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Next Generation Networks – Service aspects: Service
capabilities and service architecture

**Converged web-browsing service scenarios
in NGN**

Recommendation ITU-T Y.2235

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Converged web-browsing service scenarios in NGN

Summary

Recommendation ITU-T Y.2235 describes converged web-browsing (CWB) capabilities for NGN. CWB capabilities are based on web-based application support built on NGN release 1 (see Recommendation ITU-T Y.2201), with the aim to provide users with a consistent web environment which spans multiple network environments and multiple devices (PC, laptop, PDA, cell phone, etc.).

CWB provides advanced web-browsing capabilities in different NGN devices and various network environments, including profile-based content adaptation capabilities. The CWB capabilities enable client device (e.g., web browser) of NGN to browse web content effectively, regardless of device and network types.

This Recommendation identifies web-browsing capability requirements, provides a functional model and service scenarios making use of converged web-browsing capabilities.

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CONTENTS

Introduction

In NGN environments, web-based applications allow enhanced utilization of device capabilities and network characteristics [ITU-T Y.2201]. Web-browsing is one of the most popular web-based applications, and it is likely to be widely used in NGN environments.

In NGN environments, however, traditional web-browsing capabilities may indeed cause failure of a user's device, due to different types of devices (e.g., different screen size or resolution, etc.) and networks (e.g., roaming to different access network: CDMA, WLAN, WiMAX, Bluetooth, etc.).

To support the web-browsing capabilities in NGN environments, it is required to provide profile based web-browsing capabilities with content adaptation.

Converged web-browsing (CWB) capabilities enhance the web-browsing experience in terms of supporting different devices (e.g., mobile phone, smart phone, ultra mobile PC, laptop, etc.) and various access networks in NGN.

Recommendation ITU-T Y.2235

Converged web-browsing service scenarios in NGN

1 Scope

The objective of this Recommendation is to describe converged web-browsing capabilities that transform the content according to the different device types of NGN terminals and various network environments supporting web-browsing capabilities. The web-browsing model and service scenarios, using such converged web-browsing capabilities, are also given.

The scope of this Recommendation is targeted at the converged web-browsing capabilities in NGN with its model and service scenarios. This Recommendation covers:

• Requirements to support converged web-browsing capabilities;

• Converged web-browsing functional model;

• Converged web-browsing service scenarios.

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

[ITU-T Y.2201]   Recommendation ITU-T Y.2201 (2007), *NGN release 1 requirements*.

[ITU-T Y.2701]   Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 content transformation function: A function that has capabilities to perform restructuring, recording and optimizing content. [b-W3C CTG 1.0].

NOTE – Content transformation function is used for providing content adaptation capabilities in this Recommendation.

3.1.2 proxy: A software that receives HTTP requests and forwards that request toward an origin server (possibly by way of an upstream proxy) using HTTP. A proxy receives the response from the origin server and forwards it to the requesting client. [b-W3C CC/PP structure and Vocabularies 2.0].

3.1.3 user agent: A client within a device that performs rendering. Browsers are examples of user agents. [b-W3C GTDI].

3.2   Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1   content adaptation: Content adaptation is an action of transforming the content to adapt to device capabilities and is done by content transformation function as well as profile serving function.

NOTE – For example, content adaptation can be applied to mobile devices that require special handling because of their limited computational power, small screen size and constrained keyboard functionality, etc.

3.2.2   converged web-browsing capabilities: Web browsing capabilities that dynamically adapt web content to various terminal devices and network according to profile information, by using content adaptation in the NGN environment.

3.2.3   dynamic profile attribute: A profile attribute that may change its value, e.g., as a result of hardware, software or configuration changes. Examples are the changing of location, battery life, network status (e.g., roaming) and user-defined screen size, etc.

NOTE – Dynamic profile attribute is not limited to the specific attribute. In other words, any kind of attribute could be a dynamic profile attribute.

3.2.4   static profile attribute: A profile attribute for a device that does not change its value. Examples are supported media types and protocols, screen details (size in pixels, colour resolution, response time, etc.) [ITU-T Y.2201]. In most cases, the static profile attribute is stored in the profile server.

3.2.5   web browsing function: A software application which enables a user to display and interact with text, images, videos, music and other information typically located on a web page at a website on the world wide web or a local area network.

3.2.6   web content: A web content is the textual, visual or aural content that is encountered as part of the user experiences on websites. It may include, among other things: text, images, sounds, videos and animations.

3.2.7   web proxy function: An intermediary function between a web browsing function and a web serving function, which performs protocol conversion, encoding/decoding/caching of content and brokering the HTTP requests (inserting or modifying the profile information into the HTTP request message) on behalf of the web browsing function.

NOTE – The most common use of a web proxy function is to serve as a web cache. In this Recommendation, the meaning of web proxy function is extended.

3.2.8   web serving function: A function that is responsible for accepting HTTP requests from a web browsing function and serving them HTTP responses along with optional data content, which usually are web pages such as HTML documents and linked objects (images, etc.).

4   Abbreviations

This Recommendation uses the following abbreviations and acronyms:

CDMA   Code Division Multiple Access

CWB   Converged Web-Browsing

GSC-FE   General Services Control Functional Entity

HTML   HyperText Markup Language

HTTP   HyperText Transfer Protocol

MRC-FE   Media Resource Control Functional Entity

MRP-FE   Media Resource Processing Functional Entity

NGN	Next Generation Network
PDA	Personal Digital Assistant
SUP-FE	Service User Profile Functional Entity
TUP-FE	Transport User Profile Functional Entity
URI	Uniform Resource Identifier
W3C	World Wide Web Consortium
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network

5 Conventions

None.

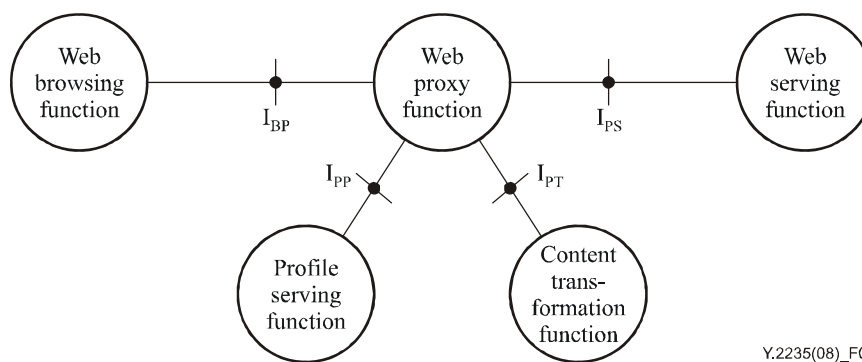## 6 Requirements for converged web-browsing capabilities

This clause describes the requirements of converged web-browsing capabilities for NGN. The converged web-browsing capabilities are required to:

- Provide 'web-based application support' satisfying with interoperability across wired and wireless network environment [ITU-T Y.2201]

- Provide the profile serving function which stores the user profile and device profile information

- Provide profile processing to support content adaptation:
    - Request and respond with the profile information to the profile serving function
    - Update the profile information
    - Adapt the profile information (inserting and modifying the profile)

- Provide content processing to support content transformation:
    - Transform the content according to profile information
    - Deliver the transformed content to requester (e.g., web proxy function)

- Provide the delivering of profile information by terminal:
    - Send the profile information through HTTP request messages by the web browsing function (e.g., when the profile attribute is changed)

- Provide the service registration function for the terminal:
    - Registration and de-registration of the web browsing function to the web proxy function

7 Functional model for converged web-browsing

This clause describes the functional model for CWB capabilities in NGN, including the functional components and operations. The roles of service components are specified in terms of profile delivery as well as content adaptation.

Figure 1 shows the functional model for CWB capabilities. This model consists of five components: a web browsing function, a web proxy function, a web serving function, a profile serving function and a content transformation function.

Figure 1 – Functional model for converged web-browsing capabilities

In CWB model, four kinds of behaviours must take place: interaction between a web browsing function and a web proxy function, interaction between a web proxy function and a web serving function, interaction between a web proxy function and a profile serving function, and interaction between a web proxy function and a content transformation function. In detail, these operations are as follows:

I_{BP} Service request with profile information and response of content

I_{PS} Service request on behalf of a web browsing function with profile information and response of content

I_{PP} Profile request and response

I_{PT} Transformation request and response of content

NOTE – It is assumed that a web browsing function must interact through the web proxy function. In other words, the web browsing function cannot directly interact with the web serving function.

7.1 Functional components

7.1.1 Web browsing function

A web browsing function allows a user to access information provided on web pages at websites by traversing hyperlinks. The web browser function is able to insert profile information into an HTTP request message as an option when initiating a request for accessing a content of a web browsing serving function.

The web browsing functions include the following, but are not limited to:

•   Request the web content with URI;

•   Navigate and display the received web content;

•   Request to register and de-register for service subscription to a web proxy function;

•   Insert the profile information into an HTTP request message and send it when some profile attribute has been changed (dynamic profile attribute).

7.1.2 Web serving function

A web serving function is responsible for providing content requested by a web proxy function or a web browsing function. In some cases, the web serving function may have a capability to transform content into an appropriate form according to the profile information. If the web serving function has no capability to perform content adaptation capability, the web proxy function can take the role of content transformation.

The web serving functions include the following, but are not limited to:

•   Provide the web content requested by a web proxy function or a web browsing function;

- Transform the web content according to the profile information (if a web serving function has a capability to perform the content transformation).

7.1.3 Web proxy function

A web proxy function is an intermediary function located between a web browsing function and a web serving function. Basically, a web proxy function receives the request message from a web browsing function and requests the appropriate profile from a profile serving function. Then the web proxy function requests the web content from the web serving function and receives the web content. In doing so, the web proxy function performs the profile processing and the content processing according to the profile information.

For the profile processing, the web proxy function does insert the profile information into the HTTP request message and sends it to the web serving function. Also, when the profile information of the web browsing function has been changed dynamically, the web proxy function delivers the changed profile to the web serving function by using an HTTP request message. In this case, the web browsing function informs the web proxy function of the change of profile information through the HTTP request message from the web browsing function.

For the content processing, if the web serving function does not perform content adaptation, the web proxy function does transform the content from the web serving function by using the content transformation function. In this case, the web proxy function requests to transform the web content to the content transformation function. If the web serving function does perform the content adaptation, the web proxy function simply bypasses the web content to the web browsing function as it is.

The web proxy functions include the following, but are not limited to:
- Register and de-register the web browsing function for service subscription;
- Forward the web content to the web browsing function from the web serving function or the content transformation function;
- Retrieve the profile information from the profile serving function;
- Update the profile information in the profile serving function;
- Request to transform the web content to the content transformation function (in case the web serving function does not perform content adaptation);
- Determine whether the profile processing and/or content processing is necessary or not according to profile information;
- Insert or modify profile information when sending an HTTP request message to the web serving function.

7.1.4 Profile serving function

The profile serving function is storing the profile information about the user and the device. It responds with the profile information to the request from a web proxy function. A user profile is a set of stored information related to authentication, authorization, mobility, location, charging, etc. A device profile is a set of stored information related to the terminal (e.g., screen size, supported media, etc.).

The profile serving functions include the following, but are not limited to:
- Store, retrieve and update a profile information about user and device profile;
- Deliver the profile information to the web proxy function.

NOTE – TUP-FE and SUP-FE in NGN [ITU-T Y.2012] could be used as a profile serving function.

7.1.5 Content transformation function

The content transformation function has the capabilities to transform the web content into an appropriate form according to the profile information. It is under the control of a web proxy function.

The content transformation functions include the following, but are not limited to:

• Transform the web content according to profile information;

– Types of transformation are restructuring, recording, and optimizing. [b-W3C CTG 1.0]

• Deliver the transformed content to the web proxy function.

NOTE – MRC-FE in NGN [ITU-T Y.2012] could be used as a part of a content transformation function.

7.2 Operation

The basic operation of CWB is shown in Figure 2. The operations are associated with all functional components described in clause 7.1. Regarding the operational aspects, the web proxy function has two capabilities, which are profile processing and content processing.
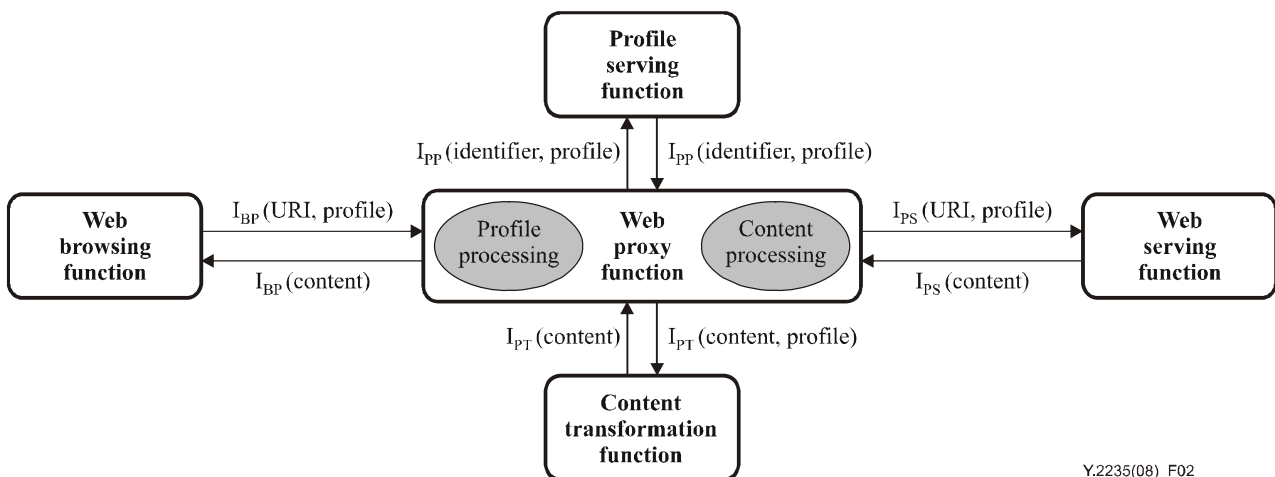
Figure 2 – Operations for converged web-browsing capabilities

7.2.1 Operation details

The details for each operation are the following:

I_{BP} (URI, profile) The web browsing function sends a browsing request with URI to the web proxy function. In case that some profile information has been changed in the terminal, the profile information is also being delivered to the web proxy function.

I_{BP} (content) The web proxy function responds with the content to the web browsing function.

I_{PP} (identifier, profile) (1) The web proxy function requests the profile from the profile serving function with identifier of a user or a browsing function (from web proxy function to profile serving function).

(2) The profile serving function responds with the profile for identifier (From profile serving function to web proxy function).

I_{PS} (URI, profile) The web proxy function requests the content from a web serving function.

I_{PS} (content) The web serving function responds with the content to a web proxy function.

I_{PT} (content, profile)   The web proxy function requests to transform the content from a content transformation function according to profile information.

I_{PT} (content)   The content transformation function responds with the transformed content to a web proxy function.

7.2.2   Profile processing

Profile processing is responsible for the management of profile at the web proxy function. The sequences of profile processing are as follows:

–   Examine the profile information of HTTP request message from a web browsing function.

–   If a message does not contain the profile information, do request the profile information from a profile serving function.

–   If a message does contain the profile information (e.g., due to dynamic profile attribute), do update the profile information to a profile serving function with received profile from a web browsing function.

–   Send the HTTP request message with URI and profile information to the web serving function.

7.2.3   Content processing

Content processing is responsible for transforming the web content according to the appropriate profile information at the web proxy function. The sequences of content processing are as follows:

–   After receiving the web content from a web serving function, do determine whether the content adaptation is necessary or not.

–   If content adaptation is required, do request to transform the received content from the content transformation function.

–   If content adaptation is not required, do deliver the received content to the web browsing function as it is.

8   Service scenarios using converged web-browsing capabilities in NGN

The NGN devices tend to be heterogeneous with highly variable capabilities. A web browsing function is also optimized for certain content format, and it has a growing number of configurations, versions, and releases. Also it may be difficult for the web serving function to take into account a large number of different devices. Therefore, the profile inconsistency can occur between the web browsing functions and the web serving functions. Specifically, mobile devices may receive the web content which could not be stored or displayed. Since device capabilities and network conditions can change dynamically, the web browsing capabilities need to be able to respond to these changes accordingly.

Therefore, content adaptation is required based on the profile attribute. The web proxy function can be introduced to enable content adaptation between the web browsing function and the web serving function in NGN.

This clause describes two scenarios that are distinguished according to whether content adaptation is required or not.

8.1   Basic scenario: Web-browsing capabilities without content adaptation

In this scenario, a web browsing function is serviced through the web proxy function without any content adaptation. The web browsing function requests the web content with URI through HTTP request message from the web proxy function, and the web proxy function gets the browser's profile from the profile serving function and then receives the best suited web content from the web serving function. In this case, it is assumed that the web serving function and the web browsing function

have matching profile, and the web serving function has the capabilities to support suitable content for the profile information. Given that content adaptation is not required, the web proxy function simply forwards the content to the web browsing function.

NOTE – Figure 3 shows an example of the information flows for basic web-browsing capabilities without content adaptation.
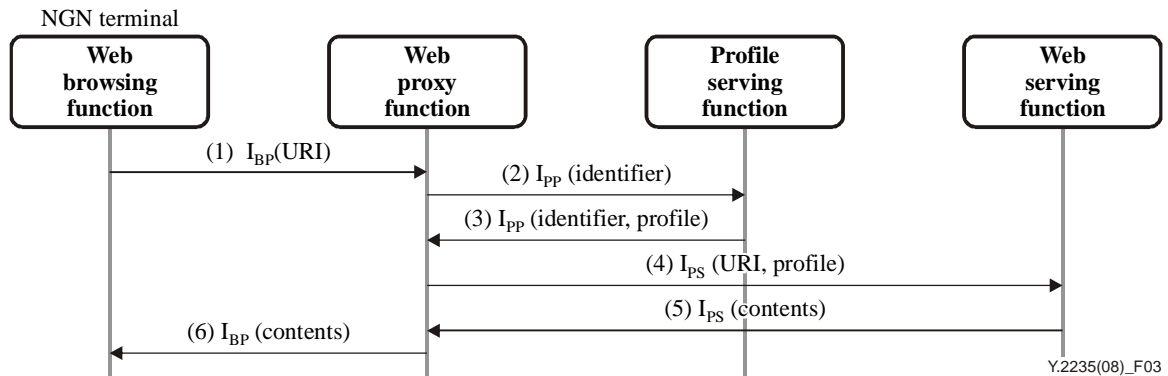
(1)   The web browsing function requests the web content with URI through an HTTP request message from the web proxy function.
(2)   The web proxy function requests profile from the profile serving function.
(3)   The profile serving function responds with the profile.
(4)   The web proxy function requests the web content from the web serving function with profile.
(5)   The web serving function responds with the requested web content to the web proxy function.
(6)   The web proxy function transmits the web content to the web browsing function as it is.

**Figure 3 – An example of information flow of web-browsing capabilities
without content adaptation**

8.2   Extended scenario: Web-browsing capabilities with content adaptation

8.2.1   Content adaptation with static profile attribute

When the web proxy function receives the web content from the web serving function, the web proxy function does compare the profile information to the received web content, and then determines whether content adaptation is necessary or not. If there is profile inconsistency with the web serving function, the web proxy function requests content transformation from the content transformation function. When the web proxy function receives the appropriate content from the content transformation function, the web proxy function delivers it to the web browsing function.

NOTE – Figure 4 shows an example of the information flows describing how the web-browsing function can be served by the web serving function through the web proxy function according to the static profile.

Figure 4 – An example of information flow of static profile-based content adaptation

(1)   The web browsing function requests the web content with URI through an HTTP request message from the web proxy function.

(2)   The web proxy function requests profile from the profile serving function.

(3)   The profile serving function responds with the profile.

(4)   The web proxy function requests the web content from the web serving function with profile.

(5)   The web serving function responds with the requested web content to the web proxy function.

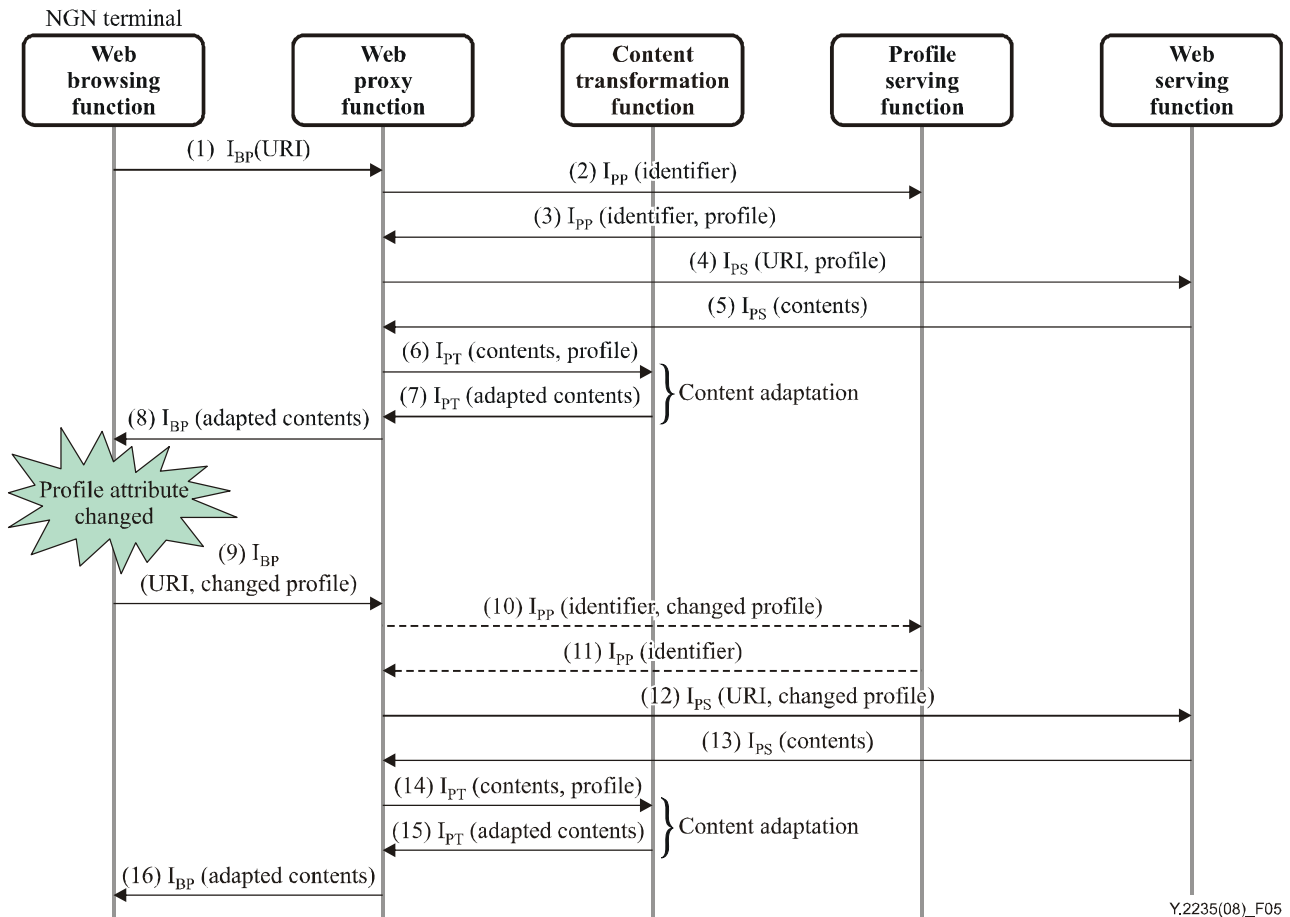(6)   If the profile attribute between the web browsing function and the web serving function does not match, the web proxy function requests to transform the web content from the content transformation function.

(7)   The content transformation function transforms the received web content into an appropriate form to enable the web browsing function to perceive it well, and then transmits it to the web proxy function.

(8)   The web proxy function transmits the adapted web content to the web browsing function.

8.2.2   Content adaptation with dynamic profile attribute

When the profile information of the terminal has been changed due to some reason, i.e., changing of network status, location, user preferences and other factors affecting it, the web browsing function informs the web proxy function of these changes through the HTTP request message with changed profile. The web proxy function executes profile processing and content processing, as described in clauses 7.2.2 and 7.2.3.

NOTE – Figure 5 shows an example of information flow describing how the web browsing function should be served by the web serving function through the web proxy function according to the dynamically changing profile.

| NGN terminal Web browsing function | Web proxy function | Content transformation function | Profile serving function | Web serving function |

(1) I$_{BP}$(URI)
(2) I$_{PP}$ (identifier)
(3) I$_{PP}$ (identifier, profile)
(4) I$_{PS}$ (URI, profile)
(5) I$_{PS}$ (contents)
(6) I$_{PT}$ (contents, profile)
(7) I$_{PT}$ (adapted contents) } Content adaptation
(8) I$_{BP}$ (adapted contents)

Profile attribute changed

(9) I$_{BP}$ (URI, changed profile)
(10) I$_{PP}$ (identifier, changed profile)
(11) I$_{PP}$ (identifier)
(12) I$_{PS}$ (URI, changed profile)
(13) I$_{PS}$ (contents)
(14) I$_{PT}$ (contents, profile)
(15) I$_{PT}$ (adapted contents) } Content adaptation
(16) I$_{BP}$ (adapted contents)

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(1)	The web browsing function requests the web content with URI through an HTTP request message from a web proxy function.
(2)	The web proxy function requests the profile from a profile serving function.
(3)	The profile serving function responds with the profile.
(4)	The web proxy function requests the web content from the web serving function with profile.
(5)	The web serving function transmits the requested web content to the web proxy function.
(6)	If the profile attribute between the web browsing function and the web serving function does not match, the web proxy function requests to transform from the content transformation function.
(7)	The content transformation function transforms the received web content into an appropriate form to enable the web browsing function to perceive it well, and then transmits it to the web proxy function.
(8)	The web proxy function transmits the adapted web content.
(9)	If profile attribute has been changed on the web browsing function side, the web browsing function informs the web proxy function about it.
(10)	If the profile needs to be updated, the web proxy function requests the profile serving function to update the profile attribute.
(11)	If the profile serving function receives the updated profile attribute, the profile serving function updates it and sends the response message to the web proxy function.
(12)	The web proxy function requests the web content from the web serving function with changed profile.
(13)	The web serving function transmits the requested web content to the web proxy function.
(14)	If the profile attribute between the web browsing function and the web serving function does not match, the web proxy function requests content transformation from the content transformation function.
(15)	The content transformation function transforms the received web content into an appropriate form to enable the web browsing function to perceive it well, and then transmits it to the web proxy function.
(16)	The web proxy function transmits the adapted web content to the web browsing function.

Figure 5 – An example of information flow of dynamic profile-based content adaptation

9 Security consideration

This Recommendation does not identify additional NGN security requirements beyond the ones contained in [ITU-T Y.2701].

Appendix I

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

This appendix describes CWB capabilities positioning within the NGN architecture as well as the relationship between the web proxy function and NGN functional entities to show the possibility of applying web-based capabilities in NGN. This appendix will be examined for the future enhancement of the NGN architecture.

I.1 CWB positioning within the NGN architecture

Figure I.1 is an extension of Figure 1 in [ITU-T Y.2012], NGN architecture overview. It shows an extended NGN architecture enabling the support of converged web-browsing capabilities. In particular, the web proxy function is added in the NGN service stratum for profile processing as well as for content processing.

From the NGN architectural point of view, the web proxy function could be an instance of GSC-FE or a new FE to define for the support of CWB.
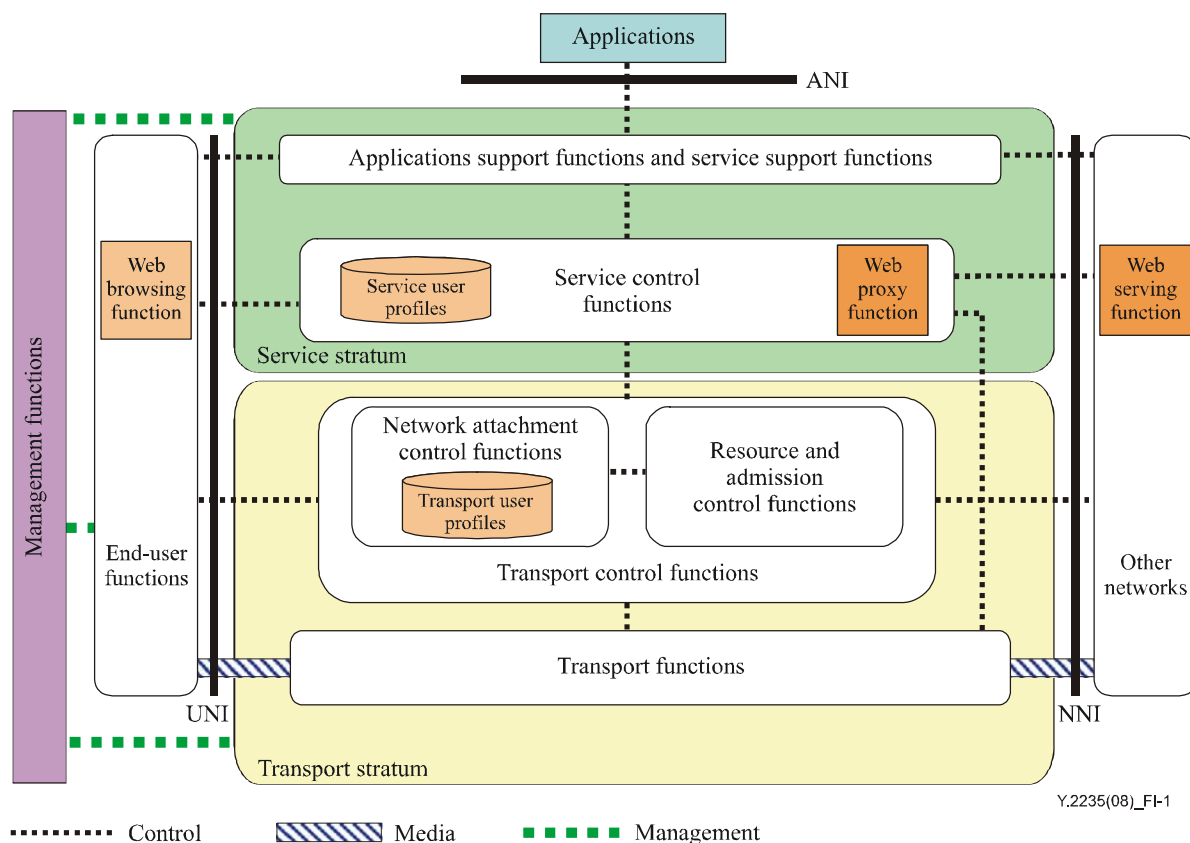
Figure I.1 – Extended NGN architecture positioning the CWB

NOTE 1 – Other networks may include other types of NGN and many existing networks, such as the PSTN/ISDN, the public Internet, and so forth [ITU-T Y.2201].

NOTE 2 – The web serving function may exist in NGN networks as well as in other networks.

I.2 Relationship between the web proxy function and NGN functional entities

In this appendix, the relationship between the web proxy function and NGN functional entities is described and some NGN FEs functionalities are expected to be extended.

[ITU-T Y.2012] describes the functional architecture of NGN for release 1. It is assumed that the NGN functional entities communicating with the web proxy function may be S-5, S-13, T-8, T-12, T-16, A-1 and A-3 as illustrated in Figure I.2. These functional entities expect to extend their functionalities to support web-browsing capabilities in NGN. From the NGN architectural point of view, web proxy could be an instance of GSC-FE or a new FE for the support of CWB.

1)   *S-5 Service user profile functional entity (SUP-FE)*

The service user profile functional entity (SUP-FE) is responsible for storing user profiles, subscriber-related location data, and presence status data in the service stratum. SUP-FE provides information such as user preference by request of a web proxy function.

2)   *S-13 Media resource control functional entity (MRC-FE)*

The MRC-FE allows MRP-FE to transform content that can be recognized by the web browsing function.

3)   *T-8 Media resource processing functional entity (MRP-FE)*

The MRP-FE provides payload processing of packets used in the NGN. It, especially, provides transcoding and recording capabilities under the control of the MRC-FE. MRP-FE expects to extend its capabilities to content transformation for the support of CWB.

4)   *T-12 Transport user profile functional entity (TUP-FE)*

The TUP-FE is responsible for storing user profiles (e.g., QoS profile, P-CSC-FE address, and HGWC-FE address) related to the transport stratum. TUP-FE expects to extend its capabilities to store user profile information (e.g., proxy address) related to CWB.

5)   *T-16 Policy decision functional entity (PD-FE)*

The PD-FE responds to service request from the web proxy function and then manages and controls the policies and resources of the transport stratum for the support of CWB.

6)   *A-1 Application server functional entity (AS-FE)*

The AS-FE provides value-added information such as user's availability and location to the web proxy function. The web proxy function, therefore, can customize and personalize the content suitable for the user's purpose.

7)   *A-3 Application service coordination manager functional entity (APL-SCM-FE)*

A web proxy function might interwork with an AS-FE via an APL-SCM to provide convergent services to the end user.
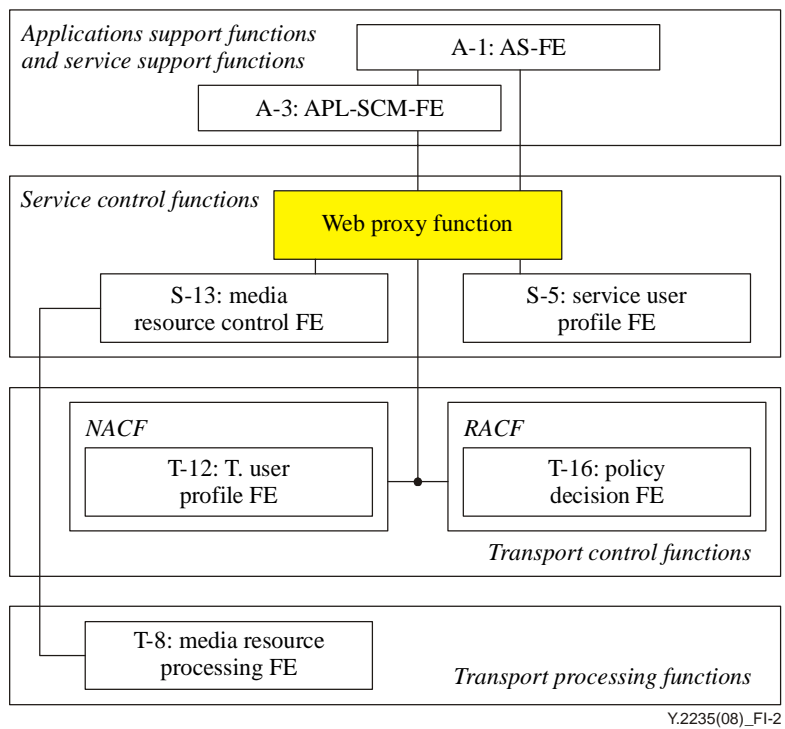
Figure I.2 – Example of NGN functional entities interacting with a web proxy function

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