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Request for Comments: 3141  
Category: Informational

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June 2001

## CDMA2000 Wireless Data Requirements for AAA

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### Abstract

This memo specifies cdma2000 wireless data AAA (Authentication, Authorization, Accounting) requirements associated with third generation wireless architecture that supports roaming among service providers for traditional PPP and Mobile IP services.



## 1. Introduction

The architecture is designed for use with a cellular network as an access medium. Sections 1, 2, present a brief high level review of the cdma2000 wireless data architecture. Section 3 presents cdma2000 AAA requirements.

This document specifies AAA requirements associated with a third generation cdma2000 wireless architecture that supports roaming among service providers for traditional PPP and Mobile IP services. The architecture is designed for use with a cellular network as an access medium.

Sections 1 and 2 present a brief, high level review of the cdma2000 wireless data architecture as an aid to interested AAA WG members. Section 3 presents cdma2000 AAA requirements, and is self contained relative to the architecture review.

### 1.1. Requirements language

In this document, the key words "MAY", "MUST", "MUST NOT", "optional", "recommended", "SHOULD", and "SHOULD NOT", are to be interpreted as described in [RFC2119].

Please note that the requirements specified in this document are to be used in evaluating AAA protocol submissions. As such, the requirements language refers to capabilities of these protocols; the protocol documents will specify whether these features are required, recommended, or optional. For example, requiring that a protocol support confidentiality is NOT the same thing as requiring that all protocol traffic be encrypted.

A protocol submission is not compliant if it fails to satisfy one or more of the MUST or MUST NOT requirements for the capabilities that it implements. A protocol submission that satisfies all the MUST, MUST NOT, SHOULD and SHOULD NOT requirements for its capabilities is said to be "unconditionally compliant"; one that satisfies all the MUST and MUST NOT requirements but not all the SHOULD or SHOULD NOT requirements for its protocols is said to be "conditionally compliant."

### 1.2. General Service Requirements

- o Provide service during subscriber visiting between wireless networks systems while maintaining a formal customer-service provider relation with only one wireless service provider.
- o Support Traditional PPP and Mobile IP services:



- o Support dynamic and static home address assignments for Mobile IP
- o Support a Home Agent in the mobile's home wireless network, home ISP, or private network.
- o Support IP Security on the Mobile IP tunnel between Foreign Agent and Home Agent, in order to avoid the overhead of a voluntary tunnel on the radio interface.
- o Provide robust authentication, authorization and accounting services (AAA):
  - o Provide separation of airlink resource AAA services and data resource AAA services.
  - o Authenticate and authorize a mobile based on an IMSI and an NAI. The architecture allows for a carrier to determine if billing is based on the IMSI or the NAI.
  - o Support optional AAA broker services between wireless carriers and between wireless carriers and other external data networks.
  - o Allow for distribution of specific Mobile IP security key information to support home agent assignment, fast handoff, and fast HA-FA authentication assignment during registration.
- o Provide QoS



## 2. High Level Architecture

The high level architecture is shown in Figure 1. The six major entities that compose the network are the Home Agent, the PDSN, the AAA Server, the Radio Network, the HLR/VLR, and Mobile Client.

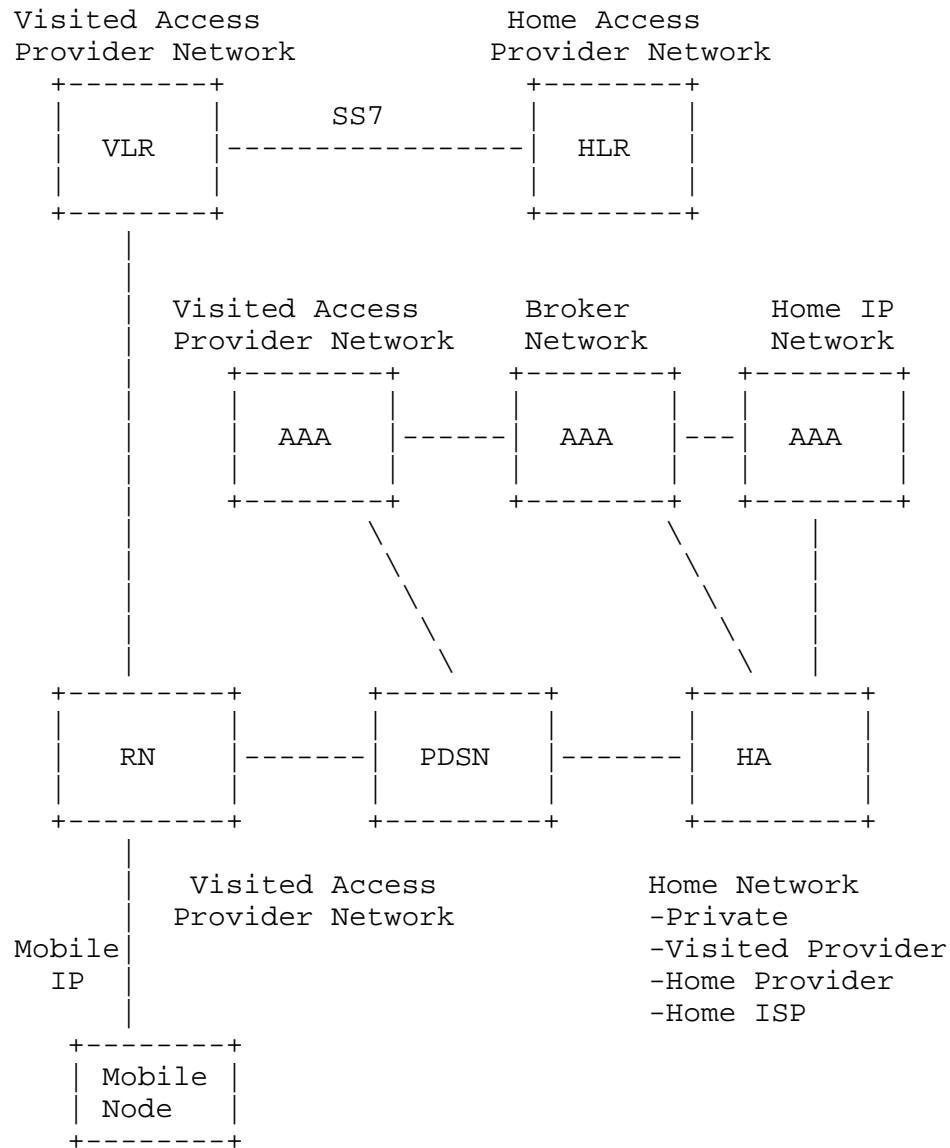


Figure 1: General cdma2000 Wireless IP Architecture



## 2.1. PDSN

- o Acts as a Foreign Agent;
- o Establish, maintain, and terminate link layer to the mobile client;
- o Initiate the authentication, authorization and accounting for the mobile client;
- o Optionally, securely tunnel using IP security to the Home Agent;
- o Receives service parameters from AAA for mobile client;
- o Collect usage data for accounting purposes to be relayed to AAA;
- o Routes packets to external packet data networks or to the HA in the case of reverse tunneling;
- o Maps home address and Home Agent address to a unique link layer identifier used to communicate with Radio Network.

## 2.2. Authentication, Authorization, and Accounting Server

- o Interact with the Foreign Agent and other AAA servers to authorize, authenticate and perform accounting for the mobile client;
- o Provides mechanism to support security association between PDSN/FA and HA and between the MN and PDSN/FA;
- o For dynamic Home Agent assignment, dynamically identify an HA and assign a MN on that HA, and provide the security association between the MN and HA;
- o Provide QoS information to the PDSN;
- o Optionally, assign dynamic home address.

## 2.3. Radio Network

- o Maps Mobile Client identifier reference to a unique link layer identifier used to communicate with PDSN;
- o Validates Mobile Station for access service;
- o Manages physical layer connection to the Mobile Client;
- o Maintain state of reachability for packet service between the access radio network and the mobile station;
- o Buffers packets arriving from the PDSN, when radio resources are not in place or are insufficient to support the flow from the PDSN;
- o Relays packets between the mobile station and the PDSN.

## 2.4. Location Registers (VLR/HLR)

- o Stores authentication and authorization information for the radio network.



## 2.5. Home Agent

- o Maintains user registration and redirects packets to the PDSN;
- o Optionally, establish an IP secure tunnel to the PDSN/FA;
- o Supports the dynamic Home Agent assignment;
- o Optionally, assigns dynamic home address;
- o Support reverse tunneling.

## 2.6. Mobile Node

- o Support PPP;
- o Can act as a Mobile IP Node; and support Foreign Agent Challenge and NAI;
- o Interacts with the Radio Network to obtain appropriate radio resources from the network for the exchange of packets;
- o Maintains knowledge of status of radio resources (e.g., active, standby, dormant);
- o Buffers packets when radio resources are not in place or are insufficient to support the flow to the network.

## 3. AAA Requirements

### 3.1. Core AAA Requirements

The following is a summary of cdma2000 AAA specific requirements. In these requirements, the serving network and home network may or may not have a direct business relationship. In such cases in which there is not a direct business relationship, service may be supported indirectly via broker.

- o Authenticate and authorize a user NAI in a roaming environment. The NAI is obtained via CHAP (for traditional PPP service) or a Foreign Agent Challenge (for Mobile IP service). A shared secret exists between the mobile and its HAAA. The FAC will typically be computed in a manner consistent with CHAP.
- o Transport wireless data attributes from the home network to the Serving network. This may often take the form of a user profile.
- o Encrypt or sign one or more AVPs in an AAA message between home, serving network, or some broker across multiple AAA server hops.
- o Support a reliable AAA transport mechanism.
  - o This transport mechanism will be able indicate to an AAA application that a message was delivered to the next peer AAA application or that a time out occurred.
  - o Retransmission is controlled by the reliable AAA transport mechanism, and not by lower layer protocols such as TCP.



- o Even if the AAA message is to be forwarded, or the message's options or semantics do not conform with the AAA protocol, the transport mechanism will acknowledge that the peer received the AAA message. However, if the message fails to pass authentication, it will not be acknowledged.
- o Acknowledgements should be allowed to be piggybacked in AAA messages
- o The reliable transport mechanism features shall have the capability to detect silent failures of the AAA peer or path to the AAA peer, to manage failure on a proactive basis.
- o Transport a digital certificate in an AAA message, in order to minimize the number of round trips associated with AAA transactions. Note: This requirement applies to AAA applications and not mobile stations.
- o Support both proxy and non-proxy brokers, where non-proxy brokers imply the broker terminates an entire request and initiates a new request. AAA brokers should have the capability to modify certain parts of AAA messages whereby to operate to in non-proxy or proxy environments.
- o Provide message integrity and identity authentication on a per hop (AAA node) basis.
- o Support replay protection and optional non-repudiation capabilities for all authorization and accounting messages. The AAA protocol must provide the capability for accounting messages to be matched with prior authorization messages.
- o Support accounting via both bilateral arrangements and via broker AAA servers providing accounting clearinghouse and reconciliation between serving and home networks. There is an explicit agreement that if the private network or home ISP authenticates the mobile station requesting service, then the private network or home ISP network also agrees to reconcile charges with the home service provider or broker. Real time accounting must be supported.
- o Provides security between AAA servers, and between AAA server and PDSN or HA via IP security.

### 3.2. Mobile IP Specific Requirements and AAA

#### 3.2.1. Mobile IP Security Discussion

Three Mobile IP security extensions are defined in RFC 2002:

- . HA - FA
- . MN - FA
- . HA - MN



Therefore, Mobile IP and IPsec security models differ in that Mobile IP provides its own authentication mechanisms calculated within the Mobile IP registration procedures whereas IPsec uses IPsec AH.

The keys and SPIs associated with the MN-FA and HA-FA extensions need to be dynamically established in a roaming wireless carrier environment. The MN-FA extension is useful for allowing a new FA (PDSN) to quickly authenticate a mobile using the previous foreign agent extension. The HA-FA extension is useful for the HA to ensure that only FAs from carrier's with roaming agreements access the HA. The MN-HA is usually provisioned, but for dynamic Home Agent assignment, this security association must be dynamically created.

It is possible to use IPsec AH between MN and FA, FA and HA, and MN and HA. IKE may be used to establish security associations between these entities. However, use of IKE may pose a problem for smaller mobiles and may introduce unacceptable delays for certain applications (e.g., Voice Over IP). The following three sections outline Mobile IP specific functions that benefit from AAA based key distribution.

### 3.2.2. Dynamic Home Agent Assignment

A visited or home AAA server will optionally be able perform dynamic HA assignment. For dynamically assigned HA, the visited AAA server will indicate to the home AAA server whether it supports dynamic HA assignment in those cases in which the mobile node requests dynamic assignment. If so indicated, the home AAA server may choose to allow the visited AAA server to perform the HA assignment. Otherwise, the home AAA assigns the HA.

### 3.2.3. Fast Handoff

To achieve a faster handoff, the mobile may attempt to avoid an AAA transaction with the home AAA server. To accomplish this, the mobile may send the PDSN the Previous FA address in the RRQ message from the mobile, along with the MN-FA authentication extension. The new PDSN passes the Previous FA address and MN-FA authentication extension to the visited AAA server. If the visited AAA server is able authenticate the MN-FA authentication extension for the mobile, then the visited AAA may be able to avoid an actual transaction to the home AAA server.



### 3.2.4. HA-FA Authentication

To achieve a fast registration for the case of a mobile station with a Home Agent, the PDSN and HA may receive from the AAA mechanism a HA-FA key and SPI that is used to authenticate the PDSN and the HA to each other.

### 3.2.5. Key Distribution

These functions are primarily useful in a wireless environment in which handoffs may occur rapidly (implying a need for low latency), or where mobile devices have limited computing power. To achieve these functions, AAA will be used to securely pass keys and SPIs between the serving network and target network in encrypted form. These keys are then used for the specific functions outlined in this document.

### 3.3. IKE and AAA

The use of IKE in the cdma2000 wireless architecture requires the use of certificates. However, the AAA servers may be able to distribute a pre-shared key to the Mobile IP Agents for use during Phase 1 ISAKMP exchanges. This may lessen the need for on-line revocation checks.

### 3.4. Interoperability with RADIUS

Users with a home AAA server based on RADIUS may desire to roam into a wireless carrier network that uses "new" AAA servers based on the requirements in this document, and vice versa. The AAA protocol should be designed in a way so as to make conversions to and from RADIUS messages straight forward. This will allow for the development of gateway processes to aid in interoperability. Note: The features of the new AAA protocols which are beyond the feature set of the RADIUS protocol will not be available for users while on home or serving networks based on RADIUS.

## 4. References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

## 5. Security Considerations

This document is very much about security. These requirements do not require the serving and home networks to not be in the same domain nor must they have a direct relationship. The serving network requires authorization from the home network so that the serving



network obtains proof it will get paid for services rendered to the mobile. This implies the home network must authenticate the user. AAA functions must be performed in a secure manner. The requirements contained in section 2 outline the security required.

Mobile IP supports authentication mechanisms outside IP Security. These mechanisms may be enhanced in a cellular wireless environment by allowing a home AAA server to distribute keys to the serving network. Additionally, the home AAA server may be able to send a pre-shared key to be used in Phase 1 ISAKMP security association establishment between FA and HA. These keys would be sent in encrypted form from the home network to the serving network. As supported in the requirements contained in section 2, the encryption could be handled via public cryptography and certificates.

## 6. IANA Considerations

This document does not create any new number spaces for IANA administration.

## 7. Acknowledgements

The authors are active members of the TIA TR45.6 committee.

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## Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.



