

Users Manual

Wireless Data Networking Unit

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1. Regulatory Information and Certifications

1.1 Antenna Related User Notification

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

WiFi Connection J2

Antenna Type	Band	Gain (Average)
Titanis 2.4GHz B4844	2.4-2.5GHz	-1.0dBi

Note: Only this antenna or those with the same specification may be used with the WiFi connection.

The following table lists the supported Wi-Fi channels of the WDNU.

Channel	Lower Frequency	Center Frequency	Upper Frequency
1	2.401	2.412	2.423
2	2.406	2.417	2.428
3	2.411	2.422	2.433
4	2.416	2.427	2.438
5	2.421	2.432	2.443
6	2.426	2.437	2.448
7	2.431	2.442	2.453
8	2.436	2.447	2.458
9	2.441	2.452	2.463
10	2.451	2.457	2.468
11	2.451	2.462	2.473

GSM Connection J3

Antenna Type	Bands	Gain (Average)
Cellular	850MHz	2dBi
	1900MHz	3dBi

Note: Only this antenna or those with the same specification may be used with the Cellular connection. The device contains Cinterion's HC25 (FCC ID: QIPHC25) and the module grants allows an antenna with these specifications.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the table above with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

FCC/IC notes regarding Radio Interference

This device complies with Part 15 of the FCC Rules and with license-exempt RSS standard(s) of Industry Canada. Operation is subject to the following two conditions : (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation of the device.

Cet appareil se plie à la Partie 15 des Règles de FCC et exemptes de licence RSS norme(s) d'Industrie Canada. L'opération est soumise aux deux conditions suivantes : (1) cet artifice peut ne pas provoquer l'interférence malfaisante et (2) cet appareil doit accepter n'importe quelle interférence reçue, en incluant l'interférence qui peut provoquer l'opération indésirable de l'appareil.

1.2 Radio Frequency radiation exposure Information:

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment when installed and operated so that a minimum distance of 20 cm between the radiator and the body of persons is maintained

Cet équipement est conforme à la radioexposition de la FCC établies pour un environnement non contrôlé lorsqu'il est installé et exploité de telle sorte qu'une distance minimale de 20 cm entre le radiateur et le corps de personnes est maintenue

1.3 Unauthorized Product Changes

Changes or modifications to this equipment not expressly approved by Digi may void the user's authority to operate this equipment.

Tout changement ou modification apportés à ce dispositif n'étant pas expressément approuvés par Digi peut priver l'utilisateur de mettre en œuvre cet équipement.

2. Introduction

This document is the user manual for the Wireless Data Network Unit (WDNU). It assumes the reader has some general knowledge of the product, which can be gained from other documents. The goal of this document is to describe the various ways to interact with and use the WDNU.

2.1 Abbreviations and Acronyms

The following abbreviations and acronyms used in this document are defined below.

AES	Advanced Encryption Standard
AHTMS	Aircraft Health and Trend Monitoring System
AHTMU	Aircraft Health and Trend Monitoring Unit
APN	Access Point Name
BIT	Built In Test
CHIP	Command Handler Interface Protocol
CLI	Command Line Interface
DES	Data Encryption Standard
DHCP	Dynamic Host Control Protocol
GE	General Electric
GSM	Global System for Mobile
HSPA	High Speed Packet Access
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISAKMP	Internet Security Association and Key Management Protocol
LRU	Line Replaceable Unit
MAC	Media Access Control
Mbps	Mega bits per second
PBIT	Power on Built In Test
PC	Personal Computer
POST	Power On Self Test
PTCRB	PCS Type Certification Review Board
SDRL	Subcontractor Data Requirements List
SIM	Subscriber Identity Module
UI	User Interface
WEP	Wired Equivalency Privacy
WDNU	Wireless Data Networking Unit
Wi-Fi	Wireless Fidelity (IEEE 802.11)
WPA	Wi-Fi Protected Access

3. Reference Documents

The following documents are referenced by this manual.

Ref.	Document Number	Document Title	Revision
1	P4618-4	Technical Requirements Specification for the Wireless Data Networking Unit	3 May 2010
2	YV2818	Command Handler Interface Protocol Specification for the Wireless Data Network Unit	13 Oct 2010
3	96003702	Interface Control Drawing, Wireless Data Network Unit	B
4	SDRL E005	BIT Description	B
5	LB-D003	WGNU Hardware Specification Document	A
6	SDRL C001	WGNU Mechanical and Electrical Interface Control Document	A1

4. WGNU Overview

4.1 General Description

The WGNU (radio) provides the wireless bridge between the Aircraft Health and Trend Monitoring Unit (AHTMU) or the “host” and access points while the aircraft is on the ground. Operation of the radio occurs when the AHTMU provides power and requests connection via either Wi-Fi or GSM.

Physically, the subsystem is comprised of a small WGNU LRU that connects to a Wi-Fi and GSM antenna providing optimized Wi-Fi and GSM connectivity and range. 28 Vdc power is supplied to the WGNU LRU by the aircraft power system. A control signal is provided by the host system for the WGNU LRU to energize itself.

The WGNU LRU will provide an Ethernet interface direct to the host LRU. The host LRU will transmit and receive data in standard Ethernet packets to and from the WGNU LRU. The WGNU supports VPN connections over the Wi-Fi and GSM interfaces to provide data security.

4.2 Physical Description

The physical configuration of the WDNU is described by drawing 96003702, part of which is reproduced in Figure 1 below.

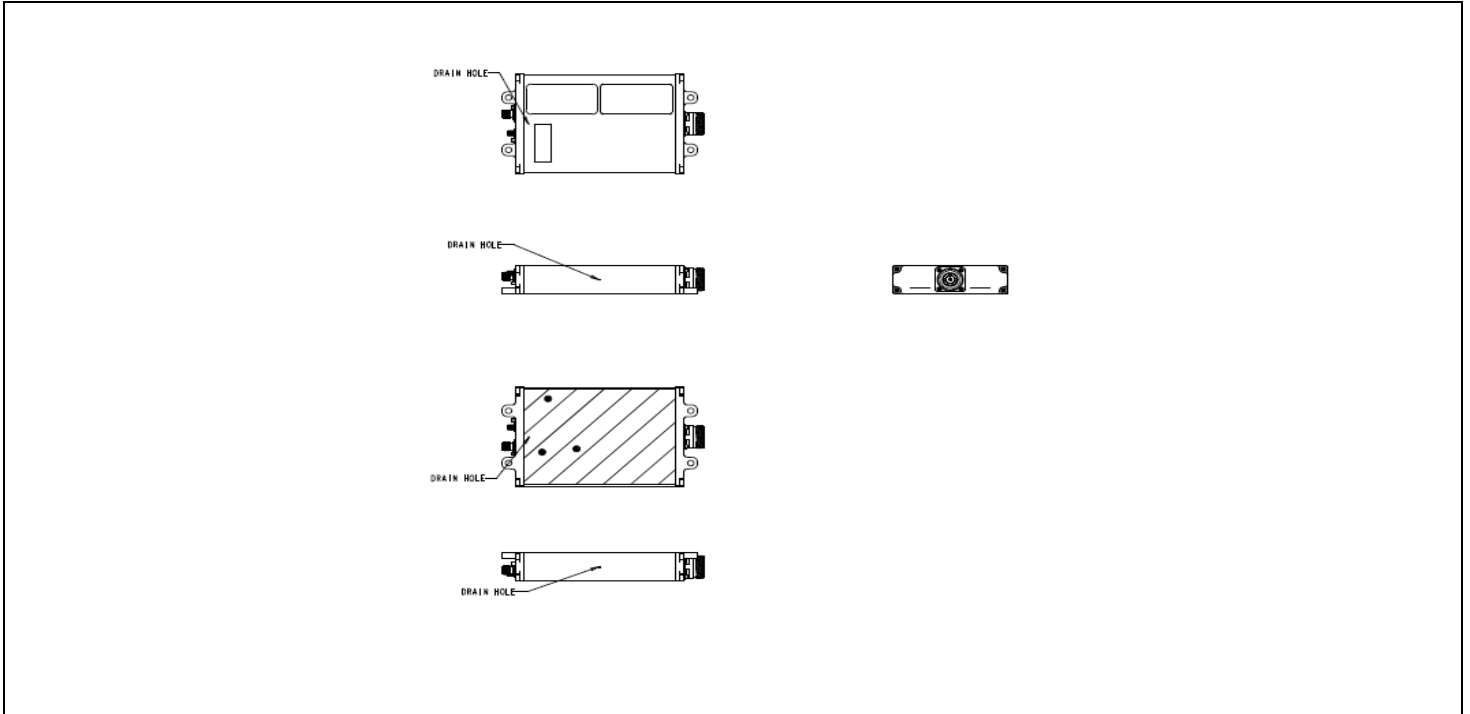


Figure 1 WDNU Top, Bottom and Side Views

4.3 WDNU Interfaces

The WDNU interfaces to the AHTMU through the electrical signals listed below. All connections are through the main host connector J1.

The pinout description for the main host to board connection interface is reproduced from SDRL C001 in Figure 2 below.

PIN ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Amphenol Connector	Chassis Ground	28 VDC Popover In 1	28 VDC Popover In 2	28 VDC Popover Return 1	28 VDC Popover Return 2	Reserved 1	Reserved 2	Reserved 3	Reserved 4	Reserved 5	Reserved 6	Reserved 7	Reserved 8	Reserved 9	Reserved 10	Reserved 11	Reserved 12	Reserved 13	Reserved 14	Reserved 15
Amphenol Connector	Reserved 16	Reserved 17	Power On Discrete In	Power On Discrete Out	Shield/Ground	Reserved 20	Reserved 18	Reserved 19	RS-232 In	RS-232 Out	RS-232 Common	Not Connected	RS-422 Rx (+)	RS-422 Rx (-)	RS-422 Tx (+)	RS-422 Tx (-)	RS-422 Common	Not Connected		
Center Quadrax	1-Q Ethernet RX (+)	2-Q Ethernet TX (-)	3-Q Ethernet RX (-)	4-Q Ethernet TX (+)																

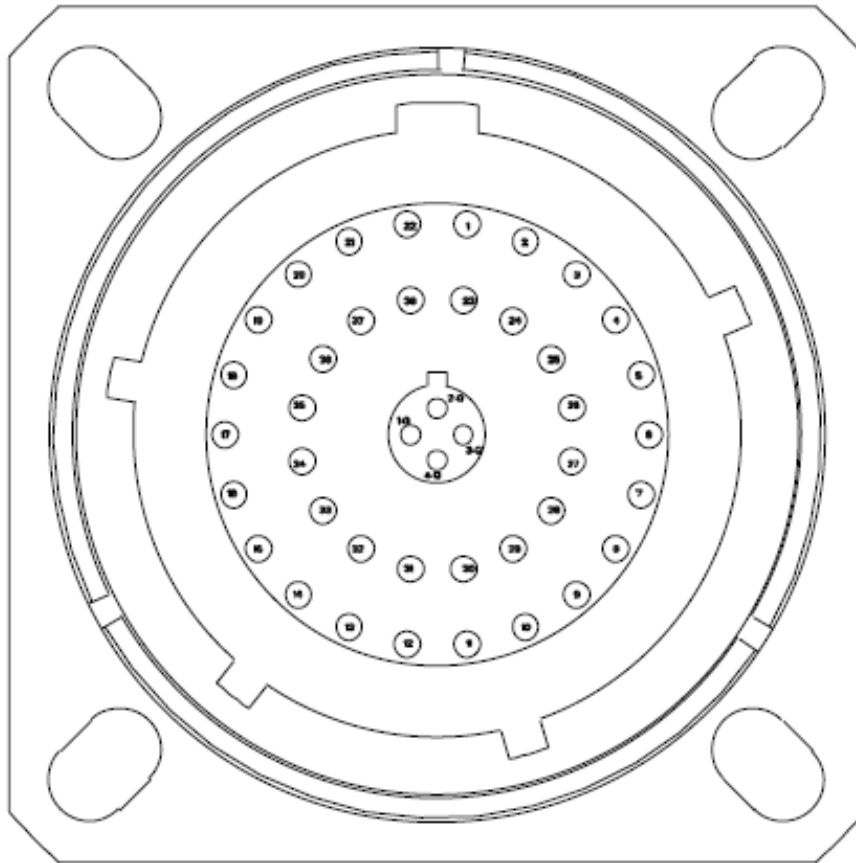


Figure 2 Main host to board connection pinout

The connector J1 is an Amphenol part number TV00RQF-17-2-P. The mating connector is Amphenol part number TV06RQF-17-2S.

4.3.1 Radio Power On Discrete

The radio power on signal is an Open/Ground discrete output from the Aircraft Health and Trend Monitoring System used to turn the WDNU on or off. When asserted (grounded), power to the WDNU is applied and the system is on. When de-asserted (open), the WDNU is off.

4.3.2 Radio Power Off Discrete

The radio power off signal is a 28VDC/Open discrete output from the WDNU to indicate whether the WDNU is on or off. When the AHTMU turns the WDNU on with the radio power on discrete, the radio power off discrete will be open to signal that the WDNU is on. When the WDNU is off this signal will be pulled up to the aircraft supply voltage (28VDC nominal).

4.3.3 Ethernet Interface

The WDNU provides one Ethernet interface for communications with the AHTMU. The Ethernet channels will support the IEEE-STD-802.3 10/100 Ethernet protocol with auto-negotiation. The cable configuration specified is a crossover connection.

4.3.4 RS-232 Interface

A RS-232 serial communication interface has been included through the main connector to the AHTMU. The settings for the RS-232 interface are shown in Figure 3.

Baud rate	115200
Number of data bits	8
Parity	None
Number of stop bits	1
Flow control	None

Figure 3 RS-232 port settings

4.3.5 RS-422 Interface

A RS-422 serial communication interface has been included through the main connector to the AHTMU. The hardware interface has been designed and implemented on the WDNU, but this interface is not supported by the current version of the operating system.

4.4 WDNu RF Interfaces

The WDNu has two external coaxial connections for the GSM and WiFi transceivers.

The two transmitters (WLAN/Cellular) cannot transmit at the same time. The unit has software control to disable one transmitter when the other when is on.

4.4.1 WiFi Connection J2

Amphenol TNC connector – 031-2318

Antenna Type	Band	Gain (Average)
Titanis 2.4GHz B4844	2.4-2.5GHz	-1.0dBi

Note: Only this antenna or those with the same specification may be used with the WiFi connection.

4.4.2 GSM Connection J3

Amphenol SMA bulkhead connector – 901-9610

Antenna Type	Bands	Gain (Average)
Cellular	850MHz	2dBi
	1900MHz	3dBi

Note: Only this antenna or those with the same specification may be used with the Cellular connection. The device contains Cinterion's HC25 (FCC ID: AIPHC25) and the module grants allows an antenna with these specifications.

5. WDNU Functional Description

The WDNU is a gateway product which runs a server that allows the Aircraft Health and Trend Monitoring Unit (AHTMU) to connect to a remote server over a secure connection. This section describes some of the features of the WDNU, which are illustrated in the following figure.

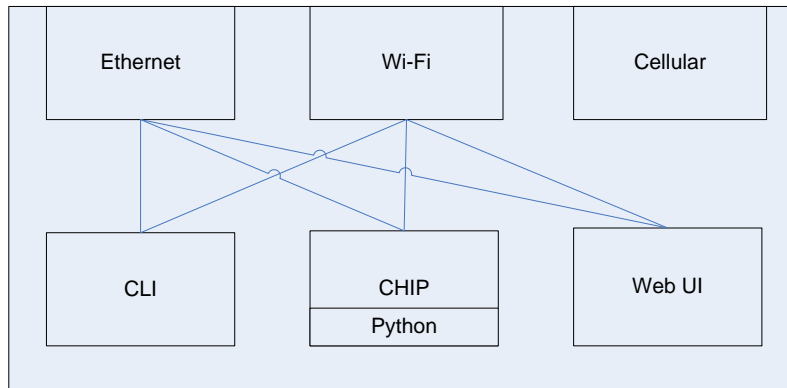


Figure 4 Major functional components

5.1 Network Interfaces

The WDNU has Ethernet, Wi-Fi (802.11 b/g) and cellular (GSM 3G) network interfaces.

5.1.1 Ethernet

The Ethernet interface is configured with a static IP address of 192.168.114.1. Three main services are provided on the Ethernet interface. These services are the Command-Line Interface (CLI), the Command Handler Interface Protocol (CHIP), and the web user interface (web UI). The general use case for the Ethernet port is the AHTMU communicates with the WDNU using CHIP.

5.1.2 Wi-Fi

The Wi-Fi interface supports the same three services as the Ethernet, which are the CLI, CHIP and web UI services. The Wi-Fi interface is not enabled by default, but can be configured with any of the available services on the Ethernet interface. For example, it can be configured to connect to an open wireless network called TEST with the following CLI command:

```
#> set wlan channel=0 ssid=TEST authentication=open encryption=open
```

5.1.3 Cellular

The GSM cellular interface does not support the three services that are supported on the Ethernet and Wi-Fi interfaces. It is used by the AHTMU to connect to a remote server when there are not any Wi-Fi access points available or when the operator defines it as the primary communication links. The WDNu contains two SIM card slots which are populated with an AT&T SIM and a Vodafone SIM. The cellular interface can be configured via the CLI, CHIP or the web UI services using either the Ethernet or Wi-Fi interfaces. For example, Figure 5 illustrates the configuration of the cellular connection using the web UI.

The screenshot displays the 'Mobile Configuration' web interface. It features a dark blue header with the title 'Mobile Configuration'. Below the header is a light blue section titled 'Mobile Settings' with a dropdown arrow. Underneath, there is a paragraph of text: 'Select the service provider, service plan, and connection settings used in connecting to the mobile network. These settings are provided by and can be retrieved from the service provider.' This is followed by another light blue section titled 'Mobile Service Provider Settings'. It contains three fields: 'Service Provider:' with a dropdown menu showing 'AT&T/Cingular Wireless (Blue Network)', 'Service Plan / APN:' with a dropdown menu showing 'Custom APN', and 'Custom Plan Name:' with a text input field. Below this is a section titled 'Mobile Connection Settings' containing a checked checkbox labeled 'Re-establish connection when no data is received for a period of time.' and an 'Inactivity timeout:' field with a value of '3600' and the unit 'seconds'. The next section is 'Mobile Band Settings' with a 'Band configuration:' dropdown menu showing '850/1900 MHz (North America)'. At the bottom of the form are two buttons: 'Apply' and 'Set to Defaults'.

Figure 5 Mobile configuration

5.2 Services

This section describes the services that are available on some of the network interfaces. To access these interfaces an example of a basic test configuration setup is detailed below in figure 4.2-1

Equipment Needed:

1. WDNu board loaded with pre-installed SIM cards.
2. GSM antenna (see section 4.4 for antenna)
3. Wi-Fi antenna (see section 4.4 for antenna)
4. 2 DC power supplies
5. Mating cable for WDNu
6. Windows XP 32bit PC.

Connection Diagram:

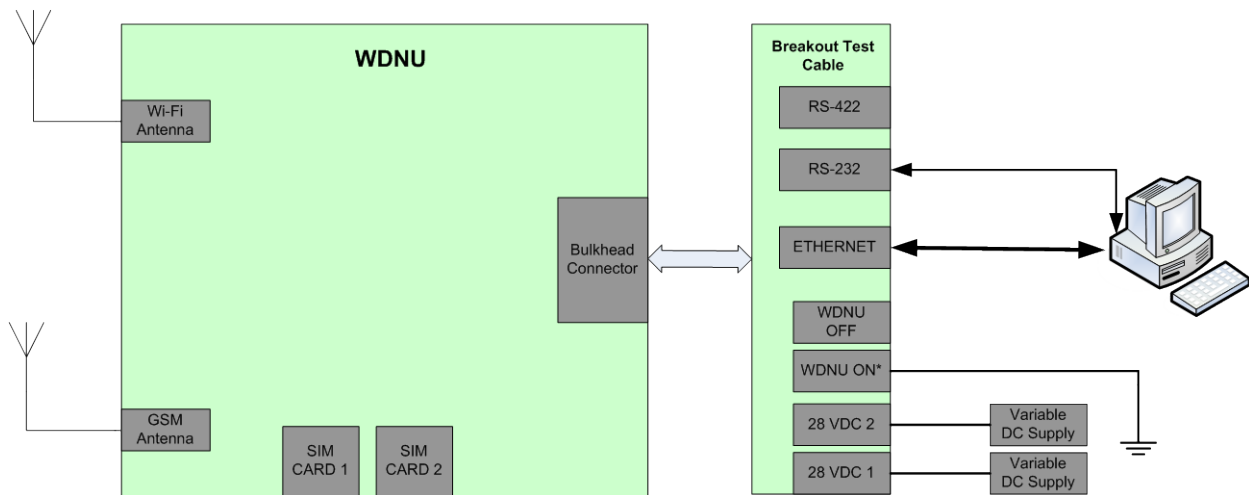


Figure 4.2-1 – Example test configuration setup.

5.2.1 Command-Line Interface

The command-line interface provides commands for interacting with the WDNUnit. In addition to the network interfaces, it is also available on the RS-232 serial interface. To use the commands you must first access the WDNUnit using the Telnet protocol. For example, this can be done on a Windows machine by opening a command prompt and entering `telnet <WDNU IP address>`. The commands and their options are described in detail in the Command Reference guide for the Digi Connect Family. Currently, the latest revision is available here: http://ftp1.digi.com/support/documentation/90000566_H.pdf.

One of the key features available in the CLI is the ability to update the WDNUnit firmware. Refer to section 6.2 for more information.

5.2.2 Command Handler Interface Protocol

CHIP provides many of the same configuration and status commands that are available through the command-line interface, but in a better defined and more consistent format. The available commands in CHIP are defined in the Command Handler Interface Protocol Specification for the Wireless Data Network Unit (YV2818). The CHIP service is available on UDP port 49000.

5.2.3 Web User Interface

The WDNUnit provides a collection of web pages for interacting with the WDNUnit. Much of the information available on the web pages is also available through the CLI and CHIP services. The WDNUnit web UI is available via HTTP on port 80 and can be accessed by a modern web browser like Internet Explorer, Firefox or Chrome. Figure 6 shows the home page for the web UI, and the sidebar shows many of the other available web pages. Help is available on each page by clicking the Help link in the upper right hand corner.

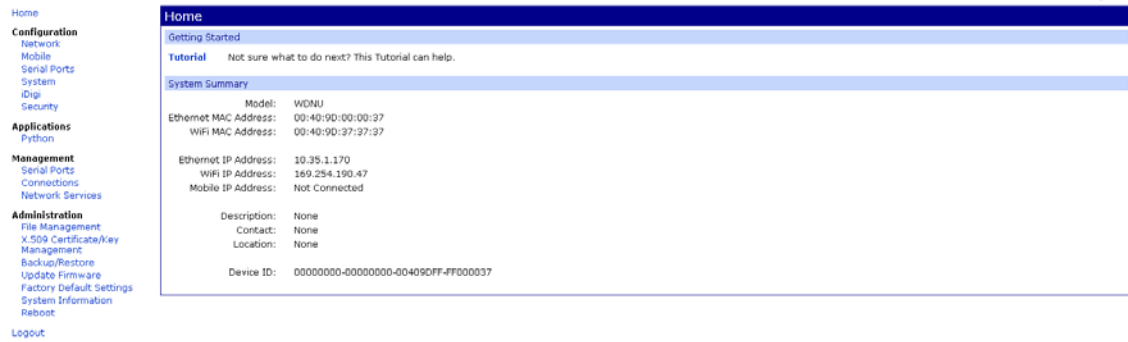


Figure 6 Web UI home page

5.3 Customization

Some parts of the WDNU can be customized with the WDNU Configuration and Management web page, which is accessible via the Ethernet interface. The URL is <http://<WDNU IP address>/admin/customization.htm>. Detailed customization information is available online at http://ftp1.digi.com/support/documentation/90000734_B.pdf.

5.3.1 Factory Defaults

The WDNU is manufactured to contain a custom set of factory default configuration settings. The WDNU uses these configurations every time it boots up. In other words, configuration changes are not persisted from one boot to the next. The custom defaults include setting the Ethernet IP address to 192.168.114.1 and auto-running the WDNU Python application. The custom default settings are stored in the defaults.rci file under the Customization Management section of the Customization Administration web page. There is also a template defaults.rci file under the Customization Settings section of the page. The template defaults.rci is the released defaults.rci for the WDNU, and can be changed by uploading a new defaults.rci in the Customization Settings section.

5.3.2 Configuration File

Some of the settings related to the web UI can be customized using the Configuration File config.ini. A template for this file is in the Customization Settings section of the Customization Administration web page. This file includes settings for company and product information, tech support links and logo and stylesheet resources.

5.3.3 Stylesheet

The CSS stylesheet used by the web UI can also be customized. A template stylesheet can be retrieved from the Customization Settings section of the Customization Administration web page. The template includes comments that describe where each group of style settings is used.

5.4 Python

The WDNU can be customized using the Python programming language. The Python interpreter can be invoked from the CLI with the `python` command. A Python application was developed for the WDNU to support the CHIP service. Python applications and other files can be loaded and viewed using the Applications->Python page in the web UI. Much more information about Python on Digi products is available on the web at http://www.digi.com/wiki/developer/index.php/Python_Wiki.

5.5 Startup Sequence

During boot the WDNU runs Power On Self Test (POST). This tests RAM, flash, and the validity of the firmware image. It also runs BIT, where it tests the physical and logical connections to the Wi-Fi and cellular interfaces and both SIM cards. BIT is described further in SDRL E005. The results of the BIT test can be retrieved with the Transmit BIT Results CHIP command. Once booted, the Wi-Fi transceiver is off, the cellular radio is on and the CHIP server application is running. The WDNU uses the factory default settings on every boot, which is described more in section 5.3.

6. Detailed WDNU-specific description

6.1 CHIP

CHIP stands for the Command-Handler Interface Protocol. It was developed by GE for use on a communication network between a client and server. It defines the protocol used for communication between the host (such as the AHTMU) and the WDNU. It is defined in document YV2818.

6.1.1 CHIP Commands

CHIP contains a number of commands that can be used by the AHTMU to configure the WDNU, get BIT status, and setup a VPN.

6.1.1.1 *Generic Command*

One of the commands is the generic command. This command can be used to execute a standard Digi CLI command over the CHIP protocol. The command can be up to 1020 characters long and the response is the same as if the command had been executed directly on the command line, including blank lines and newline characters. The maximum size of the response data is 1022 characters and the response will be truncated to 1022 characters if necessary.

6.1.1.2 *Transmit BIT Status*

This command reports on the BIT status of the Wi-Fi and cellular interfaces. Note that this command switches the active SIM card.

6.1.1.3 *Configure Wi-Fi*

The WiFi radio can be configured by enabling the interface with the WiFi Interface Control command, and then configuring the interface with the Set WiFi Mode and Set WiFi Tx Power commands.

6.1.1.4 *Configure GSM*

The GSM radio can be configured by enabling the interface with the GSM Interface Control command, and then configuring it with the Set Active SIM Card command.

6.1.1.5 *Configure VPN*

The VPN can be set up by executing this CHIP command sequence:

1. Set Global VPN Mode
2. Set VPN Tunnel Options
3. Set VPN Phase 1 Proposal Options
4. Set VPN Phase 2 Proposal Options
5. Set VPN Interface ID.

6.1.2 *Python and CHIP*

The Python application implements the CHIP interface on the WDNu. This means the Python application is responsible for accepting CHIP command messages, translating the commands to the native format, executing the commands, and sending back the responses in CHIP ACK or data messages.

6.1.2.1 *Python application*

The Python application consists of three files: app.py, wdnapp.zip and python.zip. The CHIP handling is all in app.py. It basically consists of a CHIP server and a CHIP request handler. The CHIP server listens for a CHIP client on UDP port 49000. When a UDP message is received, the server creates a thread to execute the CHIP request handler. The CHIP request handler does general validation of the request message, and then executes the appropriate CHIP command handler routine. Wdnapp.zip contains support libraries for running the app. Python.zip is the standard Digi python.zip that contains only standard Python libraries which are used for running the app.

6.1.2.2 *Logging*

The Python application logs debugging information to the applogX.txt files. The files are limited in size to 32KB each, and to a total number of 6 files. The active log file is always applog.txt. When this file reaches 32KB, the oldest log file is removed, applog4.txt is renamed to applog5.txt, applog3.txt is renamed to applog4.txt, etc... and a new applog.txt file is created. The application logs information in memory about CHIP commands it receives, but the log messages are only written to the log files when an error message is logged. This prevents unnecessary wear on the flash when there are no errors. An example of the log messages is shown below.

```
2010-07-09 13:19:17|=====
2010-07-09 13:19:17| Message 20: Executing message handler
2010-07-09 13:19:17| Message 20: 01 13 00 04
2010-07-09 13:19:17| Message 20: sequence number = 19
2010-07-09 13:19:17| Message 20: length = 4
2010-07-09 13:19:17| Message 20: message code = 1 (Command)
2010-07-09 13:19:17| Message 20: command = 0x0004 (Transmit Server Status)
2010-07-09 13:19:17| Message 20: long command valid = 0x010a (Report WiFi
Information and Statistics)
2010-07-09 13:19:17| Executing short running command handler
2010-07-09 13:19:17| 'Transmit Server Status' handler: Long running command
handler still running
2010-07-09 13:19:17| Sending: ACK - status: 'Busy' (5) msg: None
2010-07-09 13:19:17| Short running command handler execution complete
```

6.2 LRU update procedure

The WDNU BOOT, POST and EOS firmware can be updated using the CLI or the web UI, but only on the Ethernet interface. To update using the CLI, telnet to the WDNU and execute the `boot` command with the `load` option, with `host` set to the address of a TFTP server accessible from the WDNU, and `filename` set to the firmware update file. For example, if the TFTP server is at 10.35.1.50 and the firmware image filename is 82002543, it can be loaded onto the WDNU with the following CLI command:

```
#> boot load 10.35.1.50:82002543
```