



Adapt4 XG1 Radio Installation Manual



A4-00103-011-01, Rev. 0.7b
December 2, 2005

NOTICE

Adapt4, Inc. assumes no responsibility for any errors that may appear in this document, nor does it make any commitment to update the information contained herein. However, questions regarding the information contained in this document are welcomed.

Adapt4, Inc. also reserves the right to make changes to the specifications of the XG1 Series and to the information contained in this document at any time without notice.

This manual is not all inclusive of our products and services. The software and procedures discussed herein are continuously evolving just as are the requirements of our customers. Its format is informal, and hopefully will stimulate as many questions as it answers. Copies of cut sheets, engineering data, customer lists, installation guides, and test procedures are all available for further information.

© Adapt4, Inc.
605 N. John Rodes Blvd., Melbourne, FL 32934
Phone 321-259-5009 | Fax 321-259-4006
www.adapt4.com

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1.0 Overview

The XG1 Installation Software provides a tool that enables a field installer to configure an Adapt4 *XG1* radio as part of its installation in the field. The field installer “installs” the radio to make it capable of communicating on the correct network. Subsequently, the Network Operator will “commission” the site, possibly after the field installer has left the site. The commissioning process includes further configuring of the site over-the-air and coordinating the start of service with the end-user. When the site is commissioned, it may begin carrying end-user traffic.

The Installation Software normally runs on a laptop computer and has the following capabilities:

- Network configuration – Set the *XG1* radio configuration so that it can join the correct network. The network's Element Management System (EMS) will further configure the radio after it has joined the network.
- Software updates – Download new software distributions from the laptop to the radio.
- Antenna Pointing – Point the station's antenna using the laptop software's visual and audible indications of the signal strength received from the Base Station.
- Interface configuration – If applicable, configure the RS-232 serial ports.
- Channel Selection/Interference Blocking – Optionally, select blocks of channels to use and block out (“notch out”) frequency channels known to have interfering radio signals.

The above list of capabilities is also a brief outline of the tasks of installing the radio. More details will be given below.

Table 1.0-1 provides an equipment list needed to support use of the XG1 Installation Software.

Table 1.0-1: Items Needed to Connect Radio to Computer

1. Laptop with: • Windows 98 or later • Ethernet port • 128 MB RAM • Correct time/date set 2. Ethernet cable • Cross-over (if directly connected) • Straight-through (if connected via hub) 3. RS-232 cable (for testing user ports) • DB-9F, null cable or null adapter • XG1 Installation software
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Figure 1.0-1 illustrates an *XG1* radio network, which is comprised of three *XG1* radio Remote Sites and a Base Station (Hub). The Remote Sites are further comprised of an antenna, the *XG1* radio and end-user equipment. The end-user equipment is attached to the radio via Ethernet and/or RS-232 serial cables.

The Base Station comprises an antenna (typically omnidirectional), an *XG1* Base Station Radio, Ethernet and optional RS-232 serial cabling from the radio into a shelter or building. These cables connect to user host equipment. In addition, the Ethernet cable connects to the Element Management System (EMS) computer that manages the *XG1* radio network and provides a graphical user interface (GUI) to Network Operators.

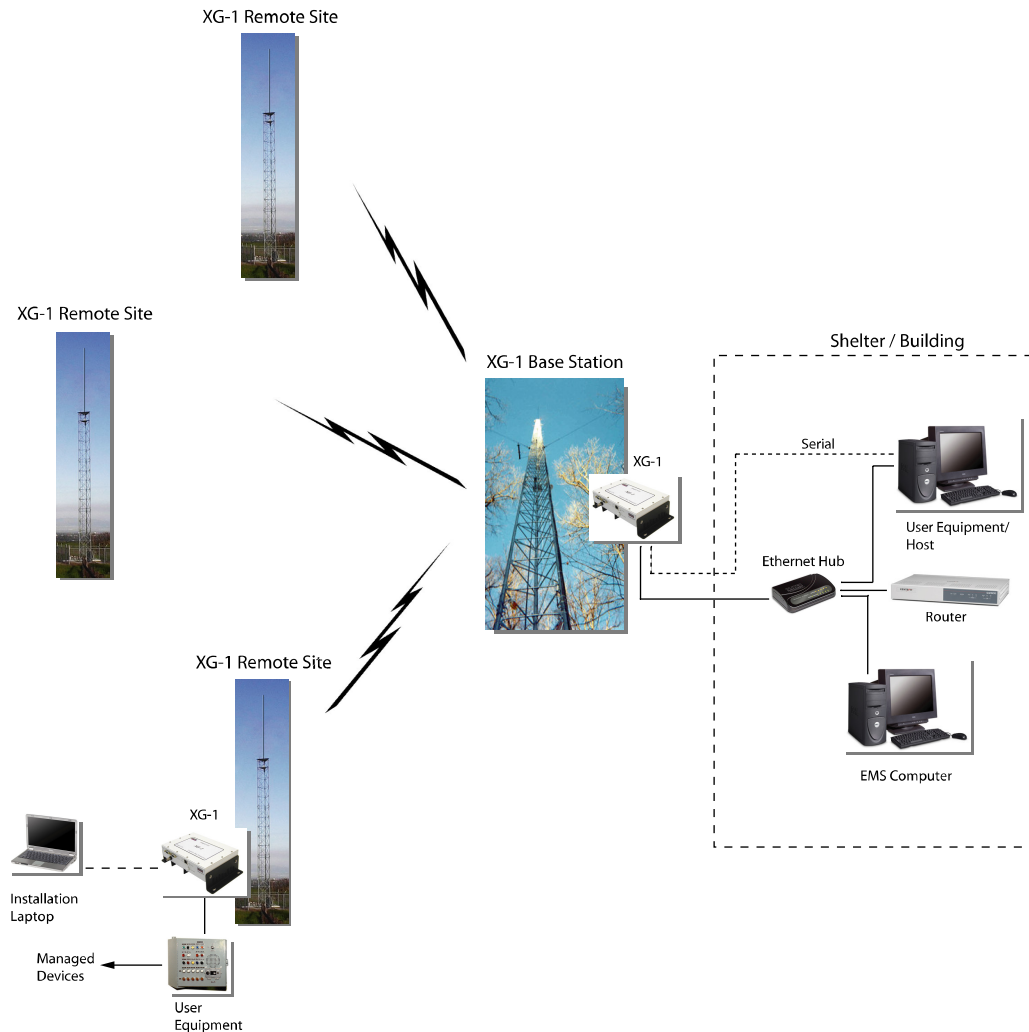
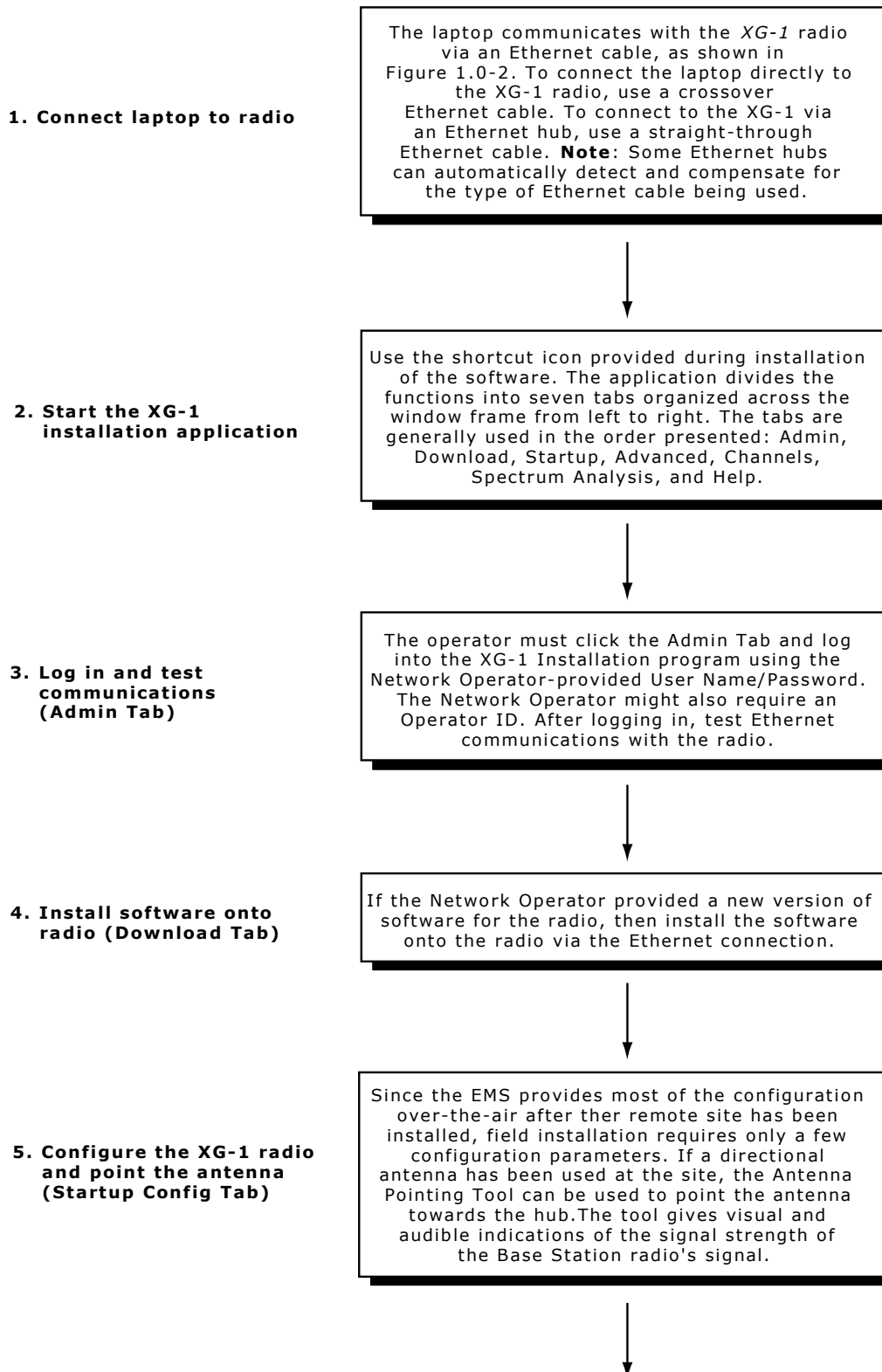


Figure 1.0-1: XG1 Radio Network

The Field Engineer performs the following basic steps to install a Remote Site XG1 radio:



**6. Configure RS-232 Ports
(Interfaces Config Tab)**

If the user application requires RS-232 serial ports, use this tab sheet to configure the ports.

**7. Configure Channels to
be used in the network
(Channels Tab)**

Use this sheet to select the blocks of channels to be used in the network. (The blocks are lettered A to F.). Optionally, under the direction of the Network Operator, block out ("notch out") any channels to be avoided due to interference. (Usually the EMS blocks channels for the whole network and the field installers can skip this step.)

**8. View graphical
representation of spectrum
(Frequency Spectrum Tab)**

Use the Frequency Spectrum Tab to view a graphical representation of the entire spectrum in the band, showing frequencies in use by other networks.

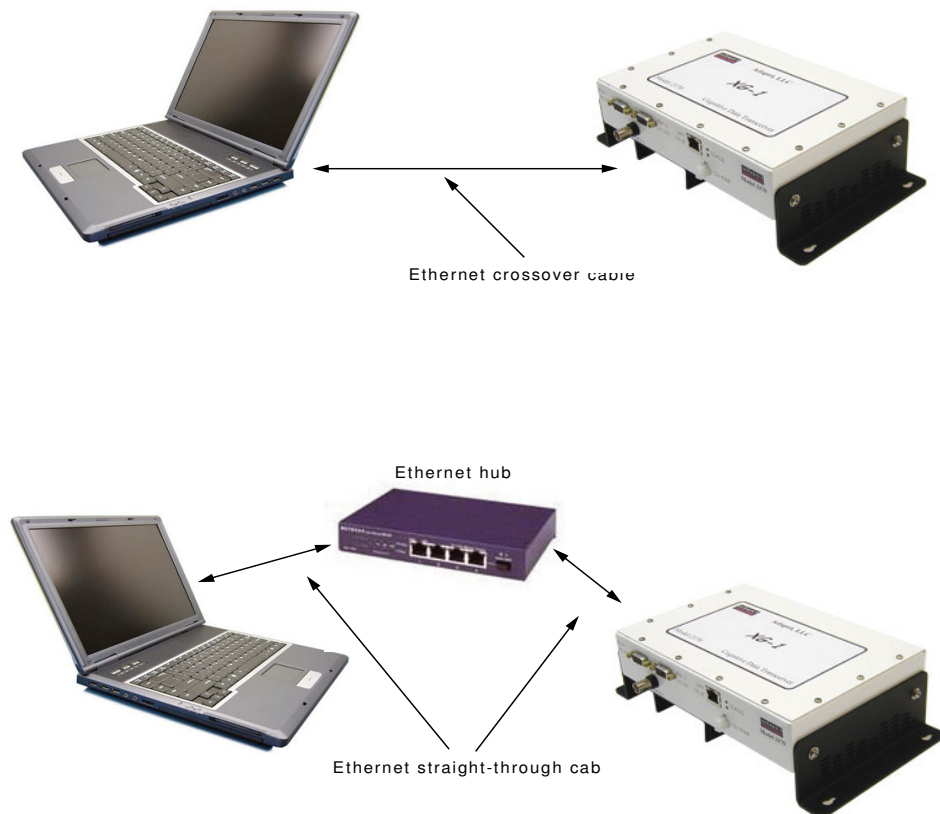


Figure 1.0-2: Connecting XG1 Radio to a Laptop

1.1 Admin Tab

General: Use the Admin tab (Figure 1.1-1) to log onto the XG1 radio Installation Software for operator authentication and to test communications with the radio connected to the laptop via the Ethernet port. In addition, the operator may save some default configuration parameters (such as the default radio IP address) for convenience during subsequent installations.

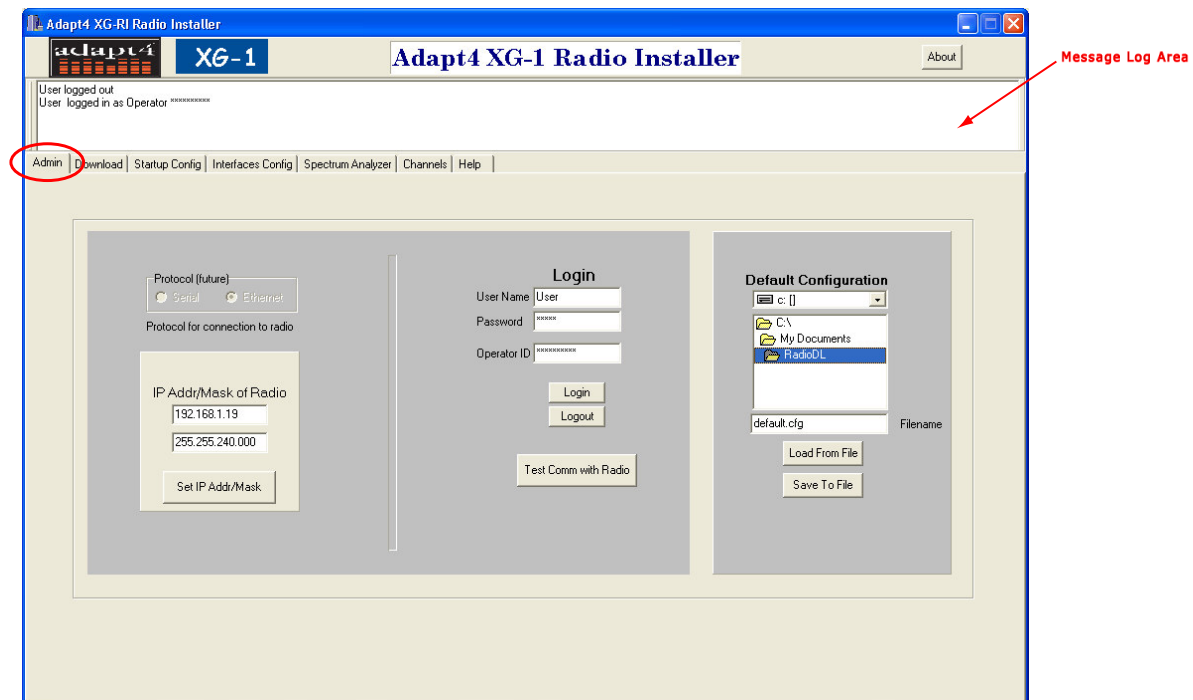


Figure 1.1-1: Admin Tab

Login – Enter your User Name and Password (provided by Network Operator). Optionally, enter your Operator ID, also provided by the Network Operator. Click the **Login** button. (Later, click **Logout** to cancel your session.) A message will be sent to the EMS that an operator has logged in. A message will appear in the Message Log area of your screen. (The User is the user login name for all users of the software. The Operator ID is unique for the individual user.)

Test Communications with Radio – Enter the IP address and IP mask of the radio. The default values for an unconfigured radio are IP address (10.255.0.1) and mask (255.255.240.0). This address can be used for configuring the radio only. Your laptop must be configured on this IP subnet as well. Use the Network Connect tool on the Windows Control Panel to set the static IP address (instructions vary with Windows version).

Click the **Test Comm with Radio** button to verify that you have communications with the radio via the Ethernet port. A message will be displayed in the Message Log area when the test message is sent to the radio. If the radio replies successfully, a “From Radio: test reply” message will be displayed.

Save Default Configuration – To save your configuration (at any time) come to this tab, select a directory in the directory box, and click the **Save To File** button. At some time later, restore this

configuration by clicking the **Load From File** button. This stores the laptop installation application configuration, not the radio configuration. The configuration items stored are default IP address/mask of radio.

1.2 Download Tab

General: Use this tab to install (download) new software onto the *XG1* radio, if the Network Operator provided a new version of software. The laptop sends this software to the radio via the Ethernet connection.

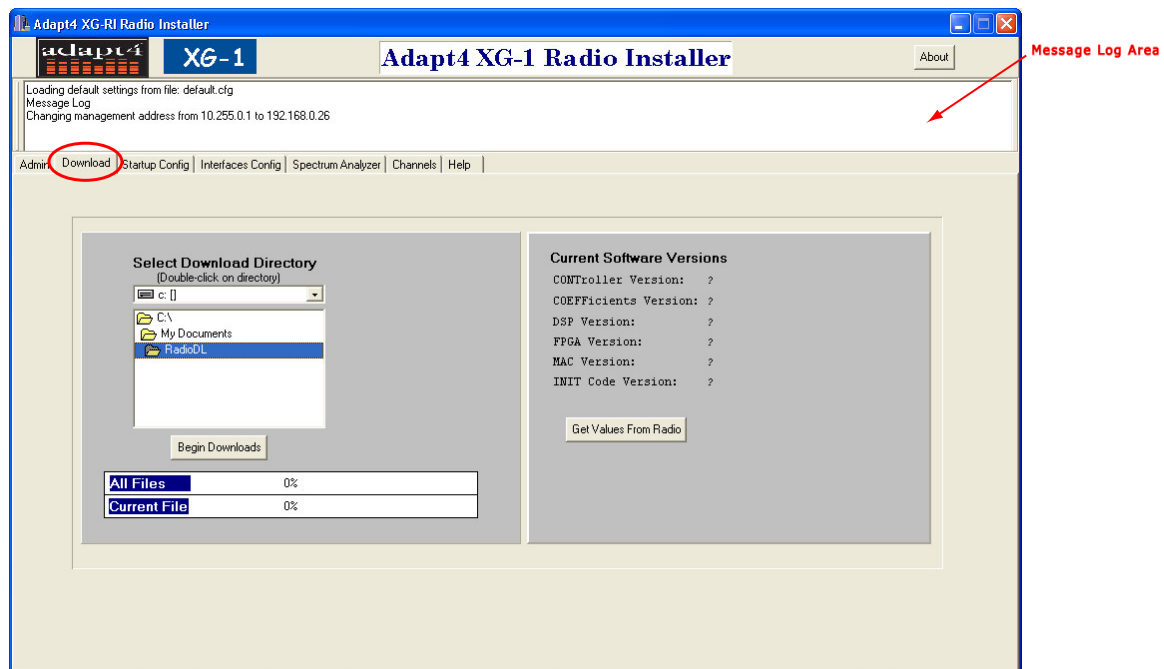


Figure 1.2-1: Download Tab

Procedure

1. Copy the software directory to be downloaded to the radio into a folder on your laptop or desktop computer. Only one revision of software should be placed in a directory.
IMPORTANT: Adapt4 distributes the files in a single directory, which will have a name that indicates the software release. The directory *must* be kept intact; the Downloader will reject the directory if it is not kept intact.
2. From the **Select Download Directory** box, select the drive and folder containing the software release to be installed in the *XG1*.
3. Click **Begin Downloads**. The progress of the downloads will be shown via the **All Files** and **Current File** progress indicators. The file names will be listed in the Message Log area.

To determine the current software version of every software file in the radio, click **Get Value From Radio** from the Current Versions panel. Table 1.2-1 describes the download files.

Table 1.2-1: Description of Download Files

EMS: Download Tab	Description	Type
ControllerVersion	Version of Dig Microprocessor Firmware	Read-only text
CoefficientsVersion	Version of Coefficients File	Read-only text
DSPVersion	Version of DSP Firmware	Read-only text
FPGAVersion	Version of FPGA code	Read-only text
MACVersion	Version of MAC Software	Read-only text
InitVersion	Version of Initialization Software	Read-only text

1.3 Startup Config Tab

General: Use this tab to give the *XG1* radio the minimum network configuration that it needs to join (become part of) the network. After the radio has this information, it will receive further configuration over-the-air from the EMS. The radio needs the proper Network ID to join the network and needs the Radio Function to perform the correct role: Hub (Base Station), Remote, Mobile/Remote, or Digipeater/Remote. These configuration values will be provided by the Network Operator. The radio joins the network by looking for special transmissions (preambles) containing the Network ID.

The installer also uses the Antenna Pointing Tool on this tab to point the Remote Site's directional antenna towards the Base Station (Hub).

Note: The Channel Set must be set before the radio can become operational; this is described in the Channels Tab section

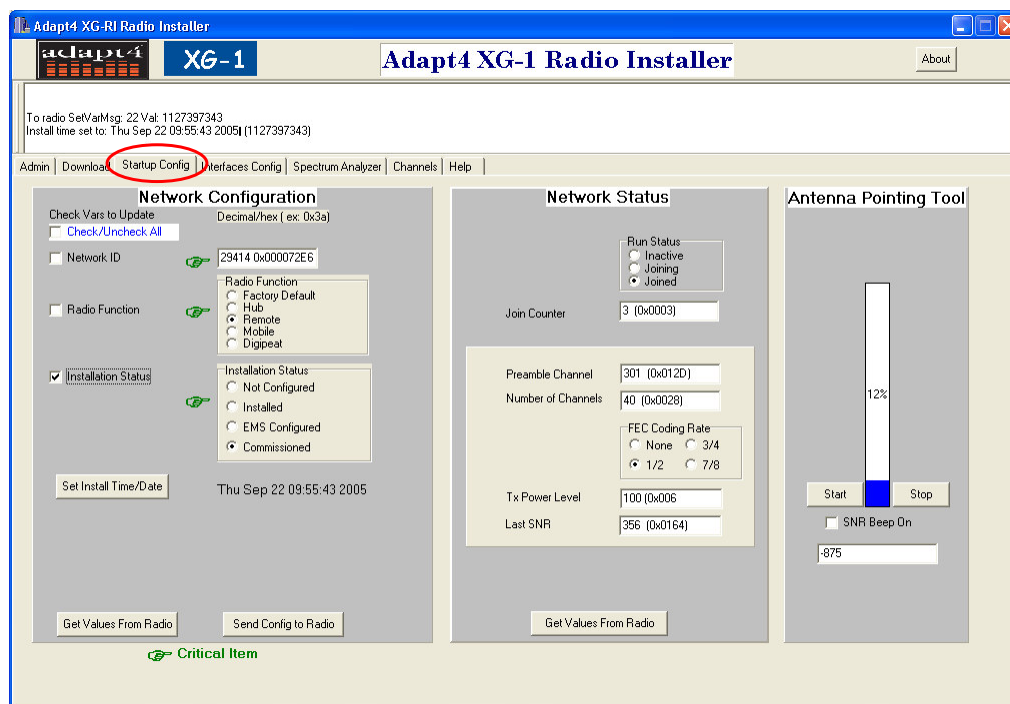


Figure 1.3-1: Startup Config Tab

1.3.1 Network Configuration Panel

1. Set the **Network ID** and **Radio Function** fields:

- Enter the **Network ID** in decimal or hexadecimal (beginning with “0x”). For example: 25238 (decimal) or 0x6296 (hexadecimal). These two example values are equivalent (refer to the same network).
- Click the **Network ID** checkbox (if it is not already checked).
- Select a radio type by clicking the appropriate option (**Factory Default**, **Hub**, **Remote**, **Mobile**, or **Digipeat**) in the Radio Function area.
- Click the **Radio Function** checkbox (if it is not already checked).
- Click the **Send Config to Radio** button.

2. Set the Installation Status

When the Field Installer has completed all steps and the field installation is complete, return to this tab and set the installation status of the radio via the **Installation Status** field. The Field Installer indicates that the radio is installed and ready for further configuration from the EMS (which might not happen until after the Field Installer has left the site) by setting the **Installation Status** field to the **Installed** value.

- Deselect the **Network ID** and **Radio Function** checkboxes by clicking them.
- Click the **Installed** radio button in the Installation Status area.
- Click the **Send Config to Radio** button.
- Click the **Set Install Time/Date** button to record the installation's time and date.

Note: The EMS operator will set the **Installation Status** field to **Commissioned** (over-the-air) after the EMS has further configured the radio - possibly after the Installer has left the location.

The present values stored in the radio can be retrieved by selecting all the checkboxes (or clicking the **Check/Uncheck All** checkbox) and clicking the **Get Values from Radio** button.

1.3.2 Network Status Panel

Use this panel to determine if the radio has joined the network. (This can happen before being configured by the EMS; however, user traffic will not pass over the network until the EMS configures the site.) Click the **Get Values from Radio** button in this panel. The network status will be displayed, including:

- **Run Status:** If Run Status is in the joined state, the radio has connected with the network
- **Preamble Channel** (changes frequently)
- **Number of Channels** (1-45)
- **FEC Coding Rate** (none, 1/2, 3/4 or 7/8)
- **Tx Power Level** (changes frequently)
- **Last SNR** (signal/noise ratio, which changes frequently)

1.3.3 Antenna Pointing Tool Panel

Click the **Start** button to start the tool. The tool will begin periodically polling the attached remote radio for its signal strength from the Base Station. The tool will show the relative strength

in a vertical bar graph, and if **SNR Beep On** is selected (and the laptop sound is enabled), a beep will sound at a rate proportional to the signal strength. This enables the Installer to adjust the antenna without viewing the laptop screen.

Table 1.3-1: Description of Startup Config Tab Fields

EMS: Startup Config Tab	Description	Type
Network ID	A value in every multicarrier transmission that identifies the network; determined by the network planner.	Read-write integer
FEC Rate	Forward error-correction rate (none, 1/2, 3/4, 7/8); used to correct transmission errors on the receiving side.	Read-write pick list
Number of Channels	The number of 6.25 Khz channels that all radios in the network will use (numbered from 0 to 479).	Read-write Integer (0-479)
Signal Strength (Antenna pointing tool)	Displays a vertical bar (and “beep” tone rate) that is proportional to the signal strength of the hub's preamble channel.	Read-only visual, aural and textual indicator
Run Status	Indicates whether or not a remote site is inactive, is trying to join the network, or has joined the network.	
Site ID	A unique site number for radio with network. Site ID usually equals last octet of site's IP address.	Read-only numeric

1.4 Interfaces Config Tab

General: Use the Interfaces tab shown in Figure 1.4-1 to configure the RS-232 serial port(s), if these are used in the end-user's application.

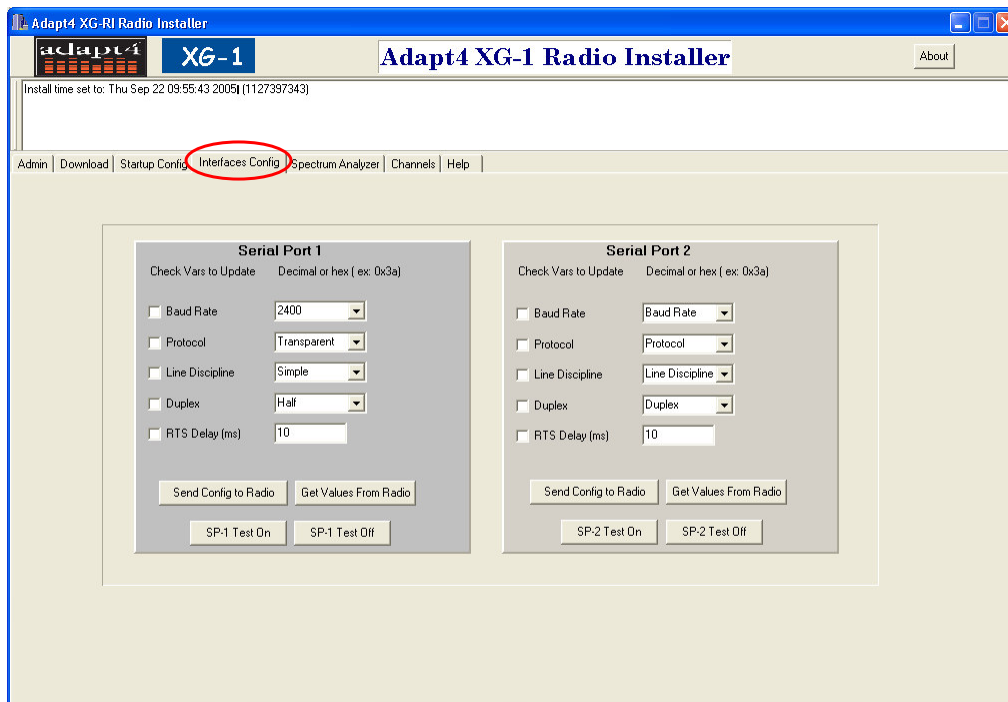


Figure 1.4-1: Interfaces Config Tab

Procedure for Serial Port Configuration

1. For each serial port being used, enter values for baud rate, protocol, line discipline, duplex, and RTS/CTS delay. See Table 1.4-1 for more information on these variables.
2. Click **Send Config to Radio** when all the variables have been defined to configure serial port.
3. A test fixture may be used to test the serial ports. For further information, contact Adapt4.

Table 1.4-1: Serial Port Configuration

Option	Description
Baud rate	Serial port baud rate; standard rates are 1200, 2400, 9600, 19200 and 38400 baud.
Protocol	Port protocol: Transparent, Data Flow Systems, Modbus, Modbus ASCII, or DNP.3
Line Discipline	2-wire, RTS/CTS Signaling, or Full RS 232 Signaling
Duplex	Half or Full Duplex
RTS/CTS delay	A delay between receipt of RTS and the subsequent issue of CTS – used in some protocols

1.5 Channels Tab

General: The Channels tab, shown in Figure 1.5-1, provides two functions: selecting the Channel Set(s) assigned to the network and blocking out (“notching out”) channels that have known interference sources. The Network Operator will provide the Channel Set(s) to use and may provide a list of channels to block.

A Channel Set is a pre-defined set of channels that a radio may use in its channel hopping sequence; all sites in the network must have the same Channel Set. Adjacent networks should use different Channel Sets in order to avoid co-interference. This is one reason why the Network Operator must coordinate remote site installations.

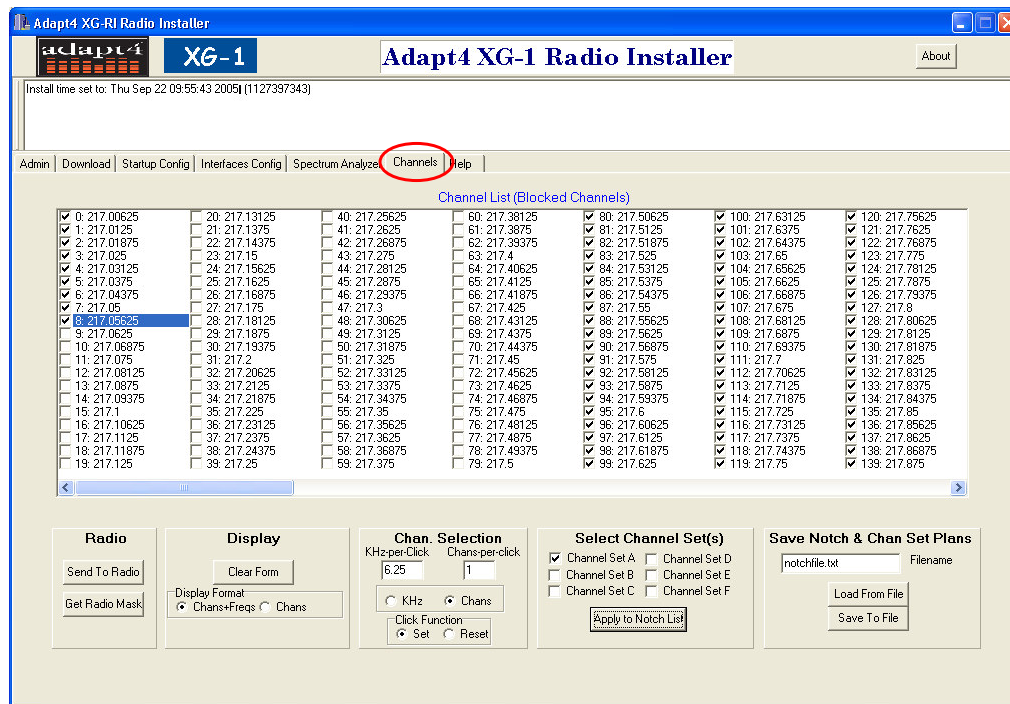


Figure 1.5-1: Channels Tab

In the figure above, the list of channel checkboxes (the “channel list”) represents the 6.25 KHz channels that have been blocked from use. If you click on a checkbox and put it in the checked state, that channel is blocked (or “notched out”). This is important to understand, because when you then select the Channel Sets to use, all other channels are checked and therefore blocked.

The channels in the Channel List can be displayed with the channel number only (you can see all channels at once), or it can be displayed with the channel number *and* frequency (you must use the scroll bar to see all channels). Select the option you want in the Display Format area. Figure 1.5-1 shows the channel number and frequency (**Chans+Freqs**) display format; Figure 1.5-2 shows a snippet of the Channel-only (**Chans**) display format.

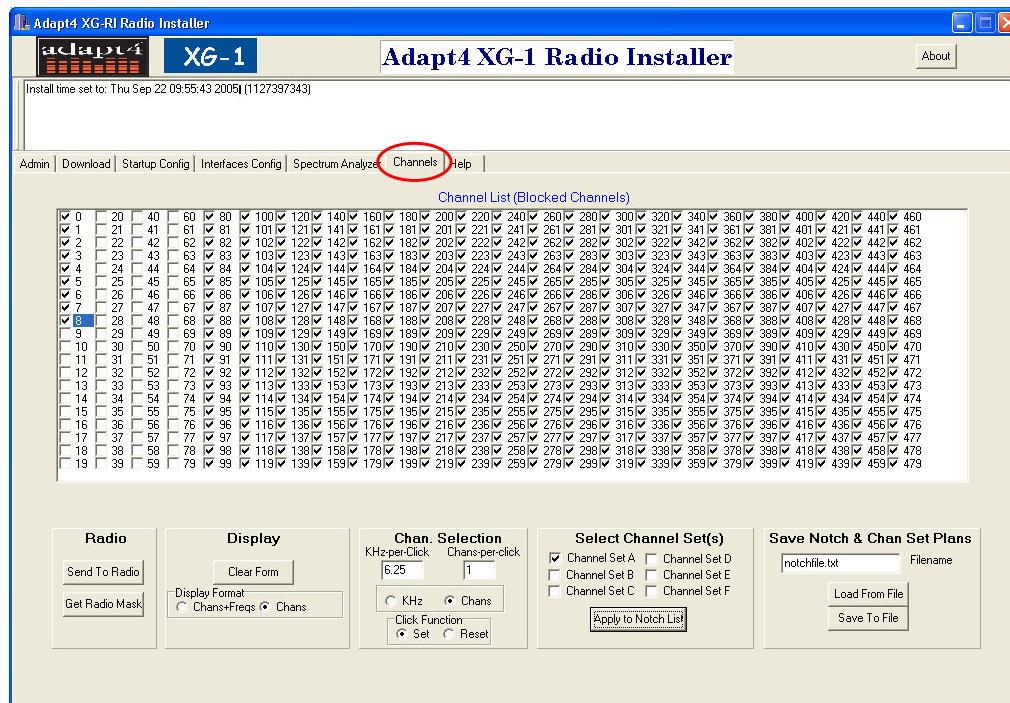


Figure 1.5-2: Channels Tab (Channel-only display format)

Note: Normally, blocking interference channels is only done at the Base Station, because that site sends the blocked channel information automatically to all remotes. However, the Channel Set must be selected at each remote site.

1.5.1 Most Common Steps To Use

- **Clear the Channel List Table:** Click the **Clear Form** button. This clears all checkboxes.
- **Retrieve a pre-stored configuration:** To use or modify a previously stored Channel List, load it into the Channel List Table by entering the file name in the **Filename** box and clicking the **Load From File** button. If that file is already appropriate for the site, send it to the radio by clicking the **Send to Radio** button.
- **Blocking out channels:** If you don't have a pre-stored file, or you want to change the present one, then block out the channels by clicking on them. (You can block multiple channels per click by using the advanced feature described below.)
- **Select the network's Channel Set:** Click one or more of the Channel Set checkboxes; the Network Operator will determine which ones are to be used in the network. (All sites must agree.). After selecting the Channel Sets, click the **Apply to Notch List** button. All channels not in the selected Channel Sets will be blocked. (The associated checkboxes will be checked.) If you make a mistake, clear the form by clicking the **Clear Form** button and begin again.
- **Send Channel List to radio:** When you are satisfied with the channel list, send it to the radio by clicking the **Send to Radio** button.

- **Store the channel list:** Optionally, you can store your channel list on your laptop for later use at another site by entering a file name in the **Filename** field and clicking the **Save To File** button.

1.5.2 Advanced features:

1.5.2.1 Retrieve Blocked Channel List from Radio (Radio Panel)

If a blocked channel list has been stored in a radio, you can retrieve it, operate on it as described above, and either write it back to the radio and/or store it on the laptop. To retrieve a Channel Blocked list from the radio, click the **Get Radio Mask** button. You can further edit this list using the methods describe in the previous section.

1.5.2.2 Blocking Multiple Channels At A Time (Chan. Selection Panel)

Select Set on the Click Function group. Enter the number of channels that you want to select per click in the Chans-Per-Click field. When you then click on a channel in the Channel Table, that number of channels will be selected. If the number of channels is odd, the channel you select will be the center channel. If the number of channels that you select is even, the channel that you click will be the upper of the two center channels and the lower channels will get one more channel than higher channels. Figure 1.5-3 illustrates the example of blocking channels 42-45. The Chans-per-click field is set to 4 and Chans is selected. If channel 44 is clicked, the channels 42-45 will be blocked (checked).

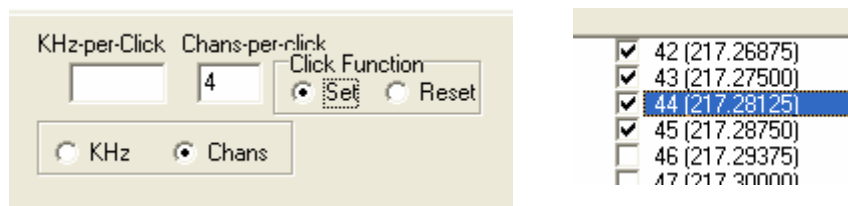


Figure 1.5-3

1.5.2.3 Blocking A Frequency Range

This is similar to blocking a range of channels, except that the amount of bandwidth to block is measured in KHz. Select **Set** in the Click Function area, select **KHz** as type of range, and enter a value in the **KHz-per-Click** field. Some standard ranges are: 6.25 KHz, 12 KHz and 25 KHz, but non-standard ranges may be used. When you click on a checkbox in the channel list after setting these values, the equivalent number of channels is blocked.

1.6 Spectrum Analyzer Tab

General: A unique feature of the *XG1* radio is that it does a distributed/network-wide spectral analysis of each band. Each Remote Site contributes its local view of the spectrum and the Base Station creates a composite view. This screen plots 480 channels of the band and shows a graphic representation of the detected RF energy (log 10 of the signal strength reported by the radio).

Note that the radio gathers this information only while no radios in the network are transmitting. Therefore, the plot shows potential interference and can be used to roughly validate the choice of Channel Set and Blocked Channels.

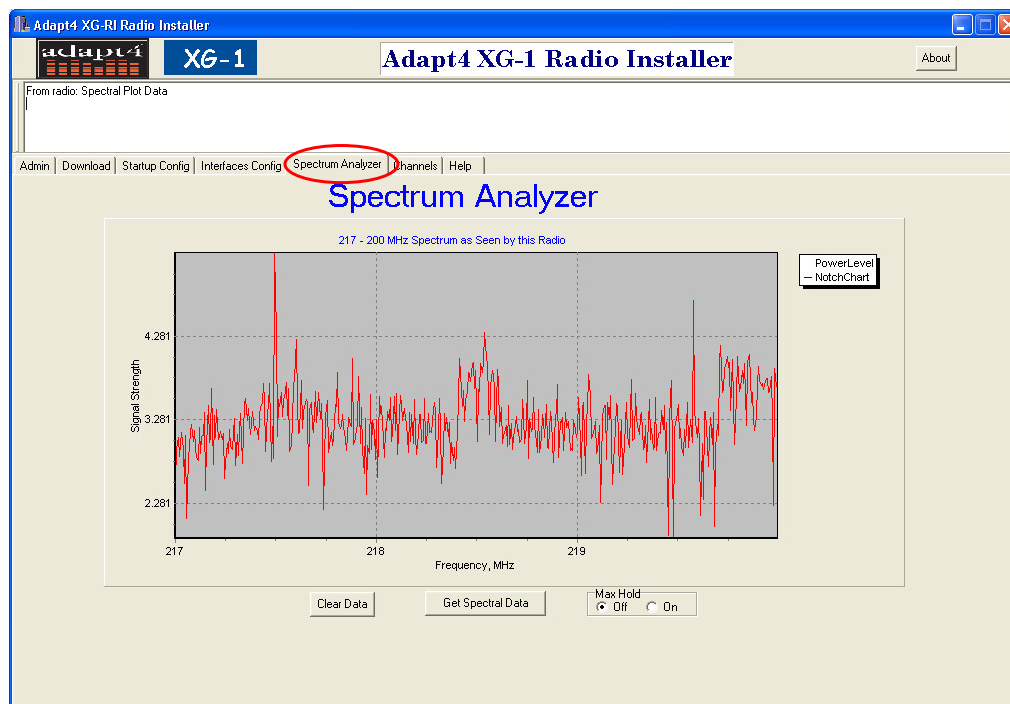


Figure 1.6-1: Spectrum Analyzer Tab

Usage

- Click **Get Spectral Data**. The most recent spectral information from the radio is plotted.
- Click **Clear Data** to clear the screen.
- **Max Hold** behaves much like a similar control on a Spectrum Analyzer instrument. It keeps the highest value for each plot point over time until either **Clear Data** is clicked or **Max Hold** is set to **Off**.
- You can zoom in on the plot, as shown in Figure 1.6-2, by dragging the mouse from upper left to lower right. Do the reverse to zoom back out.

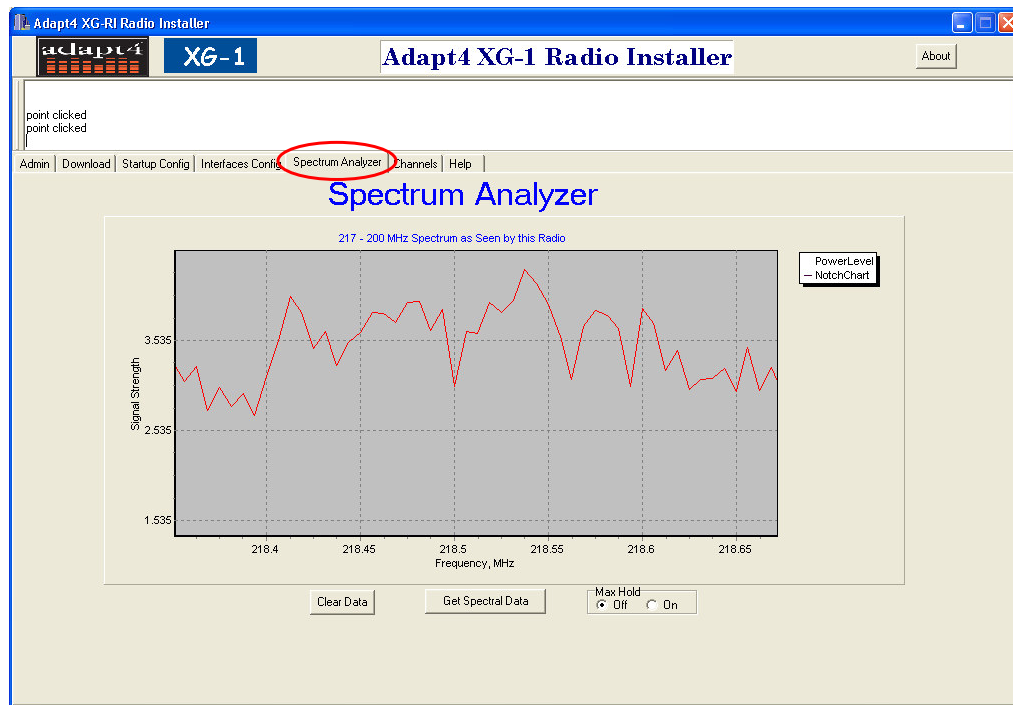


Figure 1.6-2: Zoomed In Plot

1.7 Summary

Now that the Remote Site is installed, it is ready for commissioning by the Network Operator so that it may begin transferring user traffic over the radio network. The Adapt4 radio network appears like an Ethernet switch, so that it can transparently support most layer-3 protocols, such as IP and IPX. As shown in Figure 1.7-1, a Remote Site may communicate with a host computer connected to the Base Station via a local network, or via the Internet. Remote Sites may communicate peer-to-peer, but the traffic must go through the Base Station and through an Ethernet switch or IP router. The traffic may be bidirectional or unidirectional (or both with a mixture of applications).

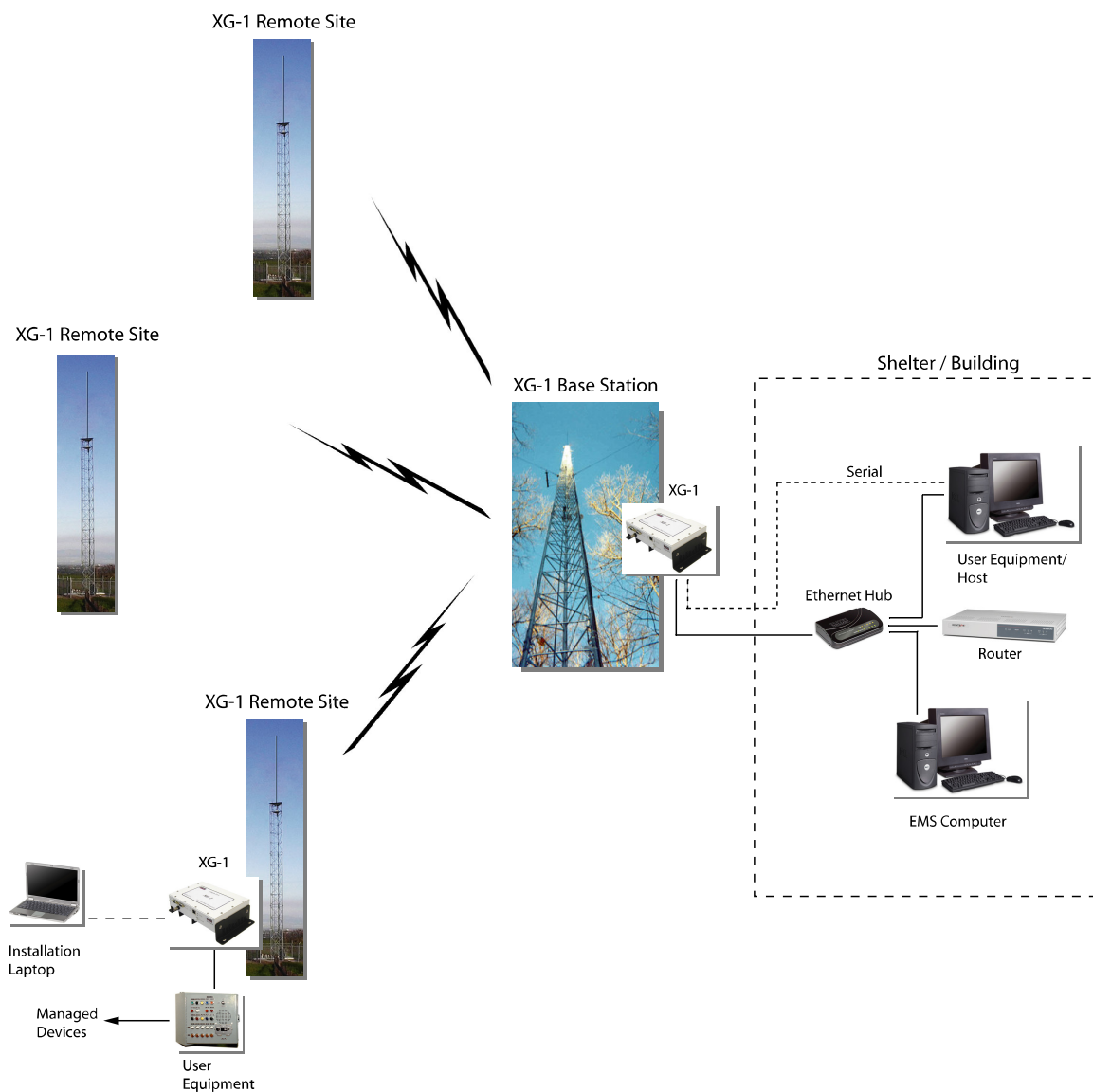


Figure 1.7-1: XG1 Network

Glossary

EMS (Element Management System): Computer and software at the Base Station that is used to monitor, control, and configure the radio network.

Install Time/Date: When you have completed the installation of the Remote Site, you can record the time and date by checking the **Install Time/Date** checkbox (Startup Config tab) and clicking the **Send Config to Radio** button. The time will be taken from your computer's system time, so you will want to verify that it is correct.

Installation Status: After the Remote Site is installed and ready to be commissioned and configured from the Base Station's Element Management System, set the **Site_Status** value to "Installed." This status indicates to the Network Operator that the field installer has completed all tasks needed for the radio to begin service.

Network ID: A value used in radio transmissions to identify the network. This value should differ from the Network ID in all surrounding, nearby networks. A system administrator will assign the proper value for the network.

Radio Function: Set to "Remote" for a Remote Site and "Hub" for a Base Station.

Tx Power Level: This value can be used to set the radio transmit power, if needed. It is not possible to set the value above the maximum allowed. The values are in tenths of a dB. The practical range is -1000 (lowest power) to 0 (nominal). On the form, enter a negative number, such as -52 for a 5.2-dB reduction in power.

Operational and Safety Warnings



RF Exposure

The equipment described herein emits radio frequency (RF) energy and requires professional installation. Although the power emitted is two watts or less, care should be taken to use the radio equipment properly to avoid the concentrated radio frequency energy near an antenna, especially a directional antenna (for example, a *yagi* antenna). No person should be within 81 centimeters (32 inches) of the antenna when the radio is transmitting. This includes indoor, outdoor and mobile use of the radio equipment.

FCC Part 15 Compliance

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE CONDITION THAT THIS DEVICE DOES NOT CAUSE HARMFUL INTERFERENCE.

NOTE: the manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

Questions or Comments on This Manual

If you find a problem with any of the information in this manual or have suggestions on how it could be improved, please contact us at the address below:

Adapt4, Inc.
Documentation Department
605 N. John Rodes Blvd.
Melbourne, FL 32934

Alternatively, e-mail us at: sales@adapt4.com



Adapt 4, Inc.

605 N. John Rodes Boulevard
Melbourne, FL 32934

(321) 751-2811

www.adapt4.com

info@adapt4.com