



WiMAX Forum[®] Network Architecture
Architecture, detailed Protocols and Procedures
Self-Organizing Networks

WMF-T33-120-R016v01
WiMAX Forum[®] Approved
(2010-06-25)

WiMAX Forum Proprietary
Copyright © 2010 WiMAX Forum. All Rights Reserved.

SON

Copyright Notice, Use Restrictions, Disclaimer, and Limitation of Liability

Copyright 2010 WiMAX Forum. All rights reserved.

The WiMAX Forum® owns the copyright in this document and reserves all rights herein. This document is available for download from the WiMAX Forum and may be duplicated for internal use, provided that all copies contain all proprietary notices and disclaimers included herein. Except for the foregoing, this document may not be duplicated, in whole or in part, or distributed without the express written authorization of the WiMAX Forum.

Use of this document is subject to the disclaimers and limitations described below. Use of this document constitutes acceptance of the following terms and conditions:

THIS DOCUMENT IS PROVIDED “AS IS” AND WITHOUT WARRANTY OF ANY KIND. TO THE GREATEST EXTENT PERMITTED BY LAW, THE WiMAX FORUM DISCLAIMS ALL EXPRESS, IMPLIED AND STATUTORY WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF TITLE, NONINFRINGEMENT, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE WiMAX FORUM DOES NOT WARRANT THAT THIS DOCUMENT IS COMPLETE OR WITHOUT ERROR AND DISCLAIMS ANY WARRANTIES TO THE CONTRARY.

Any products or services provided using technology described in or implemented in connection with this document may be subject to various regulatory controls under the laws and regulations of various governments worldwide. The user is solely responsible for the compliance of its products and/or services with any such laws and regulations and for obtaining any and all required authorizations, permits, or licenses for its products and/or services as a result of such regulations within the applicable jurisdiction.

NOTHING IN THIS DOCUMENT CREATES ANY WARRANTIES WHATSOEVER REGARDING THE APPLICABILITY OR NON-APPLICABILITY OF ANY SUCH LAWS OR REGULATIONS OR THE SUITABILITY OR NON-SUITABILITY OF ANY SUCH PRODUCT OR SERVICE FOR USE IN ANY JURISDICTION.

NOTHING IN THIS DOCUMENT CREATES ANY WARRANTIES WHATSOEVER REGARDING THE SUITABILITY OR NON-SUITABILITY OF A PRODUCT OR A SERVICE FOR CERTIFICATION UNDER ANY CERTIFICATION PROGRAM OF THE WiMAX FORUM OR ANY THIRD PARTY.

The WiMAX Forum has not investigated or made an independent determination regarding title or noninfringement of any technologies that may be incorporated, described or referenced in this document. Use of this document or implementation of any technologies described or referenced herein may therefore infringe undisclosed third-party patent rights or other intellectual property rights. The user is solely responsible for making all assessments relating to title and noninfringement of any technology, standard, or specification referenced in this document and for obtaining appropriate authorization to use such technologies, standards, and specifications, including through the payment of any required license fees.

NOTHING IN THIS DOCUMENT CREATES ANY WARRANTIES OF TITLE OR NONINFRINGEMENT WITH RESPECT TO ANY TECHNOLOGIES, STANDARDS OR SPECIFICATIONS REFERENCED OR INCORPORATED INTO THIS DOCUMENT.

IN NO EVENT SHALL THE WiMAX FORUM OR ANY MEMBER BE LIABLE TO THE USER OR TO A THIRD PARTY FOR ANY CLAIM ARISING FROM OR RELATING TO THE USE OF THIS DOCUMENT, INCLUDING, WITHOUT LIMITATION, A CLAIM THAT SUCH USE INFRINGES A THIRD PARTY’S INTELLECTUAL PROPERTY RIGHTS OR THAT IT FAILS TO COMPLY WITH APPLICABLE LAWS OR REGULATIONS. BY USE OF THIS DOCUMENT, THE USER WAIVES ANY SUCH CLAIM AGAINST THE WiMAX FORUM AND ITS MEMBERS RELATING TO THE USE OF THIS DOCUMENT.

The WiMAX Forum reserves the right to modify or amend this document without notice and in its sole discretion. The user is solely responsible for determining whether this document has been superseded by a later version or a different document.

“WiMAX,” “Mobile WiMAX,” “Fixed WiMAX,” “WiMAX Forum,” “WiMAX Certified,” “WiMAX Forum Certified,” the WiMAX Forum logo and the WiMAX Forum Certified logo are trademarks or registered trademarks of the WiMAX Forum. All other trademarks are the property of their respective owners. Wi-Fi® is a registered trademark of the Wi-Fi Alliance.

SON

1 **Table of Contents**

2	1	INTRODUCTION AND SCOPE.....	6
3	1.1	Document Scope.....	6
4	2	DEFINITIONS AND CONVENTIONS.....	7
5	2.1	Definitions.....	7
6	2.2	Conventions.....	7
7	3	REFERENCES.....	8
8	4	SON REQUIREMENTS.....	9
9	5	NETWORK REFERENCE MODEL.....	10
10	6	SON FUNCTIONS OVERVIEW.....	11
11	7	MANAGEMENT PLANE PROTOCOLS AND PROCEDURES.....	13
12	7.1	Self Initialization and Configuration.....	13
13	7.1.1	Overview.....	13
14	7.1.2	SON Server Discovery.....	13
15	7.1.2.1	SON Server Discovery using MA-CID and Civic Location.....	13
16	7.1.3	WFAP Location Authorization.....	15
17	7.1.4	WFAP Self Initial PHY & MAC Configuration.....	16
18	7.1.5	WFAP Initial ANR Configuration.....	18
19	7.1.5.1	ANR based on WFAP Location.....	18
20	7.1.5.2	ANR based on WFAP Scanning.....	19
21	7.2	Self Optimization.....	21
22	7.2.1	WFAP re-configuration.....	21
23	7.2.2	ANR Self Optimization.....	23
24	7.2.2.1	ANR updated by SON Server.....	23
25	7.2.2.2	ANR updated triggered by the WFAP.....	24
26	7.2.3	Load Balancing Optimization.....	26
27	7.2.4	FeGWRe-selection.....	28
28	7.3	Self Healing.....	29
29	7.4	WFAP Exit from SON.....	30
30	8	MESSAGE AND PARAMETER DEFINITIONS.....	31
31	8.1	Constants and Counters.....	33
32	8.1.1	Function type.....	33
33	8.1.2	Function Primitive.....	33
34	8.2	Message Definitions.....	34
35	8.2.1	Location Authorization.....	34
36	8.2.2	WFAP Initial PHY&MAC Configuration.....	34
37	8.2.3	WFAP Initial ANR Configuration.....	34
38	8.2.4	Self Optimization.....	35
39	8.2.5	ANR Self Optimization.....	35
40	8.2.6	Load Balancing Query.....	35
41	8.2.7	Spare Capacity Query.....	35
42	8.2.8	Parameter Modification.....	35
43	8.2.9	Automatic Backhaul Fault Detection and Recovery.....	36
44	8.2.10	WFAP Exit from SON.....	36
45	8.2.11	FeGWRe-selection.....	36

SON

1	8.3	Data Definitions.....	36
2	8.3.1	<i>wfapSon</i>	36
3	8.3.1.1	<i>sonServerDiscover</i>	36
4	8.3.1.1.1	<i>sonServerDiscoverRequest</i>	36
5	8.3.1.1.2	<i>sonServerDiscoverResponse</i>	37
6	8.3.2	<i>Attribute tables for Location Authorization</i>	37
7	8.3.3	<i>Attribute tables for WFAP Initial PHY&MAC Configuration</i>	39
8	8.3.4	<i>Attribute tables for WFAP Initial ANR Configuration</i>	43
9	8.3.5	<i>Attribute tables for Self Optimization</i>	45
10	8.3.6	<i>Attribute tables for ANR Self Optimization</i>	47
11	8.3.7	<i>Attribute tables for Load Balancing Query</i>	47
12	8.3.8	<i>Attribute tables for Spare Capacity Query</i>	49
13	8.3.9	<i>Attribute tables for Parameter Modification</i>	51
14	8.3.10	<i>Automatic Backhaul Fault Detection and Recovery</i>	52
15	8.3.11	<i>Attribute tables for WFAP Exit from SON</i>	52
16	8.3.12	<i>FeGWRe-selection</i>	52
17	APPENDIX A.	WFAP STATE DIAGRAM.....	54
18			
19			

SON

1 **List of Figures**

2	FIGURE 7-1: SON SERVER DISCOVERY FLOW	14
3	FIGURE 7-2: LOCATION AUTHORIZATION FLOW	15
4	FIGURE 7-3: WFAP SELF-CONFIGURATION FLOW	16
5	FIGURE 7-4 ANR BASED ON WFAP LOCATION	18
6	FIGURE 7-5 ANR BASED ON SCANNING	20
7	FIGURE 7-6: AUTOMATIC SELF-OPTIMIZATION FLOW	22
8	FIGURE 7-7 NRT UPDATE TRIGGERED BY SON SERVER	24
9	FIGURE 7-8 NRT UPDATE TRIGGERED BY WFAP	25
10	FIGURE 7-9 LOAD BALANCING AMONG NEIGHBORING WFAPS	27
11	FIGURE 7-10: F EGW RE-SELECTION	29
12	FIGURE 7-11: WFAP EXIT FROM SO	30
13	FIGURE 8-1 : WFAP AND SON SERVER INITIATED TRANSACTIONS	31
14	FIGURE A-1: WFAP STAGE DIAGRAM (INFORMATIVE).....	54

16 **List of Tables**

17	TABLE 6-1 FEMTO SON FUNCTIONS OVERVIEW	11
18	TABLE 8-1 : SON MESSAGES	31
19	TABLE 8-2 : MESSAGES BETWEEN THE SON SERVER AND THE MANAGEMENT SERVER	32
20	TABLE 8-3 : MAPPING OF THE MESSAGES IN WFAP TRIGGERED TRANSACTIONS.....	32
21	TABLE 8-4 : MAPPING OF THE MESSAGES IN SON SERVER TRIGGERED TRANSACTIONS	32
22	TABLE 8-5 : SON FUNCTION TYPE	33
23	TABLE 8-6 : SON FUNCTION PRIMITIVES.....	34
24	TABLE 8-7 : LOCATION AUTHORIZATION REQUEST	37
25	TABLE 8-8 : LOCATION_AUTHORIZATION_RESPONSE	39
26	TABLE 8-9 : WFAP INITIAL PHY&MAC CONFIGURATION.....	39
27	TABLE 8-10 : WFAPSCANNEDNEIGHBORPHY&MAC	40
28	TABLE 8-11 : INITIAL ANR CONFIGURATION REQUEST	43
29	TABLE 8-12 : INITIAL ANR CONFIGURATION RESPONSE	44
30	TABLE 8-13 : INITIAL ANR CONFIGURATION ACKNOWLEDGE	45
31	TABLE 8-14 : WFAF MEASUREMENT REPORT	45
32	TABLE 8-15 : SON RECONFIGURATION REQUEST	46
33	TABLE 8-16 : SON RECONFIGURATION RESPONSE	46
34	TABLE 8-17 : ANR SELF OPTIMIZATION REQUEST	47
35	TABLE 8-18 : LOAD BALANCING QUERY REQUEST	47
36	TABLE 8-19 : LOAD BALANCING QUERY RESPONSE	48
37	TABLE 8-20 : SPARE CAPACITY QUERY REQUEST	49
38	TABLE 8-21 : SPARE CAPACITY QUERY RESPONSE	50
39	TABLE 8-22 : PARAMETER MODIFICATION REQUEST	51
40	TABLE 8-23 : PARAMETER MODIFICATION RESPONSE.....	51
41	TABLE 8-24 : WFAP EXIT FROM SON REQUEST	52

42

1 Introduction and Scope

2 The design intent of Self-Organizing Networks (SON) is to enable the radio and network components to interact
3 among themselves, and to configure and tune the mobile system automatically in real time. SON is a process that
4 involves Network Elements (NEs) in Radio Access Networks (RAN) and Core networks to enable automatic
5 configuration, to measure/analyze KPI (Key Performance Indicator) data, and to fine tune network attributes in order
6 to achieve optimal performance. It helps the network operators to reduce OPEX by minimizing human intervention
7 in both deployment and operational phases. It is especially important to Femtocells. Otherwise, operators will not be
8 able to ramp up Femto AP deployment to huge volume quickly.

9 This document describes the scope, architecture reference model, reference points, and protocols and procedures for
10 WiMAX® SON system.

11 1.1 Document Scope

12 The scope of this work item is to define the end-to-end SON solution to support WiMAX® Femto AP (WFAP). The
13 specific objective for Femto is to enable plug and play model where a subscriber will be able to purchase a Femto
14 AP from the local electronic store, and then simply plug it into the broadband modem to receive services without
15 any operator intervention. The support of SON is split in phases. In phase 1, there is no impact on IEEE Std
16 802.16-2009 air interface. It is based on System Profile Release 1.0/1.5 and is expected to be available in WiMAX
17 Forum® Network Architecture Release 1.6. The solution should be extendable to support macro BS in future phases.

18 These WiMAX Femto SON requirements are based on “Requirements for WiMAX Femtocell Systems.” The scope
19 of this specification applies to Femto AP, and network components and includes, but not limited to, the following:

- 20 • Automatic configuration
 - 21 – PHY/RF parameters
 - 22 – MAC parameters
 - 23 – Other parameters such as Access Control List, time synchronization server address if network time
24 resource server is used.
- 25
- 26 • Automatic reconfiguration
 - 27 – Update of the operating MAC/PHY/RF parameters when wireless environment is changed.
- 28
- 29 • Automatic fault detection and recovery
 - 30 – Self test
 - 31 – Automatic data/information collection and report
- 32

2 Definitions and Conventions

2.1 Definitions

Self Healing

Self Healing is that during the operating period network detects its problems itself and mitigates or solves these to avoid user impact and to significantly reduce maintenance costs.

Self Configuration

Self configuration is equivalent to automatic configuration as defined in the SPWG.

Self Optimization

Self optimization is equivalent to automatic re-configuration as defined in the SPWG.

Self-Organizing Networks

Self-Organizing Networks (SON) is a process that involves Network Elements (NEs) in Radio Access Networks (RAN) and Core networks to enable automatic configuration, to measure / analyze performance data, and to fine tune network attributes in order to achieve optimal performance.

2.2 Conventions

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 below, taken from IETF RFC 2119.

Note that the force of these words is modified by the requirement level of the document in which they are used.

- **MUST:** This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.
- **MUST NOT:** This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.
- **SHOULD:** This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- **SHOULD NOT:** This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.

3 References

- 1
- 2 [1] WMF-T32-001-R016, WiMAX Forum® Network Architecture - Architecture Tenets, Reference
- 3 Model and Reference Points – Base Specification
- 4 [2] WMF-T33-001-R016, WiMAX Forum® Network Architecture – Detailed Protocols and Procedures -
- 5 Base Specification
- 6 [3] WMF-T31-123-R016, WiMAX Forum® Requirements for WiMAX Femtocell Systems
- 7 [4] IEEE Std 802.16-2009, IEEE Standard for Local and metropolitan area networks – Part 16: Air Interface
- 8 for Broadband Wireless Access Systems
- 9 [5] WMF-T33-118-R016, WiMAX Forum® Network Architecture- Architecture, detailed Protocols and
- 10 Procedures Femtocell core specification
- 11 [6] WMF-T33-119-R016, WiMAX Forum® Network Architecture- Architecture, detailed
- 12 Protocols and Procedures Femtocell management
- 13 [7] WMF-T31-123-R016, WiMAX Forum® Requirements for WiMAX Femtocell Systems

SON

1 **4 SON Requirements**

2 The SON requirements are provided in the Femtocell Requirements Specification V1.0.0, Section “SON
3 requirements.”

4

1 **5 Network Reference Model**

- 2 SON Network Reference Model is aligned with Femto NRM, please refer to section 4 in Femtocells core
- 3 specification [5].

6 SON Functions Overview

The following table depicts the SON functions overview.

Table 6-1 Femto SON Functions Overview

Self Configuration	Initial Radio Related Configuration (RF/PHY/MAC Parameters)
Self Optimization	Dynamic Radio Re-configuration
	Interference Management
	Performance Data Collection
	Coverage Capacity Optimization
	Mobility Robustness Optimization
	Mobility Load Balancing
Self Healing	Fault Detection Localization
	Automatic Fault Correction

In general, there are two levels of the WFAP configuration operations: Initial configuration, and Re-configuration as defined in the definition section..

Note: Some features in self optimization and self healing are to be supported in future releases.

Self-Configuration

Self-configuration is the process that is executed automatically after the power-on of the WFAP and the network connectivity establishment with the broadband network and the serving Femto ASN.

The self-configuration of the WFAP is split across the Femto Management function and the SON function. For the WFAP self configuration, the management function will be responsible for the self-configuration of the upper layers while the SON function will be responsible for the self-configuration of the air interface.

The self-configuration process involves functions such as:

- Location verification
- Automatic configuration system identifier and parameters
- Automatic neighbor discovery
- Auto-configuration of physical radio parameters

Self-Optimization

Self Optimization includes:

- Performance Data Collection,

SON

- 1 - Interference Management
- 2 - Coverage and Capacity Optimization
- 3 - Mobility Robustness Optimization
- 4 - Mobility Load Balancing
- 5 - Dynamic Reconfiguration Management:

6 Performance Data Collection involves the real time collection of the relevant air interface measurements.

7 Interference Management is the capability and the intelligence to identify the interference between the WFAP and
8 adjacent WFAPs/Macro BSs; and to mitigate interference.

9 Coverage and Capacity Optimization optimizes the network according to coverage and capacity. For example, call
10 drop rates give a good indication of areas with insufficient coverage and retransmission traffic counters identify
11 capacity problems. The coverage optimization algorithms must take the impact on the capacity as well as the
12 interference impact into account

13 Mobility Robustness Optimization should reduce the number of HO failures due to the radio link quality threshold
14 impacting the appropriate handover trigger time, e.g. detection of too late HO, too early HO or wrong cell,
15 optimization of cell reselection parameters etc. The late handover will cause HO failure because the current
16 serving WFAP cannot provide stable services for an MS before it switches to a target WFAP, the packets will be lost
17 at the serving WFAP before the HO is triggered. On the contrary, the early HO may lead to selecting a wrong
18 target WFAP, resulting in repeatedly scanning new target WFAPs and increasing handover latency.

19 Reconfiguration Management implements the re-adjustment of certain parameters based on the results of the
20 performance management and the interference management function

21 Following are the examples of the measurements data collected from the WFAP:

- 22 • Signal strength optimization of the WFAP neighbors (Tx power control)
- 23 • MS measurement reporting or WFAP radio scanning for neighbors
- 24 • Femto HO parameters optimization and interference control
- 25 • Event measurements like cell specific call drops or handover failures
- 26 • NMS/EMS configuration data for the pre-determine WFAP neighbor for the given MS.

27

28 Self-Healing

29 Self-healing is a function that mitigates the faults automatically by triggering appropriate recovery actions. From the
30 point of view of fault management, for each detected fault, appropriate alarms SHALL be generated by the faulty
31 WFAP, regardless of whether it is an automatically detected and automatically cleared or an automatically detected
32 and manually cleared fault.

33

34 The self-healing functionality monitors the alarms, and gathers necessary correlated information (e.g. measurements,
35 testing result, etc.) and does deep analysis, and triggers appropriate recovery actions to solve the fault. It also
36 monitors the execution of the recovery actions and decides the next step accordingly. When self-healing iteration
37 ends, the self-healing functionality SHALL generate appropriate notifications to inform the management Manager of
38 all the changes performed.

7 Management Plane Protocols and Procedures

This section specifies management plane protocols and procedures for WiMAX® SON System.

The information element exchanged between the SON Server and WFAP will be conducted on the management plane. Therefore, they will be transported via standard based management plane protocols (e.g. SNMP, etc.) as defined in the Femto Management Specification [6]. However, it may be necessary for the SON Server to send huge amount of data during the WFAP initialization phase. Bulk data transfer protocol as defined in [6] should also be used in order to shorten the time of download.

A WFAP will support the same management protocol for both Femto Management and SON.

7.1 Self Initialization and Configuration

This section describes initial procedure starting from when the WFAP powered on and then to perform SON System Discovery, and authorization for WFAP radio emission based on WFAP's location and regulatory restriction.

7.1.1 Overview

The process of WFAP self-Initialization and WFAP Self-Configuration involves the following main operations:

- Location Discovery
- SON system discovery
- WFAP Location Authorization
- Self Configuration

The sequence of operations is not necessarily happen in the exact order as described above.

An example of the process of the WFAP self-initialization can be found in APPENDIX A.

7.1.2 SON Server Discovery

7.1.2.1 SON Server Discovery using MA-CID and Civic Location

It is optional to leverage the information of MA-CID and civic location for SON Server discovery.

SON

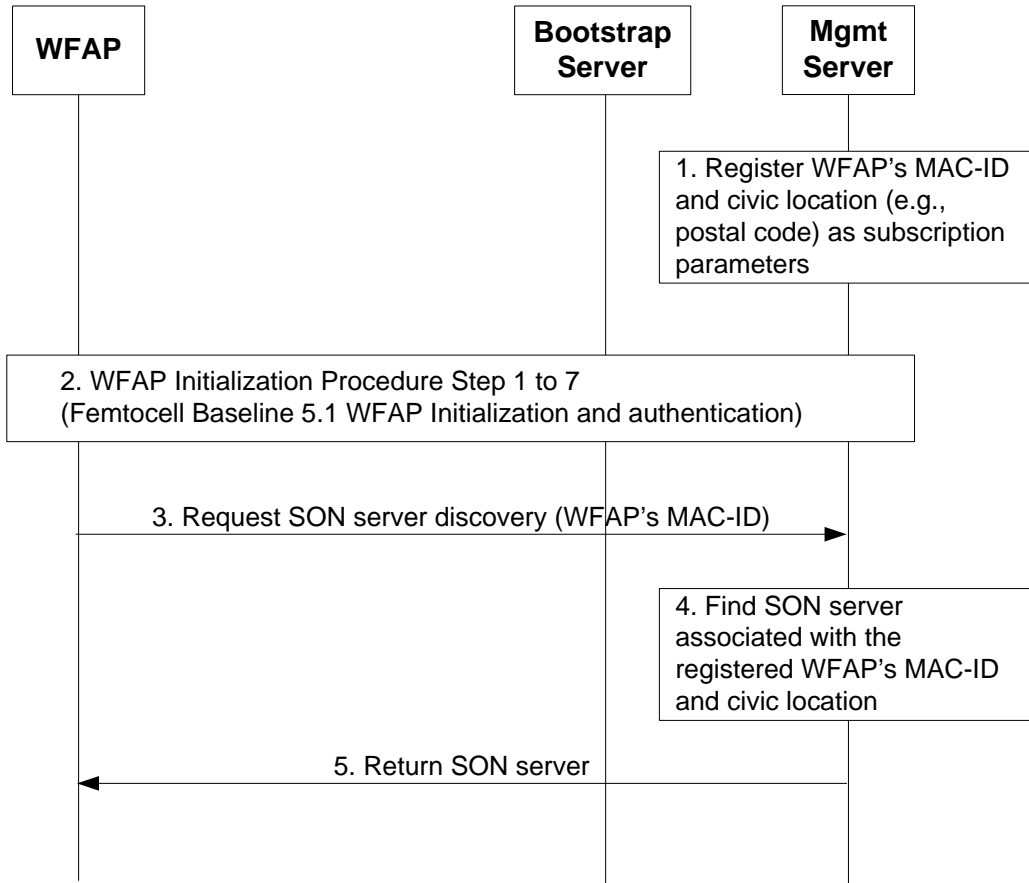


Figure 7-1: SON Server Discovery Flow

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

STEP 1

WFAP's MAC-ID and subscriber's civic location (e.g., postal code) are registered in Femto Management Server as subscription information.

STEP 2

WFAP initialization procedures are performed as step 1 to 7 in [5], section 5.1. During these steps, WFAP discovers the address of the Femto Management Server.

STEP 3

WFAP requests Femto Management Server to discover SON Server with WFAP's MAC-ID.

STEP 4

Femto Management Server finds the registered civic location with WFAP's MAC-ID then searches SON Server associated with the civic location. Unless WFAP's MAC-ID is registered in Femto Management Server, the request for SON server discovery will be failed.

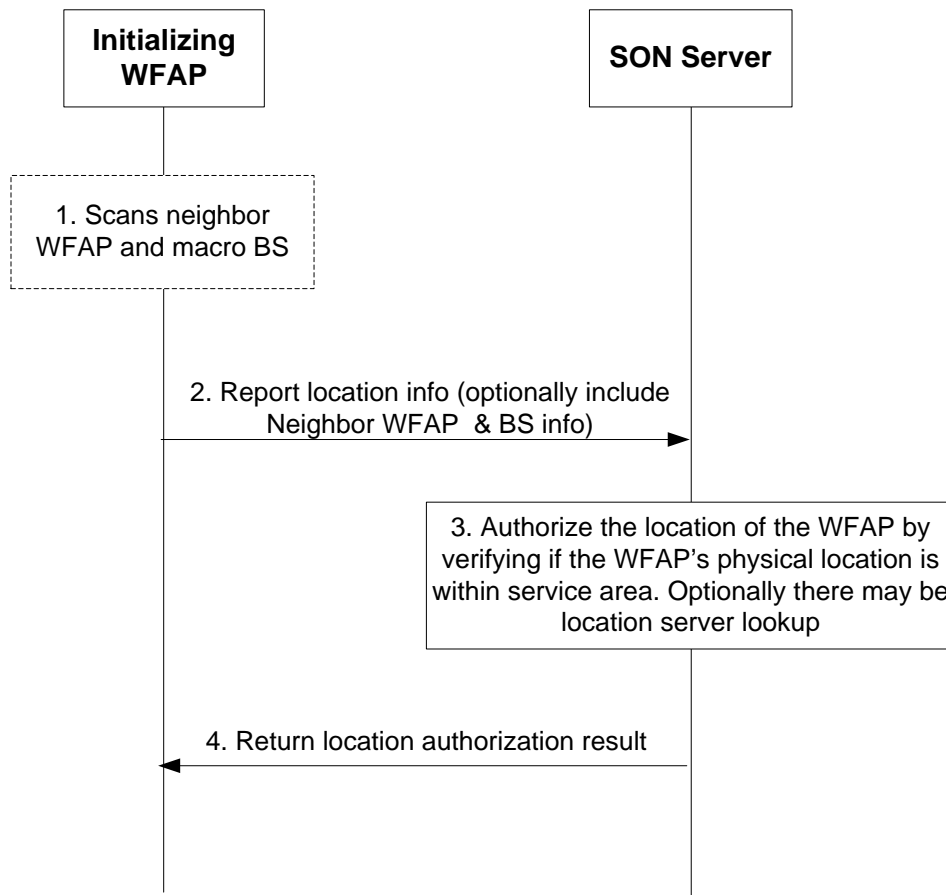
STEP 5

Femto Management Server provides WFAP with the acquired SON Server's address or FQDN. If the FQDN of the SON Server is obtained in this step, then a DNS query is executed to obtain the IP address of the SON Server.

SON

1 **7.1.3 WFAP Location Authorization**

2 Figure 7-2 shows the location authorization flow.



3
4 **Figure 7-2: Location Authorization Flow**

5 **STEP 1**

6 Initializing WFAP may obtain neighbor WFAP and overlaid macro BS by free scanning of its neighbors, it
7 learns the RF parameters and their BSIDs.

8 **STEP 2**

9 Initializing WFAP reports the location information to SON Server. The location information may be based on
10 the neighbor WFAP and macro BS information, WFAP public IP address, GPS info and/or other wireless cell
11 info. Optionally WFAP may include the list of BSID of neighbor WFAP and macro BS and the SON Server
12 may use neighbor information for location authorization and self configuration

13 **STEP 3**

14 SON Server verifies if WFAP's physical location is within the service area. There may be a location lookup via
15 the location server.

16 **STEP 4**

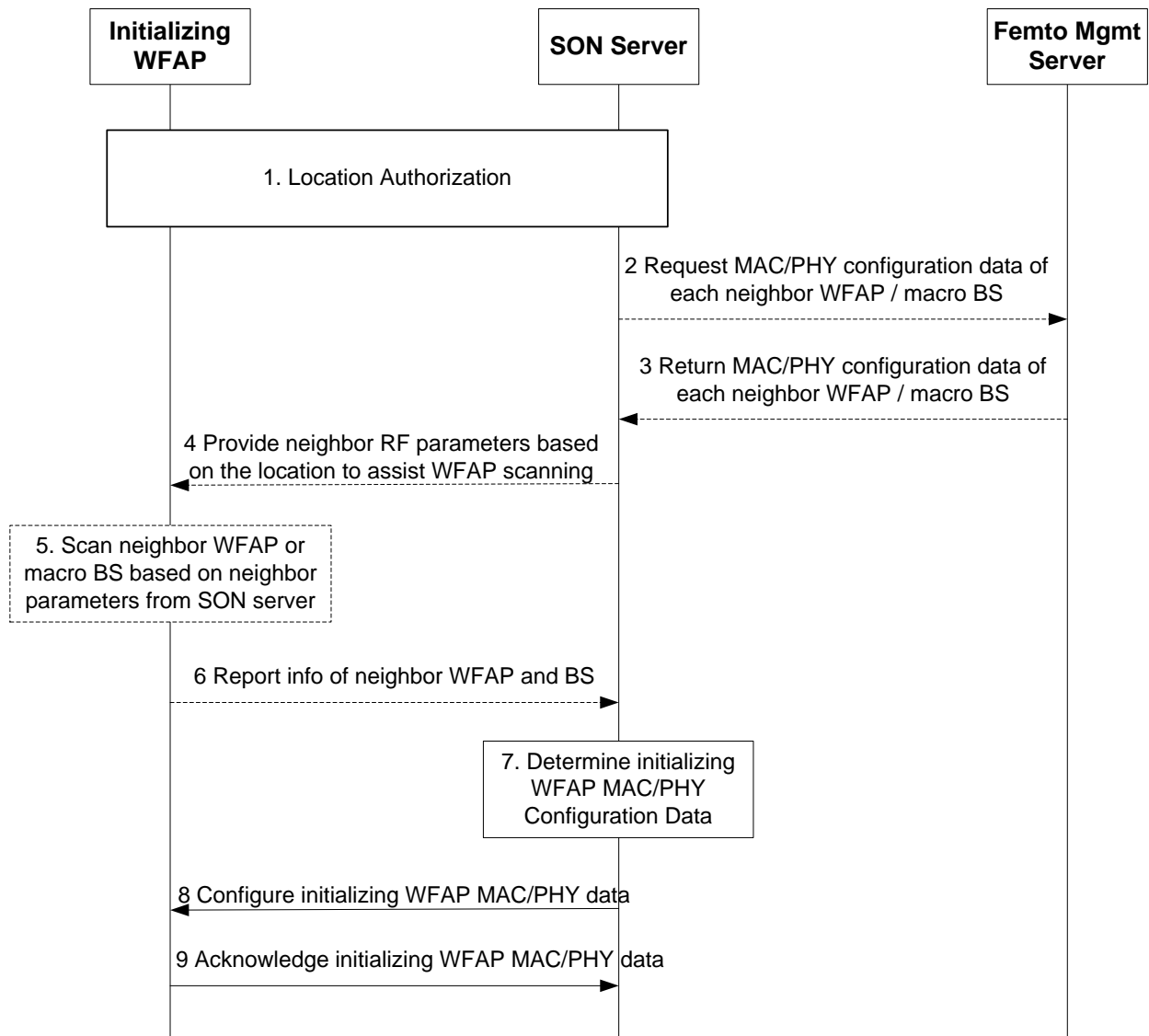
17 SON Server returns location authorization result to WFAP.

18

SON

1 **7.1.4 WFAP Self Initial PHY & MAC Configuration**

2 Figure 7-3 shows WFAP Self-Configuration flow.



3
4 **Figure 7-3: WFAP Self-Configuration Flow**

5
6 **STEP 1**

7 WFAP location authorization is performed as in Section 7.1.3

8 **STEP 2**

9 Upon the success of location authentication, SON Server may query the Femto Management Server for the
10 neighbor WFAP(s) and Macro BS(s) MAC & PHY configuration,.

11 **STEP 3**

12 Femto Management Server returns the MAC & PHY configuration data of each neighbor BS if it receives the
13 query from the SON Server. The following MAC & PHY configuration data are examples:

SON

- 1 • PHY independent uplink channel characteristics (Table 568, IEEE 802.16-2009)
- 2 • OFDMA uplink channel characteristics (Table 571, IEEE 802.16-2009)
- 3 • OFDMA uplink burst profiles (Table 574, IEEE 802.16-2009)
- 4 • OFDMA downlink channel characteristics (Table 575, IEEE 802.16-2009)
- 5 • OFDMA downlink burst profiles (Table 581, IEEE 802.16-2009)

6 STEP 4

7 SON Server may provide the neighbor RF parameters to the WFAP of which the parameters are used to assist
8 the WFAP to scan the neighbor WFAP(s) and Macro BS(s).

9 Note: Inter-NAP NRT is out of scope of this specification.

10 STEP 5

11 WFAP may scan its neighbor WFAP(s) and overlaid BS(s) to derive the neighbor associated MAC/PHY
12 parameters. If no WFAP scanning performs in this step, going straight to step-7.

13 STEP 6

14 WFAP may report the neighbor scanning results to SON Server. The information may include the list of BSIDs
15 of neighbor WFAP(s) and macro BS(s) and their associated MAC/PHY parameters as defined in the
16 MOB_SCN-REP message.

17 SON Server will keep the neighbor scanning results for the future self-optimization operation,
18 including the ANR management, for the given WFAP.

19 STEP 7

20 Upon receiving the optional neighbor scanning result and the MAC & PHY configuration obtained from Femto
21 Management, SON Server will proceed with the following steps:

- 22 a. SON Server determines the appropriate RF parameters and MAC & PHY configuration for the Serving
23 WFAP. In addition to the configuration as listed in step 3 above, it may include the following
24 configuration:
 - 25 • Tx power,
 - 26 • Uplink center frequency
 - 27 • Downlink center frequency
 - 28 • Preamble sequence
 - 29 • CP
 - 30 • Permutation type (e.g.: PUSC with All SC, PUSC 1/3)
 - 31 • Carrier Size/Band : Selection of a suitable Carrier and adjustment of the band within the allowed
32 range, based on available neighbor data.

33 STEP 8

34 To shorten the time required to download huge amount of MAC & PHY parameters, SON Server may use the
35 bulk data transfer protocol to send the MAC & PHY configuration data to the Initializing WFAP.

36 STEP 9

37 The WFAP acknowledges the reception of the initializing MAC & PHY parameters.

38

SON

1 **7.1.5 WFAP Initial ANR Configuration**

2 A WFAP has to maintain neighbor relations (NRs) that are useful for handover, load balancing, power adjustment,
 3 etc. ANR is an optional function for SON to meet the Automatic configuration requirements, the NRs will be
 4 configured automatically as the WFAP is most likely located in the SOHO (small office and home office) by the
 5 subscriber. The purpose of the Automatic Neighbor Relation (ANR) function is to relieve the femto operator from
 6 the burden of manually managing the NRs. The ANR function manages a Neighbor Relation Table (NRT) which
 7 consists of neighbor cell relations. In the SON Server, a neighbor cell relation from a source cell to target cell means
 8 that the source cell knows the BSID of the target cell, and it has an entry in the NRT for the source cell identifying
 9 the target cell. Depending on the type of cell, there are two configuration scenarios,

- 10 • Configure the information of the neighbor Macro BS in the WFAP’s NRT automatically.
- 11 • Configure the information of the neighbor WFAP in the WFAP’s NRT automatically.

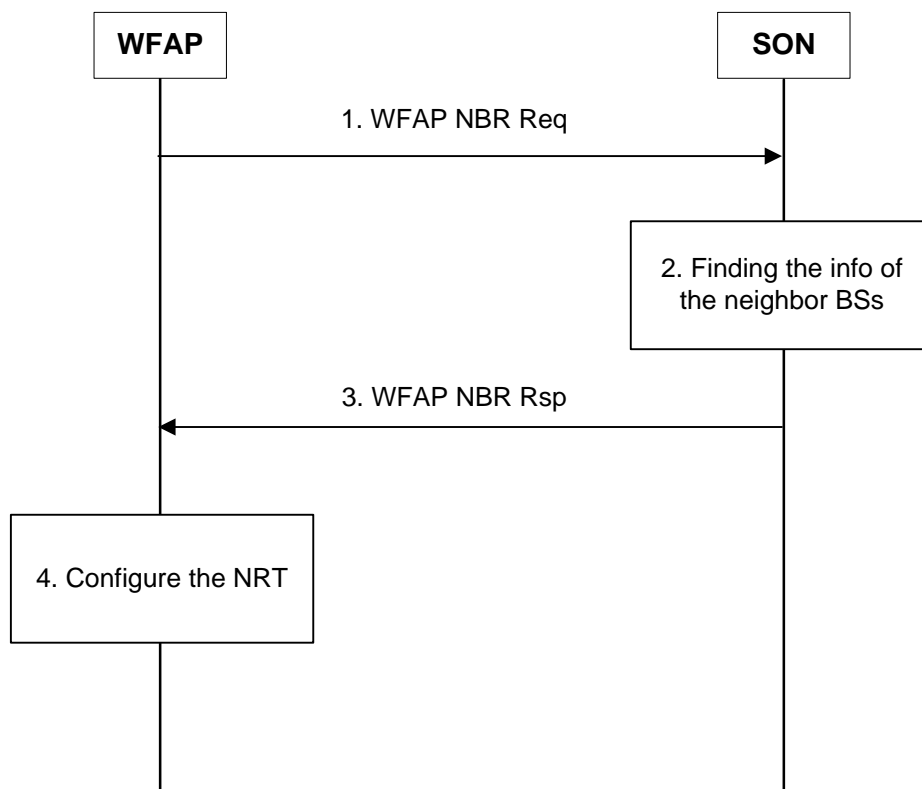
12 The femto operator may have business relationship with more than one macro NAP operators, thus, the NRT is
 13 classified based on the NAP. I.e., if the WFAP is located in a place where there are BSs from multiple NAPs, the
 14 NRT in the WFAP will include all of them. The SON Server may build the NRT considering the contractual
 15 relationships between the NAP of WFAP and the other NAPs of the neighbors.

16 Two ANR functions are described here.

17 **7.1.5.1 ANR based on WFAP Location**

18 When a WFAP enters the network, the SON Server may acquires the information of its neighbor macro BSs and/or
 19 WFAPs based on the location of the WFAP and configure them into the NRT of WFAP. The SON Server notifies
 20 the affected WFAPs in the neighborhood to update their NRT. After the WFAP exits the network, the SON Server
 21 updates the NRT of the affected WFAPs. This function is illustrated by the call flow in Figure 7-4.

22



23

24

25

Figure 7-4 ANR based on WFAP location

SON

1 STEP 1

2 The WFAP sends a WFAP Neighbor Request (WFAP NBR Req) message with the location information of the
3 WFAP to SON Server. This step is not needed if SON Server learns the location info of WFAP at location
4 authorization. Details of WFAP location request can be found in 7.1.3.

5 STEP 2

6 The SON Server finds the info of the WFAP's neighbor macro BSs and/or WFAPs based on their location info
7 which be obtained by the SON Server, and then the SON Server compiles the information of neighbor WFAP(s)
8 and BS(s) such as the BSID, center frequency, and so on according to their location maintained on the server.
9 The SON Server configures the information of the neighbor Macro BS and WFAP(s) in the WFAP's NRT
10 separately.

11 STEP 3

12 SON Server sends the configuration info in a WFAP NBR Rsp message including the merged NRT info of the
13 neighbor BS(s) and WFAP(s) to the WFAP. This message may be combined with Step 8 in Figure 7-3: WFAP
14 Self-Configuration Flow.

15 STEP 4

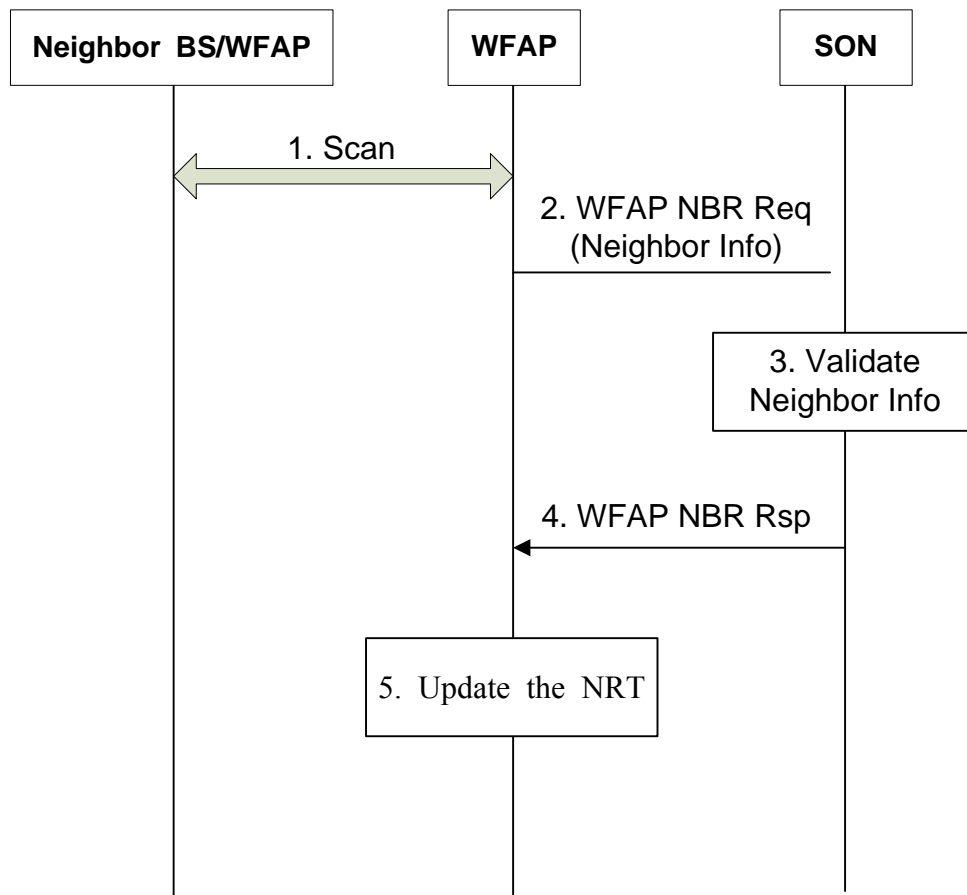
16 The WFAP configures the NRT with the neighbor WFAP's and BS's info.
17

18 7.1.5.2 ANR based on WFAP Scanning

19 ANR based on WFAP scanning is optional. After the WFAP has been authenticated by the network during
20 initialization, and before the WFAP becomes operational to serve MS, the WFAP may scans the air interface for the
21 signal of neighboring BS(s) and acquires the info in the UCD and DCD messages. The WFAP configures the NRT
22 and report the info of its neighboring BS(s) and/or neighbor WFAPs to the SON Server. This function is illustrated
23 by the call flow in Figure 7-5.

SON

1



v

Figure 7-5 ANR based on scanning

2

3

4

STEP 1

The WFAP performs autonomous scanning by receiving the UCD and DCD messages from neighboring BS(s). Details of WFAP scanning can be found in 7.1.4.

STEP 2

The WFAP reports its neighbor relation info to the SON Server in WFAP NBR Req. Details of WFAP reporting can be found in 7.1.4.

STEP 3

The SON Server validates the neighbor information it received from the WFAP and updates its neighbor relations table (NRT) according to related info in neighbor info of WFAP NBR Req.

STEP 4

The SON Server sends Configuration Info in a WFAP NBR Rsp message to the WFAP and all the other affected WFAPs if they exist. This message may be combined with the SON Server sending configuration to WFAP as defined in 7.1.4.

17

SON

1 **STEP 5**

2 The WFAP updates the NRT with the info received from SON Server.

3

4 **7.2 Self Optimization**

5 **7.2.1 WFAP re-configuration**

6 Once the WFAP becomes operational, the WFAP may experience the interference from its surrounding elements
7 (e.g. neighbor Macro-BSs , neighbor WFAPs , mobile stations and other electronic equipments etc.), which
8 operating on a same or adjacent frequency channel, as a result, the WFAP may require to further optimize its RF
9 channel performance.

10 The operational WFAP can detect its uplink radio condition and via the MS assistance it can also recognize its
11 downlink radio condition. The operational WFAP also collects neighbor information obtained from the MS scanning
12 report and/or from the HO request, such as BS ID, preamble and frequency of the target WFAP and Macro BS.

13 The WFAP may report the collected surrounding radio performance information to the SON Server. T he
14 frequency (e.g. periodically, trigger when reaching to the certain interference threshold etc.) of the neighboring radio
15 performance reporting to SON Server is local policy decision to the Femto network.

16 Given the neighboring radio performance condition for the given WFAP, the SON Server may reconfigure the
17 reporting WFAP and/or one or more neighboring WFAPs by specifying a new set of MAC/PHY parameters.

18 During the reconfiguration initiation process, the target WFAP may require to disable its radio interface to support
19 the reconfiguration. If the target WFAP currently has MS(s) attached, the WFAP may initiate the network-initiated
20 handover or the network exit to the attached MSs prior to disabling its radio interface. In the case when
21 network-initiated handover is triggered to the attached MS, the re-configured WFAP can remain as the neighbor
22 WFAP for the affected MS to be able to handover. The detailed procedures for the network-initiated handover and
23 for the network exit SHALL be referred to [5] and [2].

24 This function is illustrated in the following call flow.

25

SON

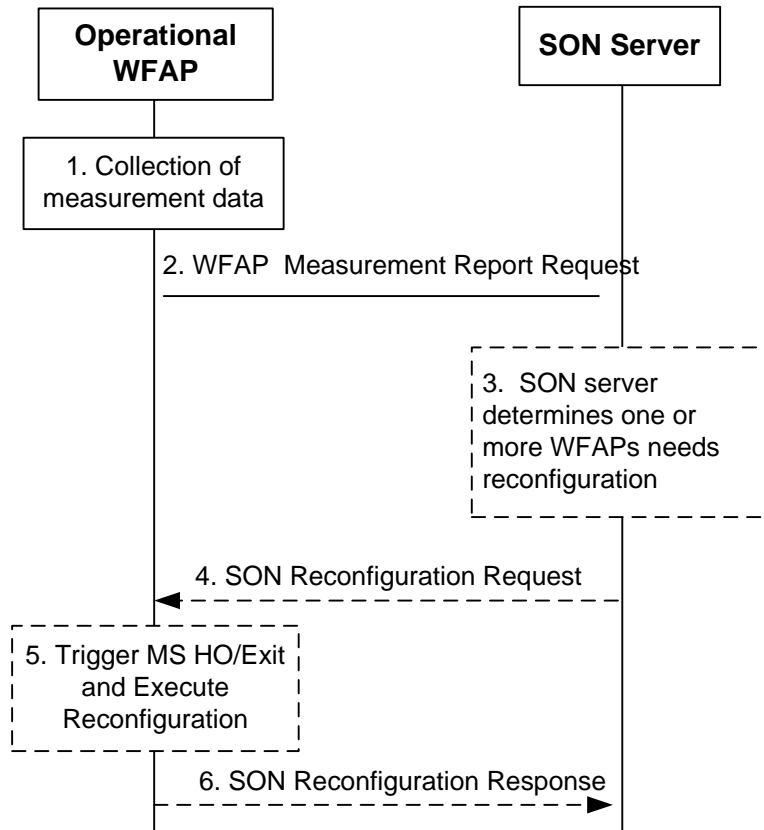


Figure 7-6: Automatic Self-optimization Flow

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

The function works as follows:

STEP 1

The operational WFAP collects the UL measurement, and via the support by its attached MS(s), it collects the DL measurement for the surrounding radio environment.

STEP 2

The operational WFAP reports the collected surrounding radio performance measurements to the SON Server. The frequency of the reporting is local policy decision to the WFAP.

STEP 3

Based on the measurements report from the operational WFAPs, the SON Server SHALL determine if one or more operational WFAPs need to be reconfigured. If required, the SON Server SHALL specify a new set of MAC/PHY parameters to initiate the reconfiguration towards the target WFAPs.

STEP 4

The SON Server sends the reconfiguration request message to the target WFAP(s) with the new MAC/PHY reconfiguration parameters included.

STEP 5

The WFAP processes the reconfiguration request. If the reconfiguration operation requires the target WFAP to disable its radio interface (e.g. change the channel center frequency), prior to the execution to such operation, the WFAP may initiate the network-initiated handover, or may initiate the network exit to the attached MSs. The detailed procedures of the network-initiated handover and the network exit SHALL be referred to [5] and [2].

SON

1 STEP 6

2 When the WFAP completes its MAC/PHY reconfiguration, it SHALL send the reconfiguration response message to
3 the SON Server to indicate the completion of the reconfiguration and the latest radio performance result, if any.

4

5

6 7.2.2 ANR Self Optimization

7 A WFAP receives its neighbor relationships during its initialization, this neighbor relationship SHALL be updated
8 when the neighbor relationship is changed. This feature is critical to support the proper handover behavior, load
9 balancing, power adjustment, etc. To meet the automatic re-configuration requirements, the neighbor relationship
10 SHALL be automatically updated. There are two mechanisms to update the WFAP NRT:

11 • SON Server to initiate NRT updated;

12 • WFAP initiate NRT updated;

13

14 7.2.2.1 ANR updated by SON Server

15 The WFAP may detect its neighbor information change in the following two possible ways, although, additional
16 ANR detection mechanism for WFAP is not precluded:

17 • By receiving explicit notification

18 The notification (e.g. system alarm or system configuration update) is sent to the SON Server when a
19 BS(s)/WFAP(s) becomes in-service (e.g. add a new WFAP) or out-of-service (e.g., backhaul offline). In this
20 case, SON Server SHALL notify the affected neighbor WFAP(s) to update (e.g. remove, add or modify) the
21 neighbor BS(s)/WFAP(s) from their corresponding NRT(s).

22 • By NRT discrepancy checking

23 If the SON Server detects NRT discrepancy, the SON Server SHALL notify the affected neighbor WFAP(s) to
24 update the neighbor BS(s)/WFAP(s) from their corresponding NRT(s). Note that, this consideration is to
25 ensure that any explicit notification which was sent to the SON Server regarding the operation status of the
26 WFAP has not been lost.

27 After a WFAP becomes operational, whenever the SON Server detects the change of neighbor information for the
28 corresponding WFAP, the SON Server SHALL notify the WFAP with the neighbor change information. The
29 WFAP will then update its NRT based on the newly received notification from SON Server. This NRT update
30 operation is illustrated in Figure 7-7.

31

SON

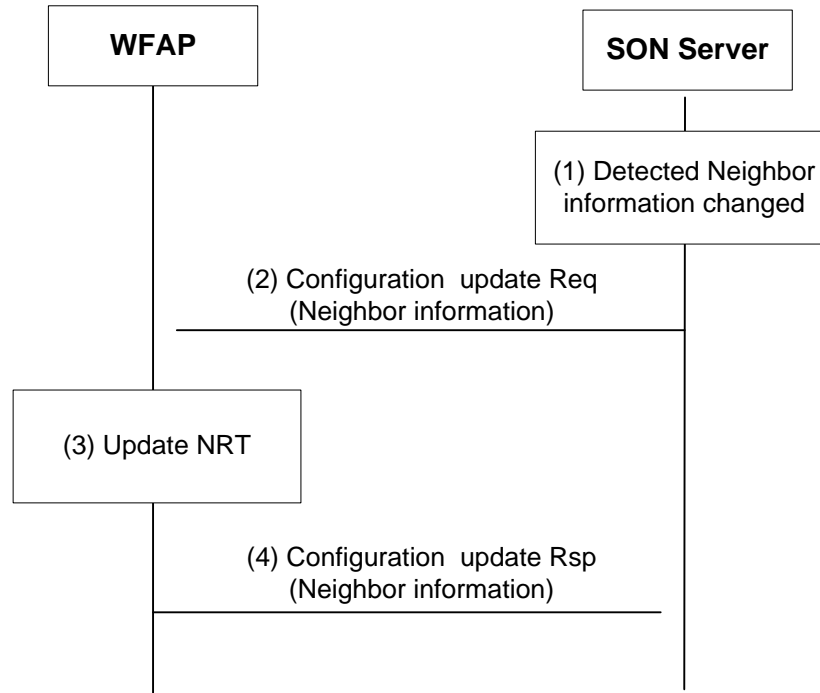


Figure 7-7 NRT update triggered by SON Server

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

STEP 7

SON Server detects neighbor information of WFAP has been changed.

STEP 8

SON Server sends Configuration update Req with neighbor information changes to the WFAP;

STEP 9

The WFAP updates its NRT based on neighbor information changes from SON Server;

STEP 10

The WFAP sends Configuration update Rsp to SON Server after it updated its NRT.

7.2.2.2 ANR updated triggered by the WFAP

The SON Server may detect WFAP neighbor information changes in the following two possible ways, although, additional ANR detection mechanism for SON Server is not precluded:

- ✓ By receiving MS report relating to the neighbor update messages (e.g., MOB_SCAN-RSP/REQ, MOB_MSHO-REQ);
- ✓ By uncontrolled or unpredicted HO events;

The WFAP SHALL notify the neighbor information changes to SON Server when it detects the change of its neighbor information. The WFAP updates the NRT only after the SON Server has validated the change. This NRT update is illustrated in Figure 7-8.

SON

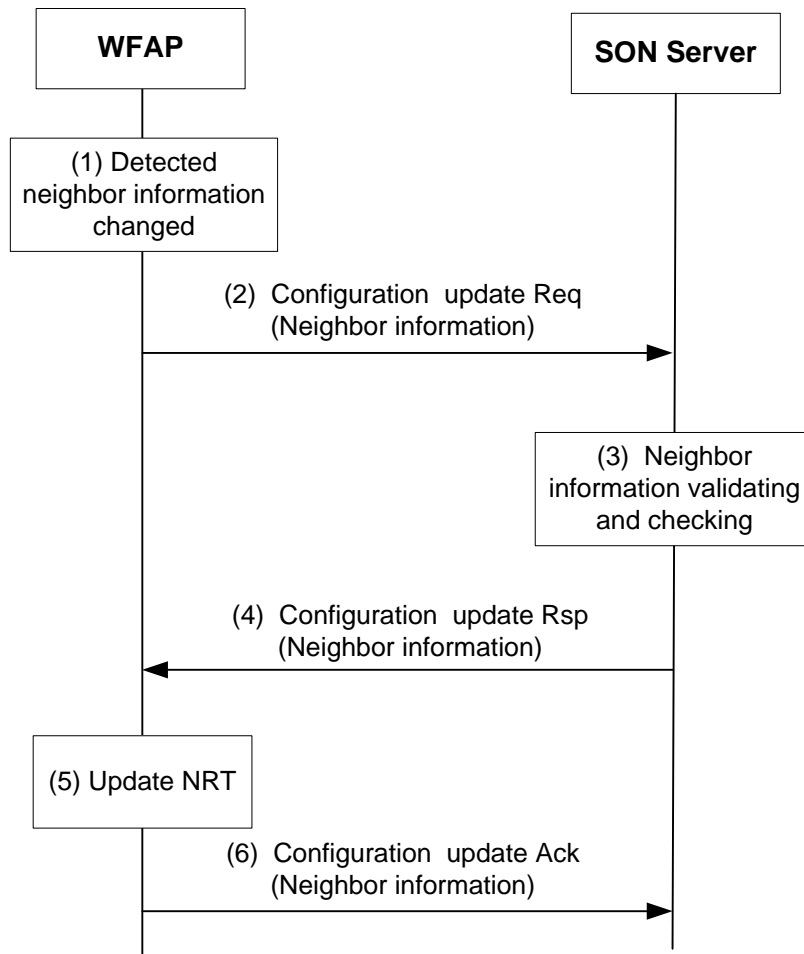


Figure 7-8 NRT update triggered by WFAP

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

STEP 1

WFAP detected its neighbor(s) have been changed.

STEP 2

WFAP sends Configuration update Req with neighbor information changes to the SON Server;

STEP 3

SON Server validates these changes;

STEP 4

SON Server sends Configuration update Rsp with validation result to the WFAP ;

STEP 5

The WFAP updates its NRT;

STEP 6

The WFAP sends Configuration update Ack to SON Server after it updated its NRT.

SON

1

2 7.2.3 Load Balancing Optimization

3 Backhaul between the WFAP and the WiMAX core network has limited bandwidth. WFAP overload happens when
4 the QoS cannot be satisfied for the users. Load balancing can be achieved between WFAP and BS or among
5 WFAPs.

6 Load balancing is more common on an enterprise network where usage profile change causes persistent overload on
7 a certain WFAP or in an office area where users crowd the coverage area during certain hours of the day. WFAP
8 may trigger a handover to offload itself from compromising the QoS. However, load balancing is preferable in
9 distributing the load between the WFAP and its neighboring BS or WFAP.

10 At load balancing between WFAP and neighbor macro BS or WFAP. The serving WFAP selects the MSs to offload
11 according to the network policy, e.g. for a CSG-OPEN WFAP, it may select the non CSG members to offload first.
12 The WFAP may trigger handover of these MSs to the target BSeS based on its neighbor list. The handover
13 procedures triggered by load balancing are as specified in the existing standards.

14 Optionally, at load balancing among neighbor WFAPs which are accessible by the same user, MSs can be offloaded
15 to these neighbor WFAPs with the assistance of SON. This function is illustrated in the following call flow.

16

SON

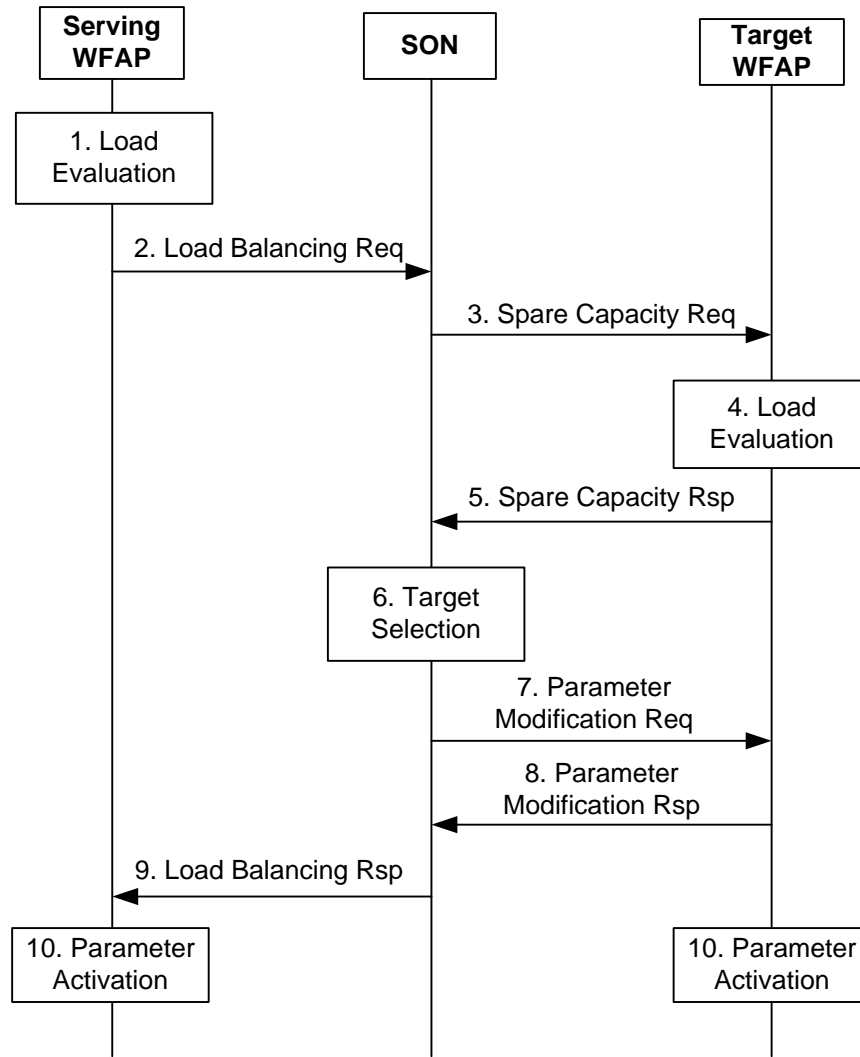


Figure 7-9 Load Balancing among neighboring WFAPs

The function works as follows,

STEP 1

The serving WFAP evaluates its load status according to the load measurement. When its load reaches load threshold, the serving WFAP triggers load balancing.

STEP 2

The serving WFAP sends a *Load Balancing Request* message with its load status and the information of its neighbor WFAPs to the SON Server.

STEP 3

Upon receiving *Load Balancing Request*, the SON Server sends *Spare Capacity Request* messages respectively to the neighbor WFAPs to request for their load status.

STEP 4

The neighbor WFAPs evaluate their load status according to load measurements.

SON

1 **STEP 5**

2 The neighbor WFAPs send *Spare Capacity Response* messages to the SON Server with their load status and
3 measurement.

4 **STEP 6**

5 The SON Server selects a WFAP among the neighbor WFAPs as the target WFAP per the received *Spare*
6 *Capacity Response* messages.

7 *The following steps (i.e., step 7-10) only occur to the selected Target WFAP.*

8 **STEP 7**

9 The SON Server sends a *Parameter Modification Request* message including HO parameters to support the load
10 balance between the serving WFAP and the target WFAP, and action time parameter to the target WFAP.

11 **STEP 8**

12 The target WFAP returns *Parameter Modify Response* message to the SON Server.

13 **STEP 9**

14 The SON Server sends a *Load Balancing Response* message to the serving WFAP including the HO parameters
15 and action time parameter.

16 **STEP 10**

17 The serving WFAP and the target WFAP activate the HO parameters at the action time.
18

19 **7.2.4 FeGW Re-selection**

20 The procedure for the WFAP Register to the Fe-GW has been defined in section 5.1.6 of [5]. It was pointed out that
21 when a WFAP Register to a Fe-GW, the Fe-GW may reject the WFAP for the load balance reason. If the original
22 target Fe-GW rejects the registration from the WFAP, and if the SON function is supported for the given Femto
23 system the WFAP may request SON Server to select a different Fe-GW. When the SON Server receives the Fe-GW
24 selection request from a WFAP, it will select a new FeGW, after examining the re-selection cause in the request
25 message, e.g. load balance re-selection. The Fe-GW re-selection procedure can work as follows.

26

SON

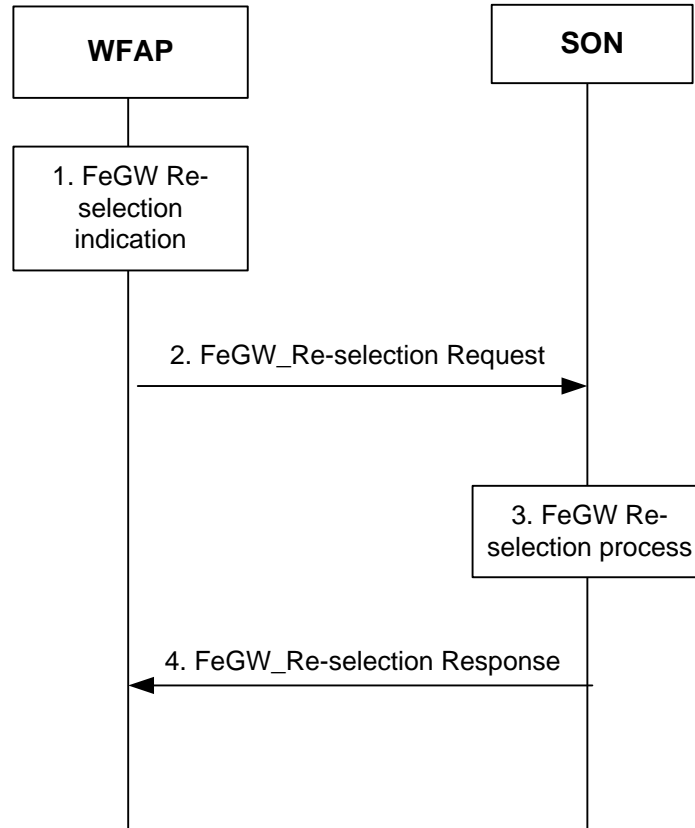


Figure 7-10: FeGW Re-selection

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

STEP 1

The WFAP has a Fe-GW re-selection indication such as receiving a failed register response message or a de-register request message from the Fe-GW.

STEP 2

The WFAP sends a *Fe-GWRe-selection Request* message to the SON Server.

STEP 3

The SON Server re-selects a proper Fe-GW for the WFAP in considering the re-selection cause and the service capability of the Fe-GW.

STEP 4

The SON Server responds back with the *Fe-GWRe-selection Response* message to the WFAP with the IP address of the re-selected new Fe-GW included. If the Se-GW that associates with the new Fe-GW is not the same as the original one, the IP address of the new Se-GW also SHALL be included.

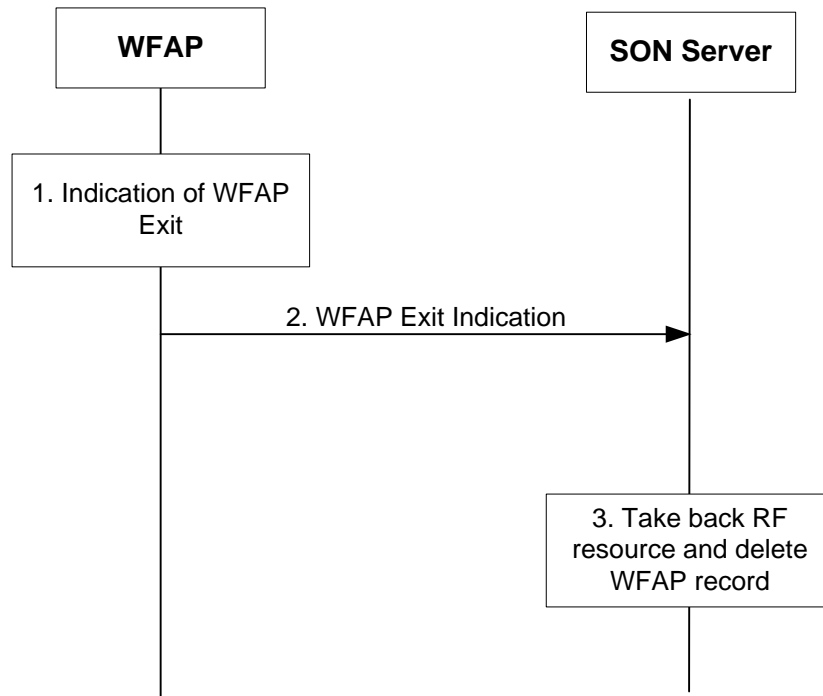
7.3 Self Healing

This section is for further study.

SON

1 **7.4 WFAP Exit from SON**

2 In the WFAP Network exit procedure, the WFAP needs to exit from the SON Server. When the WFAP has an
 3 indication to exit from the network or the SON Server, the WFAP may need to turn off its radio interface
 4 subsequently. After turn off its radio interface, the WFAP should send an exit indication message to the SON Server,
 5 with an indication parameter to indicate that its radio interface has been turned off., so the SON Server can
 6 immediately take back the radio frequency resource for the reuse purpose and delete the record of the WFAP.



7
8 **Figure 7-11: WFAP exit from SO**

9 The function works as follows,

10 **STEP 1**

11 The WFAP has an indication for exiting from the network or SON Server. In this case, the WFAP may need to
 12 turn off its radio interface subsequently.

13 **STEP 2**

14 The WFAP sends an exit indication message to the SON Server, with an optional parameter to indicate that its
 15 radio interface has been turned off.

16 **STEP 3**

17 When receiving the indication message from the WFAP, the SON Server SHALL take back the radio frequency
 18 resource ever used by the WFAP, and delete the record of the WFAP.

19
20

8 Message and Parameter Definitions

SON messages are transported on the management plane. Most management protocols have a fixed set of messages. Even though this SON is protocol agnostic, to facilitate an easy mapping of this specification to a specific management protocol, Table 8-1 defines a set of messages.

Table 8-1 : SON messages

Message Name	Message Description
WFAP_Req	In a WFAP initiated transaction, this message is sent from the WFAP to the SON Server to trigger the transaction.
WFAP_Rsp	In a WFAP initiated transaction, this message is sent from the SON Server to the WFAP in response to WFAP_Req.
WFAP_Ack	In a WFAP initiated transaction, this message is sent from the WFAP to the SON Server in acknowledgement of WFAP_Rsp. This message is only needed in a three-way handshake.
SON_Req	In a SON Server initiated transaction, this message is sent from the SON Server to the WFAP to trigger the transaction.
SON_Rsp	In a SON Server initiated transaction, this message is sent from the WFAP to the SON Server in response to SON_Req.
SON_Ack	In a SON Server initiated transaction, this message is sent from the SON Server to the WFAP in acknowledgement of WFAP_Rsp. This message is only needed in a three-way handshake.

Figure 8-1 illustrates both the WFAP initiated and the SON Server initiated transactions.

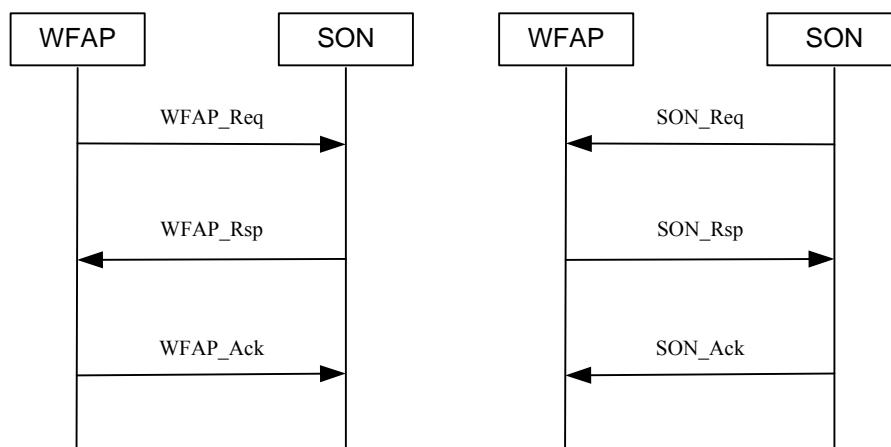


Figure 8-1 : WFAP and SON Server initiated transactions

For transactions between the SON Server and the management server, the messages are as follows,

SON

1

Table 8-2 : Messages between the SON Server and the management server

Message Name	Message Description
SON_Mgmt_Req	In a SON Server initiated transaction, this message is sent from the SON Server to the management server to trigger the transaction.
SON_Mgmt_Rsp	In a SON Server initiated transaction, this message is sent from the management server to the SON Server in response to SON_Mgmt_Req.
SON_Mgmt_Ack	In a SON Server initiated transaction, this message is sent from the SON Server to the management server in acknowledgement of SON_Mgmt_Rsp. This message is only needed in a three-way handshake.
Mgmt_SON_Req	In a management server initiated transaction, this message is sent from the management server to the SON Server to trigger the transaction.
Mgmt_SON_Rsp	In a management server initiated transaction, this message is sent from the SON Server to the management server in response to Mgmt_SON_Req.
Mgmt_SON_Ack	In a management server initiated transaction, this message is sent from the management server to the SON Server in acknowledgement of Mgmt_SON_Rsp. This message is only needed in a three-way handshake.

2

3 Depending on the specific management protocol, these management messages can be mapped to their corresponding
4 messages or commands in that protocol. For instance, there are three commands in the SNMP: get, set, and
5 notification (or trap if this is a notification of an exception). A WFAP initiated transaction may be mapped as
6 follows,

7

8

Table 8-3 : Mapping of the messages in WFAP triggered transactions

SON messages	Corresponding SNMP commands
WFAP_Req	Notification
WFAP_Rsp	Set
WFAP_Ack	Notification

9

10 Likewise, a SON Server initiated transaction may be mapped as follows,

11

12

Table 8-4 : Mapping of the messages in SON Server triggered transactions

SON messages	Corresponding SNMP commands
SON_Req	Get, set
SON_Rsp	Get-resp, Notification
SON_Ack	Set

13

14 In the following section, messages defined in Stage 2 are mapped to messages in Stage 3. However, any further
15 mapping of Stage 3 messages to management protocol messages such as SNMP, XML, etc. are out of scope of this
16 specification. In addition, constants and data are also defined to support Stage 3 mapping.

SON

1 8.1 Constants and Counters

2 8.1.1 Function type

3 Table 6-1 assigns a constant to each function type defined in Stage 2. For instance, the value “1” is assigned to the
 4 function “SON Server discovery” so that the message “WFAP_Req” with “functionType == 1” is a Stage 3 message
 5 that is mapped from the Stage 2 message “SON_Server_Discovery_Request.” This constant is included in every
 6 SON message as part of the message data.

7

8

Table 8-5 : SON function type

Value	Function Type
0	reserved
1	Report info of neighbor WFAP and BS
2	Location Authorization
3	MAC/PHY configuration data of each neighbor WFAP / macro BS
4	Provide neighbor RF parameters to assist WFAP scanning
5	Configure initializing WFAP MAC/PHY data
6	ANR Configuration
7	WFAP Measurement
8	ANR Self Optimization
9	Load Balancing Query
10	Spare Capacity Query
11	Parameter Modification
12	WFAP Backhaul Failure
13	WFAP Exit from SON
14	FeGW Re-selection
15	SON Reconfiguration

9

10

11

12 8.1.2 Function Primitive

13 Two Stage 3 SON messages may end up being mapped to the same management command. For instance, both
 14 WFAP_Req and WFAP_Ack are mapped to SNMP Notification. To eliminate that ambiguity, a constant is assigned
 15 to each message denoting its primitive as in Table 8-6 : SON function primitives. In the previous example,
 16 WFAP_Req will include “0” as its function primitive and WFAP_Ack will include “2”. This constant is included in
 17 every SON message as part of the message data.

18

SON

1

Table 8-6 : SON function primitives

Value	Primitive Type
0	Req
1	Rsp
2	Ack

2

3 8.2 Message Definitions

4 Every Stage 2 message in this section is mapped to a Stage 3 message. The Stage 3 message takes two additional
5 parameters to ensure a one to one mapping. The first parameter is the function type as defined in 8.1.1. The second
6 parameter is the primitive type as defined in 0.

7 8.2.1 Location Authorization

8

Stage 2 messages	Stage 3 messages
Report location info (optionally include Neighbor WFAP and BS info)	WFAP_Req
Return location authorization result	WFAP_Rsp

9 8.2.2 WFAP Initial PHY&MAC Configuration

10

Stage 2 messages	Stage 3 messages
Request MAC/PHY configuration data of each neighbor WFAP / macro BS	SON_Mgmt_Req
Return MAC/PHY configuration data of each neighbor WFAP / macro BS	SON_Mgmt_Rsp
Provide neighbor RF parameters to assist WFAP scanning	SON_Req
Configure initializing WFAP MAC/PHY data	SON_Req
Acknowledge initializing WFAP MAC/PHY data	SON_Rsp

11 8.2.3 WFAP Initial ANR Configuration

12

Stage 2 messages	Stage 3 messages
WFAP_Neighbor_Req	WFAP_Req
WFAP_Neighbor_Rsp	WFAP_Rsp
WFAP_Neighbor_Ack	WFAP_Ack

SON

8.2.4 Self Optimization

Stage 2 messages	Stage 3 messages
WFAP Measurement Report Request	WFAP_Req
WFAP Measurement Report Response	WFAP_Rsp
SON Reconfiguration Request	SON_Req
SON Reconfiguration Response	SON_Rsp

8.2.5 ANR Self Optimization

Stage 2 messages	Stage 3 messages
Configuration_Update_Req (WFAP initiated)	WFAP_Req
Configuration_Update_Rsp (WFAP initiated)	WFAP_Rsp
Configuration_Update_Ack (WFAP initiated)	WFAP_Ack
Configuration_Update_Req (SON initiated)	SON_Req
Configuration_Update_Rsp (SON initiated)	SON_Rsp

8.2.6 Load Balancing Query

Stage 2 messages	Stage 3 messages
Load_Balancing_Req	WFAP_Req
Load_Balancing_Rsp	WFAP_Rsp

8.2.7 Spare Capacity Query

Stage 2 messages	Stage 3 messages
Spare_Capacity_Req	SON_Req
Spare_Capacity_Rsp	SON_Rsp

8.2.8 Parameter Modification

Stage 2 messages	Stage 3 messages
Parameter_Modification_Request	SON_Req
Parameter_Modification_Response	SON_Rsp

SON

1 **8.2.9 Automatic Backhaul Fault Detection and Recovery**

2

Stage 2 messages	Stage 3 messages
wfapBackhaulFailure	WFAP_Req

3

4 **8.2.10 WFAP Exit from SON**

5

Stage 2 messages	Stage 3 messages
WFAP Exit indication	WFAP_Ack

6

7 **8.2.11 FeGW Re-selection**

8

Stage 2 messages	Stage 3 messages
FeGW_Re-selection_Request	WFAP_Req
FeGW_Re-selection_Response	WFAP_Rsp

9

10

11 **8.3 Data Definitions**

12 To comply with management protocols, data in the SON messages are modeled in accordance with the Femto
 13 Management Specification [6] and defined in attribute tables. This specification will reuse the definitions in the
 14 Femto Management specification whenever possible. When new attributes are required to support SON functions,
 15 they will be included here as enhancement to the management spec.

16 **8.3.1 wfapSon**

17 Note: the attribute tables in this section are Femto Management messages between WFAP and Femto Management
 18 Server.

19 **8.3.1.1 sonServerDiscover**

20 **8.3.1.1.1 sonServerDiscoverRequest**

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification 3.2 [ref]

21

SON

1 **8.3.1.1.2 sonServerDiscoverResponse**

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification 3.2 [ref]
sonServerDiscovery Result		Integer	R	0..1			Result of SON Server discovery request: 0 = success 1 = unregistered WFAP ID
sonServerIdType		Integer	R	0..2			SON Server identifier type could be either IPv4 address, IPv6 address or FQDN: 0 = IPv4 Address 1 = IPv6 Address 2 = FQDN
sonServerId		String	R				SON Server identifier type could be either IPv4 address, IPv6 address or FQDN

2

3

4 **8.3.2 Attribute tables for Location Authorization**

5

Table 8-7 : Location Authorization Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			2	Location Authorization function type in Table 8-5
functionPrimitive		Constant	R			0	8.1.2Request SON function primitive in Table 8-6
wfapBsIdentifier		Integer	R	0..1677 7215		0	WFAP ID. The least significant 24 bits of the neighbor BS ID. Reference to Femtocells management specification 3.2 [6].
wfapIpAddress		InetAddress	R				WFAP public IP address
gpsInfo		Integer	R	0..1			GPS info availability indicator: 0 = not available 1 = available
BsLongitudeLong		Integer	R				The longitude of the absolute BS location in long format. Reference to Femtocells management specification 3.1.2.2.4 [6].
BsLatitudeLong		Integer	R				The latitude of the absolute BS location in long format. Reference to Femtocells management specification

SON

						3.1.2.2.4 [6].
BsAltitudeLong		Integer	R			The attitude of the absolute BS location in long format. Reference to Femtocells management specification 3.1.2.2.4 [6].
BsLongitudeShort		Integer	R			The longitude of the absolute BS location in short format. Reference to Femtocells management specification 3.1.2.2.4 [6].
BsLatitudeShort		Integer	R			The latitude of the absolute BS location in short format. Reference to Femtocells management specification 3.1.2.2.4 [6].
BsAttitudeShort		Integer	R			The attitude of the absolute BS location in short format. Reference to Femtocells management specification 3.1.2.2.4 [6].
wfapNumberOfNeighbors		Integer	R	1..8		The number of neighbor femto or macro BS found through neighbor scanning. Reference to Femtocells management specification 3.2 [6]
wfapNbrBsid 1..8		Octet String	R			The BSID of n th neighbor, obtained from the WFAP scanning. Reference to Femtocells management specification 3.2 [6]. Note that this parameter is repeated for all the parameter is repeated for all the (8) neighbors.
rsi 1..8		Integer	R			RSSI of n th neighbor WiMAX® (Macro and Femto) BS obtained by WFAP scanning. Note that this parameter is repeated for all the parameter is repeated for all the (8) neighbors.
numberOfAdjacentCells		Integer	R	1..8		Number of adjacent Wi-Fi®/3G/2G cell information which WFAP may include in Location_Authorization_Request message.
ratIndication 1..8		Integer	R	0..2		Indicates radio access technology of n th adjacent cells: 0 = Wi-Fi® 1 = 3G 2 = 2G Note that this parameter is repeated for all the (8) neighbors.
cellId 1..8		String	R			The cell ID of n th adjacent Wi-Fi®, 3G or 2G (For Wi-Fi®, SSID is used; For 3GPP, a 28 bit number which unambiguously identifies a cell within a PLMN (Public Land Mobile Network).) Note that this parameter is repeated for all the (8) neighbors.

SON

1

2

Table 8-8 : Location_Authorization_Response

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			2	Location Authorization function type in Table 8-5
functionPrimitive		Constant	R			1	Response SON function primitive in Table 8-6
wfapBsIdentifier		Integer	R	0..1677 7215		0	WFAP ID. The least significant 24 bits of the neighbor BS ID. Reference to Femtocells Management specification 3.2 [6].
locationAuthorizationResult		Integer	R	0..1			Result of location authorization request: 0 = success 1 = location authorization failure

3

8.3.3 Attribute tables for WFAP Initial PHY&MAC Configuration

4

Table 8-9 shows the attributes that can be used by the following SON functions.

5

- Report info of neighbor WFAP and BS
- MAC/PHY configuration data of each neighbor WFAP / macro BS
- Provide neighbor RF parameters to assist WFAP scanning
- Configure initializing WFAP MAC/PHY data
- Acknowledge initializing WFAP MAC/PHY data

6

7

8

9

10

11

Table 8-9 : WFAP Initial PHY&MAC Configuration

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			1, 3, 4, 5	SON function type in Table 8-5.
functionPrimitive		Constant	R			0, 1, 2	Req, Rsp, and Ack SON function primitive in Table 8-6.
NeighborBsId		Integer	R	0..1677 7215			Neighbor BS or WFAP ID. The least significant 24 bits of the neighbor BS ID. Reference to Femtocells Management specification 3.2 [6].
NeighborRFparaAssistingScan (a)		Byte String	R				The neighbor RF parameters provided by SON Server to the WFAP of which the parameters may be used to assist the WFAP to scan the neighbor WFAP(s) and Macro BS(s).
wfapScannedNeighborPhy&Mac		Byte String	R				The associated MAC/PHY parameters of neighbor WFAP(s) and macro BS(s) of the WFAP scanned by the

SON

							WFAP.
PhyConfiguration			R				Contain attributes as defined in wfapBsOfdmaUplinkChannelTable, wfapBsOfdmaDownlinkChannelTable, wfapBsOfdmaUcdBurstProfileTable, wfapBsOfdmaDcdBurstProfileTable , and wfapBsOfdmaDcdDownlinkRegionTable, in Femtocells management specification [6].
MAC Configuration			R				Contain attributes as defined in wfapConfigurationTable and wfapBasicCapabilitiesTable in Femtocells management specification [6].

1

2 This data is used in both the “Report info of neighbor WFAP and BS” and the “Return MAC/PHY configuration
3 data of each neighbor WFAP / macro BS” messages.

4

5 Notes:

6 (a) NeighborRFparaAssitingScan refer to Table 3-21- nbrBsAdvTable in “T33-119-R016v01_A_Femto-Mgmt”

7

8

Table 8-10 : wfapScannedNeighborPhy&Mac

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
Report Mode		Integer	RC				0: Event-triggered report 1: Periodic report
N_current_BSs		Integer	RC				When FBSS/MDHO is supported, current_BSs is the number of BSs currently in the diversity set; When FBSS/MDHO is not supported or the MS has an empty diversity set, N_current_BSs is set to 1..
Use_Nbr_Bitmap_Index		Integer	RC				Indicates if the bitmap of BS indexes for MOB_NBR-ADV is used. 0: Bitmap of BS indexes for MOB_NBR-ADV is not used. 1: Bitmap of BS indexes for MOB_NBR-ADV is not used.
Use_Rsp_Bitmap_Index		Integer	RC				Indicates if the bitmap of BS indexes for MOB_SCN-RSP is used. 0: Bitmap of BS indexes for MOB_SCN-RSP is not used.

SON

						1: Bitmap of BS indexes for MOB_SCN-RSP is not used.
Report metric		Integer	RC			Bitmap indicating presence of certain metrics (threshold values) on which the corresponding triggers are based: Bit 0: BS CINR mean Bit 1: BS RSSI mean Bit 2: Relative delay Bit 3: BS RTD; this metric SHALL be only ensured between the serving BS/anchor BS and the reporting MS Bits 4–7: <i>Reserved</i> ; SHALL be set to zero
Temp BSID		Integer	RC			Diversity set member ID assigned to this BS. When the MS has an empty diversity set or FBSS/MDHO is not supported, Temp BSID SHALL be set to 0.
BS CINR mean		Integer	RC		0.5 dB	The BS CINR Mean parameter indicates the CINR measured by the MS from the particular BS. The value SHALL be interpreted as a signed byte with units of 0.5 dB. The measurement SHALL be performed on the subcarriers of the frame preamble that are active in the particular BS's segment and averaged over the measurement period.
BS RSSI mean		Integer	RC		0.25 dB	The BS RSSI Mean parameter indicates the Received Signal Strength measured by the MS from the particular BS. The value SHALL be interpreted as an unsigned byte with units of 0.25 dB, e.g., 0x00 is interpreted as -103.75 dBm. An MS SHALL be able to report values in the range -103.75 dBm to -40 dBm. The measurement SHALL be performed on the frame preamble and averaged over the measurement period.
Relative delay		Integer	RC			In case FBSS/MDHO is in progress, this field SHALL include the relative delay of BSs currently in the diversity set, except for that of the anchor BS.
BS RTD		Integer	RC		1/Fs	This field SHALL include the RTD between the serving BS/anchor BS and the reporting MS. The BS RTD parameter indicates the round trip delay (RTD) measured by the MS from the serving BS. RTD can be given by the latest time advance taken by MS. The value SHALL be

SON

							interpreted as an unsigned byte with units of 1/Fs (see 10.3.4.3). This parameter SHALL be only measured on serving BS/anchor BS.
Configuration change count for MOB_NBR-ADV		Integer	RC				The value of Configuration Change Count in MOB_NBR-ADV message referred in order to compress neighbor BSID.
Nbr_Bitmap_Size		Integer	RC				Size of Nbr_Bitmap_Index in nibbles ((Nbr_Bitmap_Size + 1) \llcorner 4), which may be less than or equal to the number of BSs in MOB_NBR ADV.
Nbr_Bitmap_Index		Integer	RC				Each bit position in this bitmap corresponds to a BS Index of the corresponding MOB_NBR-ADV message, where the least significant bit corresponds to the first BS Index, each next significant bit corresponds to the next BS Index, the most significant bit corresponds to the BS Index of the last reported BS, and BSs with BS Index greater than the last reported BS are not reported and do not have a corresponding bit position in the bitmap. Bitmap position bit value: 0: the corresponding BS is not reported. 1: the corresponding BS is reported. When Use_Rsp_Bitmap_Index equals 1, Nbr_Bitmap_Index only includes reported BSs that were included in the MOB_NBR-ADV message but that were not included in the corresponding MOB_SCN-RSP message.
N_Neighbor_BS_Index		Integer	RC				Number of neighboring BS that are included in MOB_NBR-ADV message.
Neighbor_BS_Index		Integer	RC				BS index corresponds to position of BS in MOB_NBR-ADV message.
N_Neighbor_BS_Full		Integer	RC				Number of neighboring BS that are using full 48 bits BSID.
Neighbor BSID		Integer	RC				
Rsp_Seq_Num		Integer	RC				One-bit sequence number for the corresponding MOB_SCN-RSP message.
Rsp_Bitmap_size		Integer	RC				Size of Rsp_Bitmap_Index in nibbles ((Rsp_Bitmap_Size + 1) \llcorner 4), which may be less than or equal to the

SON

						number of BSs in MOB_SCNRSP.
Rsp_Bitmap_Index		Integer	RC			<p>Each bit position in this bitmap corresponds to a BS Index of the corresponding MOB_SCN-RSP message, where the least significant bit corresponds to the first BS Index, each next significant bit corresponds to the next BS Index, the most significant bit corresponds to the BS Index of the last reported BS, and BSs with BS Index greater than the last reported BS are not reported and do not have a corresponding bit position in the bitmap.</p> <p>Bitmap position bit value: 0: The corresponding BS is not reported. 1: The corresponding BS is reported.</p>
Ranging_Parameters_Validity_Time		Integer	RC			<p>Estimated number of frames starting from the frame following the reception of the MOB_SCN-REP message, in which channel parameters learned by the MS during association of specific BS stay valid and can be reused during future Network Reentry to the BS without additional CDMA-based initial ranging. A value of zero in this parameter signifies that this parameter should be ignored.</p>

1
2
3
4
5
6

8.3.4 Attribute tables for WFAP Initial ANR Configuration

Table 8-11 : Initial ANR Configuration Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			6	Initial ANR Configuration function type in Table 8-5
functionPrimitive		Constant	R			0	Request SON function primitive in Table 8-6
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]
wfapInnerIpAddresses		Integer					WFAP inner IP address. Reference to Femtocells management specification [6]

SON

wfapNumberOfNeighbors		Integer	R	1..8			The number of neighbor femto or macro BS found through neighbor scanning. Reference to Femtocells management specification 3.2 [6]
WfapNbrBsId1..8		Octet String	RC				The BSID of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors
RssiCinrAvgParameter1..8		Integer	RW			51	The RssiCinrAvgParameter of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors
FalIndex1..8		Integer	RC				The FalIndex of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors

1
2

Table 8-12 : Initial ANR Configuration Response

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			6	Initial ANR Configuration function in Table 8-5
functionPrimitive		Constant	R			1	Response SON function in Table 8-6
FailureIndication		Integer					Failure Indication. Reference to WiMAX Forum® Network Architecture STG3 [2]
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]
wfapNumberOfNeighbors		Integer	R	1..8			The number of neighbor femto or macro BS found through neighbor scanning. Reference to Femtocells management specification 3.2 [6]
WfapNbrBsId1..8		Octet String	RC				The BSID of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors
PreambleSubchIndex1..8		Integer	RC	0..255			The PreambleSubchIndex of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors
FalIndex1..8		Integer	RC				The FalIndex of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated

SON

							for all the (8) neighbors
--	--	--	--	--	--	--	---------------------------

1
2
3

Table 8-13 : Initial ANR Configuration Acknowledge

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			6	Initial ANR Configuration function type in Table 8-5
functionPrimitive		Constant	R			2	Acknowledge SON function in Table 8-6
FailureIndication		Integer					Failure Indication. Reference to WiMAX Forum® Network Architecture STG3 [2]
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]

8.3.5 Attribute tables for Self Optimization

4
5
6

Table 8-14 : WFAF Measurement Report

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			7	WFAP Measurement function in Table 8-5
functionPrimitive		Constant	R			0	Request SON function in Table 8-6
wfapBsIdentifier		Byte String	R				Operational WFAP ID. Reference to Femtocells management specification [6]
wfapNumberOfNeighbors		Integer	R	1..8			The number of neighbor femto or macro BS found through neighbor scanning. Reference to Femtocells management specification 3.2 [6]
wfapNeighborBsId 1..8		Byte String	R				The BSID of n^{th} neighbor. Reference to Femtocells management specification 3.2 [6]. Note that this parameter is repeated for all the (8) neighbors
wfapNeighborBsRFlno 1..8		Byte String	R				The RF information of n^{th} neighbor include its DL and UL channel center frequency. Note that this parameter is repeated for all the (8) neighbors
NumberOfInterferenceRF		Byte String	R	1..4			The number of the interference RF reported by the WFAP to the SON Server.

SON

InterferenceRFInfo 1		Byte String	R				The interference RF information of 1st include its center frequency.
InterferenceRFInfo 2		Byte String	R				The interference RF information of 2st include its center frequency.
InterferenceRFInfo 3		Byte String	R				The interference RF information of 3st include its center frequency.
InterferenceRFInfo 4		Byte String	R				The interference RF information of 4st include its center frequency.

1
2
3

Table 8-15 : SON Reconfiguration Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			15	SON Reconfiguration function in Table 8-5
functionPrimitive		Constant	R			0	Response SON function in Table 8-6
wfapBsIdentifier		Byte String	R				Operational WFAP ID. Reference to Femtocells management specification [6]
Phy&MacReconfigurationParameters		Byte String	R				The RF and MAC & PHY parameters determined by the SON Server for the Operational WFAP reconfiguration purpose.

4
5

Table 8-16 : SON Reconfiguration Response

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			15	SON Reconfiguration function in Table 8-5
functionPrimitive		Constant	R			1	Response SON function in Table 8-6
wfapBsIdentifier		Byte String	R				Operational WFAP ID. Reference to Femtocells management specification [6]
ReconfigurationResult		Integer	R	0..1			Result of Reconfiguration request: 0 = success 1 = location authorization failure

6

SON

8.3.6 Attribute tables for ANR Self Optimization

Table 8-17 : ANR Self Optimization Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			8	ANRSelf Optimization function in Table 8-5
functionPrimitive		Constant	R			0/1/2	Response SON function in Table 8-6
Other attributes please refer Table 3-21- nbrBsAdvTable in "T33-119-R016v01_A_Femto-Mgmt"							

8.3.7 Attribute tables for Load Balancing Query

Table 8-18 : Load Balancing Query Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			9	Load Balancing Query function in Table 8-5
functionPrimitive		Constant	R			0	Request SON function in Table 8-6
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]
wfapInnerIpAddresses		Integer					WFAP inner IP address. Reference to Femtocells core specification [5].
DIRadioResource		Integer	RW	0..100	%		Indicates the average percentage ratio of non-assigned DL radio resources to the total usable DL radio resources. Reference to Femtocells management specification [6]
TotalSlotsDL		Integer					Total number of slots in the DL frame. This is the total (max) number of slots possible in DL. Reference to WiMAX Forum® Network Architecture STG3 [2]
UIRadioResource		Integer	RW	0..100	%		Indicates the average percentage ratio of non-assigned UL radio resources to the total usable UL radio resources. Reference to Femtocells management specification [6]
TotalSlotsUL		Integer					Total number of slots in the UL frame. This is the total (max) number of slots possible in UL. Reference to WiMAX Forum® Network Architecture STG3 [2]

SON

RadioResourceFluctuation		Integer					Indicating the degree of fluctuation in DL and UL channel data traffic throughputs. Reference to WiMAX Forum® Network Architecture STG3 [2]
DcdUcdConfigChangeCount		Integer					This includes the 4 LSBs of the BS's current DCD and UCD configuration change count figures. Reference to WiMAX Forum® Network Architecture STG3 [2]
wfapNumberOfNeighbors		Integer	R	1..8			The number of neighbor femto or macro BS found through neighbor scanning. Reference to Femtocells management specification 3.2 [6]
WfapNbrBsid1..8		Octet String	RC				The BSID of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors
RssiCinrAvgParameter1..8		Integer	RW			51	The RssiCinrAvgParameter of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors
FalIndex1..8		Integer	RC				The FalIndex of n^{th} neighbor. Reference to Femtocells management specification [6]. Note that this parameter is repeated for all the (8) neighbors

1
2
3

Table 8-19 : Load Balancing Query Response

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			9	Load Balancing Query function in Table 8-5
functionPrimitive		Constant	R			1	Response SON function in Table 8-6
FailureIndication		Integer					Failure Indication. Reference to WiMAX Forum® Network Architecture STG3 [6]
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]
TimeToTriggerDuration		Integer	RW		Frames		This object indicates the duration the MS needs to decide the selection of a neighbor BS as a possible target BS. It is applicable only for HO. Reference to Femtocells management specification [6]

SON

RssiCinrAvgParameter		Integer	RW			51	Bit 0..3 of Default RSSI and CINR averaging parameter TLV. Reference to Femtocells management specification [6]
wfapTxPower		Integer		4 octets (unsigned)	0.5dBm		The recommendatory transmit power of the WFAP.
ActionTime		Integer					The time that the new parameters become effective. Reference to WiMAX Forum® Network Architecture STG3 [2]

1

2 **8.3.8 Attribute tables for Spare Capacity Query**

3

4

Table 8-20 : Spare Capacity Query Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			10	Spare Capacity Query function in Table 8-5
functionPrimitive		Constant	R			0	Request SON function in Table 8-6
SpareCapacityReportType		Integer					The type of SON Spare_Capacity_Rpt Forward compatibility. Reference to WiMAX Forum® Network Architecture STG3 [2]
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification[6]
ReportingCharacteristics		Integer					Indicates whether reporting SHALL be once, or periodically, or event driven, in which case the event is specified. Reference to WiMAX Forum® Network Architecture STG3 [2]
AveragingTimeT		Integer					Used by WFAP as the measurement interval for producing the information requested by SON. Reference to WiMAX Forum® Network Architecture STG3 [2]
ReportingPeriodP		Integer					Used by WFAP as the reporting period for producing the information requested by SON. Reference to WiMAX Forum® Network Architecture STG3 [2]
AbsoluteThreshold Value J		Integer					Used by WFAP as the absolute threshold for reporting. Reference to WiMAX Forum® Network Architecture STG3 [2]
RelativeThreshold RT		Integer					Used by WFAP to keep track of the threshold from the last measurement period. Reference to WiMAX Forum® Network Architecture STG3 [2]

SON

1
2

Table 8-21 : Spare Capacity Query Response

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			10	Spare Capacity Query function in Table 8-5
functionPrimitive		Constant	R			1	Response SON function in Table 8-6
FailureIndication		Integer					Failure Indication. Reference to WiMAX Forum® Network Architecture STG3 [2]
SpareCapacityReportType		Integer					The type of SON Spare_Capacity_Rpt Forward compatibility. Reference to WiMAX Forum® Network Architecture STG3 [2]
ReportingCharacteristics		Integer					Indicates whether reporting SHALL be once, or periodically, or event driven, in which case the event is specified. Reference to WiMAX Forum® Network Architecture STG3 [2]
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]
DLRadioResource		Integer	RW	0..100	%		Indicates the average percentage ratio of non-assigned DL radio resources to the total usable DL radio resources. Reference to Femtocells management specification [6]
TotalSlotsDL		Integer					Total number of slots in the DL frame. This is the total (max) number of slots possible in DL. Reference to WiMAX Forum® Network Architecture STG3 [2]
ULRadioResource		Integer	RW	0..100	%		Indicates the average percentage ratio of non-assigned UL radio resources to the total usable UL radio resources. Reference to Femtocells management specification [6]
TotalSlotsUL		Integer					Total number of slots in the UL frame. This is the total (max) number of slots possible in UL. Reference to WiMAX Forum® Network Architecture STG3 [2]
RadioResourceFluctuation		Integer					Indicating the degree of fluctuation in DL and UL channel data traffic throughputs. Reference to WiMAX Forum® Network Architecture STG3 [2]
DcdUcdConfigChangeCount		Integer					This includes the 4 LSBs of the BS's current DCD and UCD configuration change count figures. Reference to WiMAX Forum® Network Architecture

SON

							STG3[2]
--	--	--	--	--	--	--	---------

1
2
3
4
5

8.3.9 Attribute tables for Parameter Modification

Table 8-22 : Parameter Modification Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			11	Parameter Modification function in Table 8-5
functionPrimitive		Constant	R			0	Request SON function in Table 8-6
wfapBsIdentifier		Byte String	R				Operational WFAP ID. Reference to Femtocells management specification [6]
TimeToTriggerDuration		Integer	RW		Frames		This object indicates the duration the MS needs to decide the selection of a neighbor BS as a possible target BS. It is applicable only for HO. Reference to Femtocells management specification [6]
RssiCinrAvgParameter		Integer	RW			51	Bit 0..3 of Default RSSI and CINR averaging parameter TLV. Reference to Femtocells management specification [6]
wfapTxPower		Integer		4 octets (unsigned)	0.5dBm		The recommendatory transmit power of the WFAP.
ActionTime		Integer					The time that the new parameters become effective. Reference to WiMAX Forum® Network Architecture STG3 [2]

6
7

Table 8-23 : Parameter Modification Response

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			11	Parameter Modification function in Table 8-5
functionPrimitive		Constant	R			1	Response SON function in Table 8-6
FailureIndication		Integer					Failure Indication. Reference to WiMAX Forum® Network Architecture STG3 [2]
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]

SON

1

8.3.10 Automatic Backhaul Fault Detection and Recovery

This section is for further study.

4

8.3.11 Attribute tables for WFAP Exit from SON

6

7

Table 8-24 : WFAP Exit from SON Request

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			13	WFAP Exit from SON function in Table 8-5
functionPrimitive		Constant	R			0	Request SON function in Table 8-6
wfapBsIdentifier		Byte String	R				Operational WFAP ID. Reference to Femtocells management specification [6]
wfapRFInterfaceStatus		Constant	R			0	Radio frequency interface status of WFAP: 0= turn off. 1= turn on.

8

8.3.12 FeGW Re-selection

9

10

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			1	Reference to 8.1.1
functionPrimitive		Constant	R			0	Reference to 0
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [6]
PriorFeGWIPv4Address		<u>InetAddress</u>					The object indicates the IPv4 address that the Prior FeGW was assigned in 4-octet.
PriorFeGWIPv6Address		<u>InetAddress</u>					The object indicates the IPv6 address that the Prior FeGW was assigned in 16-octet.
FeGWReselectionCause		<u>Integer</u>	R	0...255			Indicate the reason for FeGW Reselection. The values are: 0x01 = Normal 0x02 = Overload

SON

							0x03 = Unspecified All other values are Reserved.
--	--	--	--	--	--	--	--

1

Attributes	M/O	Type	R/W	Type Const.	Unit	Def.	Description
functionType		Constant	R			1	Reference to 8.1.1
functionPrimitive		Constant	R			0	Reference to 0
wfapBsIdentifier		Byte String	R				WFAP ID. Reference to Femtocells management specification [ref]
NewFeGWIPv4Address		InetAddress	R				The object indicates the IPv4 address that the New FeGW was assigned in 4-octet.
NewFeGWIPv6Address		InetAddress	R				The object indicates the IPv6 address that the New FeGW was assigned in 16-octet.
NewSeGWIPv4Address		InetAddress	R				The object indicates the IPv4 address of the SeGW corresponding with the New FeGW.
NewSeGWIPv6Address		InetAddress	R				The object indicates the IPv6 address of the SeGW corresponding with the New FeGW.

2

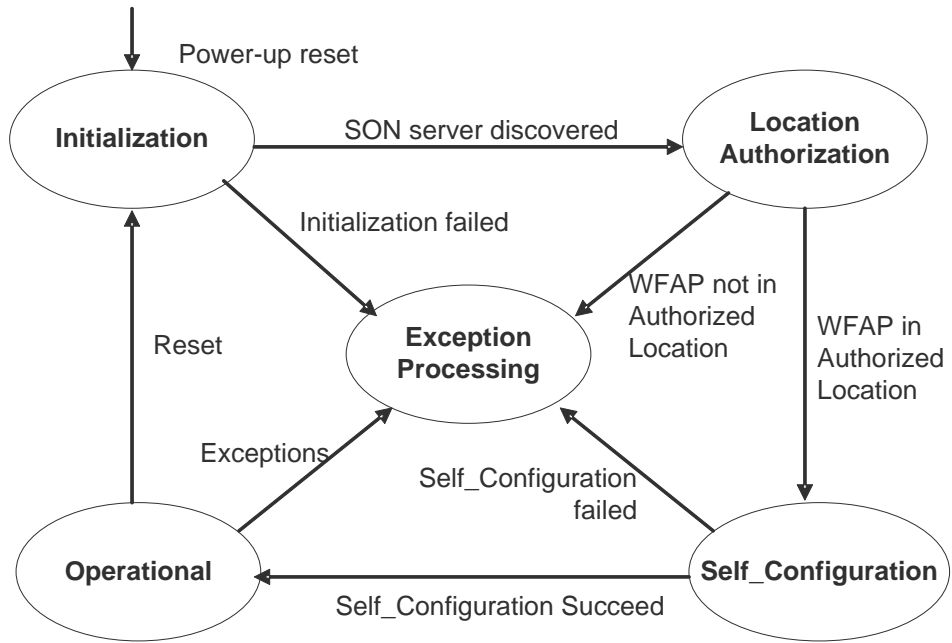
3

4

1 **APPENDIX A. WFAP State Diagram**

2 The following figure is the WFAP state diagram that shows the process of bringing a WFAP from the Initialization
 3 state to the Operational state, and the role WFAP Self-Configuration plays in such process. The diagram in Figure
 4 A-1 is informative only.

5



6
 7
 8
 9

Figure A-1: WFAP stage diagram (informative)