

Ripwave™ Base Station

Installation & Commissioning Guide

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Proprietary

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About This Document

Purpose

This document provides a Navini-certified Installation & Commissioning Technician or Field Engineer with instructions to properly install the Base Transceiver Station (BTS), Radio Frequency Subsystem (RFS), and cabling; and to test and commission the Base Station after installation.

Revision History

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Safety

To optimize safety and expedite installation and service, read this document thoroughly. Follow all warnings, cautions, and instructions marked on the equipment and included in this document.

To aid in the prevention of injury and damage to property, cautionary symbols have been placed in this document to alert the reader to known potentially hazardous situations, or hazards to equipment or procedures. The symbols are placed before the information to which they apply. However, any situation that involves heavy equipment and electricity can become hazardous, and caution and safety should be practiced at all times when installing, servicing, or operating the equipment.



Caution Symbol - possible equipment or property damage



Warning Symbol - could cause personal injury or otherwise be hazardous to your health

Navini Networks, Inc., expressly requires that when using Navini electronic equipment always follow the basic safety precautions to reduce the risk of electrical shock, fire, and injury to people and/or property.

1. Follow all warnings and instructions that come with the equipment.
2. Do not use the equipment while you are in a bathtub, shower, pool, or spa. Exposure of the equipment to water could cause severe electrical shock or serious damage to the equipment.
3. Do not allow any type of liquid to come in contact with the equipment. Unplug the equipment from the power source before cleaning. Use a damp cloth for cleaning. Do not use any soaps or liquid cleaners.
4. Follow all airport and FAA regulations when using the equipment on or near aircraft.
5. Only operate the equipment from the type of power source(s) indicated in this manual (110 VAC or Navini supplied battery). Any other type of input power source may cause damage to the equipment.
6. Power the equipment using only the battery or the AC adapter cable provided, and in accordance with the instructions specified in the User Guide.
7. Do not use a frayed or damaged power cord. Do not place the power cord where it can be stepped on or tripped over.
8. Do not touch wires where the insulation is frayed or worn unless the equipment has been disconnected from its power source.
9. Do not overload wall outlets, power strips, or extension cords. This can cause serious electrical shock or fire.
10. Do not place the equipment on an unstable surface. It can fall and cause injury or damage to the equipment.

11. Do not disassemble the equipment. Removing covers exposes dangerous voltages or other risks and also voids the warranty. Incorrect reassembly can cause equipment damage or electrical shock. Only an authorized repair technician should service this product.
12. Do not expose the equipment to extreme hot or cold temperatures.
13. Do not use the equipment under the following conditions:
 - ?? When the equipment has been exposed to water or moisture.
 - ?? When the equipment has been damaged.
 - ?? When the power cord is damaged or frayed.
 - ?? When the equipment does not operate properly or shows a distinct change in performance.

Regulatory Information

FCC Notice



WARNING! This device is a Radio Frequency transmitter. It is required to comply with FCC RF exposure requirements for transmitting devices. A minimum separation distance of 2 meter or more must be maintained between the antenna and all persons during device operations to ensure compliance with the FCC's rules for Radio Frequency Exposure. If this minimum distance cannot be maintained, exposure to RF levels that exceed the FCC's limits may result.

INFORMATION TO USER

This device has been authorized as a radio frequency transmitter under the appropriate rules of the Federal Communications Commission. Any changes or modifications not expressly approved by Navini Networks could void the user's authority to operate the equipment.

UL & NEC/CEC Regulations

1. The Ripwave BTS must be installed in accordance with NEC/CEC Articles 800/810/830.
2. As a minimum, all DC power leads and bonding/grounding straps shall be 6 AWG copper conductors.
3. GPS, RF, and power/data cables in excess of 140 feet in length must have protective devices installed that are UL listed to UL 492, UL497A or UL497B, UL497C, and UL1449.
4. If lightning protection is required, the device(s) must comply with UL497.
5. Power supplies should be UL listed to UL60950 or UL60950-1 and have earthed SELV output.
6. Ethernet connections require a UL497B listed protection device to be installed between the BTS and the first network device. T1 connections must be routed from the BTS through a UL497 listed protection device at the demarcation point.
7. T1 interconnect cables between the BTS and demarcation point must be a minimum of #26 AWG wire, in accordance with NEC/CEC standards.
8. All power and ground conductors must be mechanically supported to avoid strain of the wires and connection points.
9. A UL listed disconnect device, such as a circuit breaker or fuse, must be installed between the power supply and BTS chassis connections.
10. Power-interconnect wires between the power supply/recitifier and the BTS Digital chassis must have heat shrink tubing applied over the barrel of the terminal lugs after crimping the wire. A picture is provided in the "Installation" section of this manual.
11. If it is necessary to replace a fuse on a CHP, CC or PA board, a fuse of the same type and with the same rating must be used to insure continued protection against risk of fire.

Battery Caution & Procedures



WARNING! To reduce risk of injury or fire, follow these instructions when handling the battery.

1. Risk of explosion is possible if the battery is replaced with one not supplied by Navini Networks.
2. Do not dispose of the battery in a fire. It may explode. Check with the local codes for battery disposal guidelines.
3. Do not open or mutilate the battery. The battery contains substances that are toxic, corrosive, or harmful to humans. If battery substances come in contact with the skin, seek medical help immediately.
4. Do not attempt to recharge the battery by any means except per the instructions in this manual.
5. Remove the battery from the equipment if the equipment is not going to be used for a long period of time. The battery could leak and cause damage to the equipment.
6. Exercise care when handling the battery to prevent shorting the battery with conducting materials such as bracelets, rings, and keys.
7. Store the battery pack in a dry place, 0 to +40 degrees Celsius.
8. Dispose of used batteries according to environmental guidelines.

Glossary of Terms & Abbreviations

Term	Stands For....	Meaning
802.11	802.11 Standard	An IEEE LAN standard for wireless Ethernet replacement technology in the ISM band. Runs at up to 10 Mbps.
ACC	Access Channel or Access Code Channel	AKA, Paging Channel. The signal path that tells a mobile to prepare for an incoming call.
ACK	Acknowledge	Positive message sent by a protocol to acknowledge reception of a transmitted packet
AP	Access Point	Wireless LAN transceiver that acts as a center point of an all-wireless network or as a connection point between wireless and wired networks.
AMI	Alternate Mark Inversion	Old method for encoding data on a 64 kbps channel, which requires 8 kbps to maintain synchronization, leaving only 56 kbps available to transmit data
ARP	Address Resolution Protocol	The function of the ARP is to match higher-level network IP addresses with the physical hardware address of a piece of equipment.
ARQ	Automatic Repeat reQuest	A protocol for error control in data transmission that automatically requests the transmitter to resend a packet when the receiver detects an error in the packet.
ASYNCH	Asynchronous	Not occurring at regular intervals, as in data piped over a network
AWG	American Wire Gauge	A measure of thickness of copper, aluminum or other wiring in the U.S.
ATM	Asynchronous Transfer Mode	Transporting a broad range of user data at irregular intervals over network facilities
B8ZS	Bipolar 8-Zero Substitution	An encoding method used on T1 circuits that inserts two successive ones of the same voltage - referred to as a <i>bipolar violation</i> - into a signal whenever eight consecutive zeros are transmitted.
BB	Broadband	RF system with constant data rate of 1.5 Mbps or higher.
BBU	Battery Backup Unit	Equipment used to keep a BTS operating in the event of a power outage
BCC	Broadcast Code (or Control) Channel	A channel of data transmitted by one entity and received by many devices.
BoM	Bill of Materials	List of the actual equipment to be manufactured and shipped to the installation site.
BS	Base Station	Network Access equipment and software that transmits and receives, as well as processes, voice or data calls from mobile units to network connections. A Ripwave Base Station consists of the Base Transceiver Station (BTS) and the Radio Frequency Subsystem (RFS), or antenna, plus a Global Positioning System (GPS) antenna for timing.
BTS	Base Transceiver Station	The Ripwave BTS is a two-shelf rack that holds the RF modules and digital circuit cards that interpret radio signals into computer language and sends messages to and from the local or wide area network. It functions between the RFS and the EMS to handle the signaling.
BW	Bandwidth	Frequency spectrum usable for data transfers. It describes the maximum data rate that a signal can attain on the medium without encountering significant loss of power. Usually expressed in bits per second (digital) or Hertz (analog).
BYTE	Byte	8 bits

Term	Stands For....	Meaning
CAM	¹ Configuration & Alarm Manager or ² Content Addressable Memory	¹ An EMS functionality that is handled through a Graphical User Interface for purposes of configuring elements in the system and handling other OAM requirements. ² Module of the BTS software used to provide mappings of users to channels.
CBR	Constant Bit Rate	One of the two service categories available for the Management PVC in the ATM/T1 BTS configuration (the other one is UBR)
CC	¹ Communications Controller or ² Cross-check	¹ A type of circuit card that resides in the Digital shelf of the Ripwave BTS. It handles all interfaces between BTS and network. ² An EMS functionality that allows the system to perform an automated sanity check of the datafill.
CD	¹ Compact Disk or ² Change Directory	¹ An optical disk capable of storing large amounts of data (700x floppy disk). It can be inserted into most PCs and “read” to load files onto a computer ² A software programming term in “C” language that tells the computer to go to a different location in the computer’s memory.
CDMA	Code Division Multiple Access	Digital cellular technology that uses a spread-spectrum technique where individual conversations are encoded with a random digital sequence. Increases capacity and speed of communications messages between mobile units over other types of wireless networks.
CD-ROM	Compact Disk - Read Only Memory	See “CD.” If a CD is not Read Only, computers can write data to it with that capability.
CDVT	Cell Delay Variation Tolerance	Delay variation parameter required by UBR and CBR.
CHP	Channel Processor Card	A card in the digital shelf of the BTS that performs the first stage of signal processing for up to 4 antennae. One Navini 2.4 GHz BTS has 8 antennae. The card performs digital-to-analog conversion (DAC) and analog-to-digital conversion (ADC) for up to 10 carriers.
CLEC	Competitive Local Exchange Carrier	A telephone company that competes with an incumbent Local Exchange Carrier (LEC).
CLI	Command Line Interface	A text-based programming language through which a user communicates with an operating system or an application.
CORBA	Common Object Request Broker Agent	A standard for Network Management Systems that allows integration with NMS regardless of programming language or Operating System.
CPE	Customer Premise Equipment	Communications equipment that resides at the customer’s location.
D4	D4	A framing standard for traditional time-division multiplexing, which standard describes user channels multiplexed onto a trunk that has been segmented (framed) into 24 bytes of 8 bits each. (See also ESF.)
dB	Decibel	Unit of measurement for sound. A logarithmic expression of the ratio between two signal power, voltage, or current levels. A decibel is one-tenth of a Bel, a seldom-used unit named for Alexander Graham Bell, inventor of the telephone.
dBd	Decibel/Dipole	A ratio, measured in decibels, of the effective gain of an antenna compared to a dipole antenna (2 horizontal rods in line with each other). The greater the dBd value the higher the gain and therefore the more acute the angle of coverage.

Term	Stands For....	Meaning
dBi	Decibel/Isotropic	A ratio, measured in decibels, of the effective gain of an antenna compared to an isotropic antenna (measured along axes in all directions). The greater the dBi value the higher the gain and therefore the more acute the angle of coverage.
DHCP	Dynamic Host Configuration Protocol	A protocol for dynamically assigning IP addresses to devices on a network.
DiffServ	Differentiated Service	Different Quality of Service (QoS) descriptions for different types of traffic, i.e., voice, video, email. The DiffServ table is where each level of QoS is defined. Equivalent to Class of Service (COS) in POTS.
DIR	Directory	A special kind of file used to organize other files into a hierarchical structure.
DL	DownLink	In this case, data messages transmitted from the BTS to the CPE.
DNS	Domain Name Server	TCP/IP networking term that is a protocol for matching objects to network (IP) addresses.
DS-1	Digital Signal - 1	Also "T1" or "E1". Digital transmission equipment that can handle up to 1.544 Mbps.
DSL	Digital Subscriber Line	A type of service whereby users gain access to the Internet through high-speed data networks.
DSP	Digital Signal Processing/Processor	Compressing or manipulating analog signals to digital signals and vice-versa.
EID	Equipment Identifier	Field in EMS for assigning IP address or name to individual pieces of equipment for purposes of configuring the system.
EMS	Element Management System	An application that allows the user to define and manipulate managed objects as a system within an overall network.
enet	Ethernet	The most widely-installed local area network (LAN) technology. Ethernet is specified in the IEEE 802.3 standard and typically uses coaxial cable or special grade of twisted pair wires.
ERP	Effective Radiated Power	The actual power in Watts radiated from a transmitter's antenna.
ESF	Extended Superframe	In T-carrier, a synchronization frame that delineates 24 DS1 frames <i>Note:</i> ESF requires less frequent synchronization than the T-carrier D4 superframe format. (See also D4.)
FCC	Federal Communications Commission	United States government regulatory agency that supervises, licenses and otherwise controls electronic and electromagnetic transmission standards.
FE	Far End	A relative term that refers to the receiving element in a network, as opposed to the near-end element that is transmitting data.
FEC	¹ Forward Error Correction or ² Fast Ethernet Controller	¹ A system of error control for data transmission wherein the receiving device has the capability to detect and correct any character or code block that contains fewer than a predetermined number of symbols in error. ² A process created and attached during BTS booting for the 10/100 Ethernet ports on the BTS.
FTP	File Transfer Protocol	A TCP/IP method consisting of a client and server and used to transfer files between two or more sites or elements in a network.

Term	Stands For....	Meaning
Gain	Gain	Ratio of the output amplitude of a signal to the input amplitude of a signal, expressed in decibels (dB).
Gb	Gigabit	One billion (1,000,000,000) bits.
GB	Gigabyte	One billion (1,000,000,000) bytes.
GHz	Gigahertz	One billion (1,000,000,000) hertz - cycles per second. Ultra high frequency (UHF) signals, including microwave signals.
GPS	Global Positioning System	A constellation of 24 well-spaced satellites that orbit the earth and enable users with GPS antennas to pinpoint their exact geographical position.
GUI	Graphical User Interface	A graphic rather than purely text based user interface to a computer or computing system.
HW	Hardware	Physical, tangible equipment
Hz	Hertz	1 cycle per second.
I&C	Installation & Commissioning	Term used to describe the procedures of physically installing technical equipment then powering up the equipment to make sure it will operate (to put it "into commission").
IEC	Inter-exchange Carrier	Also IXC. Public switching network service provider (carrier) that connects across and between local exchange carriers (LEC).
IF	Interface Card	Card on the digital shelf of the Ripwave BTS that takes the analog signal from the Channel Processor card (CHP) and converts it to a baseband signal before sending it on to the RF modules for transmission (forward link), and vice-versa (reverse link).
IMA	Inverse Multiplexing over ATM	A method of building dynamic routes of 2 or more T1s to increase bandwidth so that PVCs can share the IMA resources, as needed, for data transmissions.
inet	Internet	A worldwide system of computer networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers.)
IP	Internet Protocol	A TCP/IP protocol used to route data from its source to its destination.
ISM	Industrial, Scientific and Medical	Unlicensed band around 2.4 MHz
ISP	Internet Service Provider	A company that provides access to the Internet.
Kb	Kilobit	1,024 bits
KB	Kilobyte	1,024 bytes
KHz	Kilohertz	1,000 hertz.
L1	Layer 1	Physical Layer. Part of the OSI rules and standards for network management. L1 describes the physical layer, or electrical and mechanical port-to-port connections, in the network.
L2	Layer 2	Data Link Layer. Part of the OSI rules and standards for network management. L2 describes the data link layer where data is set up and torn down in a specific format (frames), through the overall network. Also responsible for detecting and correcting errors by requesting retransmission.
L3	Layer 3	Network Layer. Part of the OSI rules and standards for network management. L3 describes the network addressing that gets data to its destination within the network, i.e., IP addressing.
LAN	Local Area Network	A data network of interconnected computers, servers, printers, and other peripherals that communicate at high speeds over short distances, usually within the same building. Also allows for sharing of resources.

Term	Stands For....	Meaning
LCP	Link Control Protocol	Basis of the Point-to-Point Protocol (PPP) scheme for negotiating and establishing connections.
LDF		see p.45
LED	Light-emitting Diode	An electronic device that lights up when electricity passes through it. Often used to indicate equipment or system state.
LLC	Logical Link Controller	A protocol that governs the transition of frames between data stations regardless of how the medium is shared. It's the upper sub-layer that further defines the Media Access Control (MAC) protocol. It provides the basis for an unacknowledged connectionless service on a LAN - i.e., error correction, multiplexing, broadcasting.
LMR		see p.45
LOS	Line-of-sight	Describes laser, microwave, RF, and infrared transmission systems that require no obstruction in a direct path between the transmitter and the receiver.
MAC	Media Access Control	Protocol that governs access to a network in order to transmit data between nodes. In a wireless LAN, the MAC is the radio controller protocol (L2).
Mb	Megabit	One million (1,000,000) bits.
MB	Megabyte	One million bytes. Literally - 1,048,576 bytes.
Mbps	Megabits Per Second	Transmission speed at rate of one million bytes per second.
MCBS	Multi-Carrier Beam Forming Synchronized	Multiple Access technology used by Navini Ripwave systems
MDM	Modem Card	A card in the Navini BTS that converts digital signals into analog so the signals can be transmitted over telephone lines, and vice-versa. Modem stands for modulator/demodulator.
MHz	Megahertz	One million (1,000,000) hertz - cycles per second. Normally used to refer to how fast a microprocessor can execute instructions.
MIB	Management Information Base	A collection of managed objects used in SNMP-based networks. MIBs carry information in a standard format so external tools can analyze network management and performance.
MMDS	Multipoint Multi-channel Distribution Service	Fixed wireless, high-speed local service that operates at 2.1 - 2.7 GHz. Speed 10 Mbps. Originally conceived for cable TV service.
MME		see p.92
NE	¹ Near-end or ² Network Element	¹ The transmitting end, versus the receiving end, of a signal transmission. ² A router, switch, or hub in an ISDN network.
NEC	National Electrical Code	Official rules and regulations that apply to the installation of electrical equipment in the U.S.
NF	Noise Floor	
NIC	Network Interface Card	A computer circuit board or card that is installed in a computer so that it can be connected to a network. Network interface cards provide a dedicated, full-time connection to a network.
NLOS	Non Line-of-site	Describes laser, microwave, RF, and infrared transmission systems that can penetrate obstructions in the path between the transmitter and the receiver.
NMS	Network Management System	A product that helps manage a network generally hosted on a well-equipped computer such as an engineering workstation. The system tracks network statistics and resources.
NOC	Network Operations Center	A centralized point, much like a traffic control tower, where technicians or engineers can monitor network activity, alarms, and statistics, as well as make network configuration and other changes dynamically. For Internet, the NOC is often a hub for ISP services.

Term	Stands For....	Meaning
OAM	Operation, Administration, Maintenance	A set of network management functions. Also describes the human-machine interface tasks - i.e., to operate the system, to administer the system, and to maintain the system.
OS	Operating System	A software program that manages the basic operation of a computer. Most Operating Systems are either based on
OSI	Open Systems Interconnection	An ISO model for worldwide communications that defines 7 layers of network protocol: L1 Physical Layer; L2 Data Link Layer; L3 Network Layer; L4 Transport Layer; L5 Session Layer; L6 Presentation Layer; L7 Application Layer.
OTA	Over-the-Air	A standard for the transmission and reception of application-related information in a wireless communications system.
PA	Power Amplifier	
PC	Personal Computer	Any IBM-compatible computer, so named because IBMs first commercial end user computer was called a PC.
PCB	Printed Circuit Board	A hardware module that holds electronic circuitry and usually fits into a larger frame where the various PCBs are interconnected electronically.
PDU	Packet Data Unit or Protocol Data Unit	A data packet. Refers to that which is exchanged between peer-layer entities. Contains header, data, and trailer information.
Ping	Ping	Generalized term from sonar science, where a short sound burst is sent out and an echo or "ping" is received. Used to determine if signals or packets have been dropped, duplicated, or reordered.
PPPoE	Point-to-point Protocol Over Ethernet	A protocol that allows dial-up Internet connections. Includes the Link Control Protocol as well as Network Control Protocols.
PRC	Peak Cell Rate	
Propagation	Propagation	To spread out and affect a greater area; travel through space, as in radio waves.
PSK	Phase Shift Keying	Digital transmission term that means an angle modulation where the phase of the carrier varies in relation to a reference or former phase. An encoded shift. Each change of phase carries one bit of information, where the bit rate equals the modulation rate.
PSN	Packet Switched Network	A network in which data is transferred in units called packets. Packets can be routed individually and reassembled to form a complete message at the definition.
PSTN	Public Switched Telephone Network	Typically used in the same context as POTS. Analogous to a network of major highways originally built by a single organization but added to and expanded by multiple organizations. AKA, backbone networks.
PVC	Private Virtual Circuit	A software-defined logical connection between end points in a network.
QAM	Quadrature Amplitude Modulation	A bandwidth conservation process routinely used in modems. Creates higher throughput but decreased coverage area.
QoS	Quality of Service	A guaranteed throughput for critical network applications, such as Voice over IP. Term primarily used in an ATM environment. Five classes of service: Class 1 Video; Class 2 Audio; Class 3 Data Connection.
RAM	¹ Random Access Memory or ² Responsibility Assign Matrix	¹ Computer memory that can be accessed randomly. ² A document created during the BTS installation and Commissioning, defining who is responsible for performing each task.
RBW	Resolution Band Width	A parameter set on the spectrum analyzer during insertion loss measurements

Term	Stands For....	Meaning
RF	Radio Frequency	A portion of the electromagnetic spectrum in the frequency range between audio and infrared: 100 KHz to 20 GHz. RF measurements are expressed in Hz (unit for measuring frequency); MHz = 1 Million Hz; GHz = 1 Billion Hz.
RFS	Radio Frequency Subsystem	A term for the antenna portion of the base station.
RH	Relative Humidity	The amount of water vapor in the air, given as the percent of saturation humidity, generally calculated in relation to saturated vapor density.
RMS	Root mean Square	The most common mathematical method of defining the effective voltage or current of an AC wave
RS	Reed-Solomon	Reed-Solomon codes are block-based error correcting codes with a wide range of applications in digital communications.
RSSI	Receiver Signal Strength Indicator	A term that describes the measure of the signal strength in kilohertz or gigahertz between the transmission and the receiving end.
Rx	Receive	An abbreviated way of expressing the term, receive, as in to receive a transmission.
S-CDMA	Synchronous Code Division Multiple Access	Wireless technology based on data being transferred at a fixed rate using Code Division Multiple Access algorithms.
SELV	Safety Extra Low Voltage	A secondary circuit which is designed and protected in such a way that, under normal operative conditions or under a single fault condition, its voltage does not exceed a safe value.
SLIP	Serial Line Internet Protocol	A TCP/IP protocol used for communication between two machines that are previously configured for communication with each other.
SMDS	Switched Multi-megabit Data Service	Connectionless service for MAN/WAN based on 53-byte packets that target the interconnection of different LANs into a public switched network at speeds higher than T1.
SMS	¹ Short Message Service or ² Systems Management Server	¹ A protocol that allows mobile users to send text-based messages from one device to another. The text appears on a device's screen and may be a maximum 160 characters in length. ² A Windows NT process that allows a network administrator to inventory all hardware and software on the network, then perform software distribution over the LAN.
SNMP	Simple Network Management Protocol	Standard management request-reply protocol for managing TCP/IP networks. A device is said to be SNMP compatible if it can be monitored or controlled using SNMP messages.
SNR	Signal-to-noise Ratio	Related to RSSI, a measurement of the intended signal being transmitted against the other entities that can interfere with the signal.
SO/HO	Small Office/Home Office	Small, remote office with a MAN or WAN connection back to a larger corporate network and/or the Internet.
SoW	Statement of Work	A document outlining the general activities that must be conducted in order to complete the installation and commissioning tasks for a Ripwave Base Station
SSI	Signal Strength Indicator	See "RSSI".
SW	Software	Computer instructions or data.
SYN	Synthesizer Card	A circuit card in the Navini BTS digital shelf that provides a local oscillator and system clock with a single calibration transceiver. The card is used to calibrate the Base Station so that no external spectrum analyzer or signal generator is required.
SYNCH	Synchronous	Digital packets or signals that are sent at the same, precisely clocked fixed rate of speed.

Term	Stands For....	Meaning
TCC	¹ Traffic Channel or ² Transmission Control Code	¹ A portion of a radio channel used to enable transmission of one direction of a digitized voice conversation (as opposed to the Voice Channel). ² A way of segregating traffic in order to define controlled communities of interest among subscribers.
TCP	Transport Control Protocol	A standardized transport protocol between IP-based network nodes that allows two hosts to establish a connection and exchange streams of data. TCP operates on top of Internet Protocols and handles the multiplexing of sessions, error recovery, reliability and flow; it guarantees packets are delivered in the same order in which they were sent.
TCP/IP	Transport Control Protocol/Internet Protocol	A set of protocols that allows cooperating computers to share resources across the network. TCP provides the reliability in the transmission, while IP provides connectionless packet service.
TDD	Time Division Duplex	A digital transmission method that combines signals from multiple sources and allows a single channel to alternately carry data in each direction of a link.
IFFS	True Flash File System	Memory in a computing device that does not lose its information when powered off. Available as a SIMM or PCMCIA card, it usually stores router Operating System (OS) software. Can be easily updated.
TTL	Time-to-live	A field in the Internet Protocol that specifies how many more hops a packet can travel before being discarded or returned.
Tx	Transmit	To send by wire or other medium electronically or through air via electromagnetic waves to a receiving communications device.
UBR	Unspecified Bit Rate	One of the two service categories available for the Management PVC in the ATM/T1 BTS configuration (the other one is CBR)
UDP	User Datagram Protocol	A communications protocol that offers a limited amount of service when messages are exchanged between computers in a network that uses the Internet Protocol (IP). UDP is an alternative to the Transmission Control Protocol (TCP.)
UL	UpLink	Describes the direction of signal flow being sent from a subscriber to a network system, as in from a mobile device (CPE) to a base station.
USB	Universal Serial Bus	An external bus standard for plug-and-play interfaces between a computer and add-on devices, such as a mouse, modem, keyboard, etc. One USB port can connect up to 127 devices.
VBW	Video Band Width	See p.100
VCC	Virtual Channel Circuit	AKA, Virtual Channel Connection or Virtual Circuit Connection. A logical circuit made up of Virtual Channel Links, which carry data between two end points in an ATM network.
VCI	Virtual Channel Identifier	A 16-bit value in the ATM cell header that provides a unique identifier for the Virtual Channel that carries that particular cell.
VCL	Virtual Channel Link	A connection between two ATM devices.
VDC	Volts Direct Current	
Vector	Vector	A quantity representative of both magnitude and direction (energy + orientation in space)
VPC	Virtual Private Channel	AKA, Virtual Path Connection. A grouping of Virtual Channel Connectors, which share one or more contiguous VPLs.
VP	Virtual Path	A set of Virtual Channels grouped together between cross-points (i.e., switches).

Term	Stands For....	Meaning
VPI	Virtual Path Identifier	An 8-bit value in the cell header that identifies the VP as well as the VC to which the cell belongs. The VPI + VCI identify the next destination of a cell as it passes through a series of ATM switches.
VPL	Virtual Path Link	A group of unidirectional VCLs with the same end points in a Virtual Path. Grouping VCLs into VPLs reduces the number of connections to be managed. One or more VPLs makes up a VPC.
WAN	¹ Wide Area Network or ² Wireless Access Network	¹ A communications network that spans geographically separate areas and which provide long-haul services. Examples of inter-networked connections are frame relay, SMDS, and X.25 protocols. ² General term for any product primarily used to gain access to the Internet, as opposed to being part of the actual Internet devices or software.
WCS	Wireless Communication Service	Licensed band around 2.3 GHz
WEC	WAN Ethernet Controller	Process created during BTS booting and attached to the stack to perform RFC1483 Ethernet bridging onto the ATM interface.

Chapter 1: Overview

Ripwave Description

A Ripwave system has three main components: the Customer Premise Equipment (CPE); the Base Station; and the Element Management System (EMS). The Base Station performs the CPE registration and call processing, and provides the interface between the backhaul network and the EMS. It is made up of the Base Transceiver Station (BTS) and the Radio Frequency Subsystem (RFS) (Figure 1). This manual provides the guidelines and instructions for installing and commissioning (I&C) the Base Station.

Figure 1: Base Station Installation (Combo and Split-Chassis Configurations)

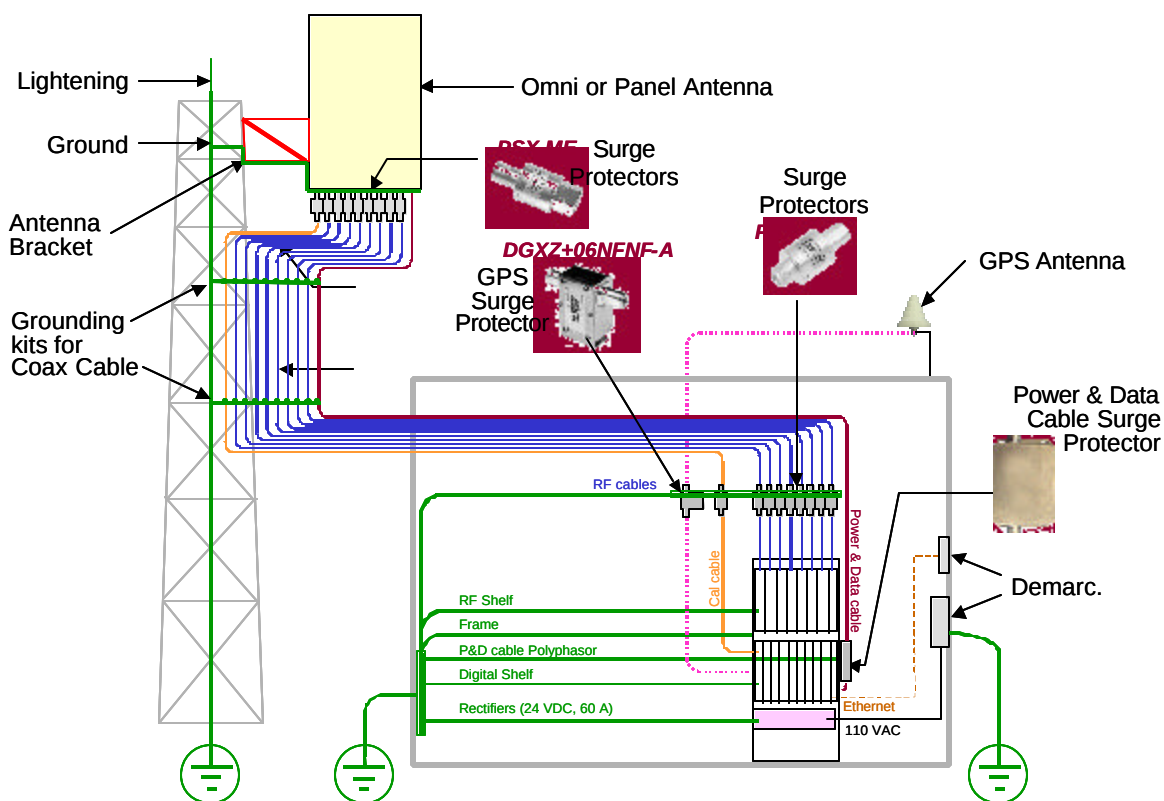
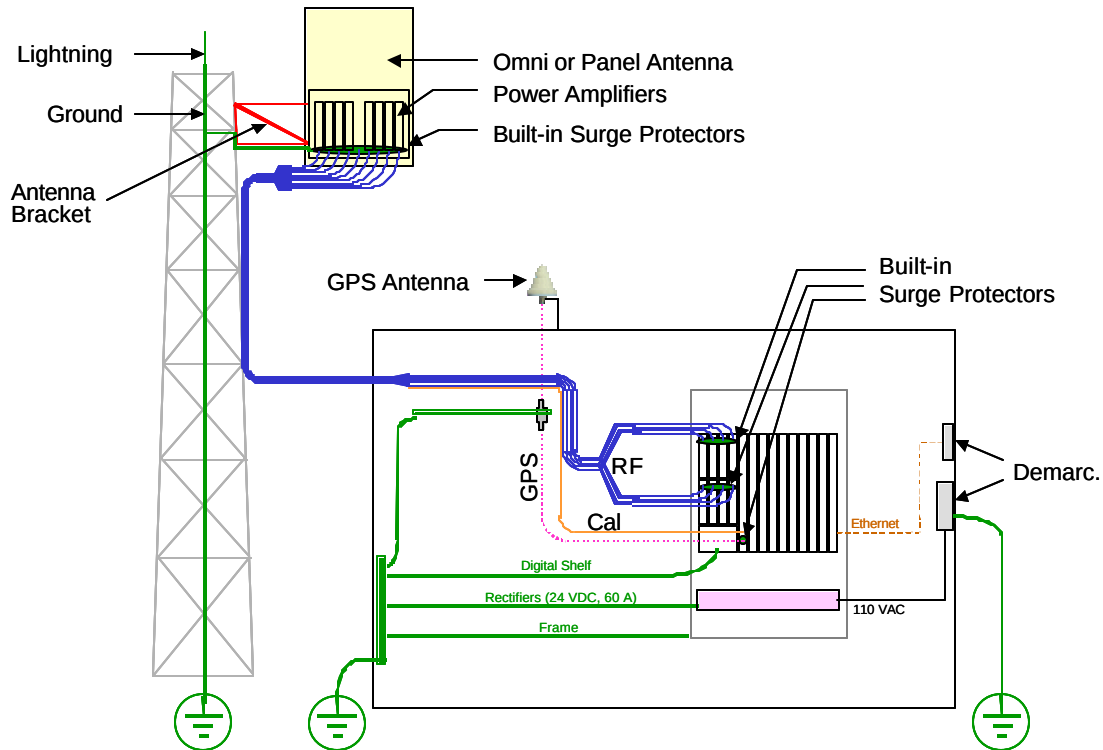
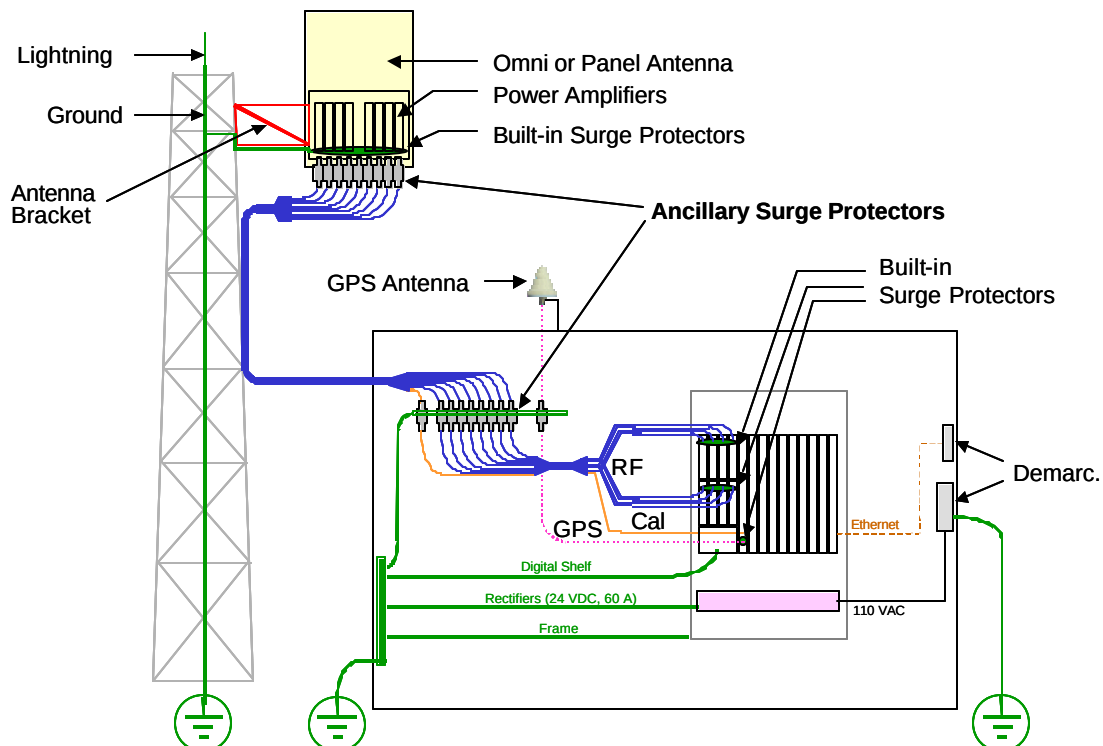


Figure 2: Base Station Installation (TTA Configuration with Built-In Surge Protection)**Figure 3: Base Station Installation (TTA Configuration with Ancillary Surge Protection)**

Procedural Documents & Forms

You will refer to other Ripwave documents, procedures, and forms in the process of installing and commissioning the Base Station. The product documentation is provided on the Ripwave Standard Documentation CD (Table 1). As well, the EMS manuals can be viewed on-line through the EMS Server and Client applications.

Table 1: Ripwave Standard Documentation CD

Order Number 95-00116-00	Component or Part Number	Format
EMS Overview Manual	40-00016-03	MSWord/.pdf
EMS Software Installation Guide	40-00017-00	MS Word/.pdf
EMS-OSS Integration Guide	40-00147-00	MS Word/.pdf
EMS Administration Guide	40-00031-00	MS Word/.pdf
Ripwave Configuration Guide	40-00016-01	MS Word/.pdf
EMS CLI Reference Manual	40-00016-02	MS Word/.pdf
Ripwave Alarm Resolution Reference Manual	40-00033-00	MS Word/.pdf
System Operations, Maintenance & Troubleshooting Guide*	00-00046-00	MS Word/.pdf
EMS Diagnostic Tools Guide	40-00032-00	MS Word/.pdf
Ripwave Modem Quick Installation Guide	40-00112-00	MS Word/.pdf
English	40-00098-00	MS Word/.pdf
Spanish	40-00096-00	MS Word/.pdf
Ripwave Modem User Guide	40-00111-00	MS Word/.pdf
English	40-00097-00	MS Word/.pdf
Spanish	40-00099-00	MS Word/.pdf
Customer Release Notes	Varies w/each release	MS Word/.pdf

*Available 4Q03

A separate CD specifically created for personnel involved with installation and commissioning of the Ripwave system, called “VAR Documentation CD”, may be ordered by authorized VARs, and business partners. The CD includes detailed procedures and electronic forms that Navini uses during the I&C process. Table 2 contains a partial listing of the files on this CD. The I&C forms found on the CD are referenced throughout this manual.

Table 2: VAR Documentation CD

Order Number 95-00017-00	Part Number	Format
Site Candidate Evaluation Form	40-00091-00	Excel Spreadsheet
RFS System Test Form	40-00093-00	Excel Spreadsheet
Base Station Calibration Verification Form	40-00059-00	Excel Spreadsheet
Drive Study Survey Form	40-00076-00	Excel Spreadsheet
Location (FTP) Test Form	40-00077-00	Excel Spreadsheet
Customer Acceptance Form	40-00117-00	MS Word Document
BTS Outdoor Selection Guide	44-00035-00	MS Word/.pdf
Rectifier/Battery Backup Specification	44-00036-00	MS Word/.pdf

High-level I&C Process

To put the I&C activities in the context of overall system deployment, Figure 4 provides a ‘flow’ of the key activities that are performed prior to and during the installation and commissioning of the Ripwave Base Station. Post-I&C, the system that has been installed and commissioned goes through Acceptance Testing against the customer’s objectives for that site. Once customer sign-off on the site is achieved, the customer becomes fully responsible for operating the system.

Different job holders may perform various portions of these activities and not necessarily all of the activities. In fact, Marketing and Engineering personnel typically handle the earlier tasks, while installation may be a stand-alone function. Commissioning may or may not be handled by the same people who designed or installed the site. Regardless of who does them, these key activities have to be accomplished for successful deployment:

- ?? Site Selection, Design, and Preparation
- ?? Physical Installation
- ?? Commissioning, with Acceptance Testing and Sign-off

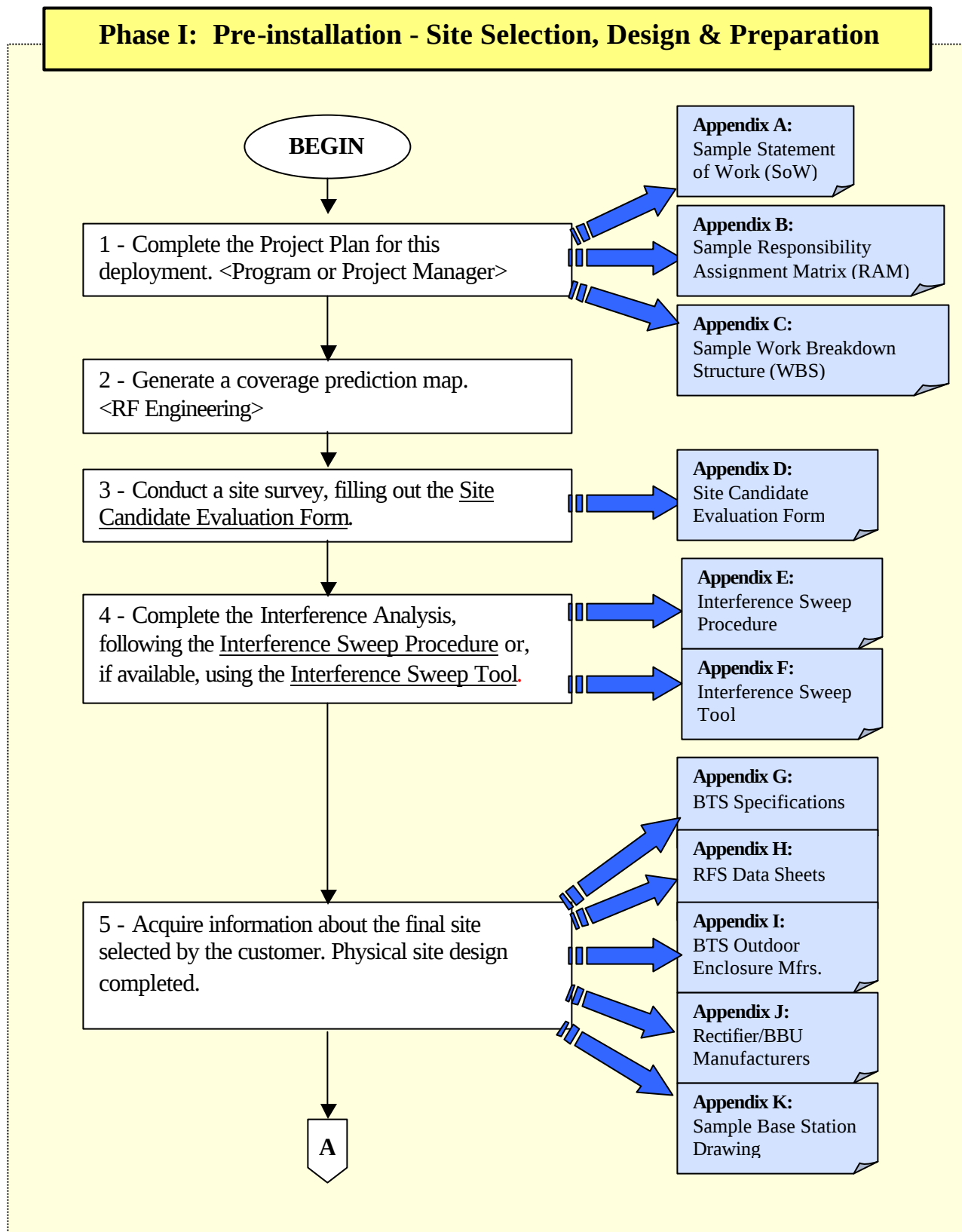
Prior to installation, Navini and the customer formulate a Project Plan and Responsibility Assignment Matrix (RAM) to clarify who will do what to complete the I&C activities. If requested by the customer, Navini may provide personnel, procedures, forms, and/or tools required to install and commission the Base Station equipment. They may also provide special commissioning software programs, computers, and any other special test equipment required.

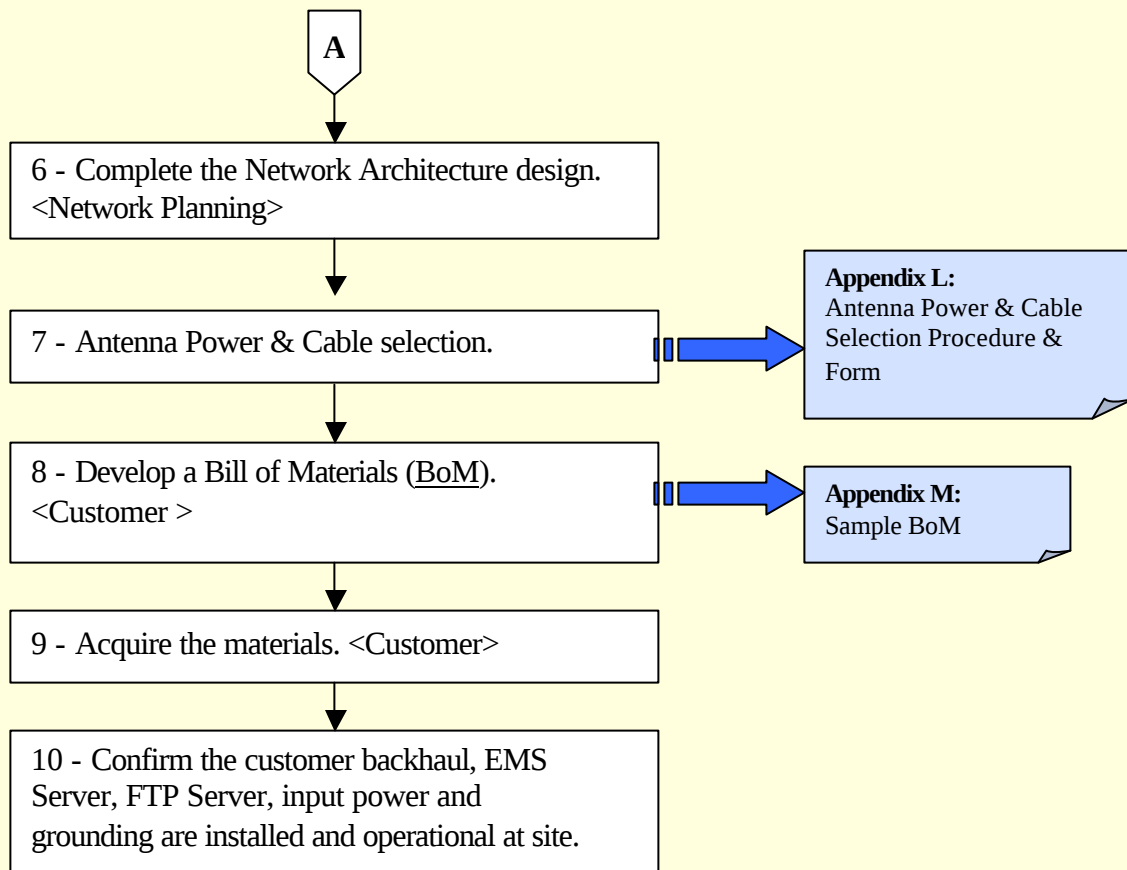
As part of the I&C duties, all testing results are recorded and kept for the customer to review and approve. These test results include the cable sweeps, the BTS Calibration Verification, RF System Tests, Drive Study, Line-of-Sight (LOS) FTP tests, and Non-Line-of-Sight (NLOS) FTP test results. The I&C Supervisor provides site tracking and weekly status reports. All of these tasks can be negotiated with the customer.

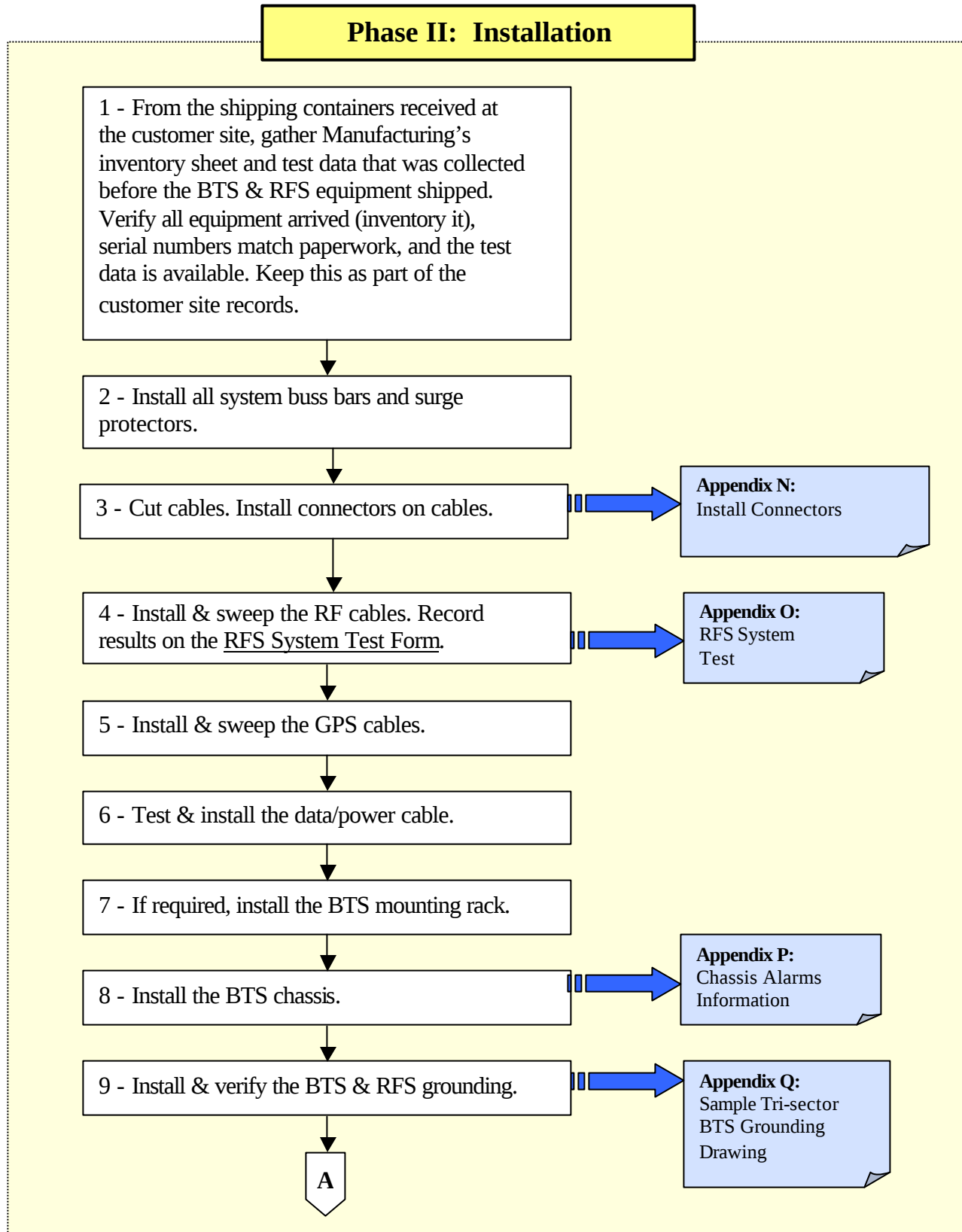
If Navini Networks is hired by a customer to provide Installation & Commissioning Services, involvement and some actual deliverables are still required by the customer. For example, the customer will need to review or perhaps even explain their Site Design Specifications, approve Logistics Plans, provide shipping information, approve the Network Architecture Plan, etc.

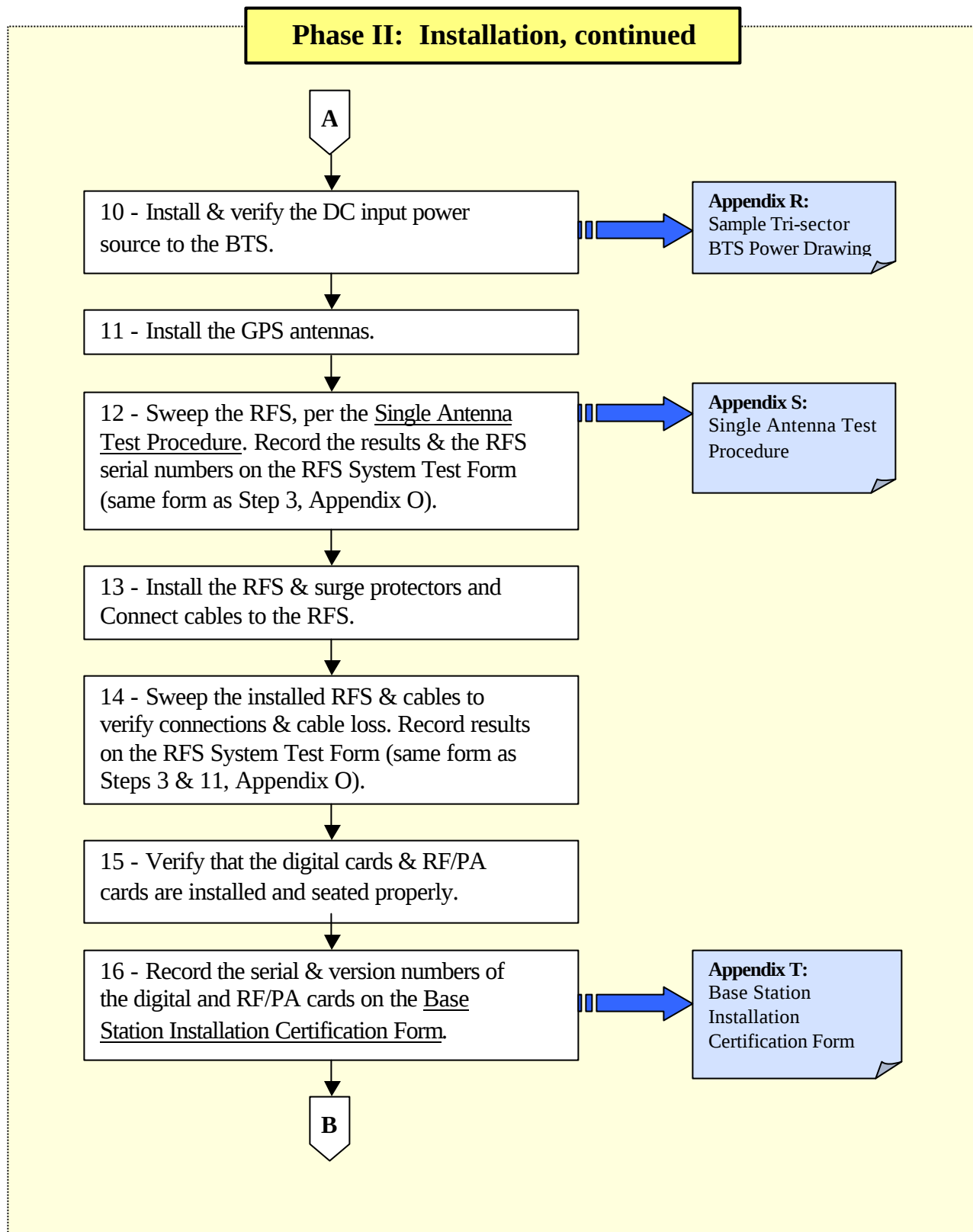
As part of a successful hand-off from Navini to the customer, it is usually necessary for Navini to provide some product training to customer personnel who will support the Base Station operation on-going. Customers may opt to take on a Train-the-Trainer program, in which case Navini certifies the customer’s instructors who then provide staff training thereafter.

Figure 4: High Level I&C Process Flowchart



Phase I: Pre-installation - Site Selection, Design & Preparation, continued





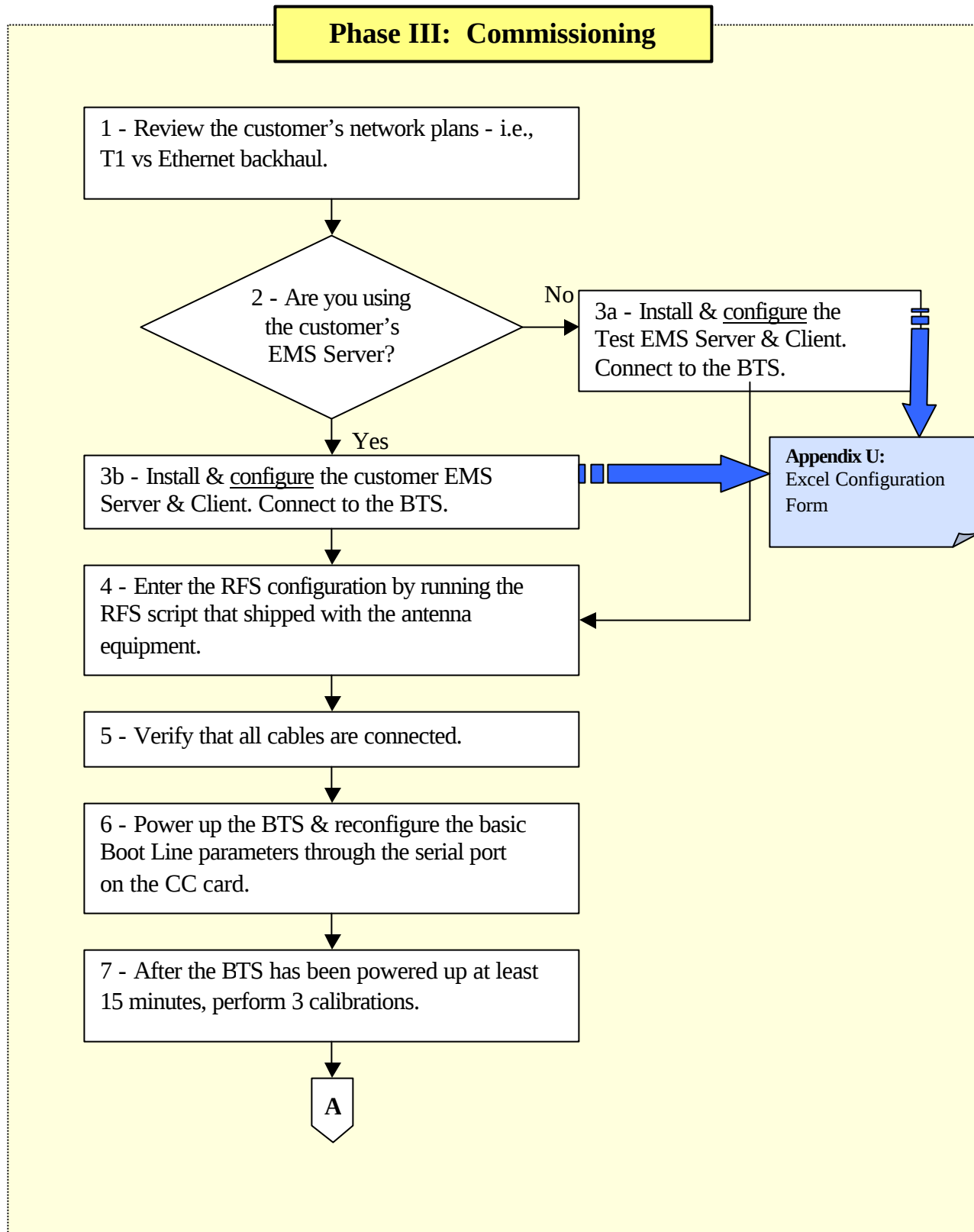
Phase II: Installation, continued

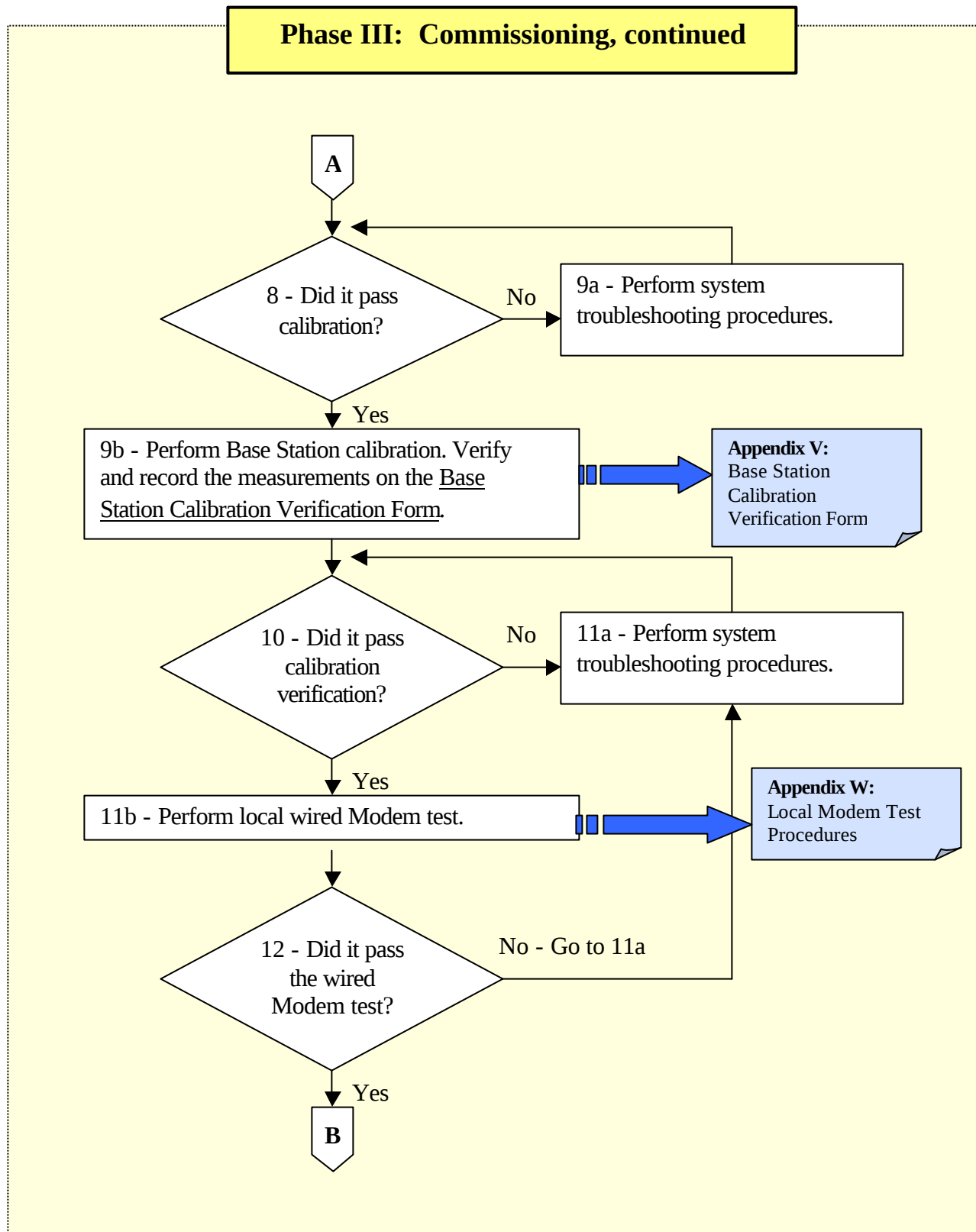
B

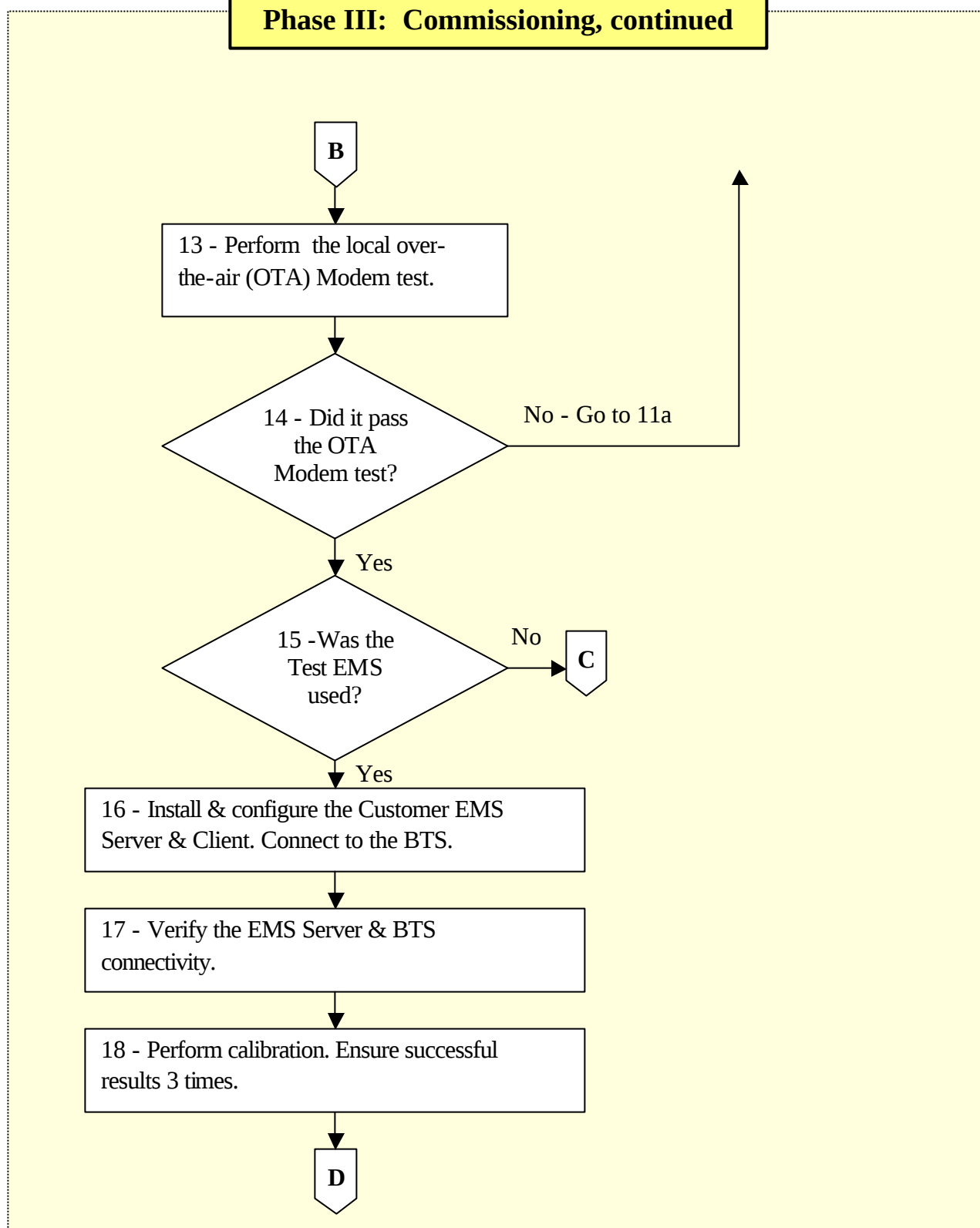
17 - If required in the Responsibility Assignment Matrix (RAM) portion of the Project Plan, test the backhaul to the customer demarcation point.

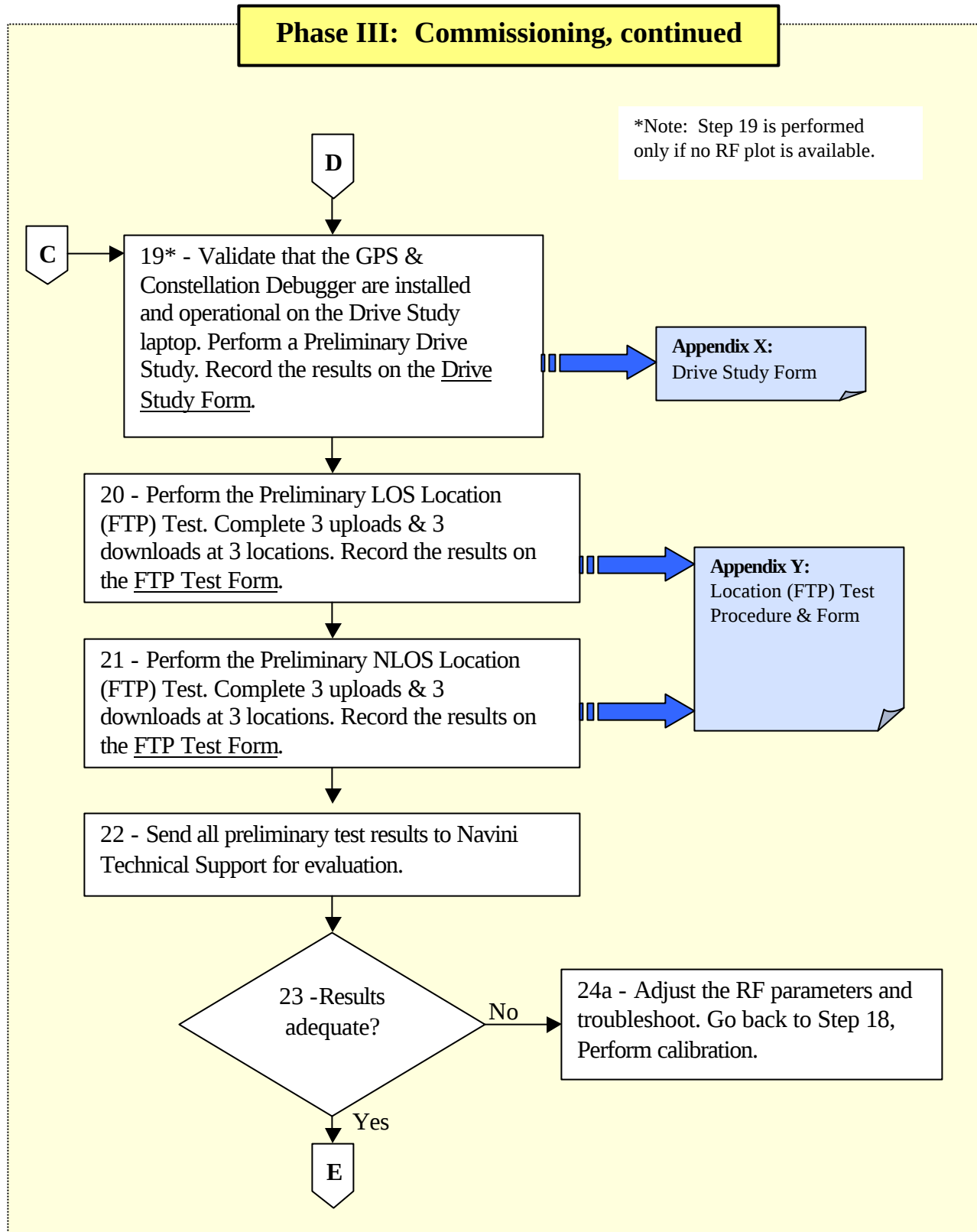
18 - Provide a printed package of the measured results and equipment inventory to the customer on-site.

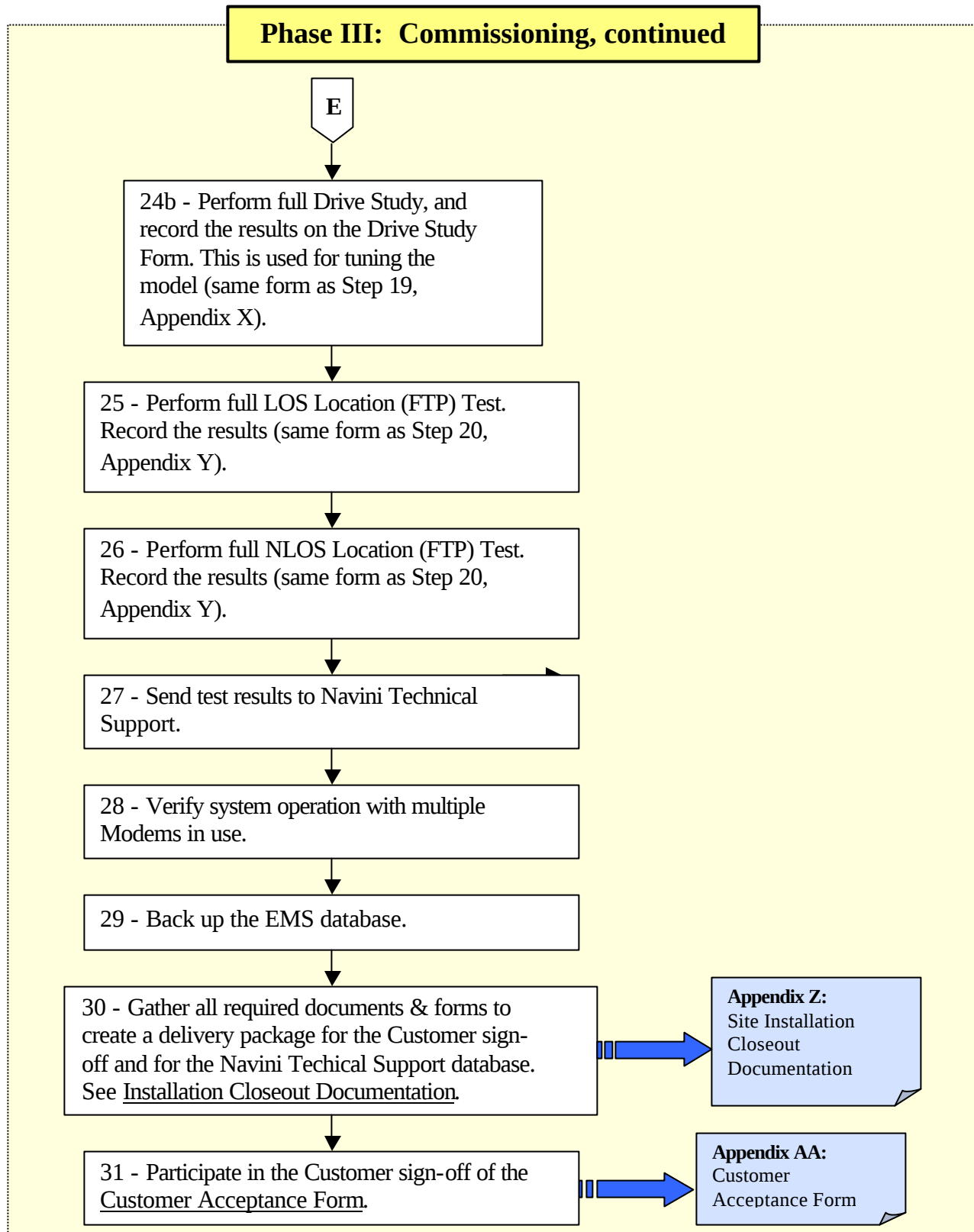
19 - Go over the results using the printed package and obtain customer sign-off on the completion of the Installation portion of the work. Use the Base Station Installation Certification Form for sign-off (same form as Step 15, Appendix T).





Phase III: Commissioning, continued





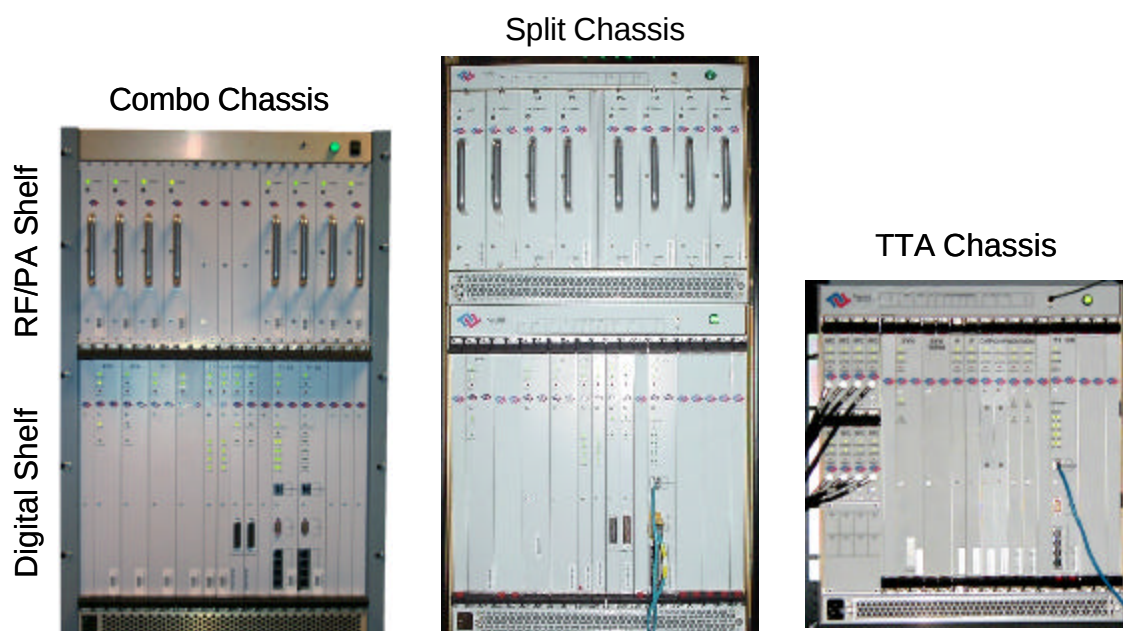
Base Station Components

Base Transceiver Station (BTS)

The BTS consists of the RF Power Amplifiers (PAs), the digital circuit cards, the backplane, and the mechanical enclosure or housing. It performs the signal processing and RF transmission for the system. There are three types of chassis: Combo, Split, and Tower Top Amplifier (TTA). The Combo Chassis is used primarily with 2.4 GHz systems. The Split Chassis is used for all other (2.3, 2.5, 2.6 GHz) systems (Figure 5). The TTA is the latest chassis design, and is available at this time for 2.4 and 3.5 GHz systems.

The chassis is compartmentalized into two sections - the RF shelf and the Digital shelf. The BTS connects to the network using a 10/100 Base-T Ethernet connection or up to 8 T1 interfaces. Up to three BTS assemblies can be installed per system, depending on the configuration. The BTS specifications are provided in [Appendix G](#).

Figure 5: BTS Chassis



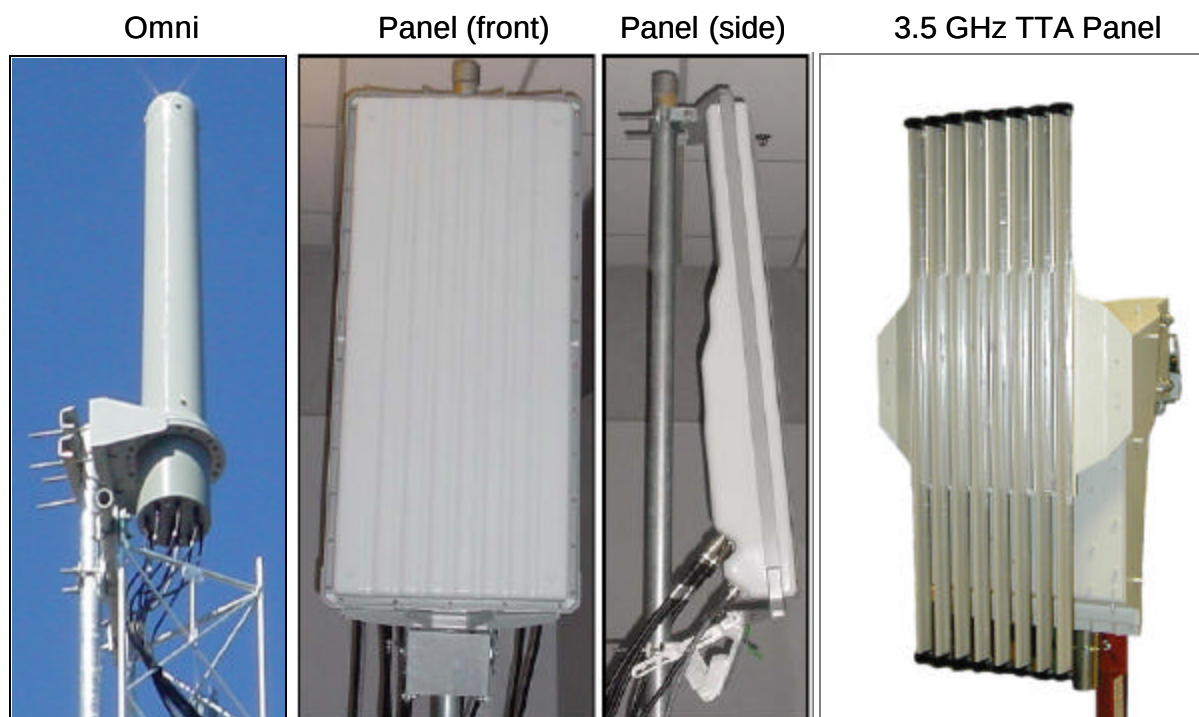
Radio Frequency Subsystem (RFS)

The Radio Frequency Subsystem (RFS) is mounted on a transmission tower or building rooftop. It transmits and receives data to and from the Ripwave Customer Premise Equipment (CPE) using a digital beamforming transmission technique. The RFS may be either a panel antenna or an omni antenna (Figure 6). The RFS data sheets are provided in [Appendix H](#).

An RFS panel transmits in a directional mode, covering a transmit angle of 120 degrees. The antenna can be used as a single mode antenna, or it can be used in a group of two or three sectorized antennas, covering 240 and 360 degrees respectively. Each panel requires a BTS to operate. For example, in a tri-sectorized cell with 3 panels, you would need 3 BTSs. The omni antenna provides omni-directional coverage of 360 degrees.

An RFS panel or omni contains eight (8) antenna elements, cavity filters, and, optionally, low noise amplifiers (LNA). In the TTA configurations, the PAs also are located in the RFS (antenna) by the LNAs and cavity filters.

Figure 6: RFS



Global Positioning System (GPS)

One Global Positioning System (GPS) antenna is used with each Base Station to provide a timing signal for synchronizatn. A second GPS antenna can be provided for redundancy. The Ripwave Base Station uses the VIC 100 GPS Antenna (Figure 7).



Figure7: VIC 100 GPS Antenna

Mounting Racks & Enclosures

The BTS can be installed indoors or outdoors in industry standard 19- or 23-inch racks. Rack adapters are needed to mount the equipment in a standard 23-inch rack. For outdoor BTSs, the customer can supply any standard enclosure from a multitude of vendors. [Appendix I](#) offers suggestions for outdoor BTS enclosures. Figure 8 shows 3 BTSs installed indoors.

Figure 8: Indoor BTS (Combo Chassis)

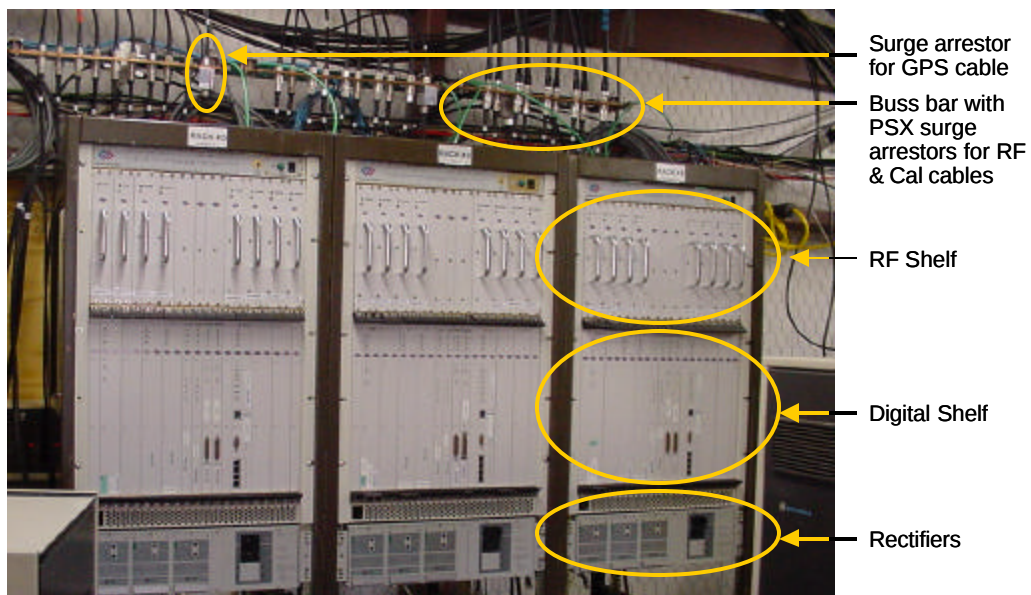
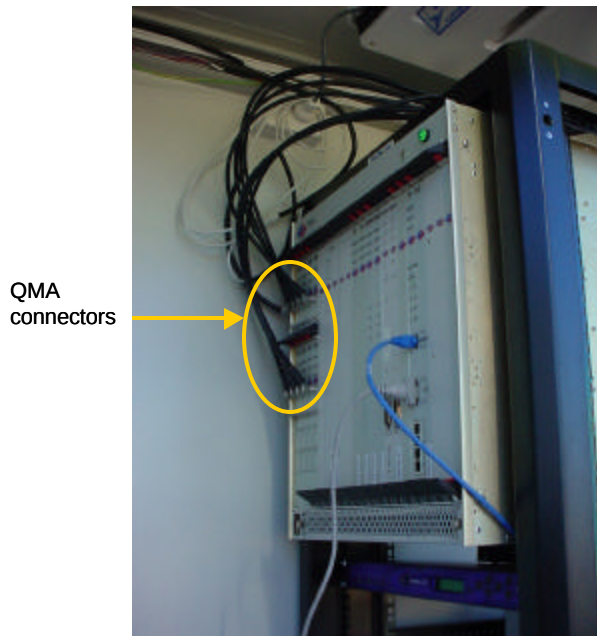


Figure 9: Indoor BTS (TTA Chassis)

Accessibility

Ripwave BTS equipment is required to be installed in a restricted access location, in accordance with NEC/CEC standards. Only authorized personnel should have access to this equipment.

Technical Specifications

Table 3a: Technical Specifications

			Combo		Split	TTA	
Frequency Band (GHz)			2.4	2.6	2.3 2.5, 2.6	2.4	3.5
Frequency Band (Name)			ISM	MMDS	WCS ITFS/MMDS	ISM	WCS
Frequency Range (GHz)			2.400– 2.473	2.602– 2.637	2.305–2.385 2.500–2.596	2.400– 2.483	3.400– 3.700
Power Dissipation (Thermal Load)	Watt	TTD 1:1	560	850	850	292	292
		TTD 3:1	725	1150	1150	360	360
	BTU per hour	TTD 1:1	1910	2900	2900	1000	1000
		TTD 3:1	2475	3925	3925	1230	1230
Rectifier Rating (Watt)*			975	1,500	1,500	580	580
Circuit Breaker Rating (Amp)			60		RF Shelf : 50 Digital Shelf : 20	40	40
Input Voltage			+21 to 28 VDC				
Relative Humidity of BTS Operating Environment			0% to 95% RH, non-condensing				
Operating Temperature (°Celsius)			0° to +50°o				
Storage Temperature (°Celsius)			–40° to +70°				
Air Flow (on each shelf)			Fresh air intake along the lower front vertical panel. Air exhaust out of the upper rear of the chassis				
Modulation	Downlink		QPSK, 8PSK & QAM16				
	Uplink		QPSK				
Antenna Downtilt	Omni		2° electrical downtilt (fixed)				
	120° Panel		6° electrical downtilt (fixed) plus 0-10° mechanical uptilt (adjustable).				
Antenna Gain (per antenna element)	Omni		12 dBi				
	120° Panel		17 dBi				
Backhaul interfaces			10/100 BaseT Ethernet or ATM over T1; up to (8) T1s with or without IMA, long haul support				
Bandwidth Allocation			Dynamic				
Duplex Format			Time Division Duplex				
Chassis Mechanical Dimensions in inches (H x W x D)			30 x 19 x 14	RF: 14 x 19 x 15.2		19.2 x 19 x 12.9	
				Digital: 19.2 x 19 x 12.9			
Chassis Weight (lb)			60	RF: 82		36	
				Digital: 33			
Omni Antenna Mechanical Dimensions (H x Diam.) in inches			60 x 15				50 x 10
Omni Antenna Weight (lb)			65				52

(continued on the next page)

*The BTS must be connected to a power supply/rectifier that is UL listed.

	Combo		Split	TTA	
Frequency Band (GHz)	2.4	2.6	2.3 2.5, 2.6	2.4	3.5
Panel Antenna Mechanical Dimensions (H x W) in inches	46 x 23				38 x 19
Panel Antenna Weight (lb)	64				50
Polarization	Vertical				
Multiple Access Scheme	Multi-carrier Beamforming Synchronous CDMA				
Power Control	Forward & reverse, open & closed loop				
Total System Capacity in Mbps (total raw capacity with QAM16 downlink and QPSK uplink)	11.6	12		11.6	12
Base Station Payload Data Rate in Mbps (with QAM16 downlink and QPSK uplink; excludes adaptive modulation based on SNR, end to end network retransmissions and Ethernet & IP protocol overhead)	6.0 (4.2 DL, 1.8 UL)	6.4 (4.2 DL, 2.2 UL)		6.0 (4.2 DL, 1.8 UL)	6.4 (4.2 DL, 2.2 UL)

BTS Input/Output Specifications

Table 3b: BTS Input/Output Specifications

Item	Description	Termination	Expected MAX Length	Protection specified in Manual
DC +24V Power	+21 to +28V input, -/+ terminals	Power Supply/Rectifier customer equipment	<140 FT	Rectifier must be UL-listed, comply with UL60950 or UL60950-1, and have earthed SELV output
GND	Chassis Ground connection	Earth Ground	<140 FT	GND required.
T1	T1 communication lines off CC card	T1s interface switch customer equipment. Typical installation requires DSU or CSU providing loopback capability and primary Type 1 protection.	>140 FT	In-Line Devices such as DSU/CSU/TSU/PPC must be UL497 listed
Ethernet	10/100 BaseT communication off CC card	PC/Router/HUB/Gateway	<140 FT	Not required
UART	D sub serial connection off CC card, used for on site communications to PC	PC	<140 FT	Not required
BBU	BBU connector can accept up to 4 alarm inputs plus GND. BTS monitors alarms and reports back to EMS condition. Inputs come from dry contacts at the BBU side, normally open circuit, can be closed circuit for alarmed condition.	BBU customer equipment.	<140 FT	Not required

(continued on the next page)

Item	Description	Termination	Expected MAX Length	Protection specified in Manual
Cabinet Alarms	Cabinet alarms: Door open and HMC alarms plus 2 GND inputs. BTS monitors alarms and reports back to the EMS condition. Inputs come from dry contacts in the cabinet, which are normally open circuit, can be closed circuit for alarmed condition.	Cabinet customer equipment.	<140 FT	Not required
TDD SYNC	TDD sync is a TTL Sync pulse at a 10 ms cycle rate, 0 to +5V swing, which is 5 ?s long in width. This output of BTS is used for equipment debugging and to synchronize test equipment.	Test equipment such as oscilloscope or analyzer equipment	<140 FT	Not required
GPS Antenna A/B (2)	The GPS coax cable carries +5V DC and 1.57 GHz RF signal to be connected to GPS antenna LNA. RF is an input to BTS; DC is an output from BTS.	GPS antenna/LNA, which is normally located at BTS or on HUT of BTS, not on tower.	<140 FT	Not required
RFS Calibration Cable (1)	This coax cable is an RF signal path to the RFS. Signal is a low power signal from 2.1 to 2.5 GHz.	RFS connection to BTS	>140 FT	Lightning protection devices must be UL497 listed
RFS Antenna Cables (8)	These coax cables are RF signal path to the RFS. Signal frequency from 2.3 to 2.7 GHz.	RFS connection to BTS	>140 FT	Lightning protection devices must be UL497 listed
Power/Data Cable (1)	This cable is a 6-twisted pair bundled cable used for sending low current DC voltage to the RFS at +8 to +12V as well as RS485 digital bus for TDD control.	RFS Connection to BTS	>140 FT	Lightning protection devices must be UL497 listed