TDC

Theater Deployable Communications

Baseline Requirements Document

Base Transceiver Station Module

BTS (v1)

Nov 2003

ESC/NI4T
5 Eglin Street
Hanscom AFB, MA 01731

Table of Contents

List of Tables

List of Figures

1.0 SCOPE

This requirements document establishes the performance, manufacture and test requirements for the TDC ICAP Remote Base Transceiver Station (BTS) Module v1.

2.0 APPLICABLE DOCUMENTS

To the extent specified herein, the following documents of latest current issue on the date of this Baseline Requirements Document form part of this BRD.

Table 1 - Standards and Applicable Documents

Document Number	Title
ISO/IEC 8802-3 1996 ANSI/IEEE Std 802.3 1996	Information Technology – Local Metropolitan Area Networks Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA-CD) Access Method and Physical Layer Specification (Documents are one and the same; from IEEE, ANSI, ISO, and IEC.)
S.I. Tech Inc.	Operating Instructions 2890 T-1/2891 E-1 Fiber Bit-Driver
MIL-STD-810F	Environmental Test Methods
	TDC BRD for Cellular Hub Module
	TDC BRD for Voice Kits
	TDC BRD for Transmission Kits
	TDC BRD for System Kits
	TDC Standards Document

3.0 REQUIREMENTS

3.1 Module Definitions

The Cellular Hub Module (CHM), Base Transceiver Station (BTS) Module, Cellular Antenna Kit, Cell Phone Kit, Operations and Maintenance Center Kit, and TRX Card and Power Amplifier Kit operate together to provide deployable non-secure and secure cellular voice and data communications. The two Modules and four Kits are shown pictorially in Figure 1. They are described briefly in the following subsections to provide the context in which the TDC cellular system will operate.

3.1.1 Cellular Hub Module (CHM)

The Cellular Hub Module can be located near the base hub of the deployed base or remotely from the base hub. When located close to the base hub, the CHM can be connected to the base hub via standard straight through Universal Service Order Code (USOC): RJ48C cable and CAT-5 Ethernet cable. If the CHM is located remotely from the base hub, it can be connected with media, including wireline, fiber, or LOS radio communication links, provided by TDC transmission facilities.

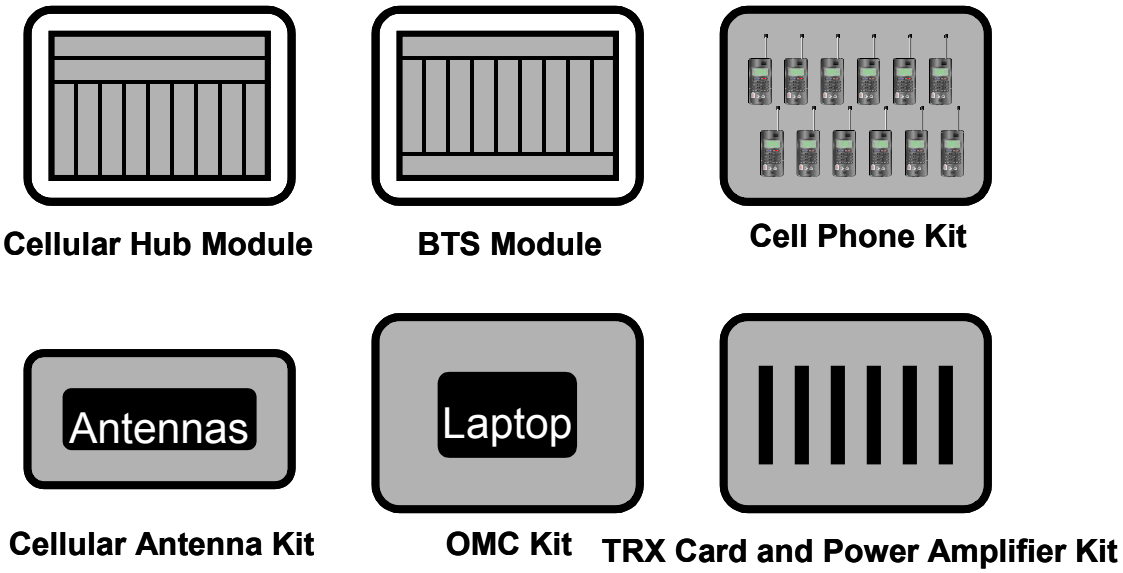

Figure 1 - Cellular Modules and Kits

3.1.2 Base Transceiver Station (BTS) Module

The Base Transceiver Station (BTS) Module provides a BTS that can be located remotely from the CHM and connected to the CHM via wireline, fiber, or radio. A minimum of two BTS Modules can be connected to a CHM.

Figure 2 shows the Mobile Equipment (cell phone), Cellular Hub Module (CHM), BTS Module, Operations and Maintenance Center (OMC), and CHM connections to TDC-ICAP. Internal elements of the CHM and BTS Module are shown in Figure 3.

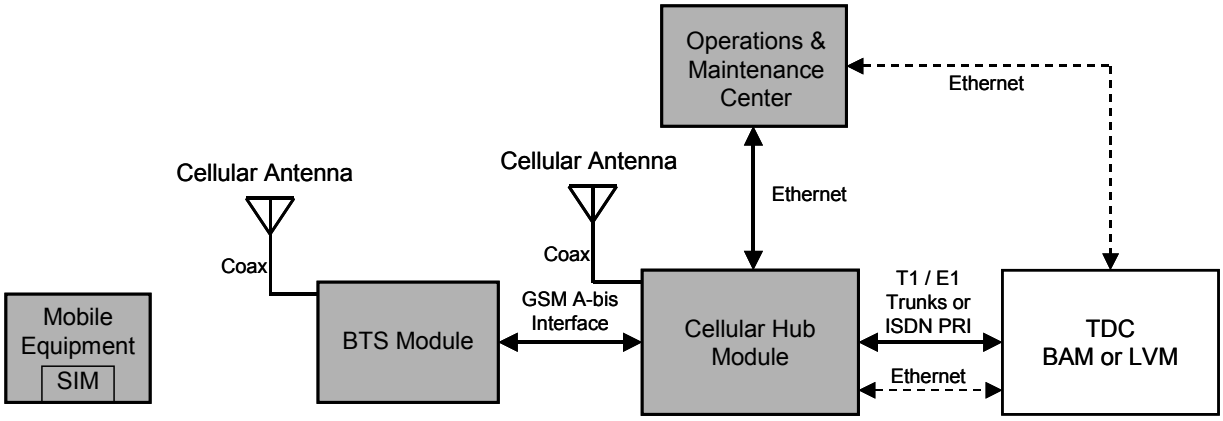

Figure 2 - Deployable Cellular System Connections to TDC ICAP

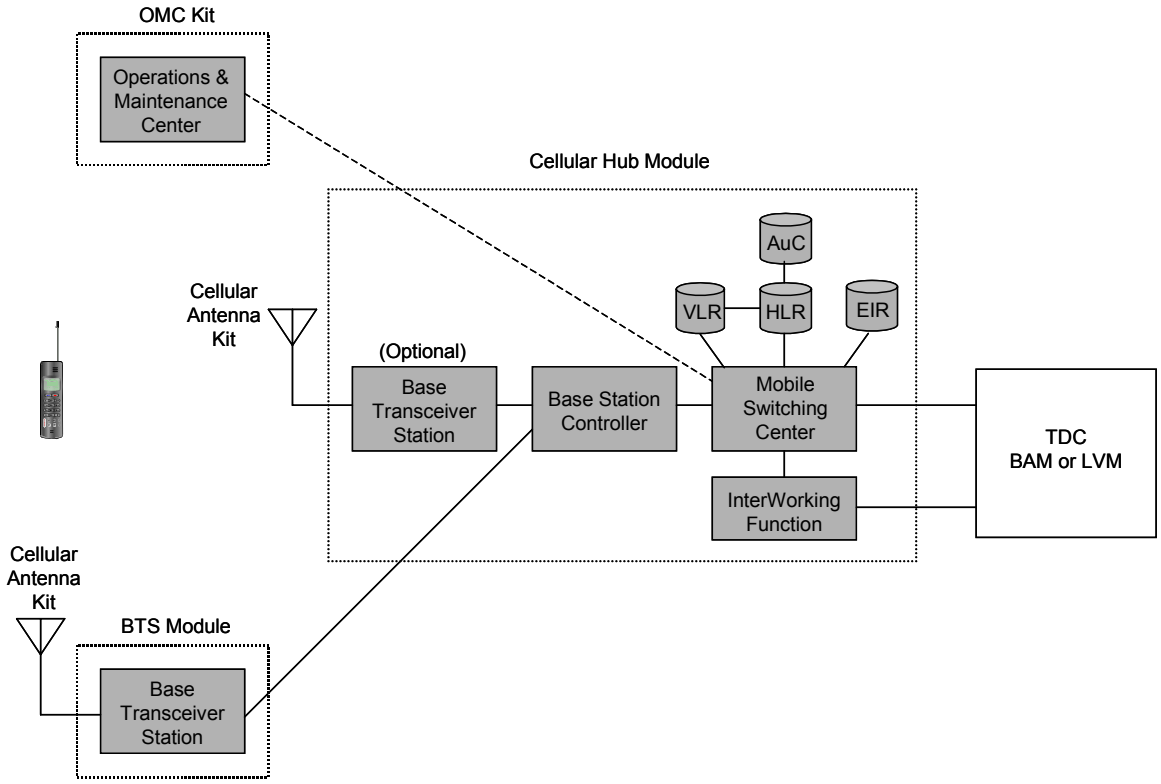

Figure 3 - Deployable Cellular System Internal Elements

3.1.3 Kits Associated with the BTS

3.1.3.1 Cell Phone Kit

The Cell Phone Kit provides 25 GSM cell phones, 25 Sectéra® NSA Type 1 Security Sleeves, and associated Subscriber Information Modules (SIMs), batteries, chargers, and user guides.

3.1.3.2 Cellular Antenna Kit

The Cellular Antenna Kit provides a multi-element cellular antenna and a dipole cellular antenna to accommodate various types of terrain in the theater. Either of these two antenna systems can be mounted on the nine-meter antenna mast provided in the TDC Antenna Mast Kit (detailed in the TDC BRD for Transmission Kits) or on other surfaces as appropriate and connected to the CHM.

3.1.3.3 Operations and Maintenance Console (OMC) Kit

The Operations and Maintenance Center laptop computer interfaces to the CHM and runs software to manage the cellular subscriber databases and perform troubleshooting.

3.1.3.4 TRX Card and Power Amplifier Kit

The TRX Cards and Power Amplifiers kit provides support for operation in the three GSM frequency bands (900, 1800, and 1900 MHz).

3.1.3.5 TDC Large UPS Kit

The TDC Large UPS kit can be used to provide power to the BTS Module to allow graceful shutdown in the event of power failure.

3.2 Performance Requirements

3.2.1 Electrical Interface Requirements (External)

The BTS Module includes the number and type of active external interfaces presented in Figure 4 and Table 2. All external interfaces shall be brought out to a Signal Entry Panel.

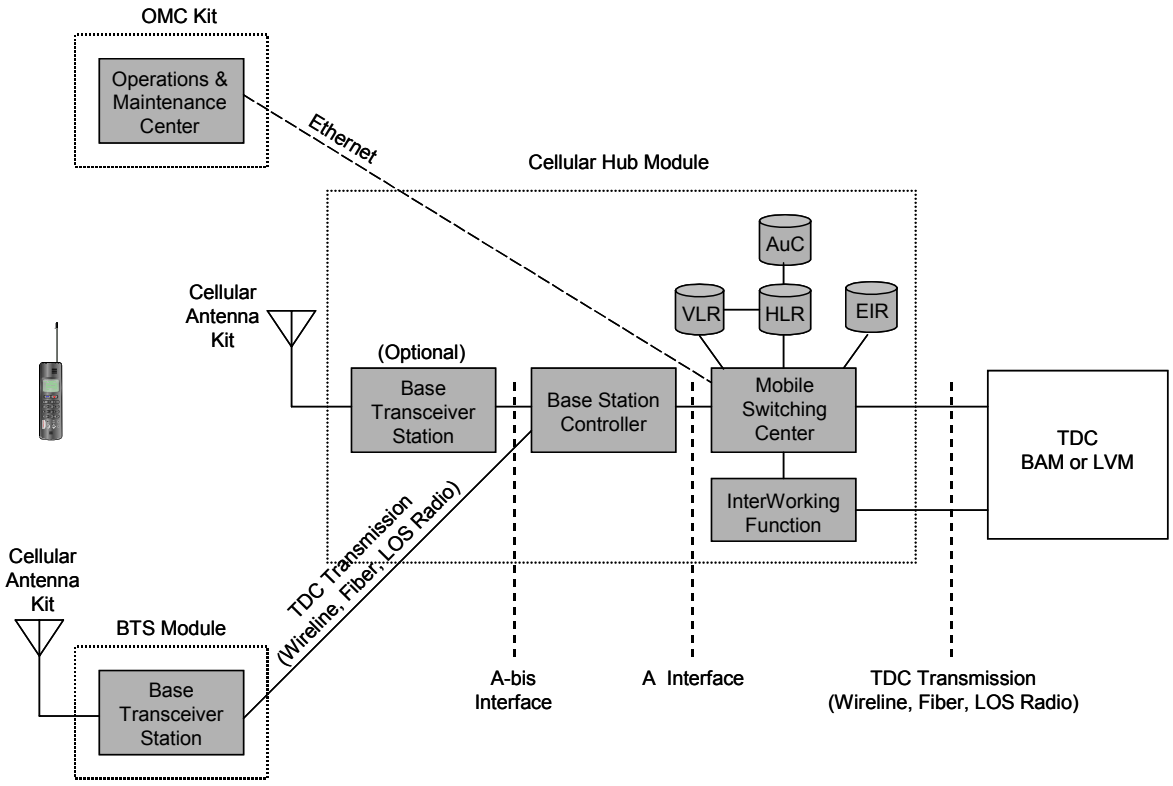

Figure 4 - Deployable Cellular System Block Diagram Showing Interfaces

Table 2 - BTS Module External Interface Characteristics

Signal Name	Quantity	Connector	Primary Interface	Electrical Characteristics
BTS Module Power	1	IEC 320 C-20 Receptacle	AC Power	120/240 VAC ± 10%, 47/63 Hz
Cellular Antenna to BTS Module	1	Type N Coaxial Connector	Cellular Antenna	RF
BTS Module to CHM	1	RJ-48C	CHM	GSM A-bis Interface (Wireline)
BTS Module to CHM	1	ST (Fiber Optic)	CHM	GSM A-bis Interface (Multimode Fiber)

3.2.1.1 Prime Power

The BTS Module operates from 120/240 VAC ± 10%, 47/63 Hz, single phase, and three-wire power. The BTS Module shall include:

- An IEC–320 C-20 male connector (or equivalent) for prime power mounted on the Signal Entry Panel.
- An internal line transient suppressor (Marway 41355 or equivalent) to minimize line variations and provide on-off power switching for each element within the BTS Module. The internal line transient suppressor shall be positioned to allow easy access to the switches controlling the individual power circuits.

System power can be supplied through the TDC Large UPS Kit detailed in the TDC BRD for System Kits.

3.2.1.2 BTS Module to Cellular Antenna Connector

The cellular antenna connector is a standard Type N coaxial connector that is lightening protected internal to the BTS. The cellular antenna connector shall be mounted on the Signal Entry Panel.

3.2.1.3 BTS Module to CHM Wireline Connector

The CHM communicates with the BTS Module through a GSM compliant 1.5 Mbit/s A-bis interface. The connector shall be a standard female RJ-48C jack mounted on the Signal Entry Panel.

Table 3 - BTS to CHM Wireline Connector

Pin	Signal
1	TBD
2	TBD
3	TBD
4	TBD
5	TBD
6	TBD
7	TBD
8	TBD

3.2.1.4 BTS Module to CHM Fiber Optic Connector

The BTS Module can also communicate with the CHM via standard TDC transmission media terminating in standard multimode fiber optic ST connectors (transmit and receive). The connector shall be in accordance with the TDC Standards Document, referenced in Table 1.

3.2.2 Electrical Interface Requirements (Internal)

The BTS Module utilizes several types of internal interfaces, including GSM-standard Um and A-bis Interfaces.

3.2.3 Functional Requirements

Figure 4 provides a block diagram of the Deployable Cellular system showing the inboard and outboard components. The BTS Module is made up of:

- Power Conditioner
- Base Transceiver Station (BTS)
- Transcoder Rate Adaptation Unit (TRAU) - optional
- Dual Fiber Optic Modem

The Base Transceiver Station (BTS) is a bi-directional radio system that communicates with the cellular handsets within a given cell. The Base Station Controller (BSC) manages the radio resources of a minimum of three BTSs. In the TDC Cellular Hub Module (CHM), the BSC controls the one optional BTS in the CHM and a minimum of two external BTSs provided by BTS Modules. A BTS Module can be used to extend cellular service to the distant end of a long runway or to another outlying area on the deployed base. The BTS Modules can be connected to the CHM with media provided in the TDC Transmission Kit. (See TDC BRD for Transmission Kits) The Mobile Switching Center (MSC) manages call set-up, authentication, routing, and tear-down. The MSC connects to TDC-ICAP.

3.2.3.1 Module Equipment Details

The following sections provide details of the functionality of the major equipment of the BTS Module.

3.2.3.1.1 Base Transceiver Station (BTS)

The BTS contains the radio transceivers for a cell. The BTS controls the RF, manages the radio interface, and controls the channel coding and interleaving. The BTS shall communicate with the Mobile Station (cell phone) through the GSM-standard Um Interface.

Each BTS shall provide at least fifteen (15) non-blocking radio channels for full-duplex voice communication. Each BTS shall operate in the 900, 1800, 1900 MHz GSM bands and have a radio power of twelve (12) to forty (40) watts. Each BTS shall include TRX cards and radio power amplifiers to operate in the 900, 1800, 1900 MHz GSM bands. A separate set of cards and amplifiers can be used for each of the three bands. If a separate set of cards is used, the unused sets of cards and amplifiers must be stored in a transit case meeting the requirements of Paragraph 3.2.4.1 if they are not in an operational card cage or chassis.

Broadcast, Pager, and Short Messaging Service (SMS) shall be provided by a combination of BTS, BSC, MCS, IWF, TRAU, and OMC.

A growth capability to include future requirements, such as operation at 850 Mhz, is highly desirable, but not required.

3.2.3.1.2 Transcoder and Rate Adaptation Unit (TRAU) - Optional

The Transcoder and Rate Adaptation Unit (TRAU) may be incorporated in either the BTS Module or the CHM. The TRAU, if empoyed, shall be capable of carrying speech, data, and operations and maintenance frames at full rate (16kbps) and half rate (8 kbps).

3.2.3.1.3 Operator Interface

Operator interface to the BTS Module is through an Operations and Maintenance Center (OMC), connected to the Cellular Hub Module, to enable an operator to configure, monitor the performance, and diagnose faults of the CHM and BTS Modules. The OMC is provided in the OMC Kit and can be used locally or remotely over an IP network.

3.2.3.1.4 Built-In Test

The OMC includes continuously running diagnostics to detect and report major faults in CHM and BTS Modules. The OMC includes built-in diagnostics to aid the operator in isolating faults to the LRU level.

3.2.3.2 Configuration Options

In addition to the basic functions and features, the installer may customize the BTS Module by utilizing items associated Kits. The Kits are listed below:

- Cellular Antenna Kit (1 required for each BTS Module)
- TRX Card and Power Amplifier Kit (1 required for each BTS Module)

3.2.4 Physical Characteristics

3.2.4.1 Transit Cases

The BTS Module shall be housed in a man-transportable transit case, in accordance with the TDC Standards Document referenced in Table 1.

3.2.4.2 Storage Space

The BTS Module transit case shall include storage pouches within each cover to contain cables, manuals, etc. that must be transported and used with the Module, in accordance with the TDC Standards Document referenced in Table 1.

3.2.4.3 Weight

The BTS Module, including all internally carried cables, manuals, etc. shall meet the two-man (78 kg/174 lb.) lifting limits in accordance with the TDC Standards Document referenced in Table 1.

3.2.4.4 Marking

Markings shall be in accordance with the TDC Standards Document referenced in Table 1.

3.2.5 Cables and Accessories

The BTS Module includes cables listed in Table 4, stored within the module's covers. Strain relief and cable management hardware are provided with the module.

Table 4 - Cables included with BTS Module

Function	Color Code	Quantity	Description
Power	TBD	1	IEC–320 receptacle to NEMA 5–15P
BTS to CHM	TBD	1	A-bis Interface Cable RJ-48C each end
BTS to CHM	TBD	1	Dual fiber optic ST to ST cable

3.2.6 Reliability

The BTS Module with its standard complement of LRUs, have a mean time between failure (MTBF) commensurate with similar commercial equipment in its class. The actual MTBF for the major system components are shown in Table 5. Where reliability data is not readily available from the vendor, this is indicated.

Table 5 - MTBF of Major Components

Component	MTBF
Power Conditioner	TBD
Base Transceiver Station (BTS)	TBD
TRAU (if equipped)	TBD
Dual Fiber Optio Modem	TBD

3.2.7 Maintainability

Maintainability characteristics will be part of the selection criteria for all hardware. Ease of maintenance, such as accessibility to Line Replaceable Units, fault detection/isolation software capability, and fault annunciation will be considered.

3.2.7.1 Mean Time Between Preventive Maintenance

The Mean Time Between Preventive Maintenance, during operation, is 30 days. The duration of preventive maintenance actions such as corrosion control, cleaning filters, etc., does not exceed 30 minutes.

3.2.8 Environmental Conditions

During storage, transport and operation the modules can withstand exposure to temperatures as shown in Table 6.

3.2.8.1 Temperature

Temperature characteristics for the major equipment components are shown in Table 6.

Table 6 - Module Temperature Characteristics

Equipment	Temperature (degrees C)	
	Operating	Non-Operating
Power Conditioner	-5 to 45	TBD
Base Transceiver Station	-5 to 45	TBD
TRAU (if equipped)	-5 to 45	TBD
Dual Fiber Optic Modem	-5 to 45	TBD

3.2.8.2 Relative Humidity

Relative humidity characteristics for the major equipment components are shown in Table 7.

Table 7 - Module Humidity Characteristics

Equipment	Humidity
	Non-condensing
Power Conditioner	10 to 90%
Base Transceiver Station	10 to 90%
TRAU (if equipped)	10 to 90%
Dual Fiber Optic Modem	10 to 90%

3.2.8.3 Altitude

Altitude characteristics for the major equipment components are shown in Table 8.

Table 8 - Module Altitude Characteristics

Equipment	Altitude (feet)	
	Operating	**Non-Operating**
Power Conditioner	TBD	TBD
Base Transceiver Station	TBD	TBD
TRAU (if equipped)	TBD	TBD
Dual Fiber Optic Modem	TBD	TBD

3.2.8.4 Sand and Dust

During storage and transport, the modules are protected when exposed to sand and dust in accordance with the best commercial practices for close proximity to operating aircraft. During operation with covers removed, the modules can withstand sand and dust in accordance with the best commercial practices for natural conditions.

3.2.8.5 Shock

Module equipment racks are equipped with rubber shock isolation mounts and is protected from shocks induced during handling, setup and tear down. Modules and components can operate without degradation following exposure to the non-operating shock environment described by Method 516.5, Procedure VI (Bench Handling) of MIL STD 810F.

3.2.8.6 Vibration

The modules are equipped with rubber shock isolation mounts so that the modules can withstand the vibration encountered while being transported by commercial and military airlift, sealift and vehicular (over unimproved roads) systems. MIL-STD-810F, Method 514.5, Procedure I, Categories 4, 7 and 8 apply; alternative procedures may be substituted after approval of the TDC Program Office.

3.3 Design and Construction

3.3.1 Material Parts and Processes

This module is built to good commercial practices. Mechanical and electrical interchangeability exists between like systems, subsystems, assemblies, subassemblies and replaceable parts.

3.3.2 Safety

This module shall not present a safety, fire or health hazard to personnel.

3.3.2.1 Electrical Safety

This module is designed to eliminate the hazard to personnel of inadvertent lethal voltage contact. All electrical conductors carrying voltages in excess of 70 volts shall be insulated to prevent contact or covered by a protective barrier. All removable protective barriers shall be interlocked to automatically disconnect power behind the barrier upon removal or clearly marked with a warning label that indicates the voltage potential that will be encountered behind the barrier. All warning labels shall remain visible after the cover has been removed.

3.3.2.2 Mechanical Safety

Sharp surfaces shall have protective covers or other suitable features to minimize injury where personnel are likely to be exposed to such surfaces.

3.4 Logistics

This module accommodates a two level maintenance concept: organizational (Air Force personnel) and depot (contractor personnel). Removal and replacement of an LRU is defined at the organizational level and any needed repair of the LRU is defined at the depot level. Any special test or support equipment required to effect removal or replacement of an LRU at the organizational level can be provided as part of the module. No more than two persons shall be required to remove or replace an LRU.

An LRU is defined as the lowest element of the module which can be isolated to be faulty through inspection; built-in test; technical manuals; TDC-ICAP system performance; spares substitution; or other diagnostic aid approved by the Government for organizational level maintenance, exclusive of expendables such as fuses, lamps and LEDs. An LRU is defined at the card/module level or higher.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General

The quality assurance program includes tests and other evaluations to the extent specified herein. The quality assurance program is designed to verify the electrical, mechanical and functional characteristics of each module. The purpose is to ensure that each module complies with or performs better than the requirements specified herein.

4.2 Responsibility for Inspection

Unless otherwise specified in the contract, the contractor shall be responsible for the performance of all inspection requirements and may use his own or any other facilities suitable for the performance of the inspection requirements. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

4.3 Product Qualification Test (PQT)

Inspections, analyses, demonstrations and tests verify compliance of Section 3 of this specification on the first production unit.

4.4 Production Acceptance Test (PAT)

Each module delivered to the Government undergoes an Acceptance Test Process as identified in Table 9. The acceptance test verifies that the module interfaces are operating properly prior to delivery to the Government.

4.5 Verification Cross Reference Matrix (VCRM)

Table 9 provides a list of each Section 3 requirement and the verification method to be used. The following paragraphs define the codes employed in the VCRM. Unless otherwise noted, where more than more one verification method is shown, one method or a combination of methods may be used to show compliance.

4.5.1 Not Required (N/R)

This method indicates that verification is not required because the paragraph is a title, heading, general introductory paragraph or statement of a goal and contains no “shall” or “must” statements.

4.5.2 Inspection

Inspection is a method of verification of the module performance or characteristics by examination of the equipment or associated documentation. Inspections are conducted with the use of inspection tools, measurement devices, visual means and comparison. Most inspections apply to verification of requirements associated with physical characteristics such as size, weight,

appearance, adherence to specified standards and engineering practices, quality design, and construction supported with quality documentation. Inspections also include the auditing of manufacturer's data that verifies the performance of non-developmental items that comprise the TDC ICAP module. Inspections may occur during any assembly stage of the unit under test.

4.5.3 Analysis

Analysis is a method of verification through technical evaluation of calculations, computations, models, analytical solutions, use of studies, reduced data, and/or representative data to determine that the item conforms to the specified requirements.

4.5.4 Demonstration

Demonstration is a method of verification whereby the properties, characteristics and parameters of the item are determined by observation alone and without the use of instrumentation for quantitative measurements. This method is used when a requirement does not contain a specific numerical parameter that must be measured. Demonstrations may occur during verification of a unit under test at any assembly stage. Pass/fail criteria are simple yes/no indications of functional performance since no quantitative values are specified.

4.5.5 Test

Test is a method to verify that a specified requirement is met by thoroughly exercising the applicable item under specified conditions and by using the appropriate instrumentation in accordance with test procedures. This method requires the use of laboratory equipment, simulators, or services to verify compliance to the specified requirements. This method is used when it is practicable to make direct or indirect measurement of a specified numerical parameter to verify compliance with a requirement. Tests may occur during verification of a unit at any assembly stage. Actual measured values are recorded, and pass/fail is determined by comparing the measured value with the specified value. Measurement accuracy is precise enough to ensure that the measured value is within the specified tolerance.

Table 9 - Verification Cross Reference Matrix

		Verification Method					
			PQT				
Paragraph	Title	N/R	Inspect	Analysis	Demo	Test	ATP
3.	REQUIREMENTS	X					
3.1	Module Definition	X					
3.1.1	Cellular Hub Module (CHM)	X					
3.1.2	Base Transceiver Station (BTS) Module	X					
3.1.3	Kits Associated with the BTS	X					
3.1.3.1	Cell Phone Kit	X					
3.1.3.2	Cellular Antenna Kit	X					

Table 9 - Verification Cross Reference Matrix

Paragraph	Title	Verification Method					
			PQT				
		N/R	Inspect	Analysis	Demo	Test	ATP
3.1.3.3	Operations Maintenance Console (OMC) Kit	X					
3.1.3.4	TRX Card and Power Amplifier Kit	X					
3.1.3.5	TDC Large UPS Kit	X					
3.2	Performance Requirements	X					
3.2.1	Electrical Interface Requirements (External)		X				
3.2.1.1	Prime Power					X	
3.2.1.2	BTS Module to Cellular Antenna Connector				X		
3.2.1.3	BTS Module to CHM Wireline Connector				X		
3.2.1.4	BTS Module to CHM Fiber Optic Connector				X		
3.2.2	Electrical Interface Requirements (Internal)	X					
3.2.3	Functional Requirements	X					
3.2.3.1	Module Equipment Details	X					
3.2.3.1.1	Base Transceiver Station (BTS)				X		X
3.2.3.1.2	Transcoder Rate Adaptation Unit (TRAU) - if equipped				X		X
3.2.3.1.3	Operator Interface				X		X
3.2.3.1.4	Built-In Test				X		X
3.2.3.2	Configuration Options	X					
3.2.4	Physical Characteristics	X					
3.2.4.1	Transit Case		X				
3.2.4.2	Storage Space		X				
3.2.4.3	Weight					X	
3.2.4.4	Marking		X				X
3.2.5	Cables and Accessories				X		
3.2.6	Reliability			X			
3.2.7	Maintainability			X			
3.2.7.1	Mean Time Between Preventive Maintenance			X			
3.2.8	Environmental Conditions	X					
3.2.8.1	Temperature					X	
3.2.8.2	Relative Humidity			X			
3.2.8.3	Altitude			X			
3.2.8.4	Sand and Dust			X			

Table 9 - Verification Cross Reference Matrix

Paragraph	Title	Verification Method					
			PQT				
		N/R	Inspect	Analysis	Demo	Test	ATP
3.2.8.5	Shock					X	
3.2.8.6	Vibration					X	
3.3	Design and Construction	X					
3.3.1	Materials Parts and Processes			X			
3.3.2	Safety	X					
3.3.2.1	Electrical Safety			X		X	
3.2.2.2	Mechanical Safety		X	X			
3.4	Logistics			X			

5.0 PREPARATION FOR DELIVERY

Each module is packaged for shipment and the package marked in accordance with the requirements of the contract under which the module is ordered.

6.0 BASELINE CONFIGURATION

6.1 Equipment

Table 10 - Components

Device	Manufacturer	Part Number	Description	Quantity
Power Conditioner	Marway	411355	Power Conditioner – 16A	1
BTS	InterWave or Other		BTS w/12 to 40 Watt Transceivers (1800 MHz)	1
TRAU (if equipped)			Transcoder Rate Adaptation Unit (TRAU)	1
Fiber Optic Modem	S.I. Tech	2890-2R-ASP-1	Dual T-1 Fiber Optic Modem	2
Transit Case	ECS Composites		Transit Case	1
Cable (in pouch)			Power Cable	1
Cable (in pouch)			Cable, RJ-48C to RJ-48C	4
Cable (in pouch)			Fiber Optic Cable (ST to ST)	5

6.2 Elevation Drawings

To Be Supplied by Contractor

Figure 5 - Front Elevation

To Be Supplied by Contractor

Figure 6 - Rear Elevation

6.3 Cable Diagrams

To to supplied by contractor.

Table 11 - Cables

Wire Number	Part Number	Manufacturer	Description

6.4 Interconnection Diagram

To be supplied by contractor.