PacketCable™ 2.0

HSS Technical Report

PKT-TR-HSS-V02-070925

RELEASED

Notice

Document Status Sheet

Document Control Number:	PKT-TR-HSS-V02-070925
Document Title:	HSS Technical Report
Revision History:	V01 – Released 09/14/06
	V02 – Released 9/25/07
Date:	September 25, 2007

Trademarks

Abstract

PacketCable is a CableLabs specification effort designed to extend cable's real-time IP communication service architecture and to accelerate the convergence of voice, video, data, and mobility technologies.

This technical report describes the Home Subscriber Server (HSS) requirements to support the PacketCable architecture, applications and services. It contains the following information:

- The reference points related to the HSS.
- Enhancements to the HSS as defined by the 3rd Generation Partnership Project (3GPP) IP Multimedia Subsystem (IMS) Release 7 (R7) specifications to support PacketCable requirements.
- For each of the necessary enhancements, the technical requirements for PacketCable along with the list of impacted components and IMS delta specifications is provided.

Contents

Figures

Tables

This page left blank intentionally.

1 SCOPE

1.1 Introduction and Purpose

The purpose of this technical report is to provide an overview of the reference points for the Home Subscriber Server (HSS) and related components. In addition, this technical report describes the specific HSS related enhancements to the 3GPP Release 7 specifications to support the PacketCable requirements.

1.2 Document Scope

The PacketCable Architecture Framework TR [ARCH TR FRM] describes the overall document organization plan for PacketCable. Since the PacketCable HSS is closely aligned with 3GPP Release 7, the PacketCable HSS normative requirements are defined in the delta specifications, which are enhanced versions of 3GPP specifications and accommodate cable-specific requirements.

The PacketCable HSS requirements are documented in the following IMS Delta specifications: [PKT 23.008], [PKT 29.229], [PKT 29.228] and [PKT 29.109]. Please note that the IMS Delta specifications listed may also contain requirements related to other portions of the PacketCable architecture.

1.2.1 Relationship to PacketCable Features and Services

This Technical Report and its associated IMS Delta specifications serve as a base for the handling of subscriber related data within PacketCable. This foundation provides for the support of a wide variety of communication services.

This foundation is service independent and, therefore, requirements specific to each PacketCable application and feature are out-of-scope for this document, and defined separately in PacketCable application specifications. Any requirements that are deemed to be non-service specific are included and are addressed within this document.

1.2.2 Relationship to Other PacketCable Documents

The PacketCable HSS specifications together define the generic HSS requirements for the following general capabilities:

- Identification Handling
- User Profile Management (Cx and non-Transparent Data)
- Application Specific User Profile Management (Transparent Data)
- Service Profile Provisioning
- Call/Session Establishment Support
- User Security Support
- Registration State Management

The PacketCable Architecture uses these general capabilities, and, to fulfill service specific requirements, may document additional capabilities in PacketCable application specifications.

1.3 Document Organization

Section 5 of this document describes the PacketCable HSS architecture, including the main functional elements and reference points.

Section 6 of this document describes the PacketCable HSS enhancements to the 3GPP Release 7 specifications motivated by the PacketCable architecture or application requirements.

Appendices in this document summarize requirements considered that do not impact the HSS.

2 REFERENCES

2.1 Informative References

This Technical Report uses the following informative references.

[ARCH TR FRM] PacketCable Architecture Framework Technical Report PKT-TR-ARCH-FRM-V03-070925, September 25, 2007, Cable Laboratories, Inc.

[PKT 23.008] PacketCable Organization of Subscriber Data Specification 3GPP TS 23.008, PKT-SP-23.008-I02-070925, September 25, 2007, Cable Laboratories, Inc.

[PKT 29.109] PacketCable Generic Authentication Architecture (GAA); Zh and Zn Interfaces based on the Diameter protocol; Stage 3 Specification 3GPP TS 29.109, PKT-SP-29.109-I02-070925, September 25, 2007, Cable Laboratories, Inc.

[PKT 29.228] PacketCable Cx and Dx Interfaces Specification 3GPP TS 29.288, PKT-SP-29.228-I02-070925, September 25, 2007, Cable Laboratories, Inc.

[PKT 29.229] PacketCable Cx/Dx Interfaces based on Diameter Protocol Specification 3GPP TS 29.229, PKT-SP-29.229-I02-070925, September 25, 2007, Cable Laboratories, Inc.

[RFC 2617] IETF RFC 2617, HTTP Authentication: Basic and Digest Access Authentication, June 1999.

[RFC 3261] IETF RFC 3261, SIP: Session Initiation Protocol, June 2002.

[SEC TR] PacketCable Security Technical Report, PKT-TR-SEC-V03-070925, September 25, 2007, Cable Laboratories, Inc.

2.1 Reference Acquisition

- Cable Television Laboratories, Inc., 858 Coal Creek Circle, Louisville, CO 80027;
  Phone 303-661-9100; Fax 303-661-9199; Internet: http://www.cablelabs.com
- Internet Engineering Task Force (IETF), Internet: http://www.ietf.org
- Third Generation Partnership Project (3GPP), Internet: http://www.3gpp.org

3 TERMS AND DEFINITIONS

PacketCable Specifications and Technical Reports use the following terms and definitions:

E.164	An ITU-T Recommendation that defines the international public telecommunication numbering plan used in the PSTN and other data networks.
IMS Delta specifications	A suite of 3GPP IMS specifications modified to reflect cable-specific deltas necessary to comply with PacketCable.
Public User Identity	Used by any user for requesting communications to other users.
Server	A network element that receives requests in order to service them and sends back responses to those requests. Examples of servers are proxies, User Agent servers, redirect servers, and registrars.
Subscriber	An entity (comprising one or more users) that is engaged in a Subscription with an operator.
Subscription	A contract for service(s) between a user and an operator.
User	A person who, in the context of this document, uses a defined service or invokes a feature on a UE.

4 ABBREVIATIONS AND ACRONYMS

PacketCable Specifications and Technical Reports use the following abbreviations and acronyms:

3GPP	3rd Generation Partnership Project
AKA	Authentication and Key Agreement
AS	Application Server
AVP	Attribute-Value Pair
BSF	Bootstrapping Server Function
CSCF	Call Session Control Function
GBA	Generic Bootstrapping Architecture
GUSS	GBA User Security Setting
HSS	Home Subscriber Server
I-CSCF	Interrogating Call Session Control Function
IM CN	IP Multimedia Core Network
IMPI	IM Private Identity
IMPU	IM Public Identity
IMS	IP Multimedia Subsystem
ISIM	IMS SIM
MAA	Multimedia-Auth-Answer
MAR	Multimedia-Auth-Request
P-CSCF	Proxy Call Session Control Function
PACM	Provisioning, Activation, Configuration, and Management
S-CSCF	Serving Call Session Control Function
SAA	Server-Assignment-Answer
SAR	Server-Assignment-Request
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SLF	Subscription Locator Function
UAR	User-Authorization-Request
UE	User Equipment
UICC	Universal Integrated Circuit Card
URI	Uniform Resource Identifier
XML	Extensible Markup Language

5 PACKETCABLE HOME SUBSCRIBER SERVER (HSS)

The Home Subscriber Server (HSS) is the master database containing the subscription related information for a particular user. There may be one or more HSSs in the network. When multiple HSSs are in the network, a Subscription Locator Function (SLF) is used to locate the proper HSS.

5.1 PacketCable HSS Architecture and Reference Points

The reference points associated with the HSS are illustrated in Figure 1. These reference points are as defined in the 3GPP IMS, with appropriate enhancements identified by PacketCable.

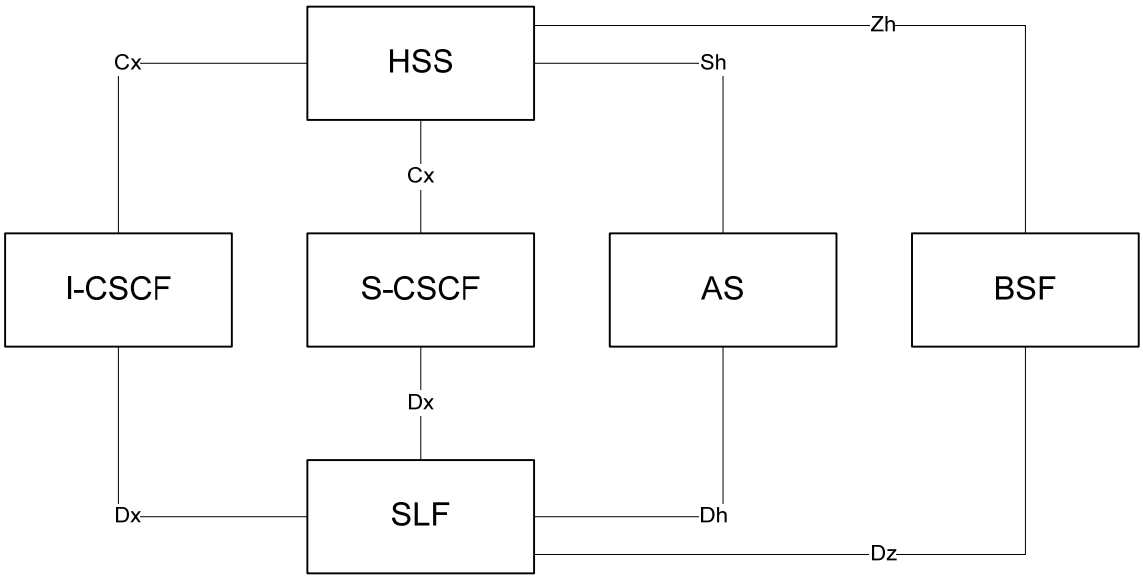

Figure 1 - HSS Reference Points

The HSS provides several logical functions needed by the various entities throughout the network in order to support session handling. Here is a list of some of the logical functions provided by the HSS:

- Registration State Management: This function supports the management of the user's registration state.
- Session Establishment Support: The HSS supports the session establishment procedures in the IP Multimedia Core Network (IM CN) subsystem. For terminating traffic, it provides information on which session control entity currently hosts the user.
- User Security Information Generation: The architecture supports the storage and generation of User security credentials and parameters required for authentication. This task may be handled by the HSS or other elements in the network depending on the authentication method and network architecture being used.
- User Security Support: The HSS supports the authentication procedures to access the IM CN subsystem services by storing the generated data for authentication, integrity, and ciphering, and by providing these data to the appropriate entity in the CN.
- User Identification Handling: The HSS provides the appropriate relations among all the identifiers that uniquely determine the user in the system (private identity and public identities for IM CN subsystem).

- Access Authorization: The HSS authorizes the user for access when requested by the Call Session Control Function (CSCF) by checking that the user is allowed to roam in a given visited network.
- Service Authorization Support: The HSS provides basic authorization for terminating call/session establishment and service invocation. The HSS updates the appropriate serving entities (i.e., CSCF) with the relevant information related to the services to be provided to the user.
- Service Profile Provisioning Support: The HSS provides access to the service profile data for use within the IM CN subsystem.

5.1.1 HSS Functional Components

5.1.1.1 Home Subscriber Server (HSS)

The HSS is the master database for a given user. It is the entity containing the subscription-related information to support the network entities managing sessions.

A Home Network may contain one or more HSSs depending on the number of subscribers, the capacity of the network elements, and the organization of the network.

The HSS provides support to the call control servers in order to complete the routing/roaming procedures by solving authentication, authorization, naming/addressing resolution, location dependencies, etc.

The HSS is responsible for holding the following user related information:

- User Identification, Numbering and addressing information.
- User Security information: Network access control information for authentication and authorization.
- User Location information at inter-system level: the HSS supports the user registration, and stores inter-system location information, etc.
- User profile information.

The HSS may generate User Security information for mutual authentication, communication integrity check and ciphering, depending on the authentication mechanism and the chosen architecture being used.

5.1.1.2 Subscription Locator Function (SLF)

When more than one independently addressable HSS is utilized by a network operator, there is a need to associate a given subscriber with the HSS that contains the subscriber's data. This functionality is provided by the SLF, which is a Diameter redirect agent.

The SLF is:

- Queried by the Interrogating Call Session Control Function (I-CSCF) during the Registration and Session Setup to retrieve the address of the HSS that contains the subscriber specific data. Furthermore, the SLF is also queried by the S-CSCF during Registration.
- Queried by the AS in conjunction with the Sh interface operation to retrieve the address of the HSS that contains the subscriber specific data.
- Accessed via the Dx interface by the CSCF and via the Dh interface by the AS.

A single HSS environment can still be achieved when there are physically multiple HSSs by using techniques such as server farms or clustering. The SLF is not required when such techniques are used to provide a logical single HSS environment.

5.1.2 HSS Reference Points

The reference points depicted in Figure 1 are described in Table 1. All reference points are DIAMETER-based.

Table 1 - Call Signaling Reference Points

Reference Point	PacketCable Network Elements	Reference Point Description
Cx	I-CSCF - HSS S-CSCF - HSS	The Cx reference point supports information transfer between CSCF and HSS. The main procedures that require information transfer between CSCF and HSS are: • Procedures related to Serving CSCF assignment. • Procedures related to routing information retrieval from HSS to CSCF. • Procedures related to authorization (e.g., checking of roaming agreement). • Procedures related to authentication: transfer of security parameters of the subscriber between HSS and CSCF. • Procedures related to filter control: transfer of filter parameters of the subscriber from HSS to CSCF.
Dx	I-CSCF - SLF S-CSCF - SLF	This interface between CSCF and SLF is used to retrieve the address of the HSS which holds the subscription for a given user. This interface is not required in a single HSS environment. An example for a single HSS environment is a server farm architecture.
Sh	AS - HSS	The Application Server (SIP Application Server and/or the OSA Service Capability Server) may communicate to the HSS. The Sh interface is used for this purpose. The Sh interface is between the HSS and the "SIP Application Server" and between the HSS and the "OSA service capability server". The HSS is responsible for policing what information is provided to each individual Application Server. The Sh interface transports transparent data for service related data, user related information, etc. In this case, the term transparent implies that the exact representation of the information is not understood by the HSS or the protocol. The Sh interface also supports mechanisms for transfer of user related data stored in the HSS
Dh	AS - SLF	This interface between AS and SLF is used to retrieve the address of the HSS that holds the subscription for a given user. This interface is not required in a single HSS environment. An example for a single HSS environment is a server farm architecture.

Reference Point	PacketCable Network Elements	Reference Point Description
Zh	BSF - HSS	The reference point Zh used between the BSF and the HSS allows the BSF to fetch the required authentication information and all Generic Bootstrapping Architecture (GBA) user security settings from the HSS.
Dz	BSF - SLF	The reference point Dz used between the BSF and the SLF allows the BSF to obtain the name of the HSS containing the required subscriber specific data. This interface is not required in a single HSS environment. An example for a single HSS environment is a server farm architecture.

6 PACKETCABLE HSS SIP DIGEST ENHANCEMENTS

This section describes the areas in which PacketCable has made enhancements to the 3GPP Release 7 HSS in order to support SIP Digest. Requirements and general information related to SIP Digest for PacketCable are specified in [SEC TR].

This section provides a description of the change and the requirement that motivated that change. Additionally, the affected components and reference points are described.

6.1 Support for SIP Digest in an IM CN

In the IMS architecture, the User Equipment (UE) contains a UICC (Universal Integrated Circuit Card) with an IM Service Identity Module (ISIM) application. The ISIM application is aware of one or more IM Private Identities (IMPIs) and associated credentials (keys) that are also provisioned in the HSS. These credentials are used during the registration process for authentication. Since not all PacketCable UEs are expected to contain UICCs, SIP Digest, as specified in [RFC 3261], is leveraged by PacketCable as an alternative authentication mechanism.

Support for SIP Digest in a PacketCable network requires determination of the network elements responsible for generation of the nonce and authentication of the user. Multiple options exist with regards to which network elements can be responsible for the generation of the nonce and performs the authentication of the user. However, this version of the document is based on having the nonce generated in the S-CSCF and having the S-CSCF authenticate the user.

In the IMS architecture, the HSS also plays a role in authentication. This requires the S-CSCF to communicate with the HSS via Diameter to participate in the authentication procedure. For SIP Digest support, this requires the introduction of additional AVPs on the Diameter interface. Figure 2 illustrates the high-level communication flow for a SIP Digest registration in the IM CN.

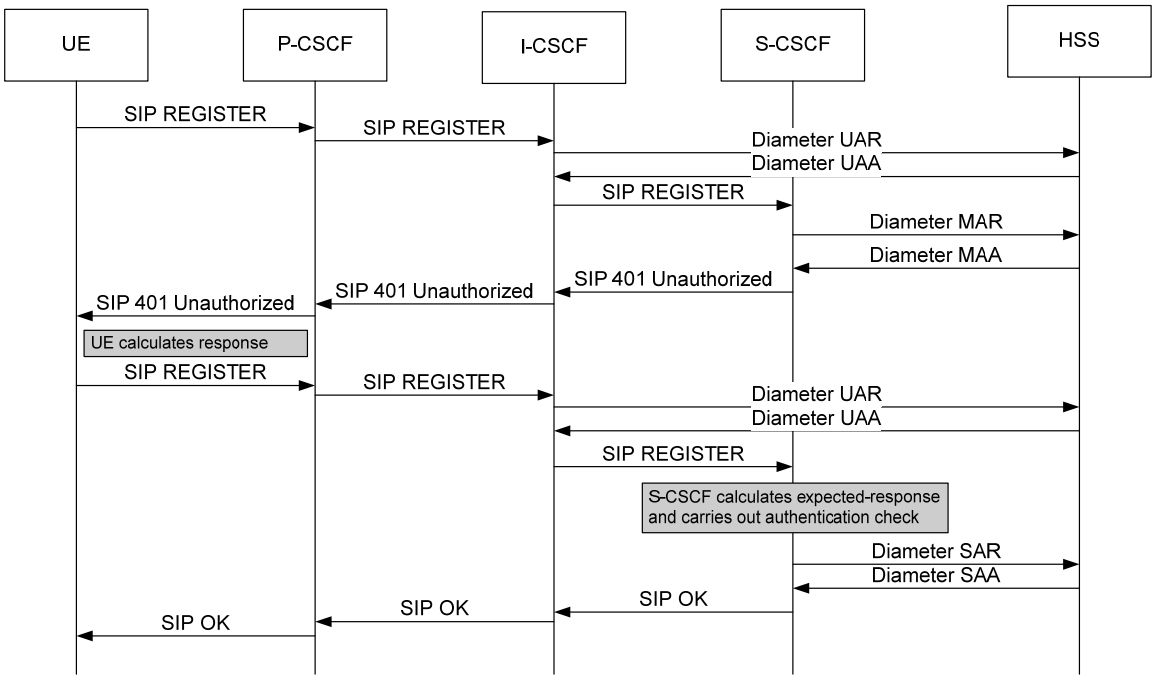

Figure 2 - Nonce Generated in S-CSCF, S-CSCF Authentications the User

6.2 Support for SIP Digest within the Generic Bootstrapping Architecture (GBA)

Supporting SIP Digest is also needed for the bootstrapping process since it also requires authentication involving the UE. Hence the bootstrapping process must be enhanced so it can use SIP Digest authentication in addition to existing mechanisms.

As with the procedures described in Section 6.1, the BSF communicates with the HSS using Diameter and requires similar enhancements to this Diameter interface. Figure 3 illustrates a high-level bootstrapping using the GBA with SIP Digest support added.

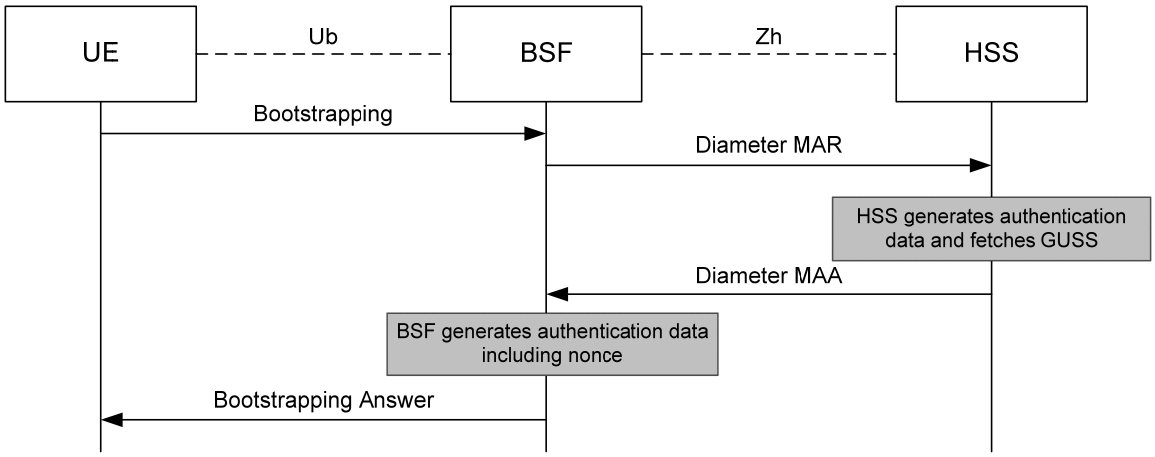

Figure 3 - Partial Bootstrapping Messaging Flow

6.3 Impacted Components

This section describes the component impacts needed to support SIP Digest.

6.3.1 HSS

Support for SIP Digest in the HSS requires new AVPs and updates to existing AVPs. The changes to the AVPs are documented in [PKT 29.228].

6.3.2 S-CSCF

The S-CSCF acts as the authenticator and as a partial authentication service. It is now doing more work as it has to generate the expected response and the nonce. The S-CSCF must be enhanced to support the SIP Digest related signaling from the UE. As with the HSS, support of the relevant AVPs is required.

6.3.3 BSF

The BSF acts as the authenticator and as a partial authentication service. It is now doing more work as it has to generate the expected response and the nonce. The BSF must be enhanced to support the SIP Digest related signaling from the UE. Additionally, the BSF must support the relevant AVPs.

Appendix I Acknowledgements

CableLabs wishes to thank the following PacketCable focus team participants for their contributions to the earlier revisions of this technical report:

- Klaus Hermanns (Cisco)
- Sean Schneyer (Ericsson)
- Ricky Kaura (Nortel)
- Ajay Gupta (Verisign)

Special thanks are extended to Sean Schneyer for making the updates to this version of the technical report and for being the primary editor of the previous revisions of this technical report.

Sumanth Channabasappa and the PacketCable Architecture team, CableLabs.