WiMAX Forum® Network Architecture

Architecture, detailed Protocols and Procedures

WiMAX® Device Reported Metrics & Diagnostics (DRMD)

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WiMAX Forum Proprietary

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1 Document Scope

This document is one of the series that describes the Stage 2 & Stage 3 implementations of the network aspects of WiMAX® systems [1]. It describes an implementation of the Phase 1 Device Reported Metrics & Diagnostics (DRMD) feature using OMA-DM or TR-069 as the retrieval mechanism. It provides an implementation of the requirements provided in [2].

It builds upon the existing OMA-DM and TR-069 applications specified by WiMAX® Rel 1.5, as it assumes the use of the same bootstrap & security mechanisms [4]. The bootstrap mechanism specified in [4] will determine whether the OMA-DM or TR-069 protocol is used for device management and metrics retrieval. The primary contents of this document are therefore the managed object (MO) used to retrieve the metric parameters from the SS/MS.

2 Abbreviations and Definitions

2.1 Conventions (Informative)

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in RFC 2119 Ref [3].

2.2 Abbreviations and Acronyms (*Informative)*

3GPP Third Generation Partnership Project
BS Base Station
BSID Base Station Identifier
CINR Carrier Interference Noise Ratio
DM Devi ce Management
DRMD Device Reported Metrics and Diagnostics
GPS Global Positioning System
HARQ Hybrid Automatic Repeat Request
MCS Modulation Coding Scheme
MIMO Multiple Input and Multiple Output
NAT Netw ork Address Translation
NSP Network Service Provider
OMA Op en Mobile Alliance
OTA Ove r the Air
RSSI Radio Signal Strength Indication
SDU Serv ice Data Unit

2.3 Definitions (*Informative)*

2.3.1 DRMD Client

The application in the User Device which receives the requests from the DRMD server; retrieves the requested metric data from various interfaces within the device; formats & returns the results to the DRMD server. The DRMD client is the same as that used for other device management functions under WiMAX Forum® Network Architecture Release 1.5 OTA, and therefore may employ OMA-DM or TR-069 protocols.

2.3.2 DRMD Server

The network entity that, on behalf of a requesting entity in the network, requests device metrics from the DRMD client; and prepares the collected device metrics for analysis. The DRMD server is the same as that used for other device management functions under WiMAX Forum® Network Architecture Release 1.5 OTA, and therefore may employ OMA-DM or TR-069 protocols.

3 References

1. WMF-T31-001-R015, WiMAX Forum® Network Requirements, Recommendations and Requirements for Networks based on WiMAX Forum Certified® Products
2. WMF-T31-116-R016, WiMAX Forum® Network Requirements, Recommendations and Requirements for Multimedia Session Continuity on WiMAX Forum Certified® Products
3. RFC 2119 "Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997, URL:http://www.ietf.org/rfc/rfc2119.txt
4. WMF-T33-103-R015, WiMAX Forum® Network Architecture-Architecture, detailed Protocols and Procedures, WiMAX® Over-The-Air General Provisioning System Specification
5. "OMA DM Protocol, Version 1.2". Open Mobile Alliance. OMA-TS-DM_Protocol-V1_2. URL:http://www.openmobilealliance.org
6. WMF-T33-104-R016, WiMAX Forum® Network Architecture- Architecture, detailed Protocols and Procedures, WiMAX® Over-The-Air Provisioning & Activation Protocol based on OMA DM Specifications
7. DSL Forum TR-069 Amendment 2, CPE WAN Management Protocol v1.1, December 2007 URL:http://www.broadband-forum.org
8. WMF-T33-105-R015 , WiMAX Forum®, Network Architecture-Architecture, detailed Protocols and Procedures, WiMAX Over-The-Air Provisioning & Activation Protocol based on TR-069 Specification
9. DSL Forum TR-098 Amendment 2, Internet Gateway Device Data Model for TR-069, , URL: http://www.broadband-forum.org
10. DSL Forum TR-106 Amendment 2, Data Model Template for TR-069-Enabled Devices, URL: http://www.broadband-forum.org
11. DSL Forum TR-157, Component Objects for CWMP, URL: http://www.broadband-forum.org

4 Metrics Description

The following tables describe the metrics that can be read by the DRM D server. These metrics can be read using OMA-DM or TR-069.

Note: Support of any specific metric is optional within this specification. Further, the exact details of the measurement of each metric are beyond the scope of this specification, so that it is expected that the accuracy of any measurement (for example) will not be subject to certification by the WiMAX Forum®.

4.1 WiMAX®-specific metrics

Name	Type	Description
ServBSID	int	This parameter specifies the Base Station Identifier of the serving base station at the time of reporting.
DownlinkFreq	int	This parameter specifies the central frequency, in kHz, as seen by the SS/MS of the serving base station at the time of reporting.
DownlinkBandwidth	int	This parameter specifies the channel bandwidth as seen by the SS/MS of the serving base station at the time of reporting. The value is in kHz.
DownlinkMeanRSSI	string	This parameter specifies the implementation-specific downlink RSSI measurements performed against the preamble, the mean being calculated using the method outlined in WiMAX® Rel 1.0 Mobility Profile. DL Mean RSSI is measured over the prescribed measurement interval. The value is in dBm rounded to the nearest whole number. If this metric is supported a report of the combined RSSI as perceived by the composite receiver chain, including the combined signal from multiple antennas SHALL be sent, and reports may also be (optionally) sent for the individual RSSI perceived by a receiver attached to any one of multiple antennas. The format for the report is a variable-length string array, composed as follows: [0,(RSSI combined),1,(RSSI Antenna/receiver 1),2,(RSSI Antenna/receiver 2), . . . ;n,(RSSI Antenna/receiver n)]; where each RSSI value is a decimal integer. The maximum length of this string is 62 characters, constricting “n” to a value of 8 or less assuming that each RSSI value is of the form –ddd, where “d” is a decimal digit. .

Name	Type	Description
DownlinkStdDevRSSI	string	This parameter specifies the implementation-specific RSSI measurements performed against the preamble used to maintain an expectation-squared statistic from which the standard deviation can be determined using the method outlined in WiMAX® Rel 1.0 Mobility Profile. DL standard deviation RSSI is measured over the prescribed measurement interval. The value is in dB, rounded to one decimal place. If this metric is supported a report of the combined SDRSSI as perceived by the composite receiver chain, including the combined signal from multiple antennas SHALL be sent, and reports may also be (optionally) sent for the individual SDRSSI perceived by a receiver attached to any one of multiple antennas. The format for the report is a variable-length string array, composed as follows: [0,(SDRSSI combined);1,(SDRSSI Antenna/receiver 1),2, (SDRSSI Antenna/receiver 2), . . . ,n,(SDRSSI Antenna/receiver n)]. The maximum length of this string is 71 characters, based on a maximum value of "n" of 8 & each SDRSSI value being of the form ddd.d, where "d" is a decimal digit.
DownlinkMeanCINR	string	This parameter specifies the implementation-specific physical CINR measurements performed against the preamble, the mean being calculated using the method outlined in WiMAX® Rel 1.0 Mobility Profile. DL Mean CINR is measured over the prescribed measurement interval. The value is in dB. If this metric is supported a report of the combined CINR as perceived by the composite receiver chain, including the combined signal from multiple antennas SHALL be sent, and reports may also be (optionally) sent for the individual CINR perceived by a receiver attached to any one of multiple antennas. The format for the report is a variable-length string array, composed as follows: [0,(CINR combined),1, (CINR Antenna/receiver 1),2,(CINR Antenna/receiver 2); . . . ,n,(CINR Antenna/receiver n)]; where each CINR value is an integer. The maximum length of this string is 62 characters, based on a maximum value of "n" of 8 & each CINR value being of the form dd.d, where "d" is a decimal digit.

Name	Type	Description
DownlinkStdDevCINR	string	This parameter specifies the standard deviation of the downlink CINR to be measured for frequency reuse configuration 1 and 3. Implementation-specific CINR measurements performed against the preamble must be used to maintain a expectation-squared statistic from which the standard deviation can be determined using the method outlined in WiMAX® Rel 1.0 Mobility Profile. DL standard deviation CINR is measured over the prescribed measurement interval. If this metric is supported a report of the combined SDCINR as perceived by the composite receiver chain, including the combined signal from multiple antennas SHALL be sent, and reports may also be (optionally) sent for the individual SDCINR perceived by a receiver attached to any one of multiple antennas. The format for the report is a variable-length string array, composed as follows: [0,(SDCINR combined),1,(SDCINR Antenna/receiver 1),2,(CINR Antenna/receiver 2), . . . ,n,(SDCINR Antenna/receiver n)]. The maximum length of this string is 62 characters, based on a maximum value of “n” of 8 & each SDCINR value being of the form dd.d, where “d” is a decimal digit.
TxPwr	int	This parameter specifies the total uplink transmission power of the SS/MS across all active subcarriers during the most recent frame in which it transmitted uplink burst(s) at the time of reporting. The values are quantized in 0.5dB steps ranging from -64dBm to 63.5dBm. The integer in the field is divided by 2 in order to obtain the value in dBm.
TxHeadroomPwr	int	This parameter specifies the difference between the maximum total uplink transmission power the User Device was capable of transmitting and the current total uplink transmission power of the User Device across all active subcarriers during the most recent frame in which it transmitted uplink burst(s) at the time of reporting. The integer in the field is divided by 2 in order to obtain the value in dB.

Name	Type	Description
ScannedBaseStations	string	This string defines the report of the signal quality metrics received during the last scan of the base stations, e.g., as described on the neighbor list. The base stations are identified by the BSID (where available), the preamble, the center frequency and bandwidth. The full BSID SHOULD be reported, unless it is not known, in which case the truncated BSID SHOULD be reported if known. The signal quality metrics strengths will be RSSI and CINR; only those base stations where the RSSI exceeds -110dBm or where the CINR exceeds -4dB need be reported. The format for this string containing measurements for 'n' base stations is [BSID,PreambleIndex(decimal integer), DownlinkFreq (decimal integer), DownlinkBandwidth (decimal integer), RSSI, CINR, BSID2 . . .Preamble Index (decimal integer), DownlinkFreq, DownlinkBandwidth,RSSI ,CINR]. Where not stated, the formats used for all metrics are the same as those of the individual metric components presented elsewhere in this table. Assuming a maximum of 16 bases stations to be reported, the maximum length of this string is 655 characters.
LinkUptime	int	This parameter specifies the time elapsed since the device established a basic CID as part of the most recent initial service entry in seconds. Note: this timer is not re-set when service re-entry occurs due to a handoff.
HARQRetTX	string	A string object comprised of a table listing the number of HARQ bursts transmitted by the User Device that represented a retransmission of HARQ bursts that had been sent since device network entry / re-entry (i.e., active state), the table entries to comprise the number of • successful 1st attempt • successful 2nd - attempt retries, • successful 3rd - attempt retries • successful 4th or more-attempt retries • total number of retries • bursts dropped Note that all of these parameters are optional within the object. Generally the detailed breakdown (first four entries) or the total number of reties will be sent; plus the number of bursts dropped. The table SHALL be sent as a comma-separated list. Each entry in the table SHALL be an eight-digit hexadecimal integer, so the maximum length of the string SHALL be 53 characters. Unsupported entries SHALL be represented by a null character.

Name	Type	Description
HARQRetRX	string	A string object comprised of a table listing the number of HARQ bursts the User Device attempted to decode that represented a retransmission of HARQ bursts that had been received since device network entry / re-entry (i.e., active state), the table entries to comprise the number of • successful 1st attempt • successful 2nd - attempt retries, • successful 3rd - attempt retries • successful 4th or more-attempt retries • total number of retries • bursts dropped Note that all of these parameters are optional within the object. Generally the detailed breakdown (first four entries) or the total number of reties will be sent; plus the number of bursts dropped. The table SHALL be sent as a comma-separated list. Each entry in the table SHALL be an eight-digit hexadecimal integer, so the maximum length of the string SHALL be 53 characters. Unsupported entries SHALL be represented by a null character.
InitRangeResp	int	This parameter specifies the total number of initial ranging code transmissions that resulted in an RNG-RSP message with any status being received since the device power-up or reset.
InitRangeNoResp	int	This parameter specifies the total number of initial ranging code transmissions which did not result in any RNG-RSP message being received since the device power-up or reset.
PerRangeResp	int	This parameter specifies the total number of periodic ranging code transmissions that resulted in an RNG-RSP message with any status being received since the device power-up or reset.
PerRangeNoResp	int	This parameter specifies the total number of periodic ranging code transmissions which did not result in any RNG-RSP message being received since the device power-up or reset.
HOSuccess	int	This parameter specifies the total number of handovers successfully performed at the first attempt of each handover event by the SS/MS to a target BS since the device power-up or reset. A handover attempt should be defined by the transmission by the SS/MS of a MOB_HO-IND message with HO IND type of Serving BS release.
HOFail	int	This parameter specifies the total number of handovers unsuccessfully performed at the first attempt of each handover event by the SS/MS to a target BS (i.e. did not result in handover to the targeted BS), since the device power-up or reset. Unsuccessful handovers should therefore include cases where having transmitted a MOB_HO-IND message with HO_IND_type of Serving BS release, the SS/MS returns to the original sector and transmits a MOB_HO-IND message with HO_IND_type of cancel.
MAPRecSuccess	int	This parameter specifies the total number of frames which the MAP (both uplink and downlink) was successfully decoded without error since the device power-up or reset.

Name	Type	Description
MAPRecFail	int	This parameter specifies the total number of frames which the MAP (either uplink or downlink) was not successfully decoded since the device power up or reset.
MCSstatsDL	string	This parameter specifies for each unique combination of modulation and coding scheme and MIMO type, a separate count of the number of bursts received since the device power-up or reset. The parameter will be a variable length string of quadruples of comma-separated integers. The first integer in each quadruple indicates the modulation scheme taken from "FEC Code type and modulation type" from the Table "DCD burst profile encodings—WirelessMAN-OFDMA" in *section 11 TLV encodings* of the corresponding 802.16 specification. The value chosen will correspond to a combination of FEC and MCS for which at least one burst has been transmitted in the sampling period. A value of 255 indicates that the modulation scheme is not specified. The second integer in the quadruple indicates a repetition coding as follows: 0: Repetition coding not specified 1: No repetition coding 2: Repetition coding of 2 used 3: Repetition coding of 4 used 4: Repetition coding of 6 used The third integer in the quadruple indicates a MIMO type as follows: 0: MIMO type not specified 1: 2-antenna STC matrix A 2: 2-antenna STC matrix B, vertical coding 3: 2-antenna STC matrix B, horizontal coding 4: 4-antenna STC matrix A 5: 4-antenna STC matrix B, vertical coding 6: 4-antenna STC matrix B, horizontal coding 7: 4-antenna STC matrix C, vertical coding 8: 4-antenna STC matrix C, horizontal coding 9: 3-antenna STC matrix A 10: 3-antenna STC matrix B 11: 3-antenna STC matrix C, vertical coding 12: 3-antenna STC matrix C, horizontal coding 13: MIMO not used Note: For WiMAX Releases 1.0 & 1.5, the only supported MIMO options are 0, 1, 2 & 13. The fourth integer in the quadruple is a count of the number of DL bursts successfully received with that combination of FEC Code type and modulation type and MIMO type where specified. The string will be variable in length depending on the number of unique FEC, MCS and MIMO types for which at least one burst has been received. Each retransmission due to HARQ will be added to the totals reported. No burst that form part of system broadcast (control channel) transmissions SHALL be counted. The integers are represented in hexadecimal format. The theoretical maximum length of this string is 6,719 characters.

Name	Type	Description
MCSstatsUL	string	This parameter specifies for each unique combination of modulation and coding scheme and MIMO type, a separate count of the number of bursts sent since the device power-up or reset. The parameter will be a variable length string of quadruples of comma-separated integers. The first integer in each quadruple indicates the modulation scheme taken from "FEC Code type and modulation type" from the Table "UCD burst profile encodings—WirelessMAN-OFDMA" in *section 11 TLV encodings* of the corresponding 802.16 specification. The value chosen will correspond to a combination of FEC and MCS for which at least one burst has been transmitted in the sampling period. A value of 255 indicates that the modulation scheme is not specified. The second integer in the quadruple indicates a repetition coding as follows: 0: Repetition coding not specified 1: No repetition coding 2: Repetition coding of 2 used 3: Repetition coding of 4 used 4: Repetition coding of 6 used The third integer in the quadruple indicates a MIMO type as follows: 0: MIMO type not specified 1: 2-antenna STC Matrix A 2: 2-antenna STC Matrix B, Vertical coding 3: 2-antenna STC Matrix B, Horizontal coding 4: Collaborative STC 5: No MIMO supported Note: For WiMAX® Releases 1.0 & 1.5, the only supported MIMO options are 0, 4 & 5. The fourth integer in the quadruple is a count of the number of UL bursts transmitted with that combination of FEC Code type and modulation type and MIMO type where specified. The string will be variable in length depending on the number of unique FEC, MCS and MIMO types for which at least one burst has been transmitted. Each retransmission due to HARQ will be added to the totals reported. The integers are represented in hexadecimal format. The theoretical maximum length of this string is 5,039 characters
VersionOfMCSMetric	int	States what version of this specification is implemented. This is version 1

Name	Type	Description
DownlinkDataRate	string	This metric is presented as a comma-separated string comprised of seven integer numbers, representing the current rate, peak rate, average rate, minimum reserved traffic rate, maximum sustained traffic rate, the measurement period (ms) & the extended measurement period (ms). All data rates are to be presented scaled in kilobits per second, rounded to the nearest integer and measured for convergence sublayer SDUs. Any unsupported measurements SHALL be left blank. The current rate will be the aggregate size (in kilobits) of convergence sublayer SDUs successfully received during the measurement period up to the current time, divided by the measurement period and multiplied by 1000. The peak data rate will be the highest value of the current rate measured during the extended measurement period up to the current time. The average rate will be the aggregate size (in kilobits) of convergence sublayer SDUs successfully received during the extended measurement period up to the current time, divided by the extended measurement period and multiplied by 1000. In the case that more than one downlink service flow is currently active, the reported minimum reserved traffic rate will be the sum of available minimum reserved traffic rates for all active downlink service flows. Moreover in this case, the reported maximum sustained traffic rate will be the sum of available maximum sustained traffic rates for all active downlink service flows. All integers are hexadecimal coded & are assumed to have a maximum length of 8 characters. The maximum length of this string is 62 characters.

Name	Type	Description
UplinkDataRate	string	This metric is presented as a comma-separated string comprised of seven integer numbers, representing the current rate, peak rate, average rate, minimum reserved traffic rate, maximum sustained traffic rate, the measurement period (ms) & the extended measurement period (ms). All data rates are to be presented scaled in kilobits per second, rounded to the nearest integer and measured for convergence sublayer SDUs. Any unsupported measurements SHALL be left blank. The current rate will be the aggregate size (in kilobits) of convergence sublayer SDUs successfully transmitted during the measurement period up to the current time, divided by the measurement period and multiplied by 1000. The peak data rate will be the highest value of the current rate measured during the extended measurement period up to the current time. The average rate will be the aggregate size (in kilobits) of convergence sublayer SDUs successfully transmitted during the extended measurement period up to the current time, divided by the extended measurement period and multiplied by 1000. In the case of transmissions over a service flow with ARQ enabled, only those CS SDUs whose constituent ARQ blocks have all been acknowledged as successfully received will contribute to the various data rates. In the case of transmissions over a service flow with ARQ disabled, only those CS SDUs for which all MAC PDUs comprising it have been transmitted at least once will contribute to the various data rates. In the case that more than one uplink service flow is currently active, the reported minimum reserved traffic rate will be the sum of available minimum reserved traffic rates for all active uplink service flows. Moreover in this case, the reported maximum sustained traffic rate will be the sum of available maximum sustained traffic rates for all active uplink service flows. All integers are hexadecimal coded & are assumed to have a maximum length of 8 characters. The maximum length of this string is 62 characters.
PacketsReceived	int	Total number of convergence sublayer SDUs successfully received since the device was last powered up. Note: it is acceptable that this counter may overflow & re-start measurements from a zero base.

Name	Type	Description
PacketsSent	int	Total number of convergence sublayer SDUs successfully sent since the device was last powered up. Note: it is acceptable that this counter may overflow & re-start measurements from a zero base. In the case of transmissions over a service flow with ARQ enabled, only those CS SDUs whose constituent ARQ blocks have all been acknowledged as successfully received will be counted. In the case of transmissions over a service flow with ARQ disabled, only those CS SDUs for which all MAC PDUs comprising it have been transmitted at least once will be counted.
MACState	string (16)	Functional state of the device at the time when the measurement command is executed. Possible values are scanning, synchronization, network_entry, normal, handover, idle.
PreambleIndex	int	Preamble of the serving base station at the time when the measurement command is executed
HOLatency	int	The time in milliseconds between the transmission of the MOB_HO_IND message with a HO_IND type of “success” and the RNG_RSP from the target BS with a message of “success” measured on the last successful handoff.
FrameRatio	string (16)	The current frame ratio in use
HOAttempts	int	The number of attempted handovers defined by transmission of HO_IND message with HO_IND_TYPE = “serving BS release”, since the device power-up or reset.
NetworkEntryLatency	int	Time in milliseconds between Initial Ranging Request and successful Registration Response for the last network entry executed
NetworkEntrySucceses	int	Total number of successful Registration Responses since the device power-up or reset.
NetworkEntryFailures	int	Total number of Initial Ranging Requests that do not result in a successful Registration Response), since the device power-up or reset.
NetworkEntryAttempts	int	Total number of Initial Ranging Requests since the device power-up or reset.
UserAccessTime	int	The time in milliseconds between Initial Ranging Request and assignment of DHCP
ARQ_Retries_Received	int	The number of retransmitted blocks that were received due to ARQ failures during the measurement period.
ARQ_Retries_Transmitted	int	The number of blocks that were retransmitted due to ARQ failures during the measurement period.
CQICH	int	The number of CQICH transmitted during the measurement period.

Name	Type	Description
Service_Flows	string	A list of the service flow types, the total number of bytes of payload either transmitted or received and a list of CIDs that used that type of service flow. The format of the metric will be [“DL: BE”:[BEbytes],BECID1:1,BECID2. . .BEICDn;”UGS”:[UGSbytes],UGSCID1,UGSCID2. . .UGSCDn; . . :”UL: BE”:[BEbytes],BECID1:1,BECID2. . .BEICDn;”UGS”:[UGSbytes],UGSCID1,UGSCID2. . .UGSCDn; ...] The service flows to be reported will include BE, , ertPS, rtPS, nrtPS for both uplink and downlink. The maximum length of the string is 2645 characters.
Airlink_Security	string (16)	The security protocol used by the device for authentication with the serving NSP; e.g. EAP-TLS, EAP-TTLS, RAP-AKA.
Certificates	string (4096)	A string consisting of the names, issuers, & expiry dates of server certificates loaded on the device. The format of this metric is [Name1,IssuerI,ExpiryDate1,Name2,Issuer2,ExpiryDate2,etc]. Date format is yyyy-mm-dd. Name & Issuer details may not contain the comma character.

4.2 Generic Metrics & Diagnostics

Name	Type	Description
RateLimiterStats	int	This parameter specifies the total number of SDUs dropped due to rate limiting mechanism; i.e., the total number of uplink SDUs that are discarded for reason other than queue overflow or SDUs exceeding their latency constraint, since the device network entry /re-entry (active state).
TimeActive	int	This parameter specifies the number of frames when the SS/MS has been in active mode, since the device network entry /re-entry. If the counter overflows, the overflow (excess) value SHALL be sent.
TimeIdle	int	This parameter specifies the number of frames when the SS/MS has been in idle mode, since the device network entry /re-entry. If the counter overflows, the overflow (excess) value SHALL be sent.
TimeSleep	int	This parameter specifies the number of frames when the SS/MS has been in sleep mode since the device network entry /re-entry (active state). If the counter overflows, the overflow (excess) value SHALL be sent.

Name	Type	Description
LastRebootCause	string (32)	This parameter specifies the last reason the device was rebooted. Enumeration of: ”unknown” “power on” “external command (from host)”, “device fault (unspecified)” “device temp”, “ACS command” “firmware update”
DeviceTemp	int	This parameter specifies the temperature of the device in degrees Celsius. Range of values: -60 to -60+(2^32-1) *.1 deg. C , i.e., 1 LSB=.1 deg C, min value = -60 deg C. Example: Device Temp =$00000300, actual temp = -60 + 3*256*.1=16.8 deg. C
SupVolt	int	This parameter specifies the power supply voltage as reported by the SS/MS in millivolts.
BatteryCap	int	This parameter specifies the battery capacity (total charge retention capability) in mAh determined over the last charge cycles. This parameter will exist for SS/MSs with an internal battery and the fuel-gauging capability.
GPSlocation_Latitude	int	Range of values: 3GPP 23.032 “Point” format to be used for latitude; 24 significant bits (1 sign bit S, 23 bits N binary representation of an absolute magnitude value of 0 to 90 degrees). Explicitly, with N designating the 23 bit absolute angle coding, we have the magnitude of the angle as Lat=N*90/(223). The sign bit S=0 for positive latitude, S=1 for negative. The 24 bit latitude values will be LSB justified within each 32 bit int quantity, and the first 8 MSBs SHALL be 0.
GPSlocation_Longitude	int	Range of values: 3GPP 23.032 “Point” format to be used for longitude; 24 significant bits (24 bit 2s complement binary representation of an absolute magnitude value of -180 to +180 degrees). Explicitly, with N designating the 24 bit 2s complement angle coding, we have the magnitude of the angle as Long=N*360/(224). The 24 bit longitude values will be LSB justified within each 32 bit int quantity, and the first 8 MSBs SHALL be 0.
GPSlocation_Altitude	int	Range of values: 3GPP 23.032 “Altitude” format to be used: 16 significant bits (1 sign bit S, 15 bits N binary representation of an absolute magnitude value in meters). Explicitly, with N designating the 15 bit absolute altitude coding, we have the magnitude of the altitude in meters as Alt=N/(215) (meters). The sign bit S=0 for positive altitudes above the WGS84 ellipsoid, S=1 for depth in meters below the ellipsoid. The 16 bit altitude values will be LSB justified within each 32 bit int quantity, and the first 16 MSBs SHALL be 0.
NATAddrTable	object	This object is currently supported in the InternetGatewayDevice object model as PortMapping and LANDevice Host objects defined in [9]

Name	Type	Description
LANEtherMAC	object	This object is currently supported in the InternetGatewayDevice object model as the LANDevice's Ethernet Interface object defined in [9]
DeviceUptime	int	This object is currently supported in the InternetGatewayDevice object model as DeviceInfo UpTime parameter defined in [9]. It is the time, in seconds, that has elapsed since the device was powered up until the start of the measurement period.
DeviceLog	string	This object is currently supported in the InternetGatewayDevice object model as DeviceInfo DeviceLog parameter defined in [9]
IPPingDiagnostics	object	This object is currently supported in the InternetGatewayDevice object model as IPPingDiagnostics object defined in [9].
Primary_DNS	string	IP address of the devices primary DNS server. In the case of an IPv6 address, zero suppressed notation (as per RFC1884) must not be used. The maximum length of this string shall be 39 characters (i.e. for hex representation of the IPv6 address (including 7 colon separators as per RFC 1884),
Secondary_DNS	string	IP address of the devices secondary DNS server. In the case of an IPv6 address, zero suppressed notation (as per RFC1884) must not be used. The maximum length of this string shall be 39 characters (i.e. for hex representation of the IPv6 address (including 7 colon separators as per RFC 1884),
Gateway	string	The IP address of the device's default route. In the case of an IPv6 address, zero suppressed notation (as per RFC1884) must not be used. The maximum length of this string shall be 39 characters (i.e. for hex representation of the IPv6 address (including 7 colon separators as per RFC 1884),
Subnet_Mask	string	Subnet mask of the device's issued WiMAX® network IP address. Note: applicable only to IPv4.
Wimax®_Interface_IP_Addr	string	The IP address of the WiMAX® air-interface. I n the case of an IPv6 address, zero suppressed notation (as per RFC1884) must not be used. The maximum length of this string shall be 39 characters (i.e. for hex representation of the IPv6 address (including 7 colon separators as per RFC 1884),
DHCP_Leases	int	The number of current DHCP leases active at the time of reporting in devices supporting a local DHCP server function.
Port_Forwarding	string	The table that contains information for port forwarding in devices supporting a local routing function. It is reported as a comma-separated list in the form of string, as follows: [[Protocol],[WANPortStart],[WANPortEnd],[LANIPAddress],[LAN Port Start],[LAN Port End]]. The maximum length of this string is 92 characters.

5 OMA DM Protocol

The WiMAX Forum® Network Architecture over the air provisioning specification based on OMA-DM [6] defines a management framework and a protocol for various management procedures.

When OMA-DM is selected by the bootstrap procedure [4], the DRMD client and server SHALL follow all existing OMA DM protocols when communicating with each other as defined in [6].

5.1 OMA DM Commands

All OMA_DM commands as described in reference [10] may be utilized in support of DRMD, except that, generally, the maximum access type to the metric nodes SHALL be GET. Exceptions to this are described in the node descriptions, when measurement conditions need to be written to the client (e.g. for IPPing) at the time when measurements are initiated. The OMA-DM server SHALL only send the GET commands to the DRMD client on the diagnostics nodes when trying to retrieve metric values & diagnostic information elements from the DRMD client.

5.2 Notification Message

The format and security mechanism for OMA DM notification message are described in the OMA DM Notification Initiated Session specification [6]. Only server initiated diagnostics sessions will be supported; the client SHALL NOT send metrics to the server autonomously. Devices that cannot accept UDP push messages from the server SHALL poll the server to determine if diagnostics retrieval is required, as per the practice used for OMA-DM provisioning in WiMAX® networks for such devices.

5.3 Message Flows

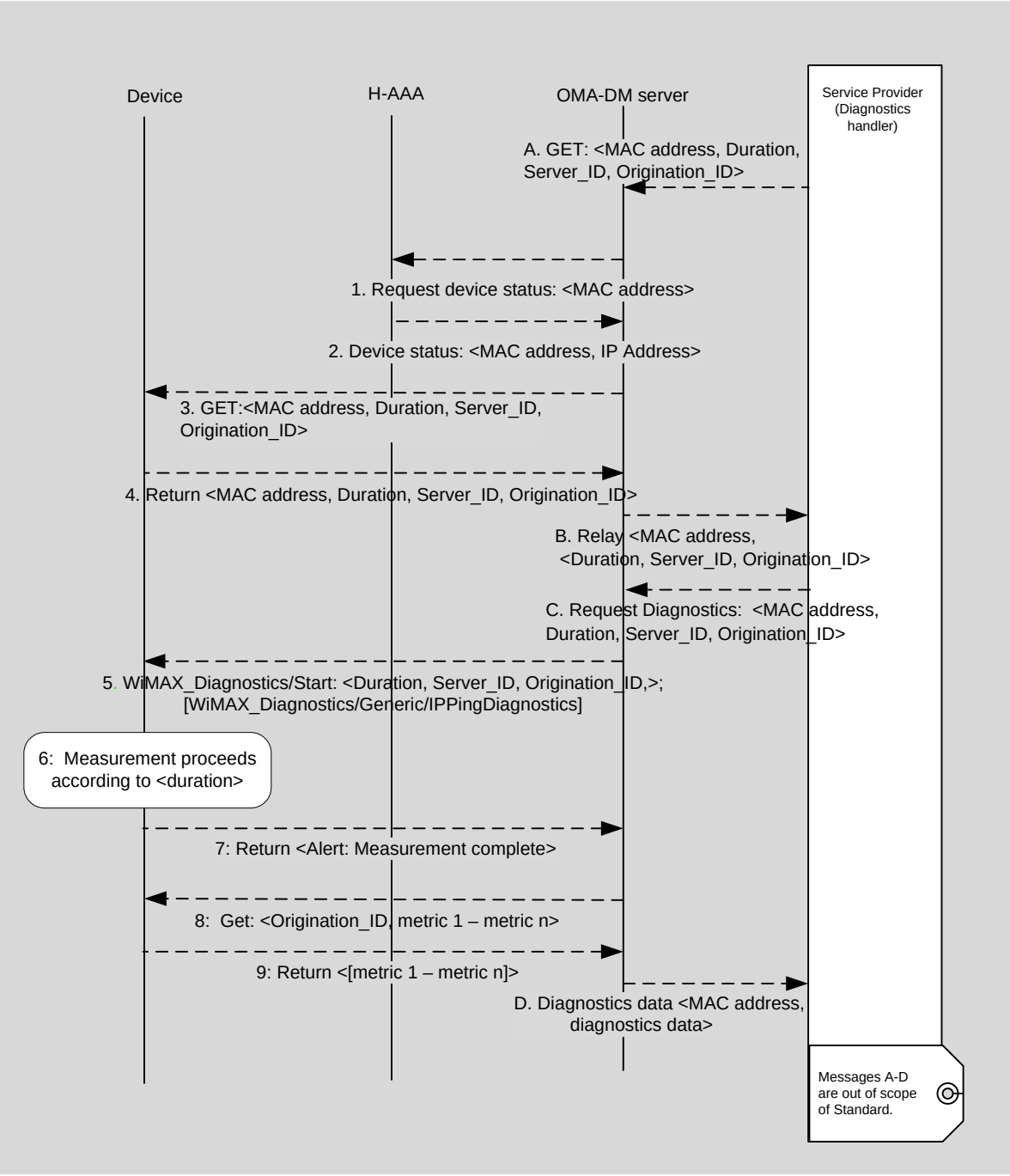

Figure 1 – OMA DM message flow

Description of the messages:

A: An external entity (e.g. the carrier's back-office server or a human on the DM server GUI) requests that the DM server GET the contents of the Duration, Server ID, & the Origination ID nodes in the client to determine whether the client is currently engaged in taking a measurement (Duration ≠ 0).

1: The OMA-DM server requests the current status of the device from the AAA.

2: The AAA returns the device's current IP address.

3: The OMA-DM requests the client sends the contents of the requested nodes.

4: The client returns the requested node values.

B. The DM server relays the returned data to the requestor/originator. Using this information the originator determines whether to proceed to request that a new measurement sequence is started by the client. The logic to make this determination is left to the preference of the originator & is beyond the scope of this specification.

Note: All above sequence is not mandatory on the requestor; sequence may begin directly with action (C).

C. The originator requests that the client starts a DRMD measurement session, specifying Duration, Server_ID, & Origination_ID.

5: The OMA-DM server sends a command to start measurements to the client. This MAY include commands to update the measurement conditions by replacement of certain nodes in the DRMD MO on the device (e.g. measurement conditions for IPPing, see 0).
Note: If this command does not reach the client due to the presence of a firewall in the client device, the Start message SHALL be queued and re-sent when the client next polls the server.

6: The client SHALL terminate any current measurement session and SHALL start a new measurement session as indicated by the new parameters in the Start message (Duration, Server_ID, Origination_ID).
Note: If the client receives another request to start measurements during this period, the client SHALL terminate the current measurement session and restart the measurements according to the new Start request.

7: On completion of the measurement period the client polls the server named in the Start Message to inform it that the metric data is ready for collection. This employs a Generic Alert message (1226) with alert type "org.wimaxforum.diagnostics.P1ready" & containing the URI of the WiMAX®/Diagnostics node and the MAC address of the device as the source.

8: That server requests the Origination ID for these measurements and the metric & diagnostic data from the client.

9: The client returns the data to the server.

D: The server returns the metric & diagnostic data to the requesting entity.

6 OMA-DM MO for WiMAX® Diagnostics

6.1 Node Descriptions

Please refer to the Section 5 for the definition and references of each corresponding matrices.

./WiMAX_Diagnostics/WiMAX consists of all the WiMAX® specific matrices in Section 5.1.

./WiMAX_Diagnostics/Generic consists of all the non-WiMAX® specific matrices in Section 5.2.

Note: All integer values ("int") SHALL be represented in the results, when sent within an XML file, by a decimal integer of maximum length 11 characters (to include a sign character ("+" or "-"where required), unless otherwise noted in the description of an individual node. Leading zeros MAY be suppressed.

6.2 WiMAX® diagnostics MO Graphical Representation

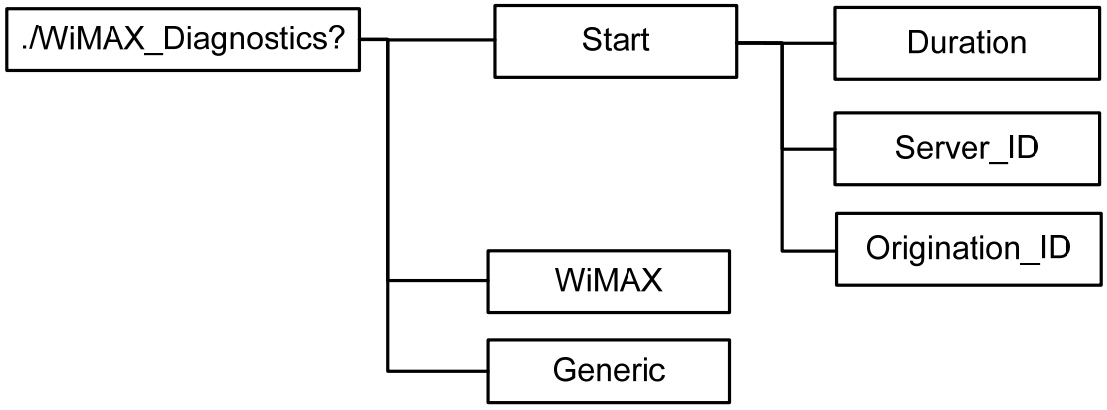

Figure 2 - WiMAX® diagnostics MO Graphical Representation

6.3 Node Description

6.3.1 WiMAX_Diagnostics/Start

Status	Tree Occurrence	Format	Min. Access Types
Required	One	node	Exec

This leaf node is the target of an 'Exec' command to start collection of data to populate all Diagnostics and Monitoring nodes supported by the device, according to control value described in the appended "duration" leaf node.
At the end of the measurement period the data is populated into the appropriate nodes as described in sections 7.3.2 & 7.3.3 below, & the client SHALL alert the server named in the appended Server_ID leaf node to inform it that the data is now ready for collection.

6.3.1.1 WiMAX_Diagnostics/Start/Duration

Status	Tree Occurrence	Format	Min. Access Types
Required	One	int	Get, Replace

This node must be populated with a value that will indicate to the client the period of time it needs to collect the supported metrics.

Possible values and associated actions are:

- If the value of the data in this node is 5 or greater, then the value represents the duration of the data collection period in seconds, which is the prescribed measurement interval used in the definition of certain metrics.
- If the value of the data in this node is 0 (zero) the "start" executive command SHALL be ignored by the client & the OMA-DM session closed..
- If the value of the data in this node is 1, the client SHALL take whatever metric data is immediately available from the device and SHALL immediately notify the server of the metric data availability. The prescribed measurement interval is that defined by the device vendor for such measurements.
- If the value of the data in this node is 2, measurement SHALL be terminated at the end of the current session (i.e. when the SS/MS next detaches from the network), and the client SHALL notify the server of the metric data availability on re-entry to the same NSP. The prescribed measurement interval is that defined by the device vendor for such measurements.
- Values of 3 & 4 are reserved for use in future versions of this document. If one of these values is received by a client conforming to this version of the documents, the "start" executive command SHALL be ignored by the client & the OMA-DM session closed.

At the end of the collection period, as defined by this node, the client shall populate this node with the value of 0 (zero).

This leaf node may also be read as part of a status request from the server.

6.3.1.2 WiMAX_Diagnostics/Start/Server_ID

Status	Tree Occurrence	Format	Min. Access Types
Required	One	chr	Get, Replace

This node contains the name of the Server to which the diagnostic data should be returned and provides reference to any relevant OMA-DM account details (DMAcc).
On completion of the measurement period, the client SHALL send a Generic Alert message (1226) containing the URI of the WiMAX/Diagnostics node and the MAC address of the device as the source to this server.
The maximum length of the Server_ID SHALL be 20 characters.

This leaf node may also be read as part of a status request from the server.

6.3.1.3 WiMAX_Diagnostics/Start/Origination_ID

Status	Tree Occurrence	Format	Min. Access Types
Required	One	chr	Get, Replace

This node contains the identifier of the entity from which the measurement was originated; e.g. the service provider diagnostics handler noted in Figure 1 of Section 5.1.

This value is stored and returned by the server when requested as part of a set of measurements or in a DRMD Status request.

The maximum length is 255 characters.

This leaf node may also be read as part of a status request from the server.

6.3.2 WiMAX_Diagnostics/WiMAX

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	node	Get

6.3.2.1 WiMAX_Diagnostics/WiMAX/ServBSID

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

The BSID is represented as a string of 12 hex characters.

6.3.2.2 WiMAX_Diagnostics/WiMAX/DownlinkFreq

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.3 WiMAX_Diagnostics/WiMAX/DownlinkBandwidth

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.4 WiMAX_Diagnostics/WiMAX/DownlinkMeanRSSI

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.5 WiMAX_Diagnostics/WiMAX/DownlinkStdDevRSSI

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.6 WiMAX_Diagnostics/WiMAX/DownlinkMeanCINR

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.7 WiMAX_Diagnostics/WiMAX/DownlinkStdDevCINR

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.8 WiMAX_Diagnostics/WiMAX/TxPwr

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.9 WiMAX_Diagnostics/WiMAX/TxHeadroomPwr

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.10 WiMAX_Diagnostics/WiMAX/ScannedBaseStations

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.11 WiMAX_Diagnostics/WiMAX/LinkUptime

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.12 WiMAX_Diagnostics/WiMAX/HARQRetTX

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.13 WiMAX_Diagnostics/WiMAX/HARQRetRX

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.14 WiMAX_Diagnostics/WiMAX/InitRangeResp

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.15 WiMAX_Diagnostics/WiMAX/InitRangeNoResp

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.16 WiMAX_Diagnostics/WiMAX/PerRangeResp

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.17 WiMAX_Diagnostics/WiMAX/PerRangeNoResp

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.18 WiMAX_Diagnostics/WiMAX/HOSuccess

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.19 WiMAX_Diagnostics/WiMAX/HOFail

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.20 WiMAX_Diagnostics/WiMAX/MAPRecSuccess

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.21 WiMAX_Diagnostics/WiMAX/MAPRecFail

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.22 WiMAX_Diagnostics/WiMAX/MCSstatsDL

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.23 WiMAX_Diagnostics/WiMAX/MCSstatsUL

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.24 WiMAX_Diagnostics/WiMAX/VersionOfMCSMetric

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.25 WiMAX_Diagnostics/WiMAX/DownlinkDataRate

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.26 WiMAX_Diagnostics/WiMAX/UplinkDataRate

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.27 WiMAX_Diagnostics/WiMAX/PacketsReceived

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.28 WiMAX_Diagnostics/WiMAX/PacketsSent

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.29 WiMAX_Diagnostics/WiMAX/MACState

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	char	GET. No other access allowed

6.3.2.30 WiMAX_Diagnostics/WiMAX/PreambleIndex

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	char	GET. No other access allowed

6.3.2.31 WiMAX_Diagnostics/WiMAX/HOLatency

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.32 WiMAX_Diagnostics/WiMAX/FrameRatio

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	char	GET. No other access allowed

6.3.2.33 WiMAX_Diagnostics/WiMAX/HOAttempts

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.34 WiMAX_Diagnostics/WiMAX/NetworkEntryLatency

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.35 WiMAX_Diagnostics/WiMAX/NetworkEntrySucceses

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.36 WiMAX_Diagnostics/WiMAX/NetworkEntryFailures

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.37 WiMAX_Diagnostics/WiMAX/NetworkEntryAttempts

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.38 WiMAX_Diagnostics/WiMAX/UserAccessTime

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.39 WiMAX_Diagnostics/WiMAX/ARQ_Retries_Received

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.40 WiMAX_Diagnostics/WiMAX/ARQ_Retries_Transmitted

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.41 WiMAX_Diagnostics/WiMAX/CQICH

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.2.42 WiMAX_Diagnostics/WiMAX/Service_Flows

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.43 WiMAX_Diagnostics/WiMAX/Airlink_Security

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.2.44 WiMAX_Diagnostics/WiMAX/Certificates

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.3 WiMAX_Diagnostics/Generic

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	node	Get

6.3.3.1 WiMAX_Diagnostics/Generic/RateLimiterStats

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.2 WiMAX_Diagnostics/Generic/TimeActive

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.3 WiMAX_Diagnostics/Generic/TimeIdle

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.4 WiMAX_Diagnostics/Generic/TimeSleep

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.5 WiMAX_Diagnostics/Generic/LastRebootCause

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.3.6 WiMAX_Diagnostics/Generic/DeviceTemp

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.7 WiMAX_Diagnostics/Generic/SupVolt

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.8 WiMAX_Diagnostics/Generic/BatteryCap

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.9 WiMAX_Diagnostics/Generic/GPSlocation_Latitude

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.10 WiMAX_Diagnostics/Generic/GPSlocation_Longitude

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.11 WiMAX_Diagnostics/Generic/GPSlocation_Altitude

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.12 Reserved for [WiMAX_Diagnostics/Generic/NATAddrTable]

This metric is not supported in this version of the specification.

6.3.3.13 WiMAX_Diagnostics/Generic/LANEtherMAC

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	node	GET

This interior node provides an envelope for the data in the LANEthernetMAC metric as described in Section 5. A maximum of 8 instances of this node may be supported.

6.3.3.13.1 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	node	GET

Each instance of this node contains seven leaf nodes that may be read by the server to determine the measurement conditions, and one leaf node that contains the results which only allows GET access. Their contents are as described by the relevant sections of TR-098 [9].
Support of the WiMAX_Diagnostics/Generic/LANEtherMAC/LANEtherMACresults node is mandatory IF the WiMAX_Diagnostics/Generic/LANEthernetMAC node is supported (conditional REQUIRED status).
The values of the other nodes MAY be pre-populated; e.g. during OTA provisioning, but description of such is beyond the scope of this specification.

6.3.3.13.1.1 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/Enable

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	Boolean	GET

The contents of this node are the character strings “TRUE” or “FALSE” as per TR-098r2.

6.3.3.13.1.2 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/Status

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET

The contents of this node are one of the character strings “Up”, “NoLink”, “Error”, “Disabled” as per TR-098r2.

6.3.3.13.1.3 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/Name

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET

The maximum length of this string is 16 characters as per TR-098r2.

6.3.3.13.1.4 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/MACAddress

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET

This mode contains a character string comprised of the MAC address of the attached device in Hexadecimal format (12 characters) as per TR-098r2.

6.3.3.13.1.5 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/MACAddressControlEnabled

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET

The contents of this node are the character strings “TRUE” or “FALSE” as per TR-098r2.

6.3.3.13.1.6 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/MaxBitrate

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET

The possible value of this node is one of the character strings “10”, “100”, “1000”,”Auto” representing the maximum bit rates in Mbps as per TR-098r2.

6.3.3.13.1.7 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/DuplexMode

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET

The possible value of this node is one of the character strings “Half” “Full” “Auto”, as per TR-098r2.

6.3.3.13.1.8 WiMAX_Diagnostics/Generic/LANEtherMAC/<x>/LANEtherMACresults

Status	Tree Occurrence	Format	Min. Access Types
Required	One	chr	GET. No other access allowed

This leaf node contains the current LANEthernetMAC metric values.
It is formatted as a comma separated string of integers as follows, using the definitions from [9]:
“[BytesSent],[BytesReceived],[PacketsSent],[PacketsReceived],[ErrorsSent],[ErrorsReceived],[UnicastPacketsSent],[UnicastPacketsReceived],[DiscardPacketsSent],[DiscardPacketsReceived],[MulticastPacketsSent],[MulticastPacketsReceived],[BroadcastPacketsSent],[BroadcastPacketsReceived],[UnknownPacketsReceived]”.

Each of the elements is an integer with a maximum value of 2^32-1, represented in OMA-DM format as 10 decimal digits. Maximum length of the contents of this node are 14*(10+1)+10 = 164 characters.

6.3.3.14 WiMAX_Diagnostics/Generic/DeviceUptime

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.15 WiMAX_Diagnostics/Generic/DeviceLog

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

The maximum length of the contents of this node is 10k characters; however, in some server implementations strings longer than 4096 characters may be truncated & the excess data discarded. It is therefore recommended that the most recent log data be sent first so that any such truncation will tend to discard the older data.

6.3.3.16 WiMAX_Diagnostics/Generic/IPPingDiagnostics

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	node	GET. No other access allowed

This interior node provides an envelope for the data in the IPPingDiagnostics metric as described in Section 4. It contains seven leaf nodes that are used by the server to set the measurement conditions which have only REPLACE access, and one leaf node that contains the results which only allows GET access. Their contents are as described by the relevant sections of TR-098 [9]. If measurement of the IPPingDiagnostics is desired, the replaceable leaf. nodes SHALL each be populated and sent prior to the execution of the ./WiMAX_Diagnostics/Start command.

All the leaf nodes in this node must be supported in order to enable the client to undertake the correct measurements & return the result; i.e. support of the leaf nodes is mandatory IF the WiMAX_Diagnostics/Generic/IPPingDiagnostics node is supported (conditional REQUIRED status).

Note: The values chosen for the measurement conditions should be such that the IPPing measurement can be comfortably completed with in the time specified in the WiMAXDiagnostics/Start/Duration node described in Section 6.3.1.1; for example,

([IPPingDiagnostics /Timeout]*([IPPingDiagnostics/NumberOfRepetitions]+1)) < [Start/Duration].

- If the Duration is set to value 1 (immediate return of current results), it will not be possible to perform a new measurement of IPPingDiagnostics.
- If the Duration is set to value 2 (terminate measurement on session close), the IPPingDiagnostics results may not be consistent with the measurement conditions requested.

6.3.3.16.1 WiMAX_Diagnostics/Generic/IPPingDiagnostics/DiagnosticsState

Status	Tree Occurrence	Format	Min. Access Types
Required	One	chr	Get, Replace

The contents of this node are one of the character strings “None”, “Requested”, “Complete”, “Error_CannotResolveHostName”, “Error_Internal” or “Error_Other”, as per TR-098r2.

6.3.3.16.2 WiMAX_Diagnostics/Generic/IPPingDiagnostics/Interface

Status	Tree Occurrence	Format	Min. Access Types
Required	One	chr	Get, Replace

In the case of an IPv6 address, zero suppressed notation (as per RFC1884) must not be used. The maximum length of the contents of this node shall be 39 characters (i.e. for hex representation of the IPv6 address (including 7 colon separators as per RFC 1884),

6.3.3.16.3 WiMAX_Diagnostics/Generic/IPPingDiagnostics/Host

Status	Tree Occurrence	Format	Min. Access Types
Required	One	chr	Get, Replace

In the case of an IPv6 address, zero suppressed notation (as per RFC1884) must not be used. The maximum length of the contents of this node shall be 39 characters (i.e. for hex representation of the IPv6 address (including 7 colon separators as per RFC 1884),

6.3.3.16.4 WiMAX_Diagnostics/Generic/IPPingDiagnostics/NumberOfRepetition

Status	Tree Occurrence	Format	Min. Access Types
Required	One	int	Get, Replace

6.3.3.16.5 WiMAX_Diagnostics/Generic/IPPingDiagnostics/Timeout

Status	Tree Occurrence	Format	Min. Access Types
Required	One	int	Get, Replace

6.3.3.16.6 WiMAX_Diagnostics/Generic/IPPingDiagnostics/DataBlockSize

Status	Tree Occurrence	Format	Min. Access Types
Required	One	int	Get, Replace

6.3.3.16.7 WiMAX_Diagnostics/Generic/IPPingDiagnostics/DSCP

Status	Tree Occurrence	Format	Min. Access Types
Required	One	int	Get, Replace

6.3.3.16.8 WiMAX_Diagnostics/Generic/IPPingDiagnostics/IPPingDiagnosticsResults

Status	Tree Occurrence	Format	Min. Access Types
Required	One	chr	GET. No other access allowed

This leaf node contains the results of the last IPPing test performed using the test conditions specified by the other leaf nodes under WiMAX_Diagnostics/Generic/IPPingDiagnostics.

It is formatted as a comma separated string as follows, using the definitions from [9]: "[DiagnosticsState],[SuccessCount],[FailCount],[AverageResponseTime],[MinimumResponseTIme],[MaximumResponseTime]". For example, if the client had been requested to ping 10 times, had 9 successes, with an average, response time of 15ms, a minimum, response time of 12ms, and a maximum, response time of 33ms, the value in this node would be "Complete,9,1,15,12,33".

The maximum length of the contents of this node is76 characters.

6.3.3.17 WiMAX_Diagnostics/Generic/Primary_DNS

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.3.18 WiMAX_Diagnostics/Generic/Secondary_DNS

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.3.19 WiMAX_Diagnostics/Generic/Gateway

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.3.20 WiMAX_Diagnostics/Generic/Subnet_Mask

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.3.21 WiMAX_Diagnostics/Generic/Wimax_Interface_IP_Addr

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

6.3.3.22 WiMAX_Diagnostics/Generic/DHCP_Leases

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	int	GET. No other access allowed

6.3.3.23 WiMAX_Diagnostics/Generic/Port_Forwarding

Status	Tree Occurrence	Format	Min. Access Types
Optional	One	chr	GET. No other access allowed

7 TR-069 Protocol

TR-069 is the CPE Wide Area Network (WAN) Management Protocol defined by the Broadband Forum [7]. It defines a mechanism that encompasses secure auto-configuration of a CPE and also incorporates other CPE management functions into a common framework.

The WiMAX Forum® Network Architecture over the air provisioning specification [8] defines a management framework and a protocol for various management procedures.

When TR-069 is selected by the bootstrap procedure [4], the DRMD client and server SHALL follow all existing TR-069 protocols when communicating with each other as defined in [8].

8 TR-069 MO for WiMAX® Diagnostics

In order to support the WiMAX® metrics specified in phase 1, the WiMAX Forum® will reuse existing objects from TR-098 [9], TR-106[10], and TR-157[11], as well as specify new objects. The new objects will be inserted into the TR-069 object model specified in Rel 1.5 [8].

8.1 Reused Objects and Parameters

This section describes parameters specified in phase l that already have corresponding entries in the TR-098 model [9].

NATAddrTable – This object is currently supported in the InternetGatewayDevice object model as PortMapping and LANDevice Host objects defined in [9].

LANEtherMAC– This object is currently supported in the InternetGatewayDevice object model as the LANDevice's Ethernet Interface object defined in [9].

DeviceUptime - This object is currently supported in the InternetGatewayDevice object model as DeviceInfo UpTime parameter defined in [9].

DeviceLog - This object is currently supported in the InternetGatewayDevice object model as DeviceInfo DeviceLog parameter defined in [9].

IPPingDiagnostics - This object is currently supported in the InternetGatewayDevice object model as DeviceInfo DeviceLog parameter defined in [9].

In addition to the parameters defined above, the TR-098 model provides additional objects and parameters that would be helpful in diagnosing problems with a CPE. For example, the TR-157 model contains diagnostics for Ping, Traceroute, and DNS Query. In addition, the Broadband Forum TR-157 [11] provides models for Device components such as CPU, Memory, Temperature sensors, Self test diagnostics, and firewall status

8.2 Deprecated Parameter

The following parameter (defined in Rel 1.5) has been deprecated:

InternetGatewayDevice.WANDevice.{i}.X_WIMAXFORUM_WiMAXInterfaceConfig.ActiveOperator.Frequency

This parameter defines the current center frequency, in kHz that is in use for this WANDevice instance. This attribute has been deprecated in favor of the InternetGatewayDevice.WANDevice.{i}. X_WIMAXFORUM_WiMAXInterfaceConfig. RadioModule.DownlinkFreq

8.3 New Objects and Parameters

This section describes new WiMAX®-specific objects and parameters that are added to the WiMAX TR-069 object model. These new objects and parameters are inserted into the table specified in Annex A7 of the TR-069 model specified in Rel 1.5 [8].

Please refer to Section 5 for description of the parameters.

1

Name[1]	Type	Write[2]	Object Default[3]
InternetGatewayDevice.	object	-	-
InternetGatewayDevice.WANDevice.{i}. X_WIMAXFORUM_WiMAXInterfaceConfig.	object	-	-
InternetGatewayDevice.WANDevice.{i}. X_WIMAXFORUM_WiMAXInterfaceConfig.Radio Module.	object	-	-
ServBSID	int	-	-
DownlinkFreq	int	-	-
DownlinkBandwidth	int	-	-
DownlinkMeanRSSI	string (62)	-	-
DownlinkStdDevRSSI	string (71)	-	-
DownlinkMeanCINR	string (62)	-	-
DownlinkStdDevCINR	string (62)	-	-
TxPwr	int	-	-
TxHeadroomPwr	int	-	-
ScannedBaseStation	string(233)	-	-
InternetGatewayDevice.WANDevice.-{i}.WANConnection Device.{i}.X_WIMAXFORUM_WiMAXLink Config.	object	-	-
LinkUptime	int	-	-
InternetGatewayDevice.WANDevice.-{i}.WANConnection Device.{i}.X_WIMAXFORUM_WiMAXLink Config.Stats.	object	-	-
HARQRetTX	string(53)	-	-
HARQRetRX	string(53)	-	-
InitRangeResp	int	-	-
InitRangeNoResp	int	-	-
PerRangeResp	int	-	-
PerRangeNoResp	int	-	-

[1] The full name of a Parameter is the concatenation of the object name shown in the grey header with the individual Parameter name.

[2] "W" indicates the parameter MAY be writable (if "W" is not present, the parameter is defined as read-only). For an object, "W" indicates object instances can be Added or Deleted.

[3] The default value of the parameter on creation of an object instance via TR-069: If the default value is an empty string, this is represented by the symbol <Empty>. A hyphen indicates that no default value is specified. For a parameter in which no default value is specified, on creation of a parent object instance, the CPE MUST set the parameter to a value that is valid according to the definition of that parameter.

Name[1]	Type	Write[2]	Object Default[3]
HOSuccess	int	-	-
HOFail	int	-	-
MAPRecSuccess	int	-	-
MAPRecFail	int	-	-
MCSstatsDL	string(6719)	-	-
MCSstatsUL	string(5039)	-	-
VersionOfMCSMetric	int	-	-
DownlinkDataRate	string(62)	-	-
UplinkDataRate	string(62)	-	-
PacketsReceived	int	-	-
PacketsSent	int	-	-
RateLimiterStats	int	-	-
TimeActive	int	-	-
TimeIdle	int	-	-
TimeSleep	int	-	-
InternetGatewayDevice.X_WIMAXFORUM_ DeviceInfo.	object	-	-
InternetGatewayDevice.-X_WIMAXFORUM_DeviceInfo.Terminal Equipment.	object	-	-
LastRebootCause	string(32)	-	-
DeviceTemp	int	-	-
CurPwr	int	-	-
BatteryCap	int	-	-
GPSlocation_Latitude	int	-	-
GPSlocation_Longitude	int		
GPSlocation_Altitude	int		

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