



WiMAX FORUM® WiMAX™ ROAMING INTERFACE
based on WiMAX Forum Certified™ Products

Stage 3: Part 0 – Overview
Release 1.0 Version 1

WMF-T43-001-R010v01

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1 Introduction

WiMAX Forum® WiMAX™ Roaming Interface (WRI) is based on the logical architecture described in WRI Stage 2 Part 0: Overview [2].

This document provides an overview of the structure of the multi-part WRI Release 1.0 Stage 3, introduces the different documents which compromise the WRI Stage 3, and contains common parts between the different WRI documents including abbreviations and references. A high-level description of the WRI architecture and the description of the logical functional entities can be found in [2].

1 **2 Scope**

2 This document provides an overview of the Stage 3 of the WiMAX™ Roaming Interface architecture. A
3 diagram of the WRI Architecture and a description of the different WRI logical functions are included in
4 WRI Stage 2 Part 0: Overview [2].

3 References

This section contains the documents which are referenced by the different WRI specifications which comprise WRI Stage 3. 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-T33-001-R010v04 WiMAX Forum® “Network Architecture Release 1.0 Version 4”.
- [2] WMF-T42-001-R010 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 2 Release 1.0.
- [3] WMF-T43-002-R010v01 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 3: Part 1 AAA Proxy Release 1.0 Version 1.
- [4] WMF-T43-003-R010v01 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 3: Part 2 Wholesale Rating Release 1.0 Version 1.
- [5] WMF-T43-004-R010v01 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 3: Part 3 Clearing Release 1.0 Version 1.
- [6] WMF-T43-005-R010v01 WiMAX Forum® WiMAX™ Roaming Interface based on WiMAX Forum Certified™ Products Stage 3: Part 4 Financial Settlement Release 1.0 Version 1.
- [7] WiMAX Forum® WRI Common Release 1.0 Version 1 XSD.
- [8] WiMAX Forum® WRI X2 Release 1.0 Version 1 XSD.
- [9] WiMAX Forum® WRI X2A Release 1.0 Version 1.XSD.
- [10] WiMAX Forum® WRI X2R Release 1.0 Version 1.XSD.
- [11] WiMAX Forum® WRI X3 Release 1.0 Version 1. XSD.
- [12] WiMAX Forum® WRI X3A Release 1.0 Version 1.XSD.
- [13] WiMAX Forum® WRI X3R Release 1.0 Version 1.XSD.
- [14] WiMAX Forum® WRI X5 Release 1.0 Version 1.XSD.
- [15] WiMAX Forum® WRI X5A Release 1.0 Version 1.XSD.
- [16] WiMAX Forum® WRI X5R Release 1.0 Version 1.XSD.
- [17] WiMAX Forum® WRI X6 Release 1.0 Version 1. XSD.
- [18] WMF-T40-002-R010 WiMAX Forum® WiMAX™ Roaming Interface Code Release 1.0.
- [19] IETF RFC 1305 “Network Time Protocol (Version 3) Specification, Implementation, and Analysis”.
<http://www.ietf.org/rfc/rfc1305.txt>
- [20] IETF RFC 2865 “Remote Authentication Dial In User Service (RADIUS)”.
<http://www.ietf.org/rfc/rfc2865.txt>.
- [21] IETF RFC 2866 “RADIUS Accounting”. <http://www.ietf.org/rfc/rfc2866.txt>.
- [22] IETF RFC 2869 “RADIUS Extensions”. <http://www.ietf.org/rfc/rfc2869.txt>.
- [23] IETF RFC 3315, “Dynamic Host Configuration Protocol for IPv6 (DHCPv6)”.
<http://www.ietf.org/rfc/rfc3315.txt>.
- [24] IETF RFC 4282 “Network Access Identifier”. <http://www.ietf.org/rfc/rfc4282.txt>.
- [25] IETF RFC 5080 “Common Remote Authentication Dial In User Service (RADIUS) Implementation Issues and Suggested Fixes”. <http://www.ietf.org/rfc/rfc5080.txt>.
- [26] IETF RFC 5176 “Dynamic Authorization Extensions to Remote Authentication Dial In User Service (RADIUS)”. <http://www.ietf.org/rfc/rfc5176.txt>.

- 1 [27] ISO 3166: Codes for the representation of names of countries and their subdivisions.
2 http://www.iso.org/iso/country_codes.
- 3 [28] ISO 4217: Codes for the representation of currencies and funds.
4 http://www.iso.org/iso/support/faqs/faqs_widely_used_standards/widely_used_standards_other/currency_codes/currency_codes_list-1.htm.
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6 [29] International Monetary Fund (IMF): Exchange Rate Conversion Table.
7 http://www.imf.org/external/np/fin/data/rms_mth.aspx?reportType=CVSDR.
- 8 [30] International Monetary Fund (IMF): Special Drawing Rights.
9 <http://www.imf.org/external/np/exr/facts/sdr.htm>.
- 10 [31] W3C Recommendation Extensible Markup Language (XML) 1.0 (Fifth Edition). <http://www.w3.org/TR/Rec-xml>.
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- 12 [32] W3C Recommendation **XML Schema Part 0: Primer Second Edition**. <http://www.w3.org/TR/2004/REC-xmlschema-0-20041028>.
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- 14 [33] W3C Recommendation **XML Schema Part 1: Structures Second Edition**.
15 <http://www.w3.org/TR/2004/REC-xmlschema-1-20041028>.
- 16 [34] W3C Recommendation **XML Schema Part 2: Datatypes Second Edition**.
17 <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028>.
- 18 [35] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".
19

4 Terminology

This WRI Stage 3 series of documents will use the following “verbal forms” and “verbal form definitions”:

- a. “SHALL” and “SHALL NOT” identify items of interest that are to be strictly followed and from which no deviation is recommended,
- b. “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, and
- c. “MAY” and “MAY NOT” indicate items of interest that are optional but permissible within the limits of this recommendation.

5 Definitions

- 1
- 2 This section expands the list of definitions described in WRI Stage 2: Part 0 - Overview [2] and contains definitions
- 3 introduced in the WRI Stage 3.

Data Dictionary	The Data Dictionary identifies and provides a detailed description for each data element exchanged via a particular Reference Point. The detailed description could include any combination of the following: the conditions when the item is to be included, the concerned format, any applicable validation rules, and error codes and error descriptions when invalid or inappropriate conditions are detected.
XML Schema	XML Schema is a means for defining the structure, content, and semantics of XML documents. Each XML document has a Logical and Physical Structure [31]. An XML document defines the XML tags and their interrelationship.
X-Reference Point	X-Reference Point is a term used to refer to all reference points that start with the letter 'X' in the WiMAX Roaming Interface (WRI) Architecture described in WRI Stage 2 Part 0: Overview [2].

4

1

6 Abbreviations

AAA	Authentication, Authorization, and Accounting
ASN	Access Service Network
ASN-GW	ASN-Gateway
BS	Base Station
BS-ID	Base Station Identifier
CMIP	Client Mobile IP
CMIPv4	Client Mobile IPv4
CMIPv6	Client Mobile IPv6
CSN	Connectivity Service Network
CUI	Chargeable User Identity
DHCP	Dynamic Host Configuration Protocol
DHCPv6	Dynamic Host Configuration Protocol for IPv6
FQDN	Fully Qualified Domain Name
GMT	Greenwich Mean Time
HA	Home Agent
H-NSP/hNSP	Home NSP
H-WRX/hWRX	Home WRX
IETF	Internet Engineering Task Force
IP	Internet Protocol
ITU	International Telecommunications Union
MAC	Medium Access Control
MS	Mobile Station
NAI	Network Access Identifier
NAP	Network Access Provider
NAP-ID	NAP-Identifier
NAS	Network Access Server
NAS-ID	NAS-Identifier
NSP	Network Service Provider
NSP-ID	Network Service Provider Identifier
NTP	Network Time Protocol
PMIP	Proxy Mobile IP
PMIPv4	Proxy Mobile IPv4
PO Box	Post Office Box
RADIUS	Remote Authentication Dial In User Service
RT	Retransmission Timeout
SDR	Special Drawing Rights [28] [29]
SLA	Service Level Agreement

SS	Subscriber Station
TBD	To Be Determined
TID	Transaction Identifier
UDR	User Data Record
VAT	Value Added Tax
V-NSP/vNSP	Visited NSP
VSA	Vendor Specific Attribute
V-WRX/vWRX	Visited WRX
W3C	World Wide Web Consortium
WRX	WiMAX Roaming eXchange
XML	eXtensible Markup Language
XSD	XML Schema Definition

7 Assumptions

In addition to the assumptions described in WiMAX Roaming Interface Stage 2 Part 0: Overview [2], the architecture described in this multi-part specification assumes the following:

- a. Network entities which are exchanging WRI files have acquired a WiMAX Roaming Interface Code or WRI Code [18] which is administered by the WiMAX Forum.
- b. No inter-operator wholesale charges will be posted for sessions for which no corresponding Accounting STOP has been received.

8 WiMAX™ Roaming Interface - Stage 3 Document Structure

The WiMAX Roaming Interface Stage 3 is a multi-part specification which is based on the WRI architecture and requirements defined in [2]. Table 1 lists the parts of this WRI Stage 3 specification.

Table 1 WiMAX Roaming Interface (WRI) Stage 3 Specifications

Part	Title	Short Description
Part 0	Overview	This document is the first part of the WiMAX Forum Roaming Interface Architecture Stage 3. It contains the index for the multi-part WRI Stage 3 specification and information shared between the other parts including references, and abbreviations.
Part 1	AAA Proxy Service [3]	This document describes functions of AAA Proxy Services and the X2 Reference Point. It contains details on: 1) Recommended Timer values 2) Error codes exchanged between AAA entities 3) The X2, X2A, and X2R Logical Structures, associated Data Dictionaries, and eXtensible Markup Language (XML) Schema Definition (XSD) files [8][8][9][10].
Part 2	Wholesale Rating [4]	This document describes the wholesale rating procedures and the X3 Reference Point processes. It includes details on the X3, X3A, and X3R Logical Structures, associated Data Dictionaries, and XSDs [7] [11] [12] [13].
Part 3	Clearing [5]	This document describes clearing procedures and the X4 and X5 Reference Point processes. It contains details on the X4, X4R, X5, X5A, and X5R Logical Structures, associated Data Dictionaries, and XSDs [7] [14] [15] [16]. Note: This version of the WRI specification does not contain any details on X4 and X4R.
Part 4	Financial Settlement [6]	This document describes the financial settlement procedures and X6 Reference Point procedures. It contains details on the X6 Logical Structure, associated Data Dictionary, and XSD [17].

Note:

For Part 1 – Part 4, the included XML and XSD are based on W3C Recommendations [31] – [34].

9 Common Methods, Processes, and Functionality

This section describes common methods, processes, and functionality which have been applied in the different parts of the WRI Stage 3 specification.

9.1 Common Encoding Scheme

Except for the Part 0, the other WiMAX Roaming Interface Stage 3 Parts have Data Dictionaries which identify and describe each data element in the files exchanged via a particular WRI Reference Point. The information in each of these files is encoded in XML as defined by [31] – [34]. For each WRI Reference Point, the applicable WRI specification contains an XML Logical Structure and associated XML Physical Structure as indicated in Table 1. XML Schema files, which contain the encoded XML Physical Structure for the relevant Reference Point, have the file extension “XSD” and have been included in the WRI Stage 3 set of specifications [7] – [17]. There is one XSD file which contains information that is common between the XML Physical Structures of the different WRI Reference Points [7].

9.2 Common Procedures – Error Handling

Each Data Dictionary includes numeric error codes with level of severity which are used to report or indicate the handling of inconsistencies in the exchange of information transferred via the different reference points of the logical WRI Architecture [2]. In this WRI Stage 3 specification, only the procedures and error handling of the public WRI Architecture reference points prefixed with the letter X are described.

Listed below are the levels of severity to be used for the public reference points of the WiMAX Roaming Interface Architecture [2]:

- **Fatal**

R-[G-S3-001] The entire file SHALL be rejected.

- **Severe**

Records with severe errors affect the ability to charge the home WiMAX subscriber. In accordance with specific bilateral agreements or WRI protocol procedures, these records should have been forwarded by the visited entity.

R-[G-S3-002] The home entity MAY reject financial liability for individual calls/events.

Rejected calls/events may be included in the reject files, which have a name with the postfix R, and the return process where available.

- **Warning**

Records with warnings are billable, for example, the problem does not affect the ability of the WiMAX home operator to charge its customer. The record contains data that might be created as a result of some failure or might cause problems for customer care.

R-[G-S3-003] Warning errors are a result of optional field validation and MAY or MAY NOT be forwarded to the source entity.

The severity of errors may depend on the context in which the element or group appears in the XML file exchanged via a particular WRI X reference point.

When a ‘Fatal’ error is detected in a received file, the file is to be rejected immediately. R-[G-S3-004] Since a received file with a ‘Fatal’ error cannot be processed, all records in that file SHALL be rejected. For all other errors detected in the received file, the receiver SHALL send only one reject file with all

1 records with errors. The records which have not been rejected are assumed to have been accepted by the
 2 recipient. To avoid stopping the invoicing of all the call/events in a file when a call/event could be
 3 rejected with both a 'Fatal' and a 'Severe' error, the recipient (i.e. the receiver of the file) is advised to use
 4 the 'Severe' error and not the 'Fatal' error. In response to a received “Reject” file, the receiver will send an
 5 “Acknowledgement” file.

6 Table 2 lists the different classification of errors by category. Each category is allocated a specific number
 7 range. Some errors will be included in the files exchanged via the different public WRI reference points.
 8 Files are named after the applicable reference points between the concerned logical WRI entities which
 9 are exchanging data. Note that the postfix R in a file name indicates that the file is a “Reject” file. The
 10 corresponding “Acknowledgement” file has the postfix A in the filename. Specific error codes for data
 11 items associated with a public WRI Reference Point are defined in the Data Dictionary related to that
 12 Reference Point. The following rules apply to the naming and numbering of errors defined for a Data
 13 Dictionary.

14 **Table 2 WiMAX Roaming Interface Error Codes**

<i>Reference Point File</i>	<i>Error Code Range</i>	<i>Description</i>
X2, X3, X4, X5, X6	001-099	<p>File Related Errors</p> <p>R-[G-S3-005] Error Code: 001: X-Reference point file size SHALL not exceed 100 MByte. To avoid error code 001, it is recommended to send multiple files.</p> <p>R-[G-S3-006] Error Code: 002: X-Reference Point file naming convention SHALL be as defined in WRI-Stage 2 [2].</p> <p>Error Code: 003: Unreadable File is detected. The file is not formatted as defined.</p>
X2, X3, X4, X5, X6	100-200	<p>XML Format Error</p> <p>All possible errors detected when attempting to validate the X-Reference Point file against the applicable XML schema defined in the XML Physical Structure.</p> <p>The validation description refers to these values as <i>Syntax error</i>.</p> <p>When a Syntax error is encountered in the X-Reference Point file, the whole file is classified as ‘invalid’ and, therefore, is to be rejected and to be reported as such to the Sender.</p> <p>Syntax errors cannot be raised based on the information in the data dictionary and therefore share the same error code. However, a detailed error description is normally made available when a Syntax error is detected.</p>
X2, X3, X4, X5, X6	500-599	<p>Value out of range in element</p> <p>The value in a field does not match the range or is not in the list of values allowed for this field.</p> <p>All these errors are uniquely identified by an error code.</p> <p>Each of these errors only relates to a particular X-Reference Point file element and has to be reported to the Sender in the related X-Reference Point Reject file.</p>
X2, X3, X4, X5, X6	600 to 699	<p>Invalid group structure</p> <p>The group has elements either missing but expected or present and not</p>

<i>Reference Point File</i>	<i>Error Code Range</i>	<i>Description</i>
		<p>expected, i.e. the structure of the group is invalid.</p> <p>All these errors are uniquely identified by an error code. Each of these errors relates only to a particular X-Reference Point file element and has to be reported to the Sender in the X-Reference Point Reject file.</p>
X2, X3, X4, X5, X6	700 to 799	<p>Inconsistencies between fields</p> <p>These errors affect more than one element and are caused by contradicting values.</p> <p>All these errors are uniquely identified by an error code. Each of these errors relates only to a particular X-Reference Point file element and has to be reported to the Sender in the related X-Reference Point Reject file.</p>
X2, X3, X4, X5, X6	800 to 999	<p>Specific Errors</p> <p>Specific Errors are errors that do not fit into one of the groups above.</p> <p>All Specific Errors are uniquely identified by an error code. Each of these errors relates only to a particular X-Reference Point file element and has to be reported in the Sender X-Reference Point Reject file.</p>
X2, X3, X4, X5, X6	9000-9999	<p>Bilateral /Multilateral Agreements Errors</p> <p>A Bilateral/Multilateral Agreement error is any validation error generated due to inconstancy or lack of information at the roaming agreement level between the involved partners. These errors and error codes are agreed between roaming partners prior to exchanging files.</p>

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1 10 Revision History

Revision	Changes	Date
1	Initial Publication	May 4, 2009

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