



**CDMA 1xRTT IP Radio Access Network
(IP-RAN)**

**AW100-1X
Product Description Document**

Version 1.2

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Revision History

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| 1.1 | 9/14/2009 | S. Roberts | Editing and adding new pictures |
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Revision Numbering Key

| | |
|-----|---|
| 0.x | Work in Progress |
| 1.0 | Initial Document Approval |
| 1.x | Revisions Following Initial Document Approval |
| 2.0 | Revisions Approval |

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1 Introduction

1.1 Proprietary Information Notice

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1.2 Purpose

This document describes the AW100 1xRTT (AW100-1X) IP-RAN product developed by AirWalk Communications Inc. The AirWalk AW100-1X is compact, standards compliant, optimal channel capacity, cost effective, and reliable cellular access point designed to provide improved mobile coverage, and capacity enhancements for the CDMA mobile operators.

This product is designed specifically for CDMA2000 1xRTT networks. The principal elements of the AW100-1X product are integrated BTS, BSC, and PCF functionality with the capability to connect to the core network via

- IOS 5.X for connectivity to CDMA softswitch networks
- IOS to SIP messages for connectivity to IMS networks

The target market and applications are in-building areas, corporations, corporate campuses, enterprises, university campuses, large industrial plants, stadiums, airports, shopping malls, blind spots, hot spots, rural areas, neighborhoods, and highways.

1.3 Scope

This document covers the functional, performance, and environmental specifications of the AirWalk AW100-1X IP-RAN.

2 References

- [1] 3GPP2 C.S0001 – 0006 Radio Interface Specifications for cdma2000 Spread Spectrum System
- [2] 3GPP2 X.S0013 – IMS/MMD Specifications
- [3] 3GPP2 A.S0013-C Interoperability Specification (IOS) for cdma2000 Access Network Interfaces – Part 3 Features
- [4] 3GPP2 A.S0014-C Interoperability Specification (IOS) for cdma2000 Access Network Interfaces – Part 4 (A1, A1p, A2 and A5 Interfaces)
- [5] 3GPP2 C.S0015 Short Message Service
- [6] RFC 3261 – Session Initiation Protocol
- [7] RFC 4566 – SDP: Session Description Protocol
- [8] RFC 3455 – Private Header (P-Header) Extensions to the Session Initiation Protocol for the 3rd-Generation Partnership Project (3GPP)
- [9] RFC 3325 – Private Extensions to the Session Initiation Protocol for Asserted Identity within Trusted Networks
- [10] RFC 3262 – Reliability of Provisional Responses in Session Initiation Protocol
- [11] RFC 3311 – The Session Initiation Protocol UPDATE Method
- [12] RFC 2976 – The SIP INFO Method
- [13] RFC 4028 – Session Timers in the Session Initiation Protocol
- [14] RFC 4306 – Internet Key Exchange (IKEv2) Protocol
- [15] TIA/EIA/IS-2000 Series Revision: C - Introduction to CDMA2000 Spread Spectrum Systems, 05/00/02
- [16] Personal Station – Base Station Compatibility Requirements for 1.8 to 2.0 GHz CDMA PCS.
- [17] TIA/EIA-664 - Wireless Features Description, 12/00/00
- [18] TIA/EIA Interim Standard 95 Revision A - Mobile Station –Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular Systems, May 1995
- [19] TIA/EIA-95-B - Mobile Station-Base Station Compatibility Standard for Dual-Mode Spread Spectrum Systems, October 31, 1998
- [20] MSC to BS Interface Inter-Operability Specification (IOS) Sprint PCS IOS Document, v2.0a, December 4, 1997
- [21] IMT-2000 Specification, (indoor wireless propagation)
- [22] RFC 3558 RTP Payload Format for Enhanced Variable Rate Codecs (EVRC) and Selectable Mode Vocoders (SMV), July 2003
- [23] RFC 2833 RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals, May 2000
- [24] 3GPP2 A.S0013-C Interoperability Specification (IOS) for cdma2000 Access Network Interfaces – Part 1 Overview
- [25] 3GPP2 A.S0013-C Interoperability Specification (IOS) for cdma2000 Access Network Interfaces – Part 2 Transport
- [26] 3GPP2 A.S0013-C Interoperability Specification (IOS) for cdma2000 Access Network Interfaces – Part 7 (A10 and A11 Interfaces)

3 Acronyms

| | |
|---------|---|
| AAA | Authentication, Authorizing, and Accounting |
| BTS | Base Station Transceiver |
| BSC | Base Station Controller |
| CALEA | Communications Assistance for Law Enforcement Act |
| CPE | Customer Premise Equipment |
| DHCP | Dynamic Host Control Protocol |
| GPS | Global Positioning System |
| HSS | Home Subscriber Server |
| I-CSCF | Interrogating Call Session Control Function |
| IKE | Internet Key Exchange |
| IMS | IP Multimedia Subsystem |
| IOS | Interoperability System |
| IP | Internet Protocol |
| IPSec | IP Security |
| LAN | Local Area Network |
| MFIF | MAP Femto cell Interworking Function |
| MG | Media Gateway |
| MGCF | Media Gateway Control Function |
| MGW | Media Gateway |
| MS | Mobile Station |
| MSC | Mobile Switching Center |
| OTA | Over The Air |
| OAM&P | Operation, Administration, Maintenance & Provisioning |
| P-CSCF | Proxy Call Session Control Function |
| PCF | Packet Control Function |
| PDE | Position Determination Equipment |
| PDSN | Packet Data Serving Node |
| PSAP | Personnel Security Assurance Program |
| QoS | Quality of Service |
| RAN | Radio Access Network |
| RF | Radio Frequency |
| RNC | Radio Network Controller |
| RN | Radio Network |
| RP | Radio Network – PDSN |
| RTP | Real-Time Transport Protocol |
| RU | remote RF Unit |
| SA | Security Association |
| SDU | Selection and Distribution Unit |
| S-CSCF | Serving Call Session Control Function |
| SIGTRAN | Signaling Transport processing module in IP-RAN (BSC) |
| SIP | Session Initiation Protocol |
| SMS | Short Message Service |

4 AW100 1xRTT System

4.1 Introduction

The AW100-1X is a CDMA-2000 IP-RAN that is unique in the way that it combines both BTS and BSC functionality in one compact platform. This product is designed for efficiency and optimized to reduce the service providers CAPEX and OPEX. It increases the number of users per assigned spectrum and provides higher capacity in less space for today's spectrum hungry data and multi-media applications.

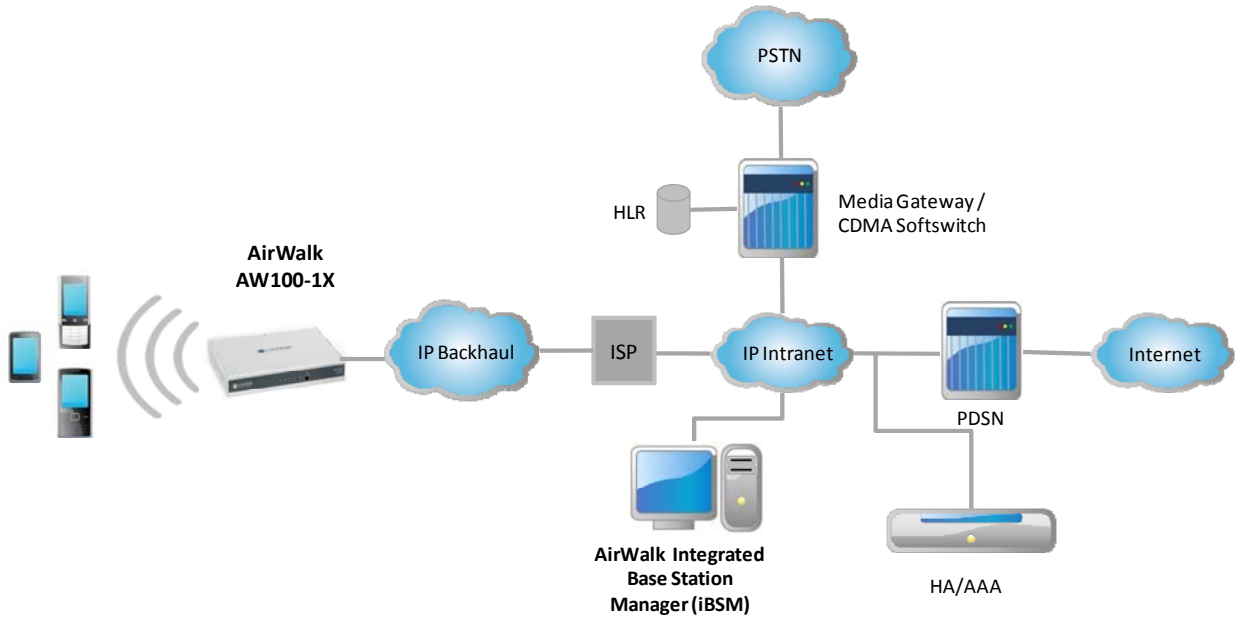
The AW100-1X platform provides the following operator benefits:

- Improve in-building service resulting in increased cellular usage in the enterprise market
- Maximize existing macro network efficiencies and reduce deployment costs
- Utilize existing IP backhaul technologies
- Advanced handoff capabilities and scalability allow for seamless coverage throughout a location
- Compatibility with existing handsets improves user satisfaction

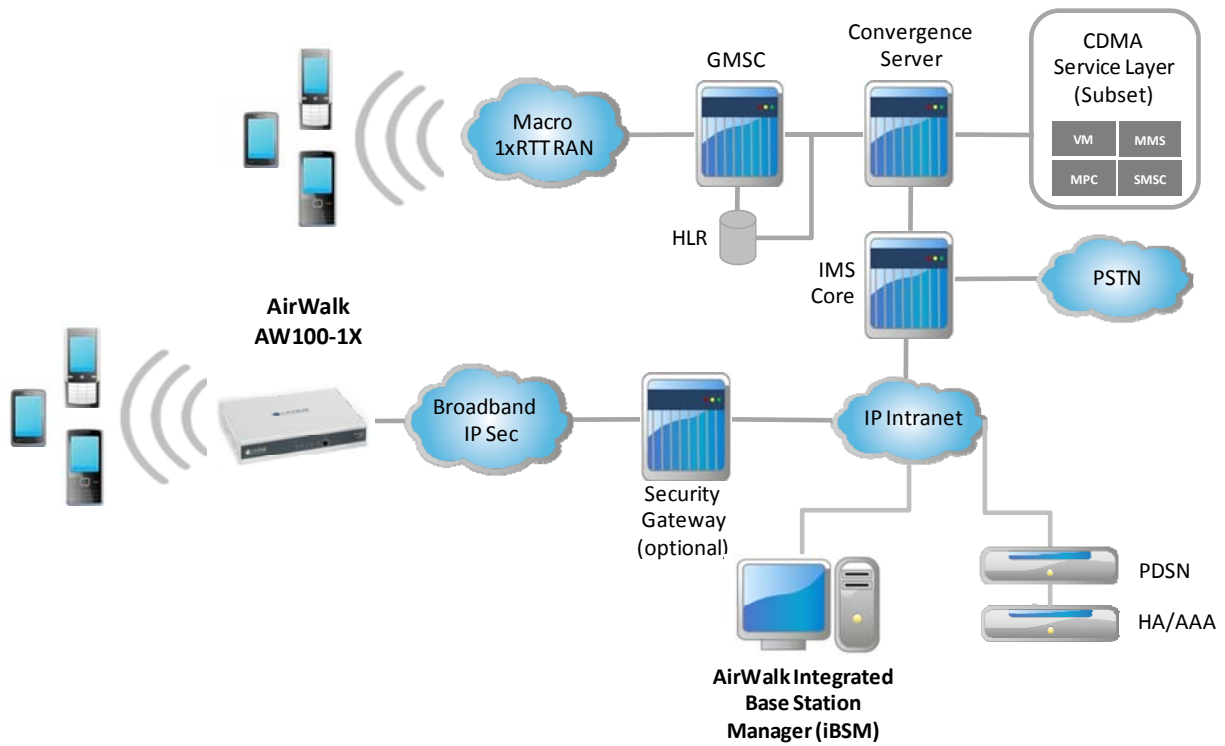
The following is a list of general characteristics:

- Supports both CDMA 1xRTT voice and data calls
- Supports 32CE and /or 64 CE (Up to 28 or 56 users)
- Supports CDMA 1xRTT data service transmission up to 144 kbps
- One carrier/omni configuration
- Supports soft handoff, and hard handoff
- Offered in 1 mW or 200 mW transmit power
- Available with 1 mW platform to connect to high power LPA
- High sensitivity internal GPS system connected with an external antenna
- Integrated BTS/BSC/PCF functionality
- Compatible with IOS5.x or native IOS-SIP adaptation
- IPSec tunnel support (for IOS-SIP Adapter only)
- Supports Integrated Base Station Management (IBSM)
- Supports 1900 MHz, 800 MHz, 450 (A) MHz bands
- 19 inch rack or cabinet mounting options
- AC or optional DC power supply systems
- Ethernet backhaul connections, compatible with most routers and multiplexers
- Remote O&M support through IP network
- Easy repair by replacement of modular units
- Improved reliability, and QoS
- Provides an 'All-IP' solution

The following diagram is typical network architecture for AW100-1X using IOS5.x standard interfacing to a CDMA softswitch network.



The following diagram is typical network architecture for AW100-1X using IOS to SIP adapter protocol interfacing to an IMS network



5 AW100 1xRTT IP-RAN Description

The AW100-1X IP-RAN has an integrated BSC and BTS function on one unique and compact physical platform, which is unique in the CDMA wireless infrastructure industry. Most other systems have separate BTS and centrally located BSC platform.

By combining the BTS and BSC functions in a single structure, AirWalk is able to locate the critical selector distribution unit (SDU) function with the radio transceiver unlike other systems equipped with a centrally located SDU.

Time delays for signals between the transceiver and the SDU are critical to be able to provide proper soft handoff operation in a CDMA system. Delays in excess of 20ms will disrupt the soft handoff process. Locating the SDU with the radio allows the tolerance for possible network traffic time delays between the SDU and the centrally located soft switch to become much less critical.

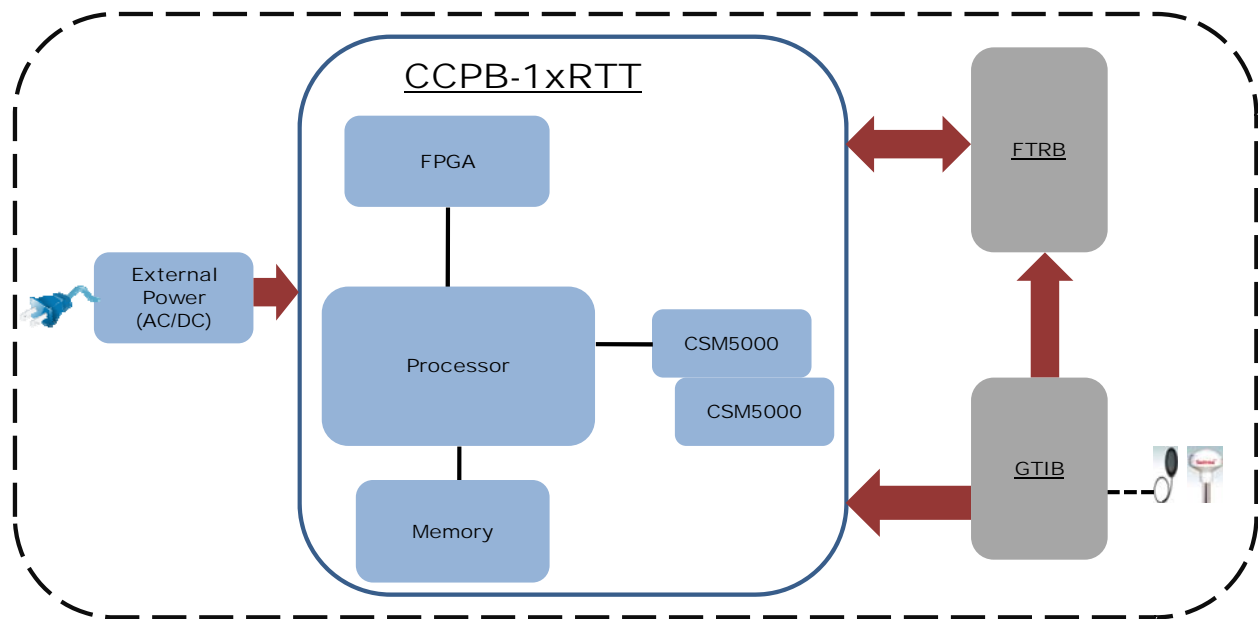
This means an operator has much more flexibility in designing backhaul IP networks for the all IP CDMA system. In fact operators can successfully use existing data networks which include multiple routers that introduce variable delays for backhaul, something that is impossible with a centrally located SDU.

The AW100-1X unit consists of a single chassis that can be mounted on a standard telecom rack (1.75"H x 12.25W x 9"D).



5.1 Main Unit Hardware Components

The following diagram shows the main unit hardware components that make up the AirWalk AW100-1X product.



Each AW100-1X IP-RAN consists of four major assemblies:

- CCPB-1X - Call & Channel Processing Board
 - Provides BTS and BSC function
- FTRP - Femto Transceiver Board
 - Provides frequency up down function
 - Offered in 1900 MHz, 800 MHz, 450 MHz (A)
- GTIB - GPS & Timing Interface Board
 - Provides highly accurate position information
- PSU – Power Supply Unit

5.1.1 CCPB-1X (Call and Channel Processing Board)

The CCPB-1X is the main control board in the AW100-1X. It handles both BTS and BSC function and controls and processes packet data, CDMA voice and data calls. It also transmits and receives voice and data signaling using the CDMA air interface.

The CCPB-1X can be configured to support either 1FA / Omni operations.

The CCPB-1X is equipped with one or two Qualcomm CSM-5000 CDMA modem processors which provide up to 64 individual CDMA channel elements. All base-band channel processing functions and BTS and BSC management functions are provided on this board which is supervised by a single power PC processor.

The CCPB-1X Board's major functions include:

- Manage the digital signal and call processing based on IS-95, IS-95A or CDMA2000 standards.
- Provide the BTS, and BSC function
- Softer handoff and channel pooling functions within the BTS

- Control of the transceivers and power amplifiers, if equipped
- Provides Ethernet interfaces for connection to the core network (Softswitch, or IMS)
- Site timing functions including GPS interface clock distribution
- Ethernet interface support
- Alarm monitoring including fan rotation alarms
- Local serial man-machine interface (MMI)

5.1.2 FTRB (Femto Transceiver Board)

The transceiver board contains the primary radio functions. It contains a 2 path diversity receiver and a one transmitter.

The AW100-1X is normally equipped with either 200 mW or 1 mW of transmit power. The 1 mW version function is designed to interface with the external RU power amplifier.

5.1.3 GTIB (GPS & Timing Interface Board Global)

The GPSR module provides accurate time signals for operation of the AW100-1X IP-RAN base station. Precise time is critical for CDMA signaling and soft handoff synchronization therefore the GTIB derives system time information from the space based GPS system satellite cluster.

An external GPS antenna unit connects to the GTIB via a connector on the rear panel of the AW100-1X.

5.1.4 PSU (Power Supply Unit)

The AW100-1X contains a power supply that conditions external power for all the internal boards and components.

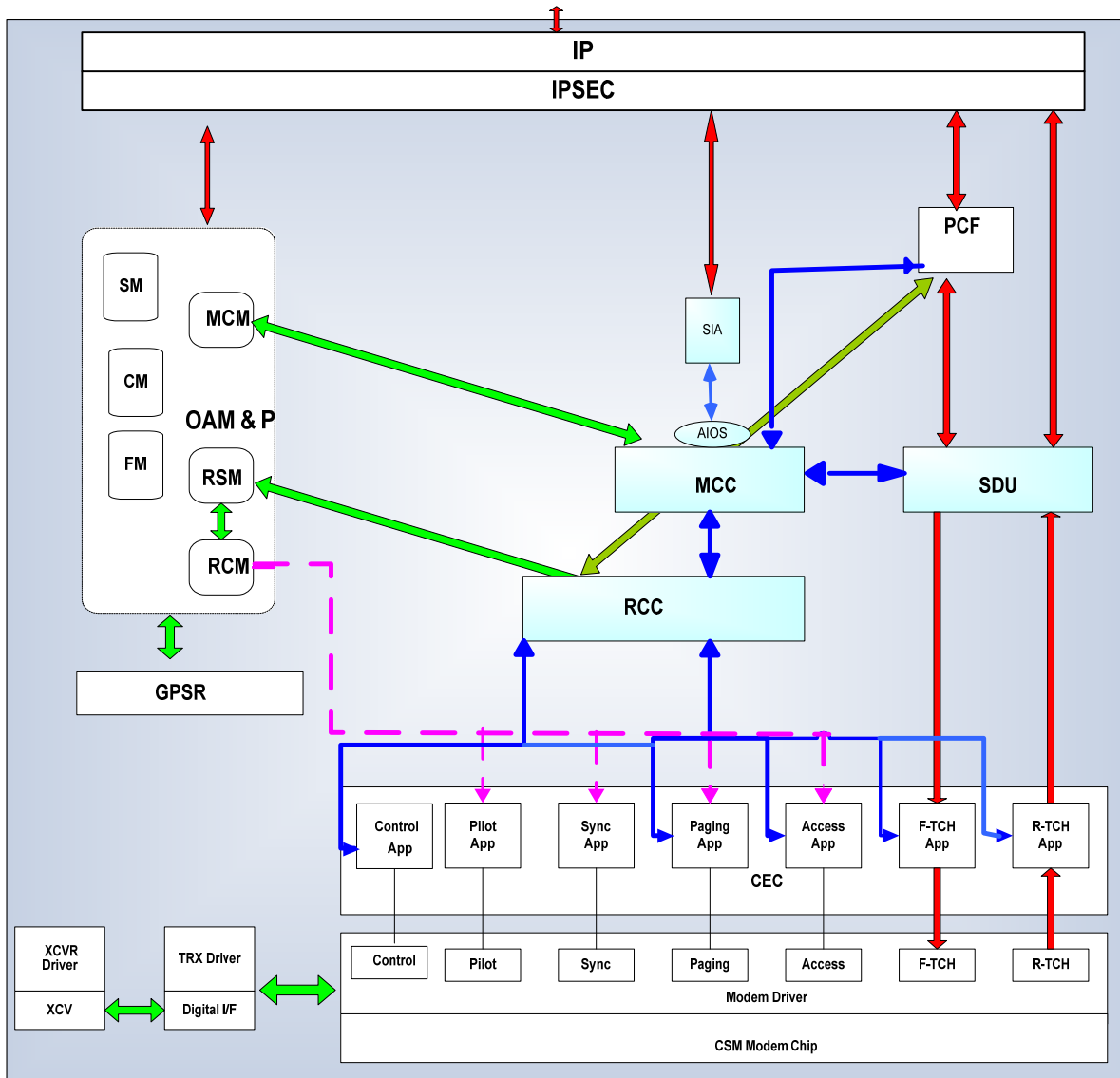
A universal AC power supply covering 100-240 VAC input voltages is normally provided

5.2 Software Architecture

The AirWalk AW100 1xRTT IP-RAN greatly reduces the complexity found in larger base station systems into an easily manageable architecture. The software is based on VxWorks operating system and combines different functionalities traditionally provided by discrete BSC, BTS, and PCF modules into a single composite module.

The BSC functionality is provided by MCC, SDU, PCF, AIOS, and SIA components. The BTS functionality is provided by RCC, CEC, and TRX/XCV components. The O&M software consists of FM, CM, SM, RCM components. The FM component monitors the alarms and then communicates them directly to the Base Station Management (BSM)

The following diagram shows the main software components.



5.2.1 Main Call Control (MCC)

The MCC provides call processing functionality and performs all the operations that pertain to individual subscribers including registration, call setup, call release, handoff and other advanced subscriber features.

5.2.2 Selection Distribution Unit (SDU)

The SDU component performs the following operations:

- Multiplex and de-multiplex
- Forward and reverse traffic frame selection and distribution
- Handoff type decision and handoff direction
- Radio link protocol (RLP) procedures
- Forward and reverse power control

- Process test call procedures
- Support for Real Time Protocol (RTP)
- Process signaling layer 2 procedures
- Support for Generic Routing Encapsulation (GRE)

5.2.3 Packet Control Function (PCF)

The PCF processes 1xRTT data calls and interfaces with the PDSN which is the end point for the mobiles to the Internet. The PDSN is responsible for allocating an IP address to the mobile so that the user may access the Internet.

5.2.4 Interoperability System (AIOS/IOS)

The IOS component provides support for the Upper Layer 3 Signaling between the AW100 and the Core network soft switch. This block performs the following operations:

- Encoding messages: conversion of OTA messages received from the mobile to A1/A1p format to send to the softswitch
- Decoding messages: conversion of A1/A1p messages to OTA messages to send to the mobile

The AIOS component provides the adaptation layer between the legacy IOS and the SIP interface adapter.

5.2.5 SIP Interface Adaptor (SIA)

This component is responsible for interoperability with the IMS Core network using SIP signaling. It provides the SIP stack message processing functionality.

5.2.6 Radio Interface Call Control (RCC)

The RCC software block provides call control to the air interface. The air interface between the MS and the BTS is specified in the TIA/EIA-95-A/B and the CDMA2000 standards, which include the core air interface, minimum performance, and service standards. The functionalities of the RCC consist of call processing, resource management, and supplementary service.

The RCC provides call processing functions in order to setup and release a call and resource management of radio resources. An example would be the CDMA channels, traffic channel elements, Walsh code channel assignments, and frame offsets. The RCC also provides signaling functionality by interfacing with other relevant software blocks.

5.2.7 Channel Element Control (CEC)

The AW100 series CEC block is equivalent to the BTS/RN function that controls the call processing to interface with the Mobile Stations. The CEC also interfaces with the upper layer SW blocks to handle the over the air messages required to set up, maintain, and terminate calls for both voice and data.

In order to make these calls, both signaling and traffic frames must be transmitted and received to and from the mobile stations. It is also important for these frames be transmitted and received at the right time with correct information. The CEC block allows these messages to be transmitted and received to and from the Mobile Stations using Qualcomm's modem chips.

5.2.8 Operations and Maintenance (O&M)

The O&M block includes Configuration Management (CM), Status Management (SM), Fault Management (FM) and Performance Management (PM) modules for the AW100.

The FM component supports the following features:

- Configure alarm severity (CRITICAL, MAJOR, MINOR, WARNING, INFORMATION) and suppress alarms
- Detect fault Information from resources (hardware, software)
- Log and show list of alarms
- Control the alarm LED for alarm status
- Send defined alarms to the BSM
- Synchronize current alarm lists
- Define thresholds to send alarms to the BSM
- Change a fault's severity in the order of frequency it happens
- Support external environment alarms
- Hardware resource tests and diagnostics
- Keep alive test between the BSC and BTS, PDSN, Softswitch, and BSM

5.2.9 Main Configuration Management (MCM/CM)

This component is responsible for initializing the AW100 with the required configuration and operating parameters at power up based on the information received from the BSM-F. This component also supports the on demand changes in the configuration of the AW100 using the BSM-F.

5.2.10 Radio Configuration Management (RCM)

The RCM component initializes the transceiver and the channel resources modules on the AW100. This component supports the following functionalities:

- Channel Element Configuration
- Overhead Channel Management
- Transceiver Initialization
- Resource Management Library Initialization
- Configuration information and Parameters Changes support

5.2.11 Radio Statistics Management (RSM)

The RSM component is responsible for all the vital statistics collection on the AW100 and reports this information back to the BSM-F on demand as well as on a periodic basis if needed.

5.2.12 TRX/XCV

These components are responsible for converting the base band radio signals to the carrier frequency on the transmit end and converting the received frequency to the base band signal on the receive end.

The base band signal output by the channel elements moves through the digital I/F module (controlled by the TRX component) where it is converted to an intermediate frequency signal. This signal then passes through the XCV component where it is converted to the carrier frequency and is transmitted into the air via the amplifier unit.

On the receiver, the incoming signal goes through the reverse process and is down converted to a base band signal before being sent to the channel element for processing.

5.3 Packaging

The AW100-1X product line is available in two configuration and packaging options. Each option possesses unique characteristics tailored to the specific needs of the operator in terms of physical size, output power, and cell configurations.

Pico/ Enterprise Solution

One Carrier / Omni configuration with 200 mW transmit power

The AW100-1X IP-RAN is size-optimized for applications where the physical package must be small to deliver small, single-carrier Omni-directional coverage.



Mini / Macro Solution

One Carrier / Omni configuration with 4/20 W External RU

The AW100-1X combined with a 4W or 20W integrated Radio Unit (RU) provides a macro solution, that can cover a large area with an optimal channel capacity on an Omni configuration cell.



5.4 Technical Specifications

5.4.1 General

| Item | Capacity and Specification |
|---------------------------|--|
| Supported Frequency Bands | 450(A) MHz, 800 MHz, 1900 MHz |
| Handoff | Soft, hard |
| Timing Source | External GPS antenna |
| Installation | Rack mount |
| IP-Network Interface | 10/100 Base-T Ethernet |
| Common Air Interface | J-STD-008, IS-95-A, IS-95-B, CDMA2000-1x |
| Channel Bandwidth | 1.25 MHz |
| Receiver Sensitivity | -119 dBm @ less than 1% FER |

5.4.2 Power Supply

| Item | Description |
|-------------|-------------------|
| AC | 100 VAC ~ 240 VAC |
| DC | +24 VDC |
| Consumption | 60W |

5.4.3 Environmental

| Item | Description |
|-----------------------|--|
| Operating Temperature | 0°C ~ 50°C (32°F to 122°F) |
| Relative Humidity | 5 to 95% non-condensing |
| Cooling | Forced air |
| Type | Indoor /outdoor with air conditioned enclosure |
| Installation | Rack mount |

5.4.4 Configuration

| Item | Description |
|----------------------|---|
| Configuration | 1 Carrier / omni |
| Transmit Power | 1 mw or 200 mW |
| Dimernsions (HxWxD) | 1.75 x 12.25 x 9 (Inc), 4.45 x 31.12 x 22.86 (CM) |
| Weight | <4 lbs; < 2Kg |
| Regulatory | FCC certified |

5.4.5 System Interface

| System | Physical Interface | Interface |
|--------------------|--|--|
| CDMA Softswitch | 10/100 Base-T/Fast Ethernet | IOS 4.2 – 5.X |
| PDSN | 10/100 Base-T/Fast Ethernet – (A10, A11) | IS-707-A, IS-835-B, RFC 2002 ~ RFC 2006 |
| Security Gateway | 10/100 Base-T/Fast Ethernet | IKEv2/IPSec RFC 4306 |
| Convergence Server | 10/100 Base-T/Fast Ethernet | IOS 4.2 / SIP 2.0 RFC 3261 |
| Media Gateway | 10/100 Base-T/Fast Ethernet | RFC 3558, RFC 2833 |
| AW100-1X | 10/100 Base-T/Fast Ethernet | IOS 4.2 |
| Mobile Station | 10/100 Base-T/Fast Ethernet | TIA/EIA IS-2000 Release 0, 3GPP2 C.S0072(MEID) |