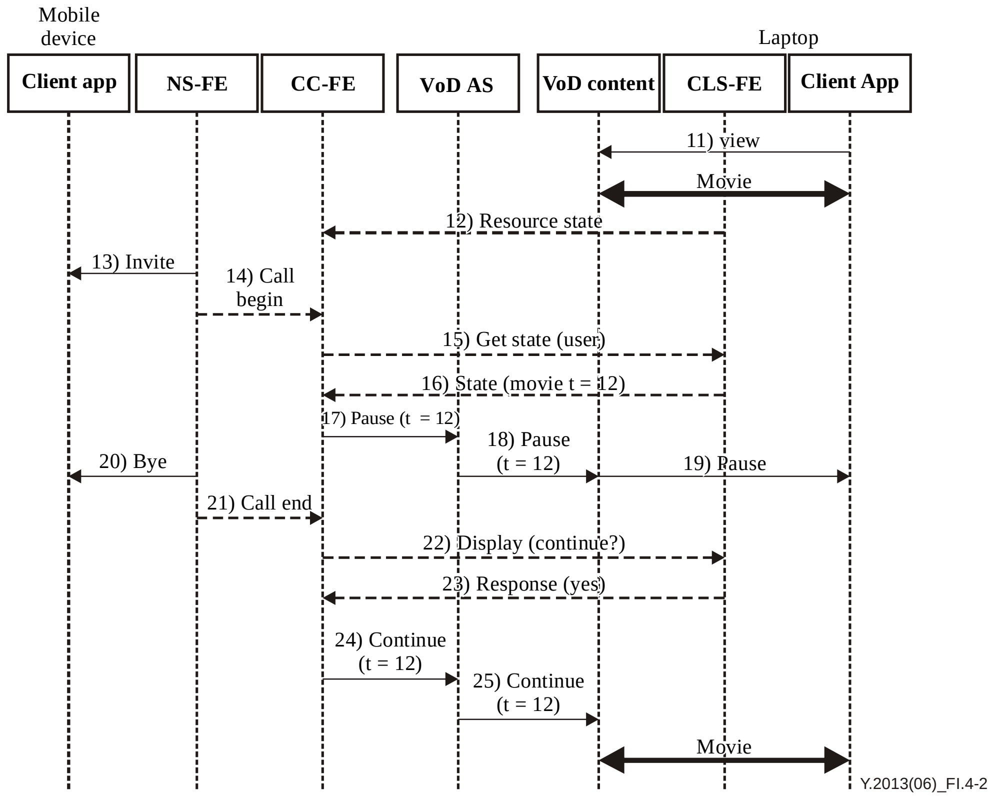


Figure I.4.2 – CSF use case: VoD with call session control

I.4.4 Call flow description

1) User sends a query from his/her mobile device to the multiple services operator (MSO) a.k.a. Operator 2, a VoD content provider, for the latest advertised movies. This query is received by the VoD application server (AS) owned by the MSO.
2) The VoD AS responds with the list of latest advertised movies to User.
3) User decides to order a selected movie from the advertised list of movies. The application in the mobile device informs the VoD AS of User's intention to buy the selected movie.

At this point, to complete the transaction, the VoD AS needs to determine what devices are available to User, what formats can be used on each of User's devices, and the required digital rights to use the purchased content. In other words it needs to know the capabilities of the mobile device, as well as other user resources, such as a laptop to view the movie or a TV at home connected to a set top box (STB).

4) The VoD AS queries the CC-FE to determine the display capabilities and preferences associated with User to view the movie.
5) In response to the query from the VoD AS, the CC-FE requests information about other user resources associated with the user ID (in this case the mobile device and laptop).
   a) CC-FE requests the mobile device's serving NS-FE to obtain point of display (POD), i.e., device capabilities such as display capability, availability of high-speed interface etc., of User's mobile device.
   b) CC-FE requests the laptop's CLS-FE to obtain POD, i.e., device capabilities such as display capability, availability of high-speed interface, etc., of User's laptop.
6) The support functions respond to the CC-FE's request:
   a) Mobile device's serving NS-FE returns to the CC-FE the requested mobile device's POD resource capability information.
   b) Laptop's CLS-FE returns to the CC-FE the requested User's laptop POD resource capability information.
7) The CC-FE provides the VoD AS with the requested information about each of User's associated devices that may be used to view the converged services managed movie.
8) VoD AS conducts the DRM determination for the user.
9) Based on the response from the CC-FE, the VoD AS constructs a licence appropriate for each individual user device. The VoD AS sends the CC-FE the resulting composite message containing all the appropriate licences; this is a required action due to the VoD AS not being a peer to all of User's devices.
10) The CC-FE sends the licences to the appropriate user devices.
11) The laptop viewer contacts the VoD content server to begin streaming the video. A VoD session is established between the content server and the laptop client application.
12) When the video session starts, the laptop CLS-FE detects this and pushes an unsolicited resource state response message to the CC-FE.
13) A phone call comes to User's mobile device, and User answers the call.
14) The NS-FE receives a trigger from the S-CSC-FE in cellular operator's IMS network, based on the mobile device's state change and sends a session response message to the CC-FE notifying the call state.
15) The CC-FE issues a get state resource request to User's laptop CLS-FE.
16) User's laptop CLS-FE responds with a time marker of when in the video stream the get state request was received and sends it to the CC-FE.

17) After CC-FE receives the state info from CLS-FE, it sends a PAUSE command to the VoD AS to instruct it to PAUSE the streaming of the video.

18) The VoD AS informs the VoD content server of a request to PAUSE streaming of video.

19) The streaming of video is paused.

20) The call ends.

21) The NS-FE notifies the CC-FE that the call has ended.

22) The CC-FE determines the appropriate CLS-FE to contact and sends the display restart request information to User's VoD display.

23) The laptop CLS-FE sends its user-defined response to the CC-FE.

24) The response is then sent to the VoD AS. In this use case we assume that User wishes to continue the viewing of the movie from the point of the call.

25) The VoD AS then sends the appropriate signal to the VoD content server to continue streaming of the movie.

NOTE – If pausing is based on user inputs, the CC-FE may add the information to the INVITE, i.e., the INVITE may have embedded information that would be given to the CLS-FE if User answers the call. The embedded information would be processed by CLS-FE in the client device and prompt User to "pause movie? Yes or no". This response would be sent by the CLS-FE to the CC-FE which in turn can talk to the VoD AS, if needed.

I.5 Integrating information to improve customer service

I.5.1 Assumptions

1) There are several enterprise domains involved: an airline, an airport WLAN operator, a cellular operator and a passenger's business.

2) The passenger's business holds his calendar which includes travel events.

3) The airline has several enterprise applications:

   a) The "passenger boarding status application" helps identify passengers who hold confirmed seats but who have not yet passed through the gate to the plane (correlated by electronically reading the boarding passes).

   b) The "passenger locator" application can resolve WLAN and cellphone registrations to determine if the devices are within the airport terminal.

   c) The "passenger data" application provides the airline's other applications with controlled access to passenger data, including methods of contact for notifications.

4) The airport operates a WLAN service that cooperates with each of the local cellular operators to provide high-speed access to cellular customers with dual mode phones while within the airport boarding areas.

5) The cellular operator provides:

   a) A "location service" that allows partner applications to request the latest position fix on a cellphone.

   b) A "travel manager" application that coordinates e-ticket transactions with the subscribers preferred airline(s) to expedite their travel needs.

   c) An "enterprise integration" application that allows enterprise applications to stimulate the cellular network to perform tasks.

I.5.2 Step-by-step: Phase 1 – Getting a boarding pass while driving to the airport

See Figure I.5.1.

1) A passenger's time-based "business calendar" application contacts the cellular operator's CC-FE to notify the passenger's personal location-capable "travel manager" application (provided by the cellular operator) that the passenger needs a boarding pass for his flight.

2) The cellular operator's "travel manager" application confirms the user is on the airport ramp and contacts the airline to confirm travel and acquire a boarding pass.

3) The airline "boarding pass" application confirms the passenger's travel plans with the airline's "passenger data" application.

4) The airline "boarding pass" application contacts the cellular operator's "travel manager" application to authorize the user and forwards the boarding pass to the "travel manager" application.

5) The cellular operator's "travel manager" application forwards the electronic boarding pass to the user's cellphone for storage.

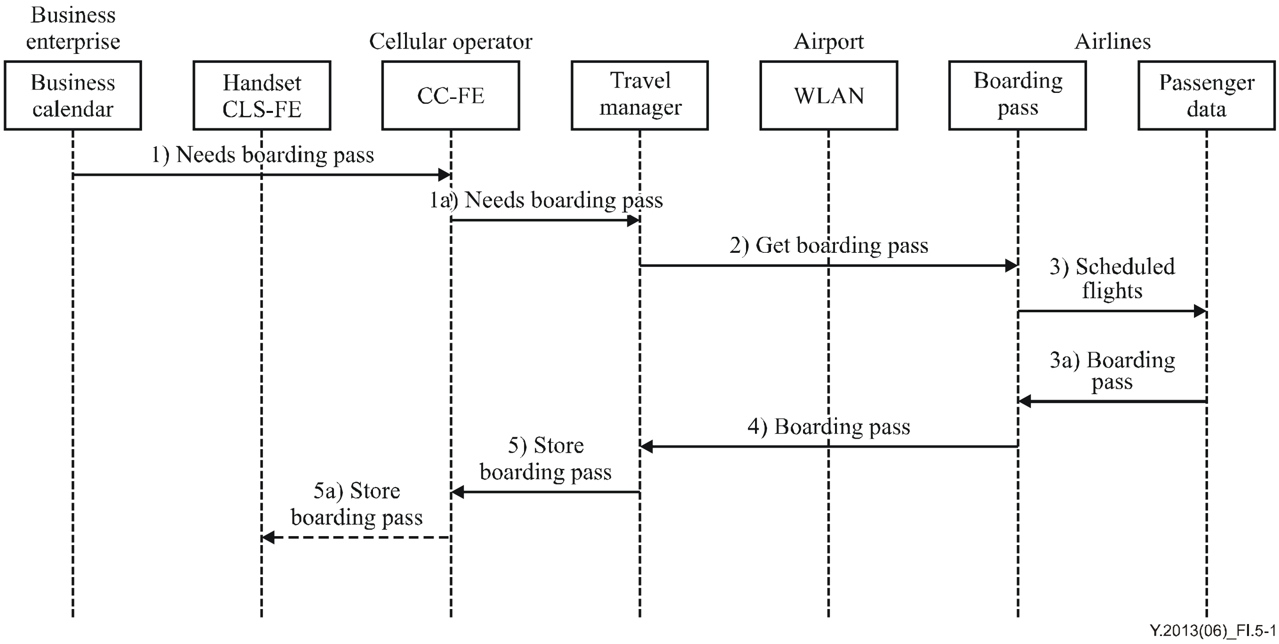


Figure I.5.1 – Getting a boarding pass

I.5.3 Step-by-step: Phase 2 – Boarding the plane

See Figure I.5.2.

1) (Some time later) The airline's gate agent finishes boarding the passengers waiting in the gate area and requests a report on the status of boarded passengers, which indicates that one passenger with a boarding pass has not boarded the plane. To expedite departure the gate agent invokes the airline's "passenger locator" application. The "passenger locator" application asks the "passenger data" application for methods of contact to the passenger.

2) The "passenger data" indicates that the passenger carries a dual mode cellphone, and provides the requisite identity information.

3) The "passenger locator" application requests notification from the airports WLAN operator for registrations of the passenger's WLAN identity within the airport for the next 10 minutes.

4) The WLAN registry responds that the passenger is not currently in the airport WLAN coverage.

5) The "passenger locator" application requests the passenger's location from the CC-FE indicated by contact information in the passenger's data.

6) The CC-FE responds with last known location of the passenger, i.e., the entrance of the airport terminal, at a time 20 minutes ago. Meanwhile, the passenger works his way through security at the airport.

7) Exiting security, the passenger's dual mode cellphone attempts to register with the airport's WLAN.

8) The airport's WLAN registry identifies the passenger's cellphone ID and immediately notifies the airlines "passenger locator" application that the passenger has registered with the AP beyond the security area.

9) The "passenger locator" application notifies the gate agent that the passenger has just cleared security.

10) The "passenger locator" application calls the gate agent and passenger (on his (now WLAN-registered) cellphone) simultaneously and the agent informs him of the gate number and that the plane is waiting on him for departure.

11) Once the passenger is in the gate area his cellphone forwards his electronic boarding pass to the ticket counter and the CLS-FE on the cellphone communicates the transaction to the CC-FE, clearing the user state for the boarding pass/locator.

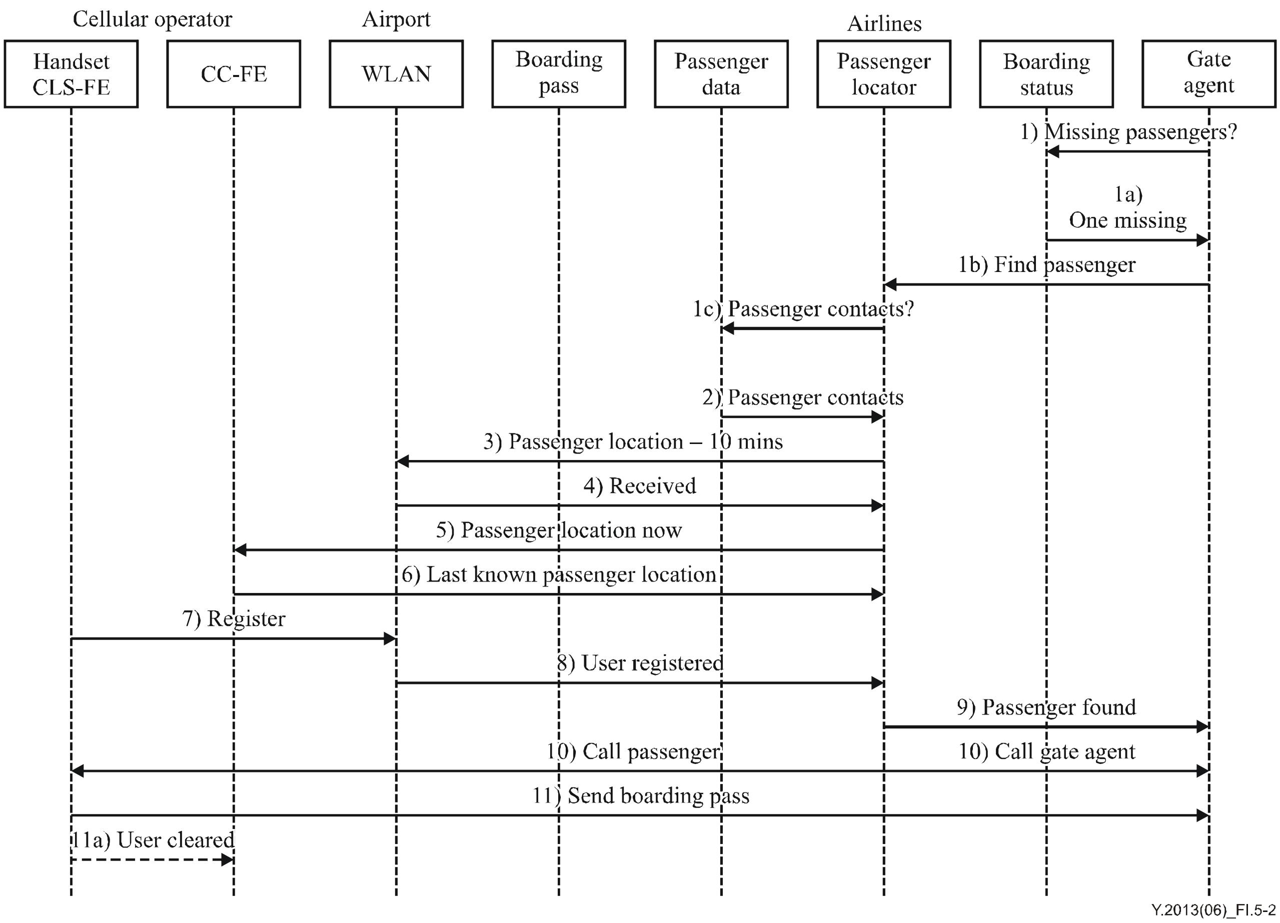


Figure I.5.2 – Boarding the plane

Appendix II

Standards related to CSF

(This appendix does not form an integral part of this Recommendation)

II.1 CSF relationship to OSA/Parlay

The CSF defines an architectural framework that provides a coherent view of information available at different network entities across dissimilar networks, with one benefit being easier creation of new services that provide a seamless user experience across multiple networks. A salient feature of the framework is that it accommodates and uses functions resident in the core network, edge devices and end user devices. The CSF framework is further concerned with enabling smooth and consistent operation of applications across disparate networks, be they NGN, legacy or other.

While a Parlay/OSA gateway provides access to information available from one or more points in a given network, the CC-FE obtains the information from multiple networks, processes them and then provides the processed information to the applications in a manner that significantly reduces the complexity of interacting with these multiple and heterogeneous networks directly.

While Parlay/OSA allows creation of applications that function in multiple networks, CSF allows the application to function smoothly and consistently when users, devices or sessions cross the boundaries of networks or administrative domains.

II.2 CSF relationship to OMA and OSE

OSE (OMA service environment) describes the logical interactions to, from and among OMA enablers and describes a logical architecture for OMA enabler implementations. It is a conceptual environment that provides interfaces to applications (interfaces I0 or I0+P), interfaces to service providers' execution environments (I1) and the interfaces to invoke and use underlying network capabilities and resources for enabler implementations (I2).

OSE focuses on service stratum, while CSF suggests functionality which exists in the core network, edge devices and terminals. OSE works on the convergence of widely deployed services and applications. It is network-resource-independent. OSE does not mention any part of the convergence of underlying the network. CSF is concerned with how to reach convergence at an underlying network. It aims to provide a smooth and consistent user experience.

II.3 CSF relationship to underlying networks

In some CSF instantiations, a network support functional entity (NS-FE) is resident in the underlying network and is administered by the operator of that network. In this case, it is helpful to illustrate the relationship of the NS-FE to the underlying network.

II.3.1 Example: CSF in an IMS-style network

An example of which components of IMS are used by the CSF, and how they extend the IMS specification set is provided below.

The CSF operates across multiple transport and service control networks. In interacting with IMS, the CSF may act like an application server (AS) and utilize the interfaces defined for an AS. Specifically, an NS-FE uses the ISC interface to interact with the S-CSCF and obtain triggers to discover and modify sessions destined to, or originated by, a user.

In the IMS release 6 [b-TS 23.228], S-CSCF via the ISC interfaces directly with application servers. The AS selection is based on initial filter criteria (iFC) which are in turn based on predefined service point triggers (SPT) in the home subscriber server (HSS).

With the addition of a CSF overlay, the trigger criteria will have available a richer set of information through the convergence coordination functional entity (CC-FE), such as session and resource state of the user across multiple, and heterogeneous networks. The CSF also enables identity management features that enable AS to be independent/unaware of the identities of the users in individual networks.

The CSF allows the session/resource state to be provided to applications via an interface.

The NS-FE may use the S_h interface to interact with the HSS and to obtain information about the user and devices associated with the user in the IMS domain.

In large networks with multiple HSSs, the NS-FE may use the D_h interface to interact with the subscription locator function (SLF) to discover an HSS possessing user information.

The NS-FE uses the U_t interface to interact with the UEs. This interface is used to interact directly with an IMS UE to obtain user inputs, preferences and state of devices from the UE. Alternatively, a CC-FE may use the CSF interface $I_{C\text{-}CL}$ to communicate with the client support functional entity (CLS-FE) in the UE to obtain user inputs and preferences and the states of devices from the UE.

It is also possible for the NS-FE to be incorporated within, for example, the S-CSCF. If implemented in this way, the NS-FE should behave in a manner consistent with the NS-FE-to-CC-FE interface. The NS-FE-IMS interface may disappear from definition, or may need to be enhanced. This is a subject for further study.

II.3.2 Example: CSF in a wireline-style network

An example of which components of a wireline-style network are used by the CSF is provided with reference to the CableLabs' PacketCable Multimedia Specification [b-PKT-SP-MM].

The CSF is intended as an overlay across transport and service control networks. In interacting with PCMM, the CSF may act like an application manager (AM) and utilize the interfaces defined for an AM. Specifically, a PCMM-specific NS-FE uses the pkt-mm-3 interface to interact with the PacketCable policy server (PS) and obtain rights for different flows traversing this access network.

Additionally, the policy server is the point of contact with the CSF for interaction with protected components such as the PacketCable record keeping server (RKS).

The NS-FE uses the mm-7 interface to interact with the client (a term specified in PCMM). This interface is used by CSF to interact with the client support function (CLS-FE) to directly obtain user inputs and preferences and the state of devices from the client. Alternatively, a CC-FE may use the CSF interface $I_{C\text{-}CL}$ to communicate with a client support functional entity (CLS-FE) in the client to obtain user inputs and preferences and the state of devices from the client.

It is also possible for the NS-FE to be incorporated within, for example, the PCMM PS. If implemented in this way, the NS-FE should behave in a manner consistent with the NS-FE-to-CC-FE interface. The NS-FE-PCMM interface may disappear from definition, or may need to be enhanced. This is a subject for further study.

Appendix III

Examples of three converged service types

(This appendix does not form an integral part of this Recommendation)

NGN defines multiple service components to provide a wide variety of services. It is the aim of the CSF to present converged services of more than one service across the service components to users in a unified manner.

Such capabilities to converge services for a subscriber by coordinating, collecting and binding a user's status information from each service component, is defined separately in this CSF Recommendation from the NGN functional architecture. This means current release 1 NGN functional architecture does not fully incorporate the converged control capabilities in each FE.

This appendix describes several examples of converged type scenarios and also presents the relationships between CSF functions.

III.1 Type 1 example: Converged service in a single service component

In the case of a single service component such as of an IP multimedia service component, multiple services must be invoked and coordinated.

For the originating party, the origination call screen and number translation services are sequentially invoked and processed. Then, for the terminating party, call forwarding on no-answer and voice mail services are invoked in sequence.

In this case, two originating services and two terminating services are converged for the originating and the terminating subscriber, respectively.

The CC-FE coordinates the interoperation between multiple services based on the converged service subscription information provided by the NS-FE, shown as part of the SUP-FE (e.g., HSS) in Figure III.1.

Also, the CC-FE decides upon the converged service control based on the user's presence and preference information from the NS-FE in the SUP-FE or AS-FE (e.g., presence server). For example, the CC-FE may decide not to invoke call forwarding on no-answer, but connect to the voice mail server (VMS) instead.

Although the APL-SCM-FE function is defined to manage interaction between multiple application services, it only considers coordination based on the iFC through S-CSC-FE.

However, the CC-FE makes use of more information (e.g., a user's status) collected from various network parts such as presence server, than simple subscription information in iFC.

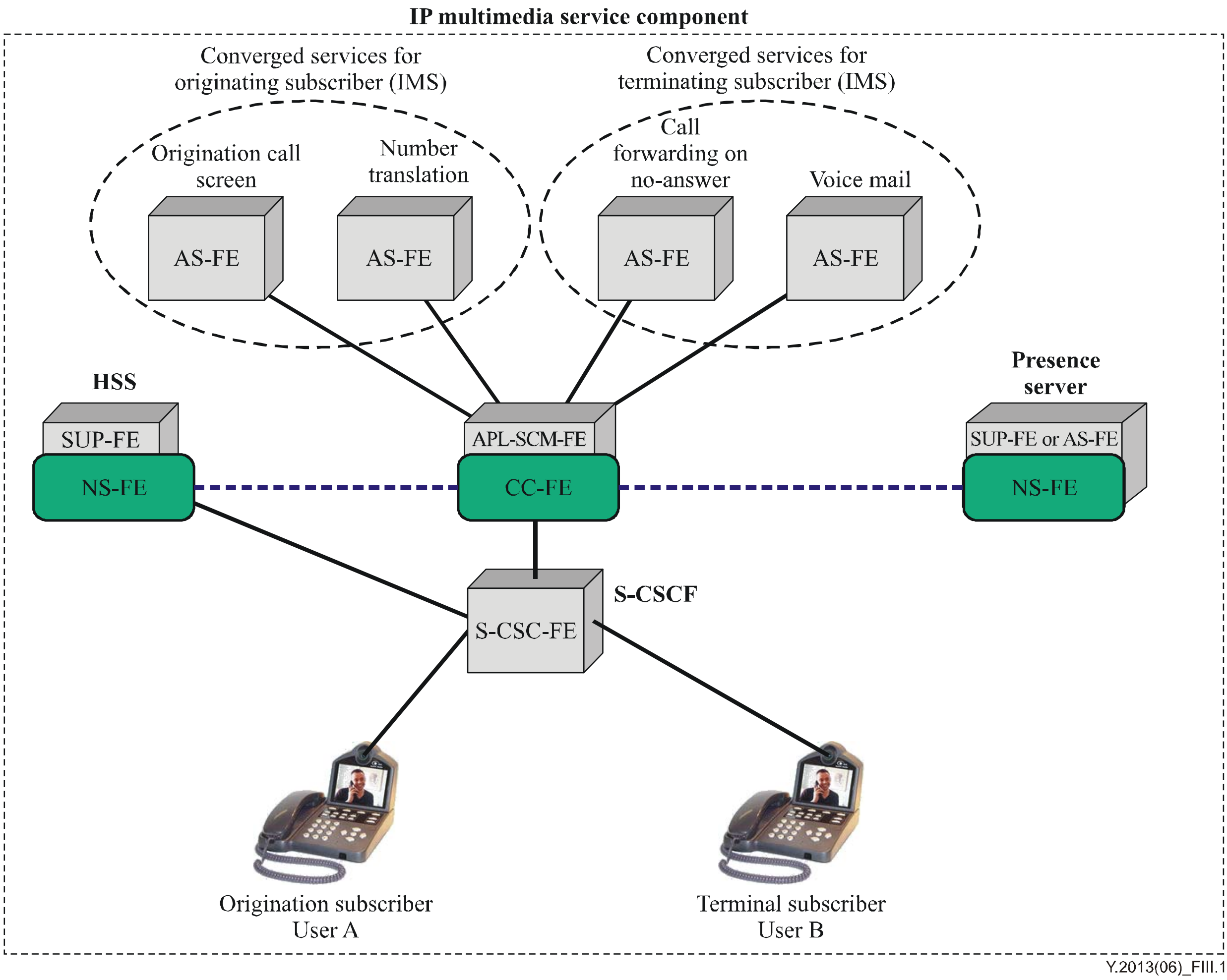


Figure III.1 – Converged service example in a single service component

III.2 Type 2 example: Converged service in multiple service components (PIEA + IMS)

In this example, service convergence is achieved across multiple service components, the first being a PSTN/ISDN emulation (PIEA) service component and the second being an IP multimedia service component.

User A has both a POTS and IP phone and subscribes two services, caller ID and number translation. Through service convergence, it should be possible to access the same services from each phone.

When user A requests a call from the POTS phone, the basic caller ID and number translation services in PIEA are invoked. In the case that user A requests a call using the IP video phone, the multimedia caller ID and number translation services will be provided by IMS.

Since the user subscribes over multiple service components, the interaction management function of the CC-FE is required between different service components or administrative domains.

To retrieve each profile for the user, the CC-FE refers to the NS-FE in the PIEA SUP-FE or the NS-FE in the IMS SUP-FE (e.g., HSS), according to the user's network.

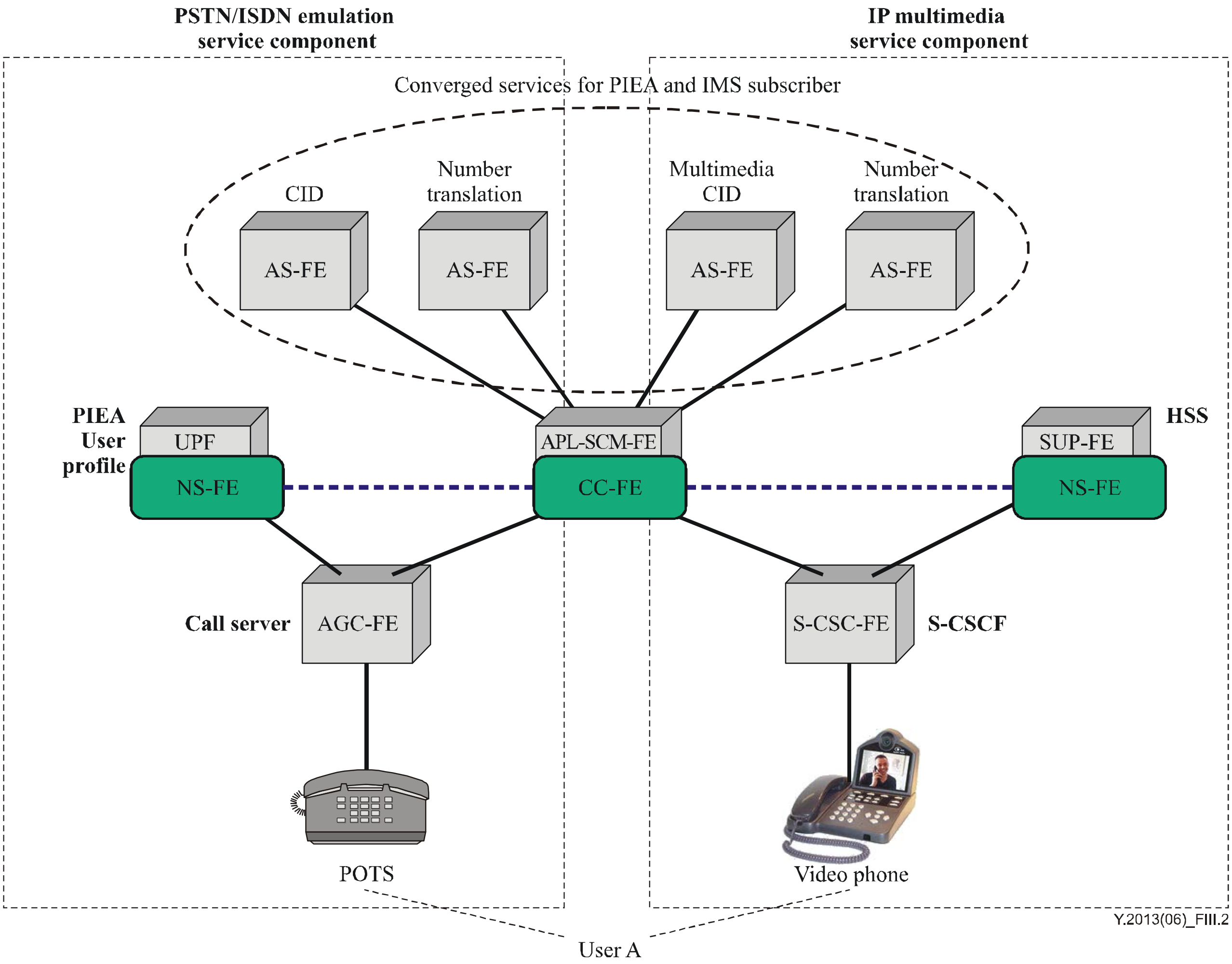


Figure III.2 – Converged service example in multiple service components (PIEA + IMS)

III.3 Type 3 example: Converged service with other network – IMS + Internet IM server

This example shows the converged service for multiple service components of an IP multimedia service component and an unspecified "other network", such as the Internet.

Figure III.3 (a) shows VoIP + IM converged service scenario:

– User A has a video phone and an Internet-connected PC on which he/she uses an instant messenger (or calendar, or similar service).

– When user A's phone establishes a call connection, the 'busy' status is notified to CC-FE. The CC-FE sends that information to an NS-FE in the instant messenger or calendar server. The user's status of the IM or calendar is changed to be 'busy'.

– Conversely, when the user A makes the status 'busy' in the IM or calendar, it informs the CC-FE, and the CC-FE notifies the NS-FE in S-CSC-FE. Then user A's video phone status becomes busy. Therefore, if an incoming call arrives, the calling party receives the busy tone for user A.

– As an alternative interworking method with IM service, the CLS-FE in the user's PC may notify the user status to the CC-FE.

Figure III.3 (b) illustrates game + IM converged service scenario:

– When user A connects to a game server, three alternative notifications to CC-FE are possible: (1) from the CLS-FE on the phone; (2) from the ES-FE on the edge node; (3) from the NS-FE on the game server.

– For (2), the ES-FE in the edge node FE monitors the video phone's out-stream packets to the network based on the source IP and/or port number. Detecting such packets, ES-FE notifies CC-FE that user A's video phone is busy (for any 'data' services other than VoIP) and then CC-FE notifies NS-FE on the IM server, which becomes aware that user A's status is 'busy'.
– Although it is not shown in the figure, the CC-FE may reside on the terminal for the enterprise, home network services and peer-to-peer service, such as personal broadcast service.
– To allow intercommunication between these two networks, the CSF glues the NS-FE/CC-FE/CLS-FE/ES-FE in each network through CC-FE.

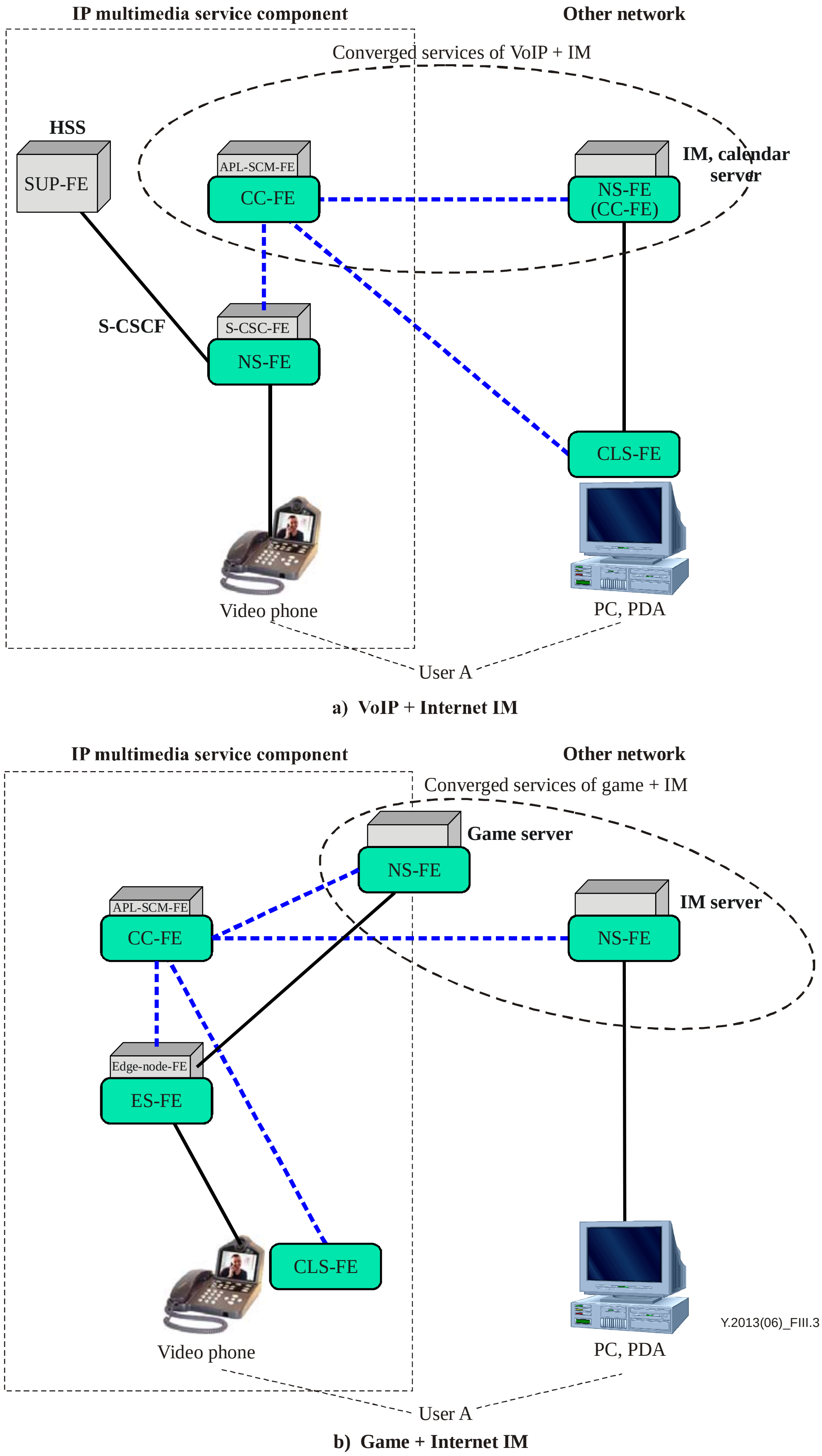


Figure III.3 – Converged service example with other networks

The dashed lines in Figure III.3 correspond to the interfaces between CSF functions.

Appendix IV

CC-FE to CC-FE interworking description models

(This appendix does not form an integral part of this Recommendation)

The converged services framework (CSF) is an architectural framework intended to provide converged NGN services. The CC-FE (convergence coordination functional entity) is a core component of the CSF and it supports coordination control and processing of necessary information in order to provide converged services.

Typically, the converged services are thought to be provided by a service provider in an administrative domain and, in that case, there will be one CC-FE in a domain.

By relating multiple CC-FEs, it is possible to provide converged services across domains; with the CC-FE to CC-FE relationship, it is possible to integrate the converged services of multiple and distributed service providers, market segments and/or administrative domains.

In order to describe the usefulness of interworking between CC-FEs, three convergence models are presented.

IV.1 Hierarchical convergence model

In a hierarchical distribution, the span of control for CC-FE is organized into a hierarchy. Figure IV.1 depicts a hierarchical model of the convergence architecture. In this case, services integrated by lower level CC-FEs are accessible and under the control of a higher level CC-FE.

For example, the personal services at the lowest level provide individual feature services, such as IM and video phone, to users. The project services of the second level hierarchy will include project features, such as conference call service, and it also includes personal-level services. For a subscriber with the converged services provided at the company level, CC-FE will include all the services integrated by the lower level CC-FEs: it includes company, project and personal features.

In this way, the CC-FE can converge lower layer converged services.

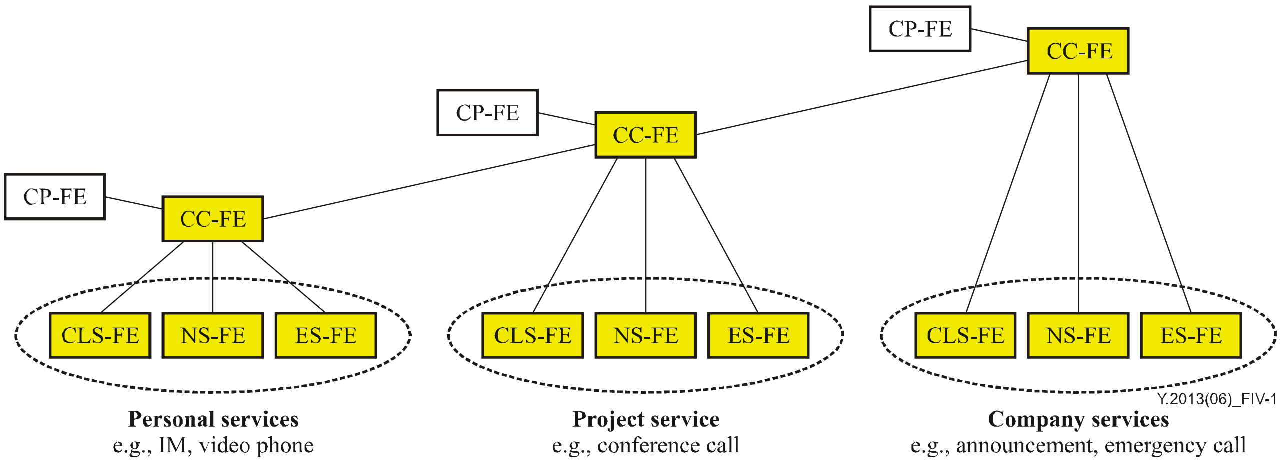


Figure IV.1 – Hierarchical convergence model

IV.2 Master-slave convergence model

In a master-slave distribution, a single CC-FE acts as a master controlling a collection of CC-FE slaves. Figure IV.2 shows the master-slave convergence model. The master CC-FE can control and provide converged services including services that a slave CC-FE provides. This is a typical way for network/service operators connecting and integrating with third party service providers.

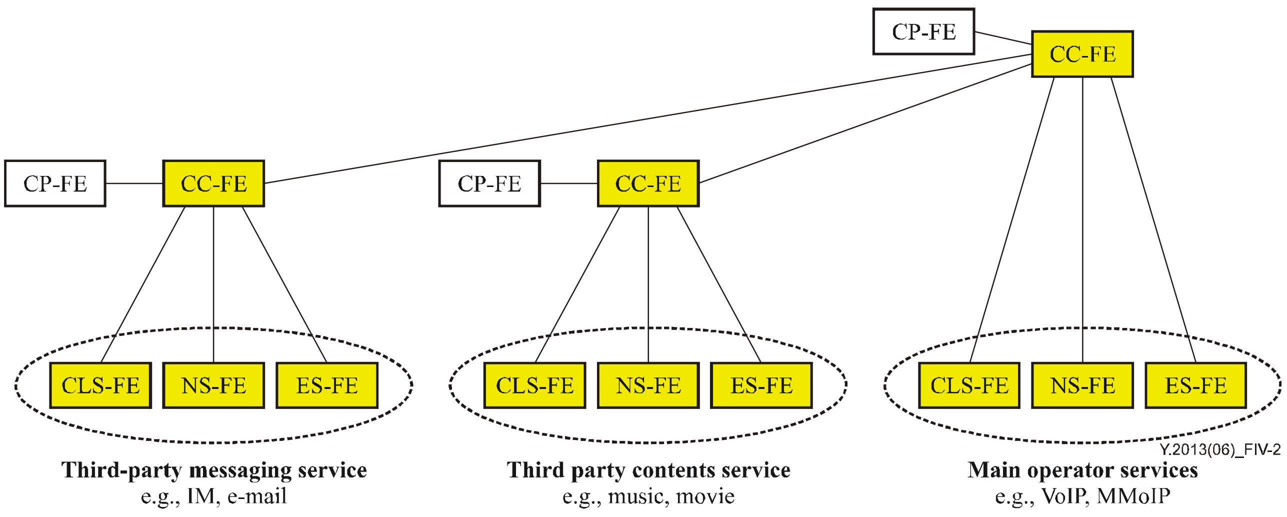


Figure IV.2 – Master-slave convergence model

IV.3 Peer-to-peer convergence model

In peer-to-peer distribution, all CC-FEs can access and coordinate the services integrated by their peers. This type of distribution typically bundles services to specific needs of a market segment. Figure IV.3 illustrates the peer-to-peer convergence architecture. In this case, there are three classes of converged services integrated for mobile, fixed and data service operators. With these relationships, operators can support bundled services of each operator.

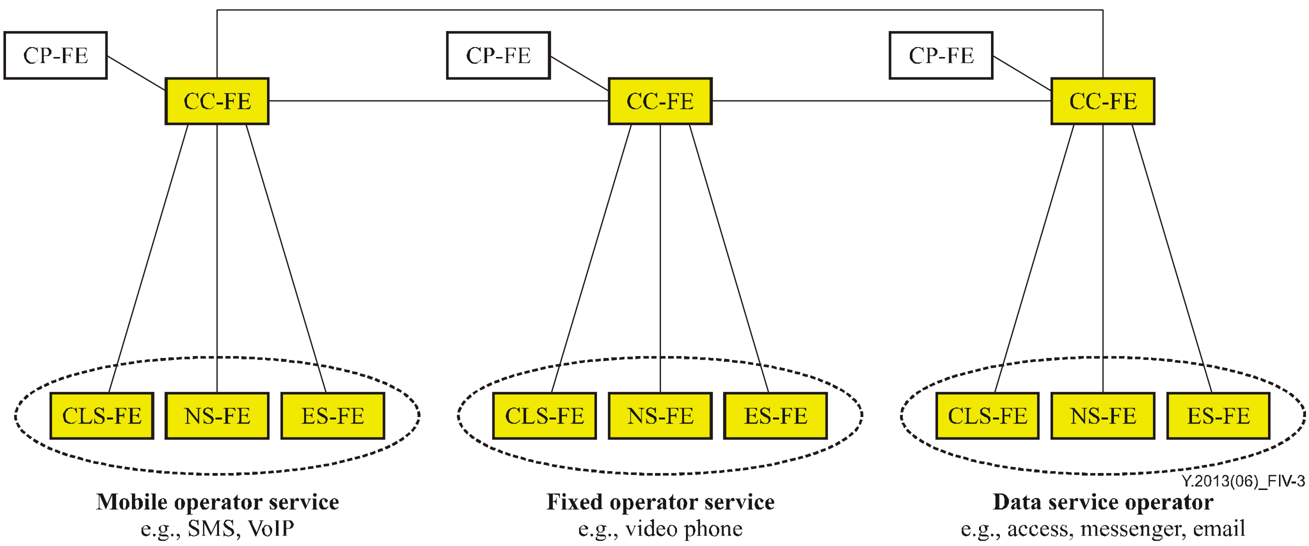


Figure IV.3 – Peer-to-peer convergence model

Although it is not exemplified, the case of CC-FE positioned in the NGN terminal is also possible in all convergence models presented.

Appendix V

CSF configuration models

(This appendix does not form an integral part of this Recommendation)

The CSF is an architecture which can be configured in different ways to accommodate existing and future access and service networks. This clause provides two typical examples of the possible physical locations of the CC-FE and its support functions (CP-FE, NS-FE, ES-FE and CLS-FE). Figures V.1 and V.2 further convey the logical and physical communication paths of the CC-FE to its support functions, and the logical and physical communication paths for the CC-FE to the access networks and their applications.

The first CSF example shown is for coordination between a PSTN and a WMAN network.

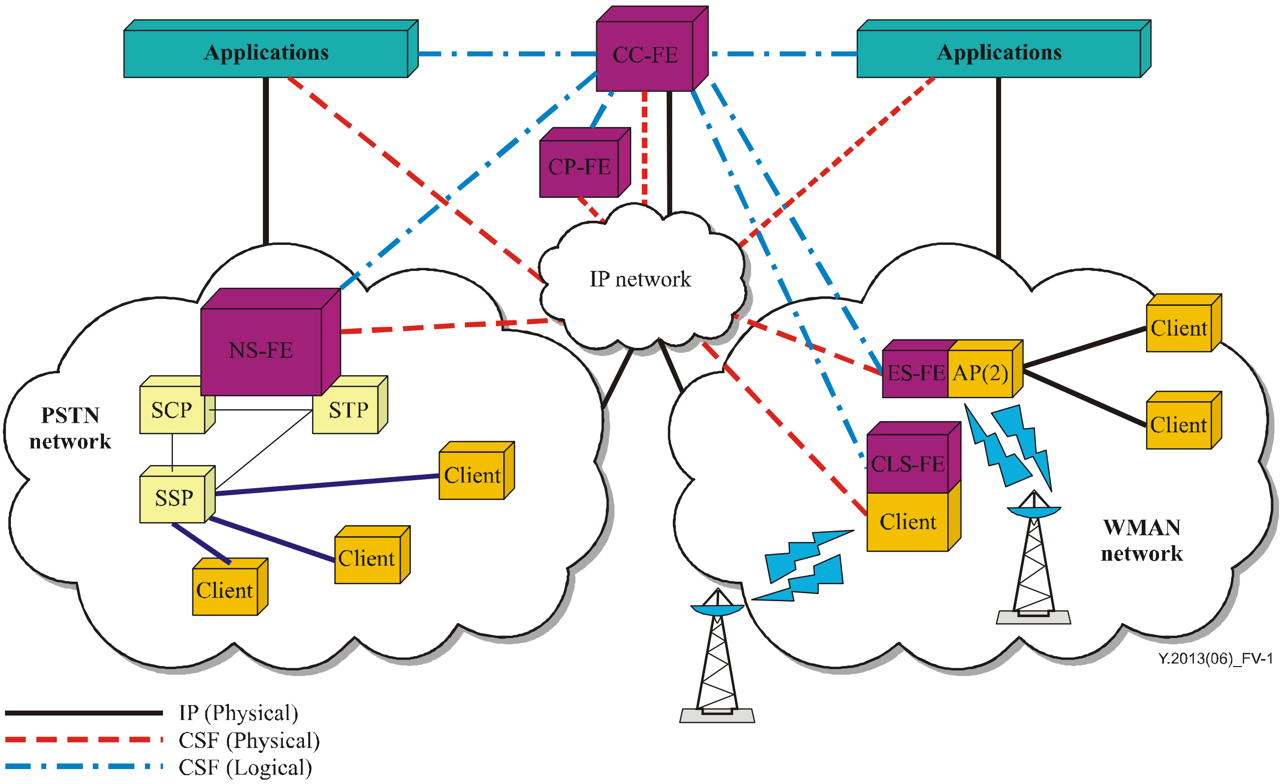


Figure V.1 – Example 1, CSF coordination for PSTN and WMAN networks

The second CSF example shown is for coordination between a PSTN and a cable-based call control network.

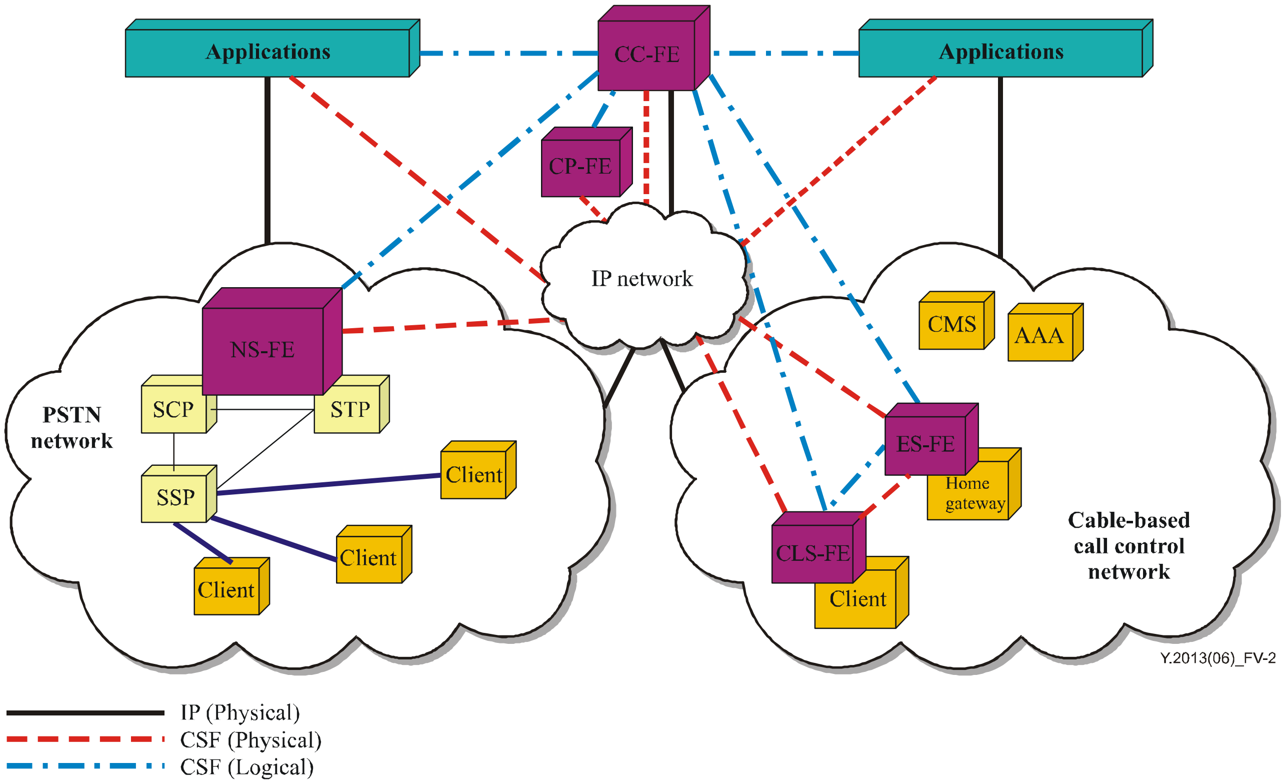


Figure V.2 – Example 2, CSF coordination for PSTN and cable networks

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