



WiMAX FORUM® WiMAX™ ROAMING INTERFACE

based on WiMAX Forum Certified™ Products

Stage 2 Part 0: Overview Release 1.0 Version 2

WMF-T42-001-R010v02

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WiMAX Forum Proprietary

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1 Introduction

WiMAX Forum® WiMAX™ Roaming Interface (WRI) is based on the WiMAX Forum® Network Architecture Stage 2 and Stage 3 set of specifications [1].

This document provides an introduction to the WRI logical functional elements and reference points included in the WRI. This document also introduces the different documents which comprise the Stage 2 of the WiMAX Roaming Interface.

2 Scope

This document contains the introduction of the Stage 2 of the WiMAX Roaming Interface architecture.

3 References

This section contains the documents which are referenced by the different WRI specifications which compromise WRI Stage 2. Note that if a release is mentioned without a version for a particular reference, it is assumed that the latest available version for that release is to be used as reference. If both the release and version are omitted, the latest document is to be used as a reference.

- [1] WMF-T32-001-R010v04 WiMAX Forum® Network Architecture Stage 2: Release 1.0 Version 4 and WMF-T33-001-R010v04 Network Architecture Stage 3: Release 1.0 Version 4.
- [2] WMF-T42-002-R010v02 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 2 Part 1:AAA Proxy Release 1.0 Version 2.
- [3] WMF-T42-003-R010v02 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 2 Part 2: Wholesale Rating Release 1.0 Version 2.
- [4] WMF-T42-004-R010v02 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 2 Part 3: Clearing Release 1.0 Version 2.
- [5] WMF-T42-005-R010v02 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 2 Part 4: Financial Settlement - Release 1.0 Version 2.
- [6] WMF-T42-006-R010v02 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 2 Part 5: Interconnection - Release 1.0 Version 2.
- [7] WMF-T48-001-R010 WiMAX Forum® WiMAX™ Roaming Agreement Template (WRA1) Release 1.0.
- [8] WMF-T48-002-R010 WiMAX Forum® WiMAX™ Roaming Agreement Annex (WRA2) Release 1.0.
- [9] ISO 4217: Codes for the representation of currencies and funds:
http://www.iso.org/iso/support/faqs/faqs_widely_used_standards/widely_used_standards_other/currency_codes/currency_codes_list-1.htm.
- [10] International Monetary Fund (IMF): Exchange Rate Conversion Table:
http://www.imf.org/external/np/fin/data/rms_mth.aspx?reportType=CVSDR.
- [11] International Monetary Fund (IMF): Special Drawing Rights:
<http://www.imf.org/external/np/exr/facts/sdr.htm>.
- [12] IETF RFC 1876 “A Means for Expressing Location Information in the Domain Name System”: <http://www.ietf.org/rfc/rfc1876.txt>.
- [13] IETF RFC 1930 “Guidelines for creation, selection, and registration of an Autonomous System (AS)”: <http://www.ietf.org/rfc/rfc1930.txt>.
- [14] IETF RFC 2119 “Key words for use in RFCs to Indicate Requirement Levels”:
<http://www.ietf.org/rfc/rfc2119.txt>.
- [15] IETF RFC 2866 “RADIUS Accounting”: <http://www.ietf.org/rfc/rfc2866.txt>.
- [16] IETF RFC 4282 “Network Access Identifier”: <http://www.ietf.org/rfc/rfc4282.txt>.

4 Terminology

The WRI Stage 2 series of documents will use the following “verbal forms” and “verbal form definitions”:

- “SHALL” and “SHALL NOT” identify items of interest that are to be strictly followed and from which no deviation is recommended.
- “SHOULD” and “SHOULD NOT” indicate items of interest that are highly desirable and particularly suitable, without identifying or excluding other items; or (in the negative form) indicate items of interest that are not desirable, are not particularly suitable, or are not recommended but not prohibited.
- “MAY” and “MAY NOT” indicate items of interest that are optional but permissible within the limits of this recommendation.

See also IETF RFC 2119 [13] for additional information.

5 Definitions

Network Access Provider (NAP)	Network Access Provider (NAP) is a business entity that provides WiMAX™ radio access infrastructure to one or more WiMAX™ Network Service Providers (NSPs). A NAP implements this infrastructure using one or more ASNs.
Network Service Provider (NSP)	Network Service Provider (NSP) is a business entity that provides IP connectivity and WiMAX™ services to WiMAX™ subscribers compliant with the Service Level Agreement it establishes with WiMAX subscribers. To provide these services, an NSP establishes contractual agreements with one or more NAPs. Additionally, an NSP may also establish roaming agreements with other NSPs and contractual agreements with third-party application providers (e.g., Access Service Providers (ASPs) or Internet Service Providers (ISPs)) for providing WiMAX services to subscribers. From a WiMAX subscriber standpoint, an NSP may be classified as Home NSP (H-NSP) or Visited NSP (V-NSP). Ref [1].
WiMAX™ Operator	WiMAX Operators are typically different Network Service Providers (NSPs) but could involve different Network Access Providers (NAPs)
Roaming	A technical and business relationship between two different WiMAX operators (these are typically different Network Service Providers, but could involve different Network Access Providers) that enables the subscribers of the first network (home network) to connect and receive services in the second (visited or serving network) network
Roaming User	The user may be a subscriber with a pre-existing relationship with an operator that is not the serving WiMAX network operator but may have a business relationship with the serving WiMAX network operator, or may be a casual user who has established usage for a limited duration of time.
Accounting Mode - IP-session (Session based)	Accounting where user is charged based on number of IP sessions. Each IP-session has its own IP address. One or more IP-sessions may map to the same device-session. IP-sessions are based on assigned IP addresses to an actual subscription/device pair.
Accounting Mode - PD-flow (Flow based)	Accounting where user is charged based on Packet Data-flows (PD-flows). There can be one or more PD-flows mapping to the same IP session. A PD-flow can be mapped to one or more service data flows. Several PD-flows can be grouped by a service data flow, identified by an SDFID.
WiMAX™ Roaming Exchange (WRX):	A business entity that implements and performs WRI functions on behalf of a NSP. A WRX may implement and perform a portion, or all, of the WRI functions on behalf of a NSP. WRI functions include wholesale rating, clearing, financial settlement and fraud detection.
WiMAX™ Roaming Interface (WRI)	A set of specifications describing how wholesale rating, clearing, financial settlement and fraud detection can be performed between different operators.
Subscriber Usage Record	Accounting data regarding subscriber's single accounting session. Data, such as, location, total amount of time and/or data volume, Chargeable User Identifier (CUI), etc..
Aggregators	Aggregators are "special/virtual" NSPs that broker WiMAX services between NSPs to which they have direct roaming agreements. The aggregator is financially responsible for the roaming traffic.
Autonomous System number	An Autonomous System number is used in both the exchange of exterior routing information (between neighboring Autonomous Systems), and as an identifier of the AS itself. AS numbers are assigned by the Internet Assigned Numbers Authority (IANA). Guidelines for creation, selection, and registration of AS numbers are documented in IETF RFC 1930 [13].
Subscriber Station	A subscriber station (SS) is a generalized equipment set providing connectivity between subscriber equipment and WiMAX base station.
Terminology	Subscriber, End-User and User have the same meaning and refer to the retail customer of the NSP.

6 Abbreviations

AAA	Authentication, Authorization, and Accounting
AS	Autonomous System
ASN	Access Service Network
ASN-GW	ASN-Gateway
ASP	Access Service Provider
BS	Base Station
BS-ID	Base Station Identifier
CCoA	Co-located Care of Address
CMIP	Client MIP
CSN	Connectivity Service Network
CUI	Chargeable User Identity
DNS	Domain Name Server
FA	Foreign Agent
FTP	File Transfer Protocol
GMT	Greenwich Mean Time
HA	Home Agent
hAAA	home AAA
H-CSN	Home CSN
hNSP/H-NSP	Home NSP
HTTP	Hypertext Transfer Protocol
IANA	Internet Assigned Numbers Authority
IETF	Internet Engineering Task Force
IMF	International Monetary Fund
IMS	IP Multi-Media System
IOT	Inter-Operator Tariff
IPsec	IP security
ISO	International Standard Organization
ISP	Internet Service Provider
MIP	Mobile IP
MPLS	Multi-Protocol Label Switching
MS	Mobile Subscriber
MVNO	Mobile Virtual Network Operators
NAP	Network Access Provider
NAP-ID	NAP Identifier
NAS	Network Access Server
NAS-ID	Network Access Server Identifier
NRT	Near Real Time

NSP	Network Service Provider
NSP-ID	NSP Identifier
RADIUS	Remote Authentication Dial In User Service
RFC	Request For Comment
SDR	Special Drawing Right [11]
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SS	Subscriber Station
QoS	Quality of Service
PD-Flow	Packet Data Flow
PMIP	Proxy MIP
UDR	User Data Records
vAAA	visited AAA
VoIP	Voice over IP
VSA	Vendor Specific (RADIUS) Attribute
WRI	WiMAX Roaming Interface
WRX	WiMAX Roaming eXchange, WiMAX Roaming eXchange Provider
vCSN/V-CSN	Visited CSN
vNSP/V-NSP	Visited NSP
VPN	Virtual Private Network

7 Assumptions

The architecture described in this multi-part specification assumes the following:

- a. RADIUS is the protocol used for communication between AAAs.
- b. AAA records will be used for invoice reconciliation and fraud management.
- c. The architecture will be based on the WiMAX Forum Network Architecture Stage 2 and Stage 3 specifications [1].
- d. Reuse of existing protocols will be promoted.
- e. The location where the logical functions of the WiMAX Roaming Interface architecture are implemented is not mandated.
- f. In this release, the following restrictions will be imposed:
 - HTTP will not be supported as transport protocol for the WRI.
 - Wholesale Fraud functionality will not be supported.
 - Procedures on handling of variations in currency will not be supported.
 - Detailed financial rejection procedures will not be addressed.
 - Rules for Financial Settlement netting are not defined.
 - Internationalization of Domain Names as described in RFC 4282 [16] is out of scope.
 - The concepts of procedures for X4 and X4R are contained in WRI Release Stage 2 but will not be described in detail in WRI Stage 3.
 - Flat Rate is not supported.
- g. Prepaid Services (i.e. on-line accounting) may be supported in a roaming environment only if the Prepaid Client (PPC) is located within the Home Agent (HA) in the Home Connectivity Service Network (CSN) and all subscriber bearer traffic is routed to this HA via Mobile IP while the subscriber is roaming.
- h. AAA Routing is statically configured when interconnection between home and visited NSP is via Direct Connection and/or WiMAX Roaming eXchanges”.
- i. Flow-based accounting is not supported in this release.
- j. MS/SS may use simple IP through Proxy MIP (PMIP) or MS/SS based Client MIP (CMIP)
- k. Either CMIP or PIMP or both shall be supported.
- l. Mobile IP V4 shall be supported.
- m. Mobile IP V6 may be supported.
- n. Mobile IP V4 Collocated Care of Address (CCoA) shall not be supported.
- o. Concurrent home and visited services are not supported.

8 WiMAX™ Roaming Interface Architecture Overview

The WiMAX Roaming Interface documents provide detailed rules and a description for implementing roaming services. Roaming can be implemented via direct connections between two NSPs or via 3rd party WiMAX Roaming eXchange (WRX). The diagram below shows all the functions and reference points needed for implementing roaming. A NSP can choose to outsource one or more of these functions and reference points to a WRX. The functions and the reference points are further explained in their relevant documents.

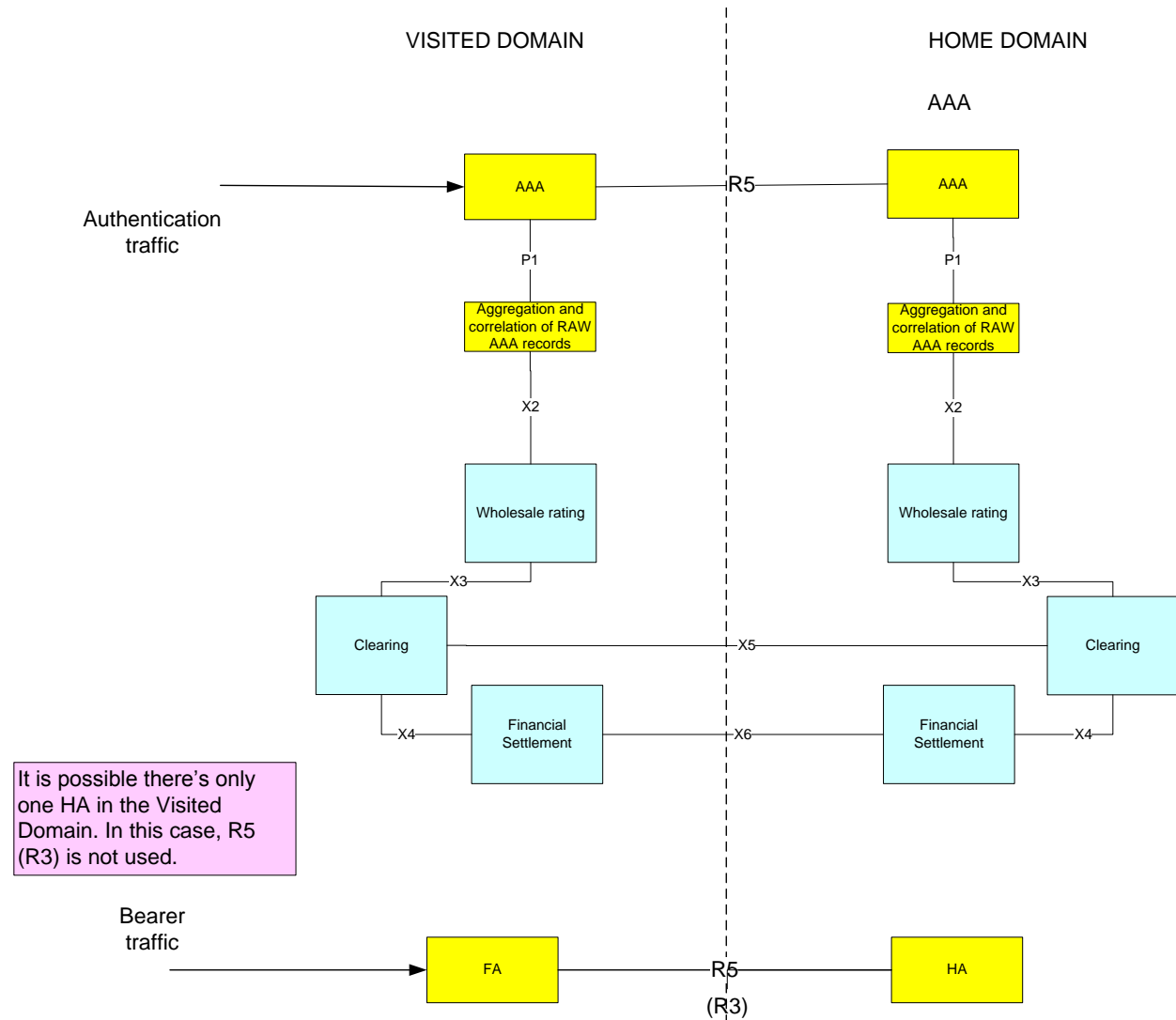


Figure 1: WiMAX Roaming Interface and Functional Diagram

The WiMAX Roaming Interface encompasses the following six additional documents:

1. WRI AAA Proxy (Service)

The WRI Stage 2 AAA Proxy (Service) document [2] describes functions related to WRI AAA Proxy Services and the X2 Reference Point.

Proxy Services involve proxy of RADIUS messages, correlation and aggregation of session records, validating roaming agreements between the roaming partners and the transfer of aggregated session records to the WRI Wholesale Rating and WRI Fraud Management logical functions. The WRI AAA Proxy service will validate attributes which are present in the RADIUS records and will create files (aggregated sessions) to be sent to the WRI Wholesale Rating logical function via the X2 Reference Point. The document also defines the RADIUS attributes, elements and rules to create X2 Reference Point file.

2. WRI Wholesale Rating

Wholesale rating involves rating of raw aggregated session records.

The WRI Stage 2 Wholesale Rating document [3] describes the WRI Wholesale Rating logical function and the X3 Reference Point.

The WRI Wholesale Rating logical function receives files (aggregated session) from the WRI AAA Proxy Service logical function via the X2 Reference Point, it will then calculate and assign monetary values to these sessions. The calculation of monetary values is based on rates and taxes agreed within the roaming agreement. These rated sessions are then used to create files which will be sent to the WRI Clearing logical function via the X3 Reference Point. This document also defines the elements and rules to create the X3 Reference Point file.

3. WRI Clearing

Clearing enables acceptance and rejection of financial liability via exchange of rated session records.

The WRI Stage 2 Clearing document [4] describes the WRI Clearing logical function, and the X4 and X5 Reference Points. The document also defines the elements and rules to create X4 and X5 files sent via the X4 and X5 Reference Points respectively.

The WRI Clearing logical function involves receiving of X3 and X5 Reference Point files, creation and validating of X5 Reference Point files, rejecting and retransmission of corrected X5 Reference Point files and providing accounting data to the Financial Settlement logical function via the X4 Reference Point by transmitting summarized X5 Reference Point files (a.k.a. X4 Reference Point files).

The WRI Clearing logical function is located in the home and the visited network. Each may perform different functions based on its location.

The WRI Clearing logical function located in the home network will receive X3 Reference Point files from the home WRI Wholesale Rating logical function and X5 Reference Point file(s) from the visited WRI Clearing logical function. Once these files are received, the home WRI Clearing logical function will validate structure and the content of the X5 Reference Point file. The structure is validated based on the WRI Stage 3 specifications whereas the content is validated by comparing the sessions and the charges to the X3 Reference Point files. If the validation fails, the home WRI Clearing logical functions will create a reject X5 Reference Point file, or X5R Reference Point file, and send it to the visited WRI Clearing logical function. If the validation passes, it will create X4 Reference Point files and send them to the home WRI Financial Settlement logical function via the X4 Reference Point.

The WRI Clearing logical function located in the visited network will receive X3 Reference Point files from the visited WRI Wholesale Rating logical function and create summarized X5 Reference Point files and transmit them to the home WRI Clearing logical function. It may also receive a rejected X5 Reference

Point file from the home WRI Clearing logical function. When the visited WRI Clearing logical function receives the reject X5 Reference Point file, it will correct the errors, and will retransmit the X5 Reference Point file. The visited WRI Clearing logical function will also create X4 Reference Point file and will send it to the visited WRI Financial Settlement logical function.

4. WRI Financial Settlement

Financial Settlement involves settlement of financial responsibilities.

The WRI Stage 2 Financial Settlement specification [5] describes the WRI Financial Settlement logical function and the X6 Reference Point. The document also defines the elements and rules to create the X6 Reference Point file.

The WRI Financial Settlement logical function is located in both the visited and the home network. In both cases, the WRI Financial logical function will receive X4 Reference Point files from the respective WRI Clearing logical function. The WRI Financial Settlement logical function will then generate one monthly X6 Reference Point file based on all the X4 Reference Point files for the given month. The X6 Reference Point file is then exchanged between the two WRI Financial Settlement logical functions and validated. If the validation fails, the WRI Financial Settlement logical function will create a reject X6 Reference Point file, or X6R Reference Point file, and send it to the peer WRI Financial Settlement logical function. The receiving WRI Financial Settlement function will then correct and retransmit the X6 Reference Point file. If the validation passes, the settlement of accounts is performed by transferring of monies.

Settlement also includes performing foreign currency exchange and tracking of any outstanding financial obligations.

Note: The procedures for generating the X6R Reference Point files are not addressed in WRI Release 1.0.

5. WRI Interconnection

The purpose of WRI Stage 2 Interconnection document [6] is to discuss Financial Settlement/Clearing, AAA traffic, and bearer traffic data path connection options and define reference point requirements to establish roaming. The document provides detailed descriptions of the following three options: roaming with no interconnection, roaming with direct interconnections and interconnections via a WRX. The WRI Interconnection defines the interfaces/reference points required for direct connections and connections via a WRX.

6. WRI Fraud Management:

The purpose of this document is to define the WRI Fraud Management logical function. The Interconnect (AAA Proxy and Aggregation) and Data Clearing (Wholesale Rating) processes represent the first opportunity to perform certain types of fraud detection and prevention.

Fraud management will use RADIUS messages and/or rated session records to perform abnormal usage pattern detection over a period of time in order to identify and proactively report potential fraudulent activities.

Note: This logical function is not addressed in the first version of WRI and is not shown in the above figure.

9 WiMAX™ Roaming Interface - Stage 2 Document Structure

This document is the first part of WiMAX Forum WiMAX Roaming Interface Architecture, which includes the following parts:

Part	Title
Part 0	Overview
Part 1	AAA Proxy Service [2]
Part 2	Wholesale Rating [3]
Part 3	Clearing [4]
Part 4	Financial Settlement [5]
Part 5	Interconnection [6]

10 Revision History

Revision	Changes	Date
1	Initial Publication	August 4, 2008
2	<p>Modifications to Align with WRI Release 1.0 Stage 3</p> <p>The following changes were introduced:</p> <p>1) 090306 GRWG WRI Stage 3 Release 1 Part 1 AAA Proxy_ Consolidated V&V Comment 1552, 1589</p> <p>2) 090306 WRI Stage 3 Release 1 Part 4 Financial Settlement Consolidated V&V Comment 1773</p> <p>3) 090309 WRI Stage 3 Release 1 Part 3 Clearing Consolidated V&V Comments:</p> <p>a) 1601 and 1840: Add IETF RFC 2866 to references.</p> <p>b) 1897 and 1907: X4 and X4R to be added in WRI Stage 3 in a future release.</p> <p>4) Editorial changes</p> <p>a) Change "Copyright ©" to "Copyright"</p> <p>b) Apply the recommended ® and TM where appropriate</p> <p>c) Include missing acronyms</p> <p>d) Change "Interface" to "reference point" where applicable</p> <p>e) Add missing references for Special Drawing Rights, IETF RFC 1876, IETF RFC 2119, and IETF RFC 1930</p> <p>f) Align definitions of WRX and WRI with SPWG Requirements for WiMAX™ Roaming Exchange Dynamic Routing and Roaming Services.</p> <p>g) Change MS to MS/SS to address differences between Part 0 and Part 5</p> <p>i) Made semantical changes to the body of the text</p>	March 23, 2009
2	<p>Modifications include:</p> <p>1) Introduced TCC document numbering format in headers and in titles of WiMAX Forum documents in the Reference Section.</p> <p>2) Added additional assumptions in the Assumption section based on 090318 GRWG Commercial Adhoc Tampa Status v3.ppt and removed the editor's note.</p> <p>3) Clarified text in Section 8 to state that:</p> <p>a) Information contained in the different WRI Stage 2 documents describe actions performed by 'WRI logical functions'.</p> <p>b) Reference Point files are being exchanged.</p> <p>4) Added the following text "Note: The procedures for generating the X6R Reference Point files are not addressed in WRI Release 1.0.</p> <p>5) Updated the Front page"</p> <p>6) Added abbreviations: IOT, MVNO, AS, IANA, vAAA, hAAA</p>	May 3, 2009
2	Incorporated changes recommended during review of May 11, 2009 including TCC number modifications from Dublin meeting.	May 15, 2009
2	WiMAX Forum Board of Directors Approved	June 24, 2009