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2019 Wireless Test Bed Range Manual

Scott L Peterson

October 2019

The INL is a U.S. Department of Energy National Laboratory
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INL Wireless Test Bed

Range Manual

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Idaho National Laboratory

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Acronyms

AAA	Authentication, Authorization, and Accounting
AMR	Adaptive Multirate
ARFCN	Absolute Radio Frequency Channel Number
ATM	Asynchronous Transfer Mode
ATCA	Advanced Telecommunications Computing Architecture
AuC	Authentication Center
BCCH	Broadcast Control Channel
BGAN	Broadband Global Area Network
BRI	Basic Rate Interface
BSC	Base Station Controller
BSR	Base Station Radio
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
CDR	Call Detail Record
CFA	Central Facilities Area
CIP	Critical Infrastructure Protection
CITRC	Critical Infrastructure Test Range Complex
CONUS	Continental United States
COW	Cell-on-Wheels
DCOSS	Digital Central Office Switch Simulator
DOE-HQ	Department of Energy - Headquarters
DSX	Digital Signal Cross-connect
DTMF	Dual-Tone Multi-Frequency
EDGE	Enhanced Data Rates for Global Evolution
EFR	Enhanced Full Rate
EPC	Evolved Packet Core
FOT	Fiber Optic Technology
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
HF	High Frequency
HLR	Home Location Register

NT-HLR	New Technology Home Location Register
HSS	Home Subscriber Server
ISDN	Integrated Services Digital Network
ISBN	Isolated Satellite Backhaul Network
LAN	Local Area Network
LTE	Long Term Evolution
MAN	Metropolitan Area Network
MGW	Multimedia Gateway
oMGW	Open Multimedia Gateway
MME	Mobility Management Entity
MSC	Mobile Switching Center
oMSS	Open Mobile Softswitch
NGWTB	Next Generation Wireless Test Bed
NIB	Network in a Box
NMS	Network Management System
NOC	Network Operations Center
NSN	Nokia Siemens Network
NSS	Network Subsystem
NTIA	National Telecommunications and Information Administration
PAN	Personal Area Network
PCRF	Policy Charging and Rules Function
P-GW	Packet Data Network Gateway
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
QDBS	Qualcomm Deployable Base Station
RF	Radio Frequency
RGW	Residential Gateway
RNC	Radio Network Controller
RTSM	Real Time Spectrum Monitoring
SART	Signaling Analyzer Real Time
SIM	Subscriber Identity Module
SGW	Serving Gateway

SMS	Short Message Service
SMSC	Short Messaging Service Center
TAN	Test Area North
TCH	Traffic Channel
TCP/IP	Transmission Control Protocol/Internet Protocol
TDD	Time Division Duplexing
TNES	Traffica Network Element Server
TRAU	Transcoder and Rate Adaption Unit
TRX	Transceiver
TS	Traffica Server
TSCM	Transcoder Submultiplier
UAV	Unmanned Aerial Vehicle
UMTS	Universal Mobile Telecommunications System
VLR	Visitor Location Register
VoIP	Voice over IP
WAN	Wide Area Network
WCC	Warning Control Center
WCDMA	Wideband Code Division Multiple Access
WLAN	Wireless Local Area Network
WMAN	Wireless Metropolitan Area Network
WPAN	Wireless Personal Area Network
WTB	Wireless Test Bed
WWAN	Wireless Wide Area Network

Introduction

Idaho National Laboratory (INL), Next Generation Wireless Test Bed (NGWTB) program, is part of the Critical Infrastructure Protection (CIP) initiative. Our nation's reliance on wireless and Internet technology is rapidly evolving as more corporations and government agencies, employees, and handheld devices include mobile connectivity for both voice and data. The competitive advantage offered by a mobile workforce is leading many corporations to make wireless integration and convergence a top business priority. Similarly, military systems worldwide are rapidly embracing next-generation commercial technologies to accelerate network-centric capabilities and provide enhanced situational awareness.

While handheld devices such as laptops, BlackBerrys, and cell phones once had limited mobility and range, they are rapidly incorporating new and multiple protocols such as Bluetooth, Wi-Fi, Satellite, and broadband cellular (3G/4G) on a single platform to increase their effectiveness and agility. Worldwide there is exponential growth in public Wi-Fi and/or Satellite connectivity access nodes, and 3G/4G cellular continues to evolve and expand the range and speed of these devices. Additionally, critical infrastructure networks, previously isolated or connected with dedicated wireline circuits, are incorporating Zigbee for wireless sensor networks, wireless LANs for maintenance functions, and cellular or Internet based backhaul to manage control centers. Yet with all the build-up surrounding wireless technology, few understand the complexities surrounding wireless protocols and security, the risks of converged network infrastructures, need for interoperability of communication systems, or mitigation measures to safely use and improve new technologies in both commercial and military environments.

With no single vendor source for all the telecommunications equipment needed for wireless infrastructure upgrades, and no one entity providing end-to-end testing or independent validation, the INL's NGWTB program fulfills a niche for facilitating integrated testing of multiple technologies, across multiple wireless domains, of next generation wireless telecommunications systems.

NGWTB engineers and technicians have constructed and operate domain infrastructure in the Wireless Personal Area Network (WPAN), Wireless Local Area Network (WLAN), Wireless Metropolitan Area Networks (WMAN), and Wireless Wide Area Networks (WWAN).

Advantages that make the INL's NGWTB the place to conduct project and programmatic testing include:

- NTIA Experimental Station authority
- Geographically isolated and low-noise radio frequency (RF) test areas located on a 890 sm DOE reservation
- Access to isolated high-speed LAN and FOT networks

The rollout of next-generation networks will involve deploying new technologies at every level including new: handsets, frequencies, antenna arrays, cell configurations that are optimized for both data and voice, massive upgrade of cell controllers' "land-line" phone links from low bandwidth connections to higher capacity fiber or wireless backhaul, and integration of voice switching and Internet/data network protocols (Voice-Over-IP, Web phones). These systems are expected to greatly transform our nation's communications infrastructure and the types of services it provides.

Wireless Test Bed Overview

The Department of Energy (DOE) Idaho National Laboratory (INL) Wireless Test Bed (WTB) performs experimental wireless communication testing under authority granted by the National Telecommunications and Information Administration (NTIA).

The INL WTB test range is located 45 miles west of Idaho Falls on 890 square miles of access-controlled high desert terrain in a low RF noise environment isolated from urban areas and military bases. Figure 1 shows the boundary of the INL Test Range.

Testing and engineering analysis are performed to satisfy US government commercial and academic entity requirements that align with missions in DOE and national security. The WTB offers advanced engineering and technical services through experience over a broad range of commercial and military telecommunications systems. The technical staff has work related experience from equipment manufacturers and service providers.

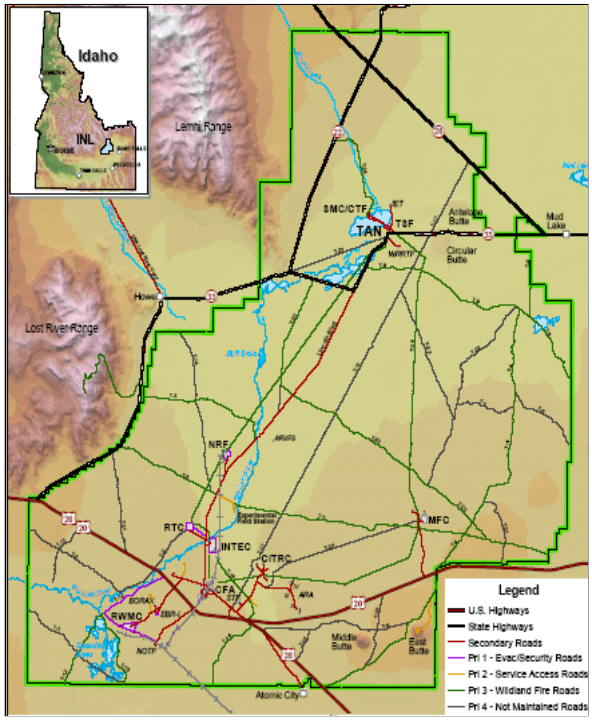


Figure 1 INL WTB Test Range Boundary

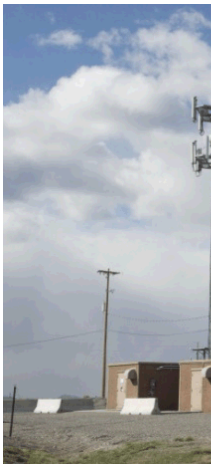
Full scale, "Tier 1" cellular and other wireless networks and technologies are deployed on the range from facilities similar to those in industry. Each network was designed to be isolated from all other WTB systems and commercial networks, though capable of inter-system operations and off-site connectivity. All aspects of each network are configurable to replicate commercial systems found worldwide, providing realistic test environments. This replication encompasses a range of system functions including core switching and signaling protocols, PSTN traffic simulation, service provider and subscriber identities, and air interface transmissions.

- 2G, 3G and 4G cellular telephony
- Corporation for national and international interests
- Convergent telephony systems (data/voice)
- High speed data networking infrastructure
- Land Mobile Radio (LMR) Telecommunications systems
- Unmanned Aerial Vehicle (UAV) platform communications
- Wireless Data Networks (WAN, MAN, LAN, and PAN)
- Communications back-haul systems (e.g., Microwave, Satellite, Free Space

Optics).

The INL Wireless Test Bed (WTB) provides four major assets to its customers:

1. Frequency Spectrum Availability
    - Low RF noise
    - NTIA Experimental Radio Station
    - Local Spectrum Manager
2. Full Scale Communications Test Networks
    - GSM & WCDMA (3GPP Rel. 11 comp)
    - Satellite Backhaul
    - CDMA2000 (ITU 1xRTT Rev 0)
    - LTE Band 13 & 14
    - LTE-Advance Band 3 & 7 (Rel.10)
    - Isolated Satellite Backhaul
    - WiFi/VoIP
    - Point to Point Microwave & Fiber Optic



3. Telecommunications Engineering Expertise
    - Design & Installation
    - System integration
    - Operation
    - Maintenance & Repair
    - Protocol capture/analysis
    - RF modeling/simulation
4. Large isolated geographical area
    - 890 square miles
    - 5000 feet elevation
    - Removed from military bases
    - Mountains on West and North
    - Rolling high desert terrain
    - Unrestricted airspace
    - Controlled access
    - Full range services

Spectrum Availability and Management

The DOE Idaho National Laboratory (INL) Wireless Test Bed (WTB) has National Telecommunications and Information Administration (NTIA) Experimental Authority. This is spelled out in Section 7.11 of the NTIA Red Book as shown in Appendix C.

The Experimental Authority grants permission to the DOE/INL to emit signals at almost any frequency as long as:

1. No harmful interference is induced onto local system/ spectrum owners
2. No commercial services are provided
3. For test purposes only

The DOE/INL Range consists of 890 sq miles located 45 miles west of Idaho Falls, Idaho. No urban areas or military bases exist anywhere near the INL range. Typical AM & FM radios along with UHF & VHF signals are present; however, little RF Noise exists on the INL Range.

The NTIA Experimental Authority allows frequency use from DC to light as long as the INL and the INL customers do not violate the Authority covenants. Therefore the INL WTB has a Frequency Manager as part of the team to gain approval for customer request of spectrum use. The frequency use approval is conducted on a case by case basis typically within one to two weeks time, and faster when necessary.

When a customer has a request for spectrum, they will work with the WTB assigned Test Lead. A Spectrum Request Form is filled out and submitted to the WTB Frequency Manger. A search is performed from both the FCC and government databases for any licensing conflicts. Also taken into consideration are the requested customer test dates, effort times and the potential for spectrum coordinated between customers. Once the initial search has been completed, the request is then forwarded to the INL Spectrum Manager for final approval. Recommendations to shift frequency use or adjust time of day for tests are accommodated as required. An RF simulation of the test case is performed, if required to gain INL Spectrum Manager approval.

The INL WTB, in conjunction with the INL Spectrum Manager, reviews each customer frequency use request on a case by case basis, taking into account the desired RF foot print and RF output power of each test.

The frequency approvals are then valid for only the period they were requested. During the effort if it is found that harmful interference is caused from WTB or customer equipment immediate changes will be made.

Cellular Frequency Availability

The INL WTB has several telecommunications assets, including HF and cellular, along with a RF spectrum monitoring system – which will be described in detail later in this manual.

The INL WTB has the following cellular assets:

- GSM 900 MHz, 1800 MHz & 1900 MHz
- UMTS 2100 MHz
- CDMA 800 MHz & 1900 MHz
- LTE 700 MHz, 1800 MHz, 2600 MHz

Table 1 provides information on the baseline RF channels that have been chosen for the WTB cellular assets, as of December 1, 2015.

Table 1 INL WTB Baseline RF Channels

Item	Spectrum Band	Channel / Frequency
1	GSM 900 P	20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42
2	GSM 1800 DCS	512, 514, 516, 518, 520, 522, 524, 526, 528, 530, 532, 534
3	GSM 1900 F Block	712, 714, 716, 718, 720, 722, 724, 726, 728, 730, 732, 734
4	UMTS-FDD 2100 Band I	10562
5	LTE Band 3	1300
6	LTE Band 7	2850
5	LTE Band 13	5180 – 5279
6	LTE Band 14	5280 – 5379
7	CDMA 800 B (10MHz)	507
8	CDMA 1900 F (5MHz)	862
9	PTMP Mobile System	4900 – 4920 MHz
10	KU Band Satellite	12 – 18 GHz
11	BGAN	1626.5 – 1660.5 MHz
12	SatSim	1556.78 MHz
13	Wi-Fi	2400 MHz

Real Time Spectrum Monitoring

The WTB Real Time Spectrum Monitoring (RTSM) system allows for the remote monitoring of RF emissions on the INL Range property. The spectrum analyzers are located at Howe Peak, EBR 1 & RTMF as shown in Figure 2. The current system is capable of monitoring the following RF emissions: 300 kHz to 14 GHz at RTMF, and 300 kHz to 3 GHz at Howe Peak and EBR 1.

Each location has a Spectrum Analyzer with a variety of antennas and various logging capabilities. The system also has remote control capabilities, including control of the azimuth pointing angle of antennas (± 180° rotation), as well as control & access to the RTSM System from CFA 609 (INL Spectrum Manager) and CFA-1609 (WTB Frequency Manager).

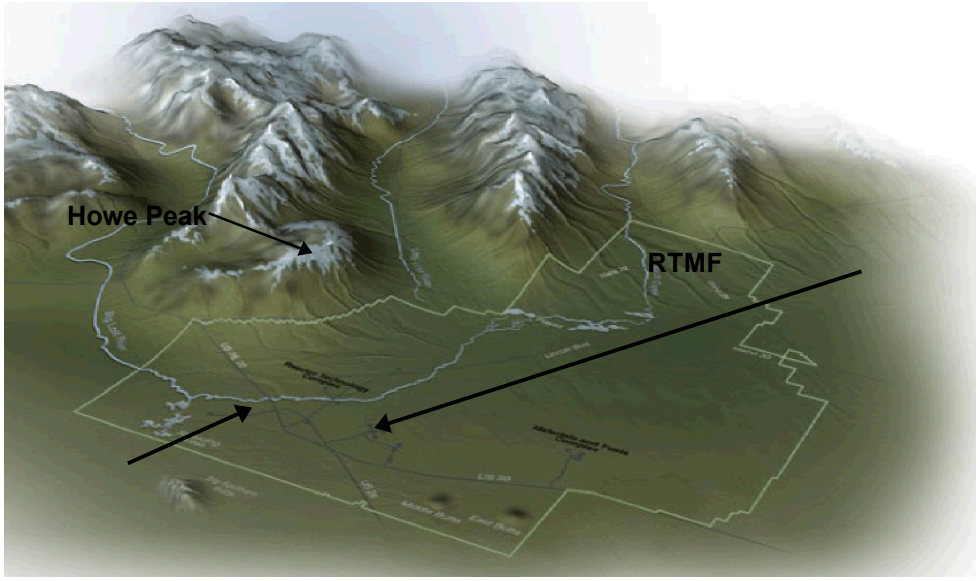


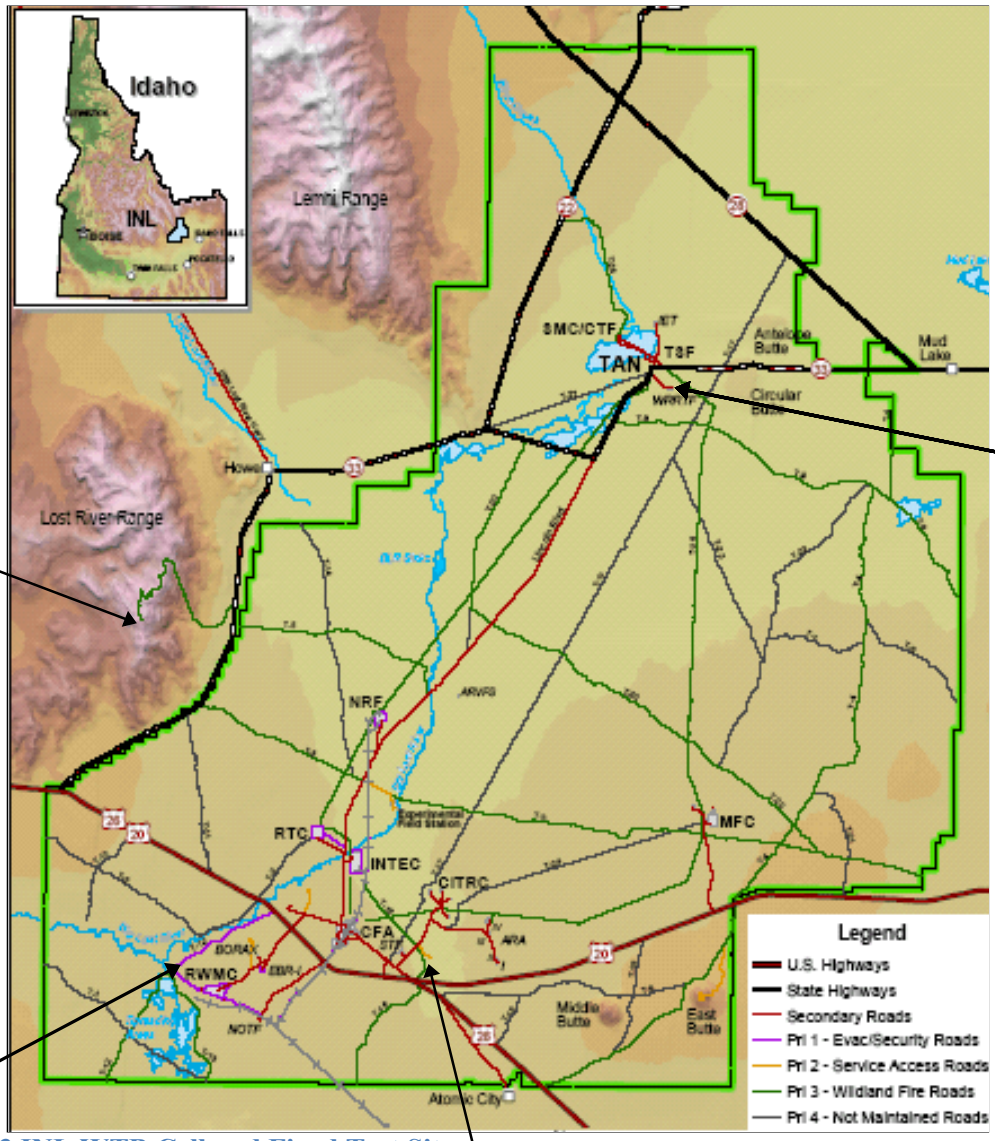
Figure 2 INL Real Time Test Monitoring range locations

WTB Communications Networks

INL WTB consists of several full scale Communications Test Networks, which include the following:

- GSM and UMTS Cellular networks isolated from the PSTN with handovers between networks supported
- Isolated Sattelite Backhaul Network
- CDMA 2000 NIBs
- Wi-Fi/VoIP network isolated from the Internet
- HF fixed and mobile radio/antenna network
- Satellite Simulator
- LTE Band 13 & 14
- Satellite ground station and field kits configured for isolated satellite comms through commercial services
- Complete control of all parts of the system
- Ability to link with other INL assets or external assets

The WTB consist of three fixed cell sites and several fixed test sites as shown in Figure 3. Figure 4 provides an overview of the communications assets currently installed at the WTB.



INL radio site at 8628 feet elev

CFA 1609 & 699 NOCs

CFA 609 Cell Site

EBR 1 Cell Site

WRRTF

RTMF

Cell Site #9

Cell Site #6

Idaho Falls 45 miles East

HFTB Site

Gate 1 Cell Site

Figure 3 INL WTB Cell and Fixed Test Sites

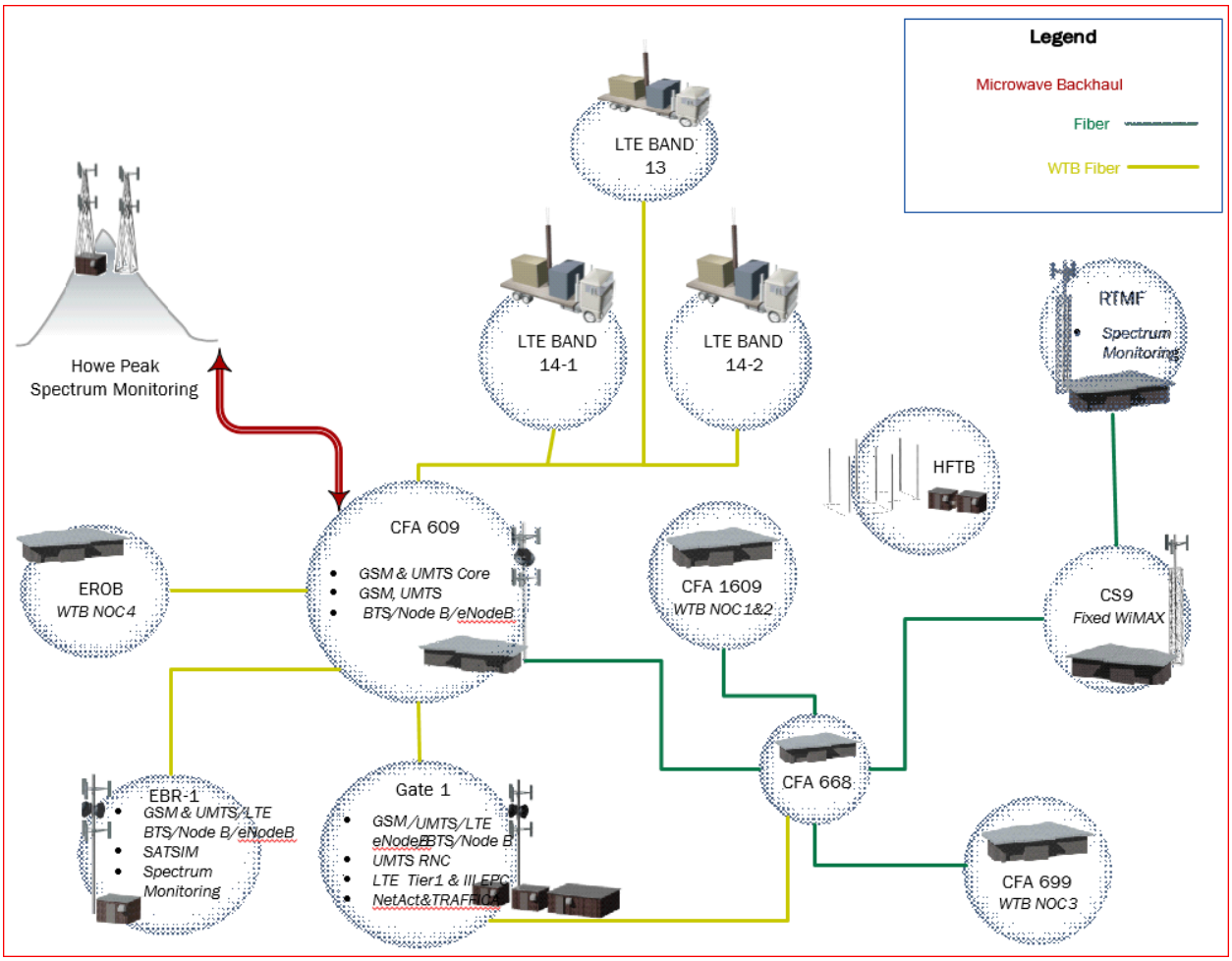
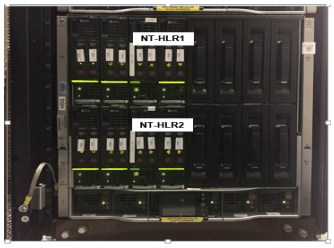


Figure 4 WTB Communications Assets

Overviews of INL WTB Communication Test Networks

A high level overview for each of the INL WTB Communications Test Networks is provided in the following sections. A detailed description for each Network is provided later in this manual.

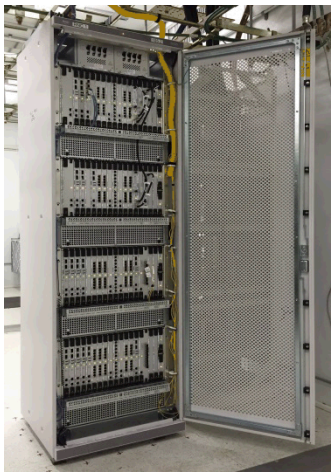


GSM

The INLWTB GSM Cellular Network consists of a full scale Tier 1 NOKIA oMSS and BSC switching center which currently controls three fixed cell sites.

The GSM network switching Hub is located at CFA-609 and is the central equipment core of the network. The NOKIA Tier1 NT-HLR is located at Gate1.

The cellular system is operated from one of four (4) Network Operation Centers (NOC), which are currently located in the CFA-1609, CFA-699 and UB-4 buildings. NGWTB engineers control and monitor the network from the NOCs. Frequencies supported are 900 MHz, 1800 MHz and 1900 MHz.



UMTS

The INL WTB UMTS (WCDMA) Cellular Network consists of a full scale Tier 1 NOKIA MSC and RNC switching center which currently controls three fixed cell sites.

The network switching Hub is located at CFA-609 and the RNC is located at Gate 1.

The cellular system is operated from one of four (4) Network Operation Centers (NOC), which are currently located in the CFA-1609, CFA-699 and UB-4 buildings. NGWTB engineers control and monitor the network from the NOCs. Frequencies supported are 1920 MHz to 2100 MHz.

Cellular Network Management

The INL WTB NOKIA Tier 1 NetAct is an operations support system for operating and maintaining the elements of the WTB GSM, UMTS and LTE cellular networks. It allows the WTB to automate many of the tasks associated with configuring and operating the cellular networks and thereby reduce errors and improve efficiency and availability. NetAct also provides monitoring of the various GSM, UMTS, and LTE Nokia network elements.

Traffica

The INL WTB Nokia Traffica is a real-time traffic monitoring tool designed to facilitate the monitoring and analysis of network traffic. Traffica allows you to see how the network functions from the network element level down to individual subscriber information. It visualizes network traffic both via pre-defined and user definable real-time graphs. The tool also stores records for each call attempt, SMS delivery and data session into a database for further use in troubleshooting and historical analysis.

The Traffica system was integrated with and supports the following operations on the WTB GSM (2G) , UMTS (3G) & LTE (4G) cellular networks.

LTE DeployableBand 13 & 14

The INL WTB LTE Cellular Network consists of a Mini Athonet EPC which controls 3 LTE eNodeBs (2 Band 14 & 1 Band 13), which are each installed in one of three COWs.

The mini EPC functionalities includes MME (Mobility Management Entity), S-GW and P-GW (Serving/Packet Data Network Gateway or SAE Gateway) HSS/AuC (Home Subscriber Service, Authentication Center), & Policing Control and Charging Rules Functions (PCRF).

The core network (mini EPC) is located at Gate1 while the 3 COWs (eNodeB) can be deployed within INLs fiber backbone. There are 2 Band 14 eNodeB and 1 Band 13 eNodeB. Both can be configured for 5 & 10 MHz bandwidth. 2x2 support SISO & MIMO and can have an adjustable power up to 40 watts. The panel antenna on each COW have electric down-tilt and azimuth control.

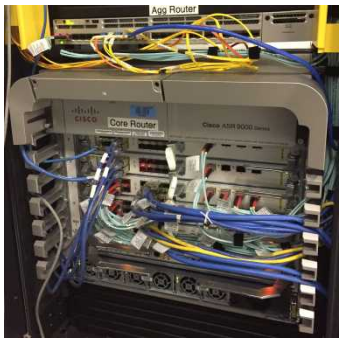
LTE Tier I Network

The INL WTB LTE Tier I Network consists of full scale Nokia Evolved Packet Core (EPC), Subscriber Data Management (SDM), & LTE eNodeBs.

The Evolve Packet Core (EPC) is located at Gate1-Shelter3, and consists of Mobility Management Entity (MME), Serving&PDN-Gateway (S&P-GW), Domaine Name Servers, and Internet Simulator. EPC handles the control and user plane traffic.

The Subscriber Data Management (SDM) is located at Gate 1-Shelter 3, and consists of Home Subscriber Server –Front End (HSS-FE) and One-Network Directory Server (One-NDS). SDM handles the subscriber databases..

LTE eNodeBs are located in Gate1-Shelter 1, CFA-609,& EBR-1 using Band 3 & Band 7, and it is a release 10 compliant.



Core & Aggregation Router

In the LTE Tier 1 network, the INL WTB uses Cisco Core and Aggregation Router that manage the layer2&3 routing, and handles the signaling and user traffic from interfaces.

Short Messaging Service Center (SMSC)

The INL WTB Tecore SMSC provides simultaneous SMS operations for GSM (2G), and UMTS (3G) wireless networks. It delivers full SMS services including: standard services i.e. (Mobile Originated (MO) and Mobile Terminated (MT) short messages, Message delivery report), measurements i.e. (Successful MOs /MTs, Failed MOs/MTs), and extended features i.e. (Custom Message Delivery to any subscriber). The SMSC runs on a DELL R610 hardware platform with LINUX operating system version: 2.6.32-358.18.1.el6.i686

GSM Simulator

The INL WTB NetHawk GSM network simulator emulates the MSC/BSC traffic on the Abis interface. The software operates with NOKIA BTSs to provide GSM air interface signals. The network allows the WTB to rapidly deploy a mobile stand-alone GSM network consisting of a laptop/PC and BTS. The Simulator supports MS registration and call functions, SMS, protocol analyzer and call generation capabilities.

PSTN Simulator

The INL WTB GL Communications DCOSS provides a simulated PSTN connection to the GSM and UMTS cellular networks. The DCOSS supports full SS7 signaling, voice call switching, and traffic generation into the cellular networks.

CDMA

The INL WTB CDMA 2000 cellular network consists of three (3) Qualcomm Deployable Base Station (QDBS) systems. Each system is a Network in a Box (NIB), two of which support 800 MHz operations and one that supports 1900 MHz operations.

Isolated Satellite Backhaul Network

The Isolated Satellite Backhaul Network (ISBN) consists of a fixed 5.6m ground station and seven autodeploy field kits. The field kits are a mixture of ground and vehicle mounted units. Encrypted voice and data communication is supported between the ground station and field kits. KU band commercially available satellites provide the interconnect.

High Frequency (HF) Radio

The INL WTB HF radio system facilitates communications testing and consists of several fixed and mobile radio systems. Fixed radio systems are located at HFTB. A variety of field expedient fixed antenna assets are located at:

- STF (on INL reservation)
- WRRTF (on INL reservation)
- INL Administration Building (Idaho Falls)
- North Yellowstone Complex (Idaho Falls)

There are several radio systems packed into mobile kits to enable the radios to be easily deployed in a vehicle and operated from a remote location. Each kit contains the radio itself in addition to equipment necessary for remote operation (i.e., antenna, amplifier, cables, power supply)

Satellite Simulator

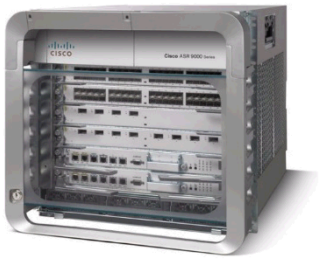
The INL WTB Satellite Simulator provides a simulated satellite phone network on the INL range from a single tower. The simulator supports typical MS functions including MS registration, MO/MT voice calls and SMS.

Backhaul

The Wireless Test Bed cellular assists are connected by means of an ATM network and microwave shots by Marconi and Ceragon equipment. The LAN networks riding on the ATM infrastructure are isolated from not only the outside world (PSTN or internet) but from each other as well. This design supports simultaneous testing of multiple networks without the concern of intrusion or interference.

LAN1 (Fixed Cell Sites LAN Network)

LAN1 is an isolated TCP/IP Ethernet network providing wireline network access at five facilities for the WTB GSM and UMTS networks. The purpose of LAN1 is to provide TCP/IP connectivity for all WTB cellular network elements and support components located in the WTB fixed network sites in addition to



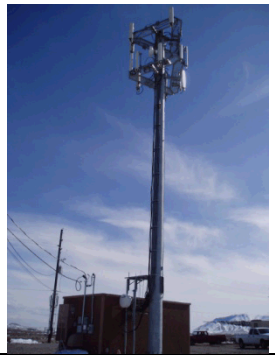
one of three (3) Network Operations Centers (NOC).

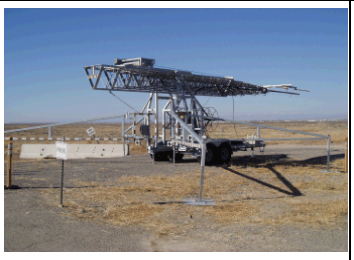
LAN4 (Real Time Spectrum Monitoring RTSM)

LAN4 is an isolated TCP/IP Ethernet network providing wireline network access at five facilities for the remote monitoring of RF emissions on the INL Range. The purpose of LAN4 is to provide TCP/IP connectivity for all WTB cellular network elements and support components located in the WTB fixed network sites in addition to one of three (3) Network Operations Centers (NOC).

Overviews of INL WTB Facilities

A high level overview for each of the INL WTB Facilities is provided in the following section.

	**CFA-609 – Cellular Hub, Fixed Cell Site** CFA-609 is the main cell site and switching center for the NGWTB cellular network. Outside of the building is the CFA tower consisting of three 120° sector platforms at 50’ and 60’ levels for mounting antennas, amplifiers and other equipment. This location is linked to fixed remote cell sites via microwave or fiber optics.
	**GATE-1 – Fixed Cell Site** Gate-1 is a fixed remote cell site linked to CFA-609 via 23 GHz microwave. There are three shelters. Shelter 1 is an environmentally controlled, 11’x22’ concrete construction. Between Shelter 1 and Shelter 2 is a 60’ tower with three 120° sector platforms at 50’ and 60’ levels for amplifiers and other equipment. Shelter 2 is of the same caliber as Shelter 1, while Shelter 3 acts as a remote cellular hub.
	**EBR-1 – Fixed Cell Site** EBR-1 is a fixed remote cell site that is linked to CFA-609 via 23 GHz microwave. There is one shelter, which is an environmentally controlled 11’x22’ concrete construction. Next to the shelter is a 60’ tower with three 120° sector platforms at 50’ and 60’ levels for mounting antennas, amplifiers and other equipment.
	CFA-1609 CFA-1609 has been specially reconstructed to support the network operations for the WTB. This building facilitates WTB support personnel, two fully capable

	Network Operations Centers (NOCs), customer operating areas, charging room, staging room, and lunch room. The outside of the building hosts Rhone towers to support customer antenna and equipment, with RF ports in each of the customer operating areas.
	**CFA-699** CFA-699 includes a third Network Operations Center (NOC) and customer operating area. This building also includes a high bay, lab area, tool and test equipment storage, storage, and hosts WTB support personnel.
	**LTE Band 13 & 14 Deployable COWs** LTE COWs are deployable within INLs fiber infrastructure The three available COWs can be towed anywhere to an approved testing area. The Mast on each COW will extend up to Approx. 60 feet. Each COW has its own diesel generator or can run on commercial power.
	**Mobile Tower-1** Mobile Tower-1 is constructed out of an ATC-106C mobile tower trailer with a retractable antenna tower. Mast height can be adjusted between 29’ and 106’. An external power source is required to operate the antenna tower.Check height with WTBS Capabilities brief Slide (105’ or 106’)
	**Mobile Tower-2** Mobile Tower-2 is constructed out of an ATC-60C mobile tower trailer with a retractable antenna tower and 6’ x 6’ environmentally controlled equipment shelter. Mast height can be adjusted between 29’ and 60’. An external power source is required to operate the antenna tower and HVAC equipment.
	**Mobile Lab-1** Mobile Lab-1 is an 8’ x 16’ enclosed trailer with AC generator and HVAC unit. The interior has approximately 12’ of counter tops/cabinets along both sides of the trailer, one full height (7’) network rack and small refrigerator. RF ports are provided. The trailer is also equipped with an INL WiMAX radio and antenna to allow access to the internet from remote locations.
	Cell Site #9

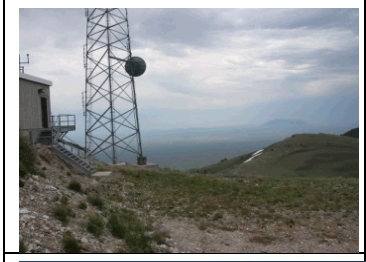
Cell Site #9 supports remote testing of various equipment through optical transport, AC power and the fixed tower.

TAN-687

TAN-687 is the secondary connection point for the WTB COWs. An antenna mounted on a tower outside of the building provides a microwave link from the OMH COW to TAN-687 at the north end of the INL reservation. The High Point is connected back to CFA-609 via fiber-optic network allowing the mobile cell network to operate geographically separated from the fixed cell network. The antenna faces southwest, allowing the OMH to be placed in a remote area in that direction out to a distance of six miles while still maintaining the microwave link.

CFA-1610

CFA-1610 is used to support classified storage, meetings, and testing efforts. There is scaffolding erected outside of the building to mount various antennas and equipment configurations.



Howe Peak Access

The WTB has access to the INL Howe Peak Radio Transmission Facility to locate and operate equipment. The elevation of Howe Peak is over 8500 feet. Howe Peak also hosts the WTB spectrum monitoring equipment in support of the WTB Real Time Spectrum Monitoring System.

HF Test Bed

The HF Test Bed is located at STF. Currently four, 60’ poles with pulley systems are available to erect various HF antenna configurations. There are 6 RF cables running out to two bang boards in the antenna field for various antennas to be set up. The HFTB also has an HF monitoring station with 3 offsite locations at UT, VA and FL as well as one INL location. There are several HF antennas stored here that can be set up for different testing

RTMF

The Real Time Monitoring Facility (RTMF) is a remote location that supports the Real Time Spectrum Monitoring System as well as the WiFi/VoIP network. RTMF is located near the Critical Infrastructure Test Range Complex (CITRC).

	
	**WRRTF** Located at the northern end of the INL range, WRRTF is home to a trailer with AC power and HVAC. This location is outside of the INL gated site grounds and supports access to the surrounding public lands.

Test Equipment

LTE Protocol Analyzer

Real time monitoring and recording of data exchange between LTE network elements is capable through the Viavi Signaling Analyzer Real Time (SART) protocol analyzer.

The Viavi LTE Protocol Analyzer is located at the Gate-1 Shelter-3 cell site location 105.2 cabinet. The SART through PacketInsight is configured to passively monitor all uplink and downlink communication transferred between all interfaces on LTE Network

Collected data can be provided in different file formats such as txt, pcap, rec or played back through a viewer utility.

UMTS Protocol Analyzer

Real time monitoring and recording of data exchange between UMTS network elements is capable through the Viavi Signaling Analyzer Real Time (SART) protocol analyzer.

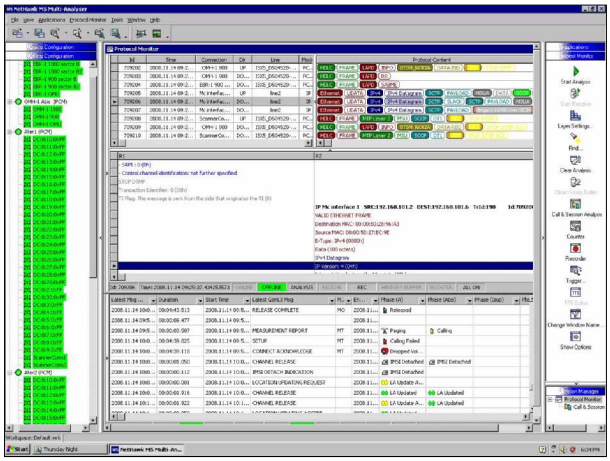
The Viavi Protocol Analyzer is located at the Gate-1 Shelter-3 cell site location 105.2 cabinet. The SART is configured to passively monitor all uplink and downlink communication transferred on the Iu and Iub signaling links.

Collected data can be provided in text file format or played back through a viewer utility.

GSM Protocol Analyzer

Real time monitoring and recording of data exchange between GSM network elements is capable through a NetHawk M5 protocol analyzer.

The M5 is located in the equipment hub at CFA-609. The M5 interfaces to the Digital Signal Cross-connect (DSX) board which acts as a patch panel for network element circuits. These interfaces passively monitor all uplink and downlink communication transferred on the A, Abis and Ater circuits as well as the IP control plane protocols.



Collected data can be provided in text file format or played back through an M5 viewer utility. The playback viewer provides filtering capabilities and a graphical user interface similar to the M5 Analyzer.

Chariot (IP Characterization)

NetIQ's Chariot evaluates network performance by assessing software and stress-testing the system. It generates traffic to measure its effects on the system and reports real-time statistics. Chariot supports multiple protocols (TCP, UDP, RTP, SPX, IPX, and SNA), and emulates the traffic of any application or protocol – including VoIP, ERP, web, videoconferencing, and IP multicast. VoIP, video and audio conferencing run over the protocol RTP.

Chariot is operated from a console that lets you create and run tests. Each computer that is used in Chariot tests must have Chariot endpoint software installed on it. The endpoints collect performance statistics and send them to the console, which produces reports reflecting the response time, transaction rate, connectivity, and throughput between the endpoints.

For each test an application script is selected that emulates an application. The endpoints use the script to create the same data flows that an application would send between the computers. Thus, the applications themselves do not have to be installed on the computers.

The two endpoints carry out the test, with endpoint

one collecting the records that contain the results. Endpoint one then returns the records to the console.

The tests run independent of the console. The consoles role is test setup, directing the test to begin, collection of the records once the test has completed and providing reports.

The test data collected includes throughput, latency, delay, jitter and packet loss measurements between the endpoints/clients depending on the application/test selected.

Chariot Test Scripts

Throughput scripts test the throughput between the computers. A file is sent, received and acknowledged. This test is designed to provide accurate measurements of network throughput.

Streaming scripts emulate multimedia applications, which send data without acknowledgements. Datagrams are sent in one direction only. These scripts where run using the RTP protocol. When this protocol is used jitter is added to the test measurement set.

The streaming script that can be used is Realmed, which emulates a real network server streaming a combined audio and video file. The file is encoded and played with Stream Smart technology (G2 version). The send data rate can vary with the type value for the payload set (for example, to H261).

Voice over IP scripts emulate voice sent over an IP network. Voice datagrams are sent between the endpoints based on the chosen codec. Delay, lost datagrams and jitter are some of the data that can be recorded for this test.

VIAVI Cell Advisor Signal Analyzer

The CellAdvisor is a portable unit which can perform RF over Fiber (RFoFiber –RFoOBSAI), LTE/LTE-Advanced (FDD and TDD), as well as Over the Air (OTA measurements). Is also has a fiber inspection scope option.

Test Planning and Conduct

The process for initiating a test project at the INL is straightforward and generally follows these steps:

- Contact the WTB Test Manager to discuss the feasibility of a prospective project
- If the project is feasible, negotiate scope, cost and schedule
- WTB provides detailed ROM Cost Proposal
- Identify appropriate funding mechanism
- Provide project documentation and funding
- Department of Energy sends project acceptance letter
- Project begins

Coordination and Scheduling

The WTB Test Manager is the central point of contact for coordinating and scheduling tests at the WTB. In order to maintain the test log, the WTB Test Manager shall be informed of all testing being conducted at the WTB.

Test Development and Execution

The WTB Test Team will develop a Test Plan for each test cycle based on sponsor provided testing requirements. Depending on the complexity and risk involved in the proposed testing, the details of the test plan and approval(s) necessary to test will vary.

The WTB Test Manager is responsible for the overall project scope, schedule and budget as defined. The Test Manager will assign a WTB Test Lead to serve as the single point-of-contact for technical execution of each project phase. The Test Manager and Test Lead will work with the sponsor to refine technical and program requirements, reporting, and other information necessary to assure that the project is conducted both safely and satisfactorily.

A pre-testing brief will be conducted at the beginning of each test cycle to review hazard mitigation requirements, and revalidate RF

spectrum environment. Upon completion of the testing cycle, a post-testing brief will be conducted to review operational activities for Noteworthy Practices and Lessons Learned.

Range Access and Services

The INL is one of the Department of Energy's (DOE) ten national laboratories across the United States. The Wireless Test Bed is located approximately 45 miles west of Idaho Falls. Access to DOE government facilities and resources has both requirements and restrictions.

Access

Admittance/access to the INL and Idaho Falls facilities must be for Official Business Only. All visitors are subject to search for prohibited articles prior to entry. (A listing of INL prohibited articles is included herein). The WTB Test Lead will collect personnel visitor information prior to the client's arrival. This information is sent to INL Personnel Security, and visitor badges will be printed. Visitor badges will be available upon check-in at the respective site or town security facilities. All visitors must present a valid photo ID for positive identification. Valid badges from other DOE sites will be honored at INL facilities. Escort requirements will be determined by the Test Lead.

NOTE: *Foreign visitor access requires additional coordination.*

Prohibited Articles

The following items are prohibited in all areas at INL (a list of these prohibited items is posted at all facility entry points):

- Firearms, ammunition and all other types of weapons
- Explosives, flammable or hazardous chemicals
- Intoxicants or illegal drugs
- All dangerous items or materials likely to produce injury or damage to personnel or property.

The following items are prohibited in Security Areas at INL without proper authorization:

- ALL cameras (including in cellular phones)
- Audio or video recorders
- Radio transmitters
- ALL wireless communication equipment (BlackBerrys, cell phones, PDAs, laptops, etc.)

Prohibited Activities

The following activities are prohibited at INL without proper authorization:

- Gambling
- Hunting or target practice
- Searching for or removing archeological artifacts
- Soliciting
- Grazing of livestock
- Recreational activities
- Mineral exploration and mining.

Vehicle Access

Unless notified otherwise, the use of private and government vehicles at the Wireless Test Bed is unrestricted. All vehicles are subject to search and seizure at the main security gates at all INL entry points. Additionally, depending on the type and/or classification of the testing being conducted at the INL Test Range, the use of private vehicles may be restricted or limited in specified areas.

Transportation

Non-INL personnel (visitors) are required to provide their own transportation to/from the INL (approximately 100 miles roundtrip). During a normal work week (Mon.-Thurs.), courtesy taxi service may be provided at some Test Range areas for transporting personnel between INL site facilities.

Visitor Computer Network

The Wireless Test Bed has dedicated workstations for visitors to conduct business "outside" of the INL Firewall via a visitor network for internet access.

Food Services

A cafeteria is available at the Central Facilities Area (CFA) and at Test Area North (TAN) on the INL Site. Visitors have the option of providing their own meals, or including the cost of catered meals in the overall testing cost. Food service contracts may not always be reliable on site, so it is important to discuss these details with the Test Lead prior to arrival.

Fueling Services

The INL Wireless Test Bed can accommodate on-site fueling services for vehicles, generators, or other equipment. The fuel charges are applied to the overall test costs. There is a fuel station (gasoline and diesel) at the CFA. The Test Bed also has a truck-mounted diesel fuel tank for refueling diesel generators in the field.

Classified Networks and Meeting Rooms

Several INL facilities, both on the Test Range and in Idaho Falls support classified processing and discussion, up to and including TS/SCI. Both Test Range and Idaho Falls classified facilities have STU-III/STE phones available. In Idaho Falls there is access to SIPRNET (S/NSI) and the JWICS (TS/SCI) mail network, as well as postal shipping addresses for classified materials.

If access to the INL classified facilities is required, the individual's clearances would have to be forwarded to appropriate INL security personnel.

Fire Department and Medical Dispensary

The INL has a fully-functional Medical Dispensary, including an operating room at the CFA area. CFA Medical is open Monday through Thursday, with physicians available 0700 – 1700 hours (24-hour nursing coverage).

Ambulance services dispatch from the INL Fire Department, also located at CFA. Typical response time, depending on training location on site, is approximately 3-6 minutes.

If a medical emergency is beyond the capability of the INL Medical Dispensary, the patient will be transported to Eastern Idaho Regional Medical Center (EIRMC). Travel time is approximately 45 minutes by ambulance, and approximately 30 minutes by life flight helicopter.

In case of emergency, while on the INL test range, contact the Warning Communications Center (WCC) at (208)526-7777 or 526-1515 via cell phone. If calling from an INL phone line, you can also dial "777." This will dispatch INL emergency response to your location.

The INL also has a full capacity Fire Department located in the CFA area.

INL Over Flight Notifications

Test range personnel are required to make over flight notifications to the WCC and PSO for aircraft flying under 1000' AGL. Flights above 1000' are only required to follow FAA regulations. The WTB Test Lead will submit INL over flight notifications for all Wireless Test Bed customer flights. The following information will be required in order to coordinate and deconflict INL over flight activities:

1. Date of Flight
2. Time (to/from) of Flight
3. INL Areas to be Flown (entire site, south, or north)
4. Aircraft Type (make and model)
5. Aircraft Color
6. ID Number

INL Addresses

The following are the standard INL mailing addresses.

Mailing Address:

Name of recipient
Idaho National Laboratory
PO Box 1625
Idaho Falls, ID 83415 – (Mail Stop).

Physical Address:

Name of recipient
Idaho National Laboratory
2525 Fremont
Idaho Falls, ID 83415 – (Mail Stop).

Freight/Fed Ex Address:

Idaho National Laboratory
Attn: Name, Area, Building

1765 North Yellowstone Hwy.
Idaho Falls, ID 83415 – (Mail Stop).

Transportation and Travel to South Eastern Idaho

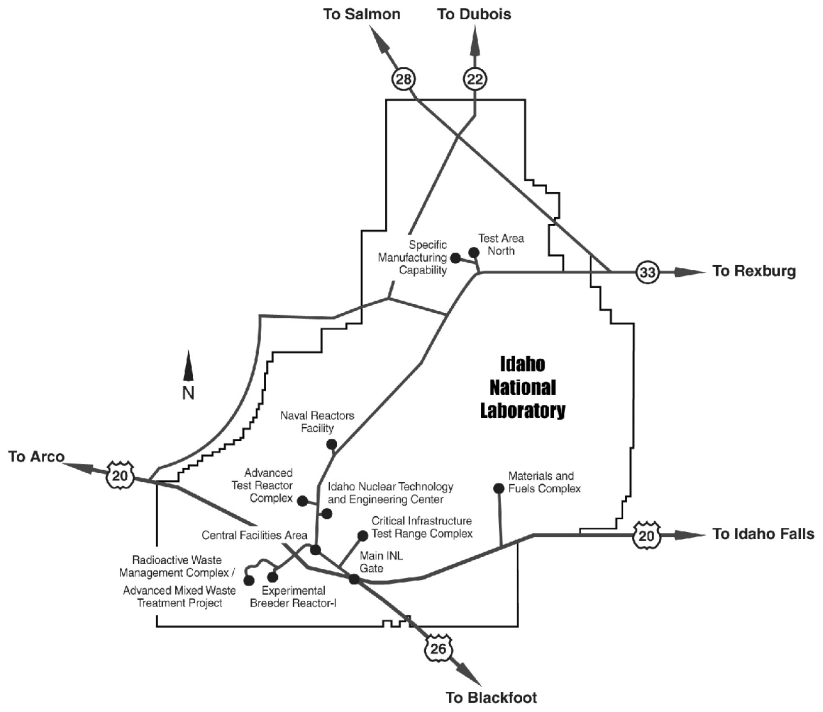
- Idaho Falls Airport (IDA), 2140 N Skyline Drive, Idaho Falls, ID, 208-612-8221 (46 miles to INL Site)
- Pocatello Airport (PIH), 1950 Airport Way, Pocatello, ID, 208-234-6154, (66 miles to INL Site)
- Salt Lake City International Airport (SLC), 776 N. Terminal Drive, Salt Lake City, UT, 801-575-2400, (215 miles to Idaho Falls facilities, 225 miles to INL Site)

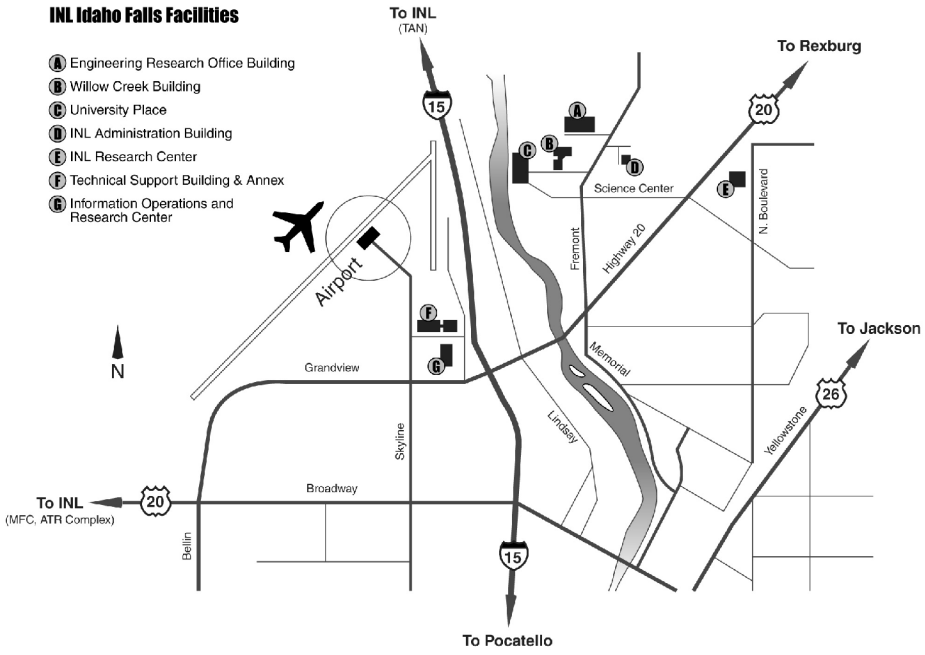
Car Rentals

Varies from airports:

- Alamo, 208-522-0340
- Avis, 208-522-4225
- Budget, 208-522-8800
- Dollar, 208-528-2332
- Enterprise, 208-523-8111
- Hertz, 208-529-3101
- National, 208-522-5276
- Overland West, 208-529-3101
- Thrifty, 208-227-0444.

INL Range and Town Facilities Maps


To Salmon
To Dubois
28
22
Specific Manufacturing Capability
Test Area North
33
To Rexburg
N
Idaho National Laboratory
Naval Reactors Facility
To Arco
20
Advanced Test Reactor Complex
Idaho Nuclear Technology and Engineering Center
Materials and Fuels Complex
Critical Infrastructure Test Range Complex
20
To Idaho Falls
Central Facilities Area
Main INL Gate
Radioactive Waste Management Complex / Advanced Mixed Waste Treatment Project
Experimental Breeder Reactor-I
26
To Blackfoot


INL Idaho Falls Facilities
A Engineering Research Office Building
B Willow Creek Building
C University Place
D INL Administration Building
E INL Research Center
F Technical Support Building & Annex
G Information Operations and Research Center
To INL
(TAN)
15
To Rexburg
20
Science Center
N. Boulevard
Fremont
Highway 20
Airport
N
Grandview
Memorial
To Jackson
26
Skyline
Lindsay
Yellowstone
To INL
(MFC, ATR Complex)
20
Broadway
Bellin
15
To Pocatello

Detailed Technical Specifications

LTE Tier I Network

Overall System Description

The LTE Tier I Cellular Network consists of a full EPC system (MME and a combine S&P-GW), Subscriber Data Management (HSS-FE and One-NDS), & E-Utran (3 eNodeBs) Nokia solution which is 3GPP Release 10 compliant.

The LTE Tier1 system is operated from one of four (4) Network Operation Centers (NOC), which are currently located in the CFA-1609, CFA-699 and EROB buildings. WTB engineers control and monitor the network from the NOC.

Network Elements

The LTE EPC network elements are all located at Gate1Shelter3.

Evolve Packet Core:

- MME (Mobility Management Entity)
  - Flexi NS15, high performance ATCA HW based solution
  - 3GPP LTE Advance (Class5& 6) compliance
  - manage the Control plane for the LTE access
  - authenticates and authorizes the user
  - manages and stores UE context
  - generates temporary identities and allocates them to UEs
  - manages mobility (idle and active mode)
  - manages Intra-LTE handover
  - S-GW relocation
- S&P-GW (combined Serving & PDNGateway)
  - Flexi NS15, high performance ATCA HW based solution
  - serves as the mobility anchor for the user plane during inter-eNodeB handovers and as the anchor for mobility between LTE and other 3GPP technologies
  - responsible for packet forwarding, routing, and buffering of downlink data for UEs that are in LTE-IDLE state
  - provides default EPS bearer termination and IP address allocation
  - provides dedicated non-GBR/GBR EPS bearer termination

Subscriber Data Management:

- HSS-FE (Home Subscriber Server – Front End)
  - Based on HP Blade System Gen8 hardware solution, high performance dual CPU (6 Cores)
  - runs on the high availability CMS-8200Telecommunication Service Platform 7000 (TSP7000)
  - acts as a flexible point of access to the data stored in the subscriber repository
  - stores mobile subscriber data for circuit-switched and packet-switched domains
  - provides support functions in mobility management, call and session setup, user authentication and access authorization
  - Supports S6a and S6d interface that enables LTE access and User Mobility for LTE / evolved PS core
- One-NDS (One Network Directory Server)
  - Based on HP Blade System Gen8 hardware solution, high performancedual CPU (8 Cores)
  - Solution that unifies the subscriber data by storing it in a single centralized repository and enable the applications share data

- Uses entirely in-memory data storage and is optimized for high transactional throughput and low directory latency
- Stores subscriber, service, network, and application configuration data
- Provides an open centralized database in compliance with the X.500 and LDAP standards for a data directory system
- Functional components; Network Directory Server (NDS), Provisioning Gateway (PGW), Notification Manager (NTF), Operation and MaintenanceServer(OAM), Installation Server (INS)

- eNodeB (Flexi Multiradio 10 Base Station)
  - Based on Flexi Multiradio System Module and multiradio-capable RF Module
  - Support features and features 3GPP Release 10, high capacity,Single-RAN, and LTE-Advance ready
  - Supports LTE FDD, and the most common interfaces between the modules and functions as defined by Open Base Station Architecture Initiative (OBSAI) and Common Public Radio Interface (CPRI)
  - fully utilizes Ethernet-based transport with security solutions, synchronization and timing methods based on synchronous Ethernet, timing over packet, and GPS methods
  - supports baseband pooling of two System Modules, making it possible to build high capacity sites
- Domain Name Server (DNS)
  - Based on Trinzic 1410 Network Service Appliance
  - Purpose-built network appliances deliver high-performance reliable and secure DNS, DHCP, and IPAM (DDI)
  - support Lights Out Management (LOM) for remote site communication and management, feature a Unit Identification Button / LED, and utilize the latest technology for achieving energy efficiency.
- Internet Chat Email (ICE) Box
  - Fully functional internet simulator server
  - Features:
    - Email Server; POP/IMAP/SMTP, Web-based Administration, WebMail Client, Anti-Spam Filter, Groupware Server
    - Internet Server; Fully Customizable, Real Websites
    - Chat Server; XMPP (Jabber) Compatible, Customizable (via plugins), Secure

Base Configuration

LTE Tier 1 Fixed Cell Sites are co-located with GSM & UMTS at Gate-1, EBR-1, and CFA-609

The Gate 1 & EBR 1 Cell sites consist of equipment enclosures and a monopole. The enclosures measure 10 feet by 10 feet by 20 feet and have racks to facilitate most any equipment, HVAC and a battery backup system. The CFA-609 Cell site monopole is near the CFA-609 equipment hub.

- Each of the three fixed cell sites has the following infrastructure components:
  - 60 ft Monopole
  - 50 ft & 60 ft platforms
  - 3rd platform possible
  - 3 sectorized antennas
  - Remote electrical down tilt capable
  - Multiple RF fiber optic transmission lines to support multiple diverse antennas
- CFA-609 Cell Site – Large Configuration
  - Flexi Multiradio BTS LTE-FDD, FL18SP SW, 3 Sectors each
  - FDD

  - 4x2 MIMO
    - 60W for Band 3 and 40W for Band 7
  - BW- 20MHz Band 3, 10MHz Band 7
  - Carrier Aggregation (CA) – 30MHz Total
- Gate 1 & EBR 1 Cell Sites – Medium Configuration
  - Flexi Multiradio BTS LTE-FDD, FL18SP SW, 3 Sectors each
  - FDD
  - 2x2 MIMO
    - 40W for Band 3 & 7
  - BW- 10MHz each
  - Carrier Aggregation (CA) – 20MHz Total

Management and Configuration Capabilities

The LTE Tier 1 network can be administer, manage, and operate via Network Management System (NMS) platform, the NetAct 18. It is also accessable locally, and remotely via secured LAN connection such using VPN.
All configuration required of the cellular network can be setup, tested and verified in advance of client arrival on range to insure correct system operation and seamless testing. Post-test practices return the system to original base configuration.

System Resources

WTB Personnel

The LTE Tier 1 cellular network was designed, installed and implemented by WTB engineers and commercial vendor teams. The WTB cellular engineers are trained to fully operate, configure, upgrade, troubleshoot and maintain the cellular network.

All WTB engineers and supporting team members possess TS/SCI security clearances.

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum. INL has "experimental station" authority granted by DOE-HQ & NTIA, which allows communications testing at INL.

The following are the GSM and UMTS bands approved to be utilized by WTB test customers:

- Band 3
  - 1710 – 1785 MHz Uplink
  - 1805 – 1880 MHz Downlink
- Band 7
  - 2500 – 2570 MHz Uplink
  - 2620 – 2690 MHz Downlink

Physical Location

All cellular network facilities are on the INL range. The fixed cell sites provide RF coverage over the southern end of the 890 square mile range. The mobile cell sites can be positioned to provide RF coverage from the Central Facilities Area to the Northern border of the reservation. This coverage terrain provides hundreds of square miles of testing environments over paved and unpaved roads, building campuses, and open desert.

The RF Coverage is dependent on frequencies, transmit powers, attenuations and antenna downtilts, which are all configurable parameters. They can be configured based on the coverage objective and other requirements.

System Capacity

EPC (licence based):

- MME and S/P GW
  - 10k LTE subscribers
  - 10k bearers
  - 1Gbps throughput license in Flexi NG
  - LTE Category 5 (required for 4x2 MIMO) and Category 6 (required for Carrier Aggregation)

Subscriber Data Management (licence based):

- One-NDS
  - Support up to 300K Subscribers
  - Support 1 million Subscriber Identities

- 1 GB Subscriber profile storage

- HSS
  - 10K licensed sessions
  - LTE EPS Access 50Mb (S6a)
- DNS/DHCP Server
  - 30,000 DNS Queries/second
  - 210 DHCP leases/second
- Internet Chat Email (ICE) Box
  - Fully functional internet simulator server for email, chat, & internet
  - Server Specifications:
    - 110-240 VAC 50/60 Hz
    - 4 GB RAM
    - Gigabit Ethernet
    - 1 TB Had Drive
    - Mirroring RAID
    - 1 RU Rack mount
    - 1.67" H x 17.10" W x 24.00" D (in)

E-UTRAN Capacity

CFA-609 eNodeB:

- 200/40 Mbps DL/UL, 200 simultaneous users, 20+10 CA band 3 @60W and band 7@40W, 4x2 DL MIMO
- 10-20 users with HD video conferencing/streaming (average of 3-5Mbps using laptop or similar device with 720p/15/30 frames/sec),
- 100-150 users internet browsing/email/background interactive and best effort applications like Skype.

EBR-1 & Gate-1

- 50/20 Mbps DL/UL, 50 simultaneous users (per site with 3 sectors), 10+10 CA band 3 @60W and Band 7@40W, 2x2 MIMO
- 3-5 users with HD video conferencing/streaming (average of 3-5Mbps using laptop or similar device with 720p/15/30 frames/sec),
- 20-30 users internet browsing/email/background interactive and best effort applications like Skype.

LTE Tier 1 Network added features and capabilities

- SGs Interface
  - Circuit Switched Fallback (CSFB
    - The CS voice service continuity is implemented through service triggered redirection from LTE to UMTS or GSM for multimode device.
  - SMS over SGs interface
    - A solution implemented between MME & MSS to carry out the SMS without the need to change radio access technoly back to 2G/3G.

LTE Network Traffic Logging

LTE real time monitoring and recording of data between LTE network elements is achieved through a Viavi PacketInsight / Signaling Analyzer Real Time (SART) protocol analyzer. The Viavi PacketInsight provides full filtering and search functions, Key Performance Indicator (KPI) analysis and call and session analysis.It can generate PCAP and REC files for analysis

The Viavi LTE Protocol Analyzer is located at the Gate-1, Shelter 3 cellular hub. The Viavi PacketInsight passively monitors all LTE Interfaces of the LTE Network.

All data is recorded and can be saved in different file formats such as text, PCAP, REC or the original Viavi SART Protocol Analyzer recording file can be saved and played back at a later time with a Viavi Decode viewer program.

LTE Band 13 & 14 Deployable Network

Overall System Description

The LTE Band 13 & 14 deployable network consists of the core network (mini EPC) from Athonet and three Nokia eNodeBs (2-Band14 & 1-Band13) installed in three Cell on Wheels (COWs) that can be deployed within INLs fiber backbone.

Base Configuration

The LTE miniEPC is a single server configuration using Athonet's Mobility Gateway Management System Release 7.0 which is part of the PRIMO solution.

The PRIMO Mobility Gateway implements the LTE Evolved Packet Core (EPC) functionality which consist of the following:

- MME (Mobility Management Entity)
  - -authenticates and authorizes the user
  - -manages and stores UE context
  - - generates temporary identities and allocates them to UEs
  - - manages mobility (idle and active mode)
  - - manages Intra-LTE mobility
  - - manages EPS bearers
- S-GW and P-GW (Serving/Packet Data Network Gateway or SAE Gateway)
  - - serves as an anchor point both for inter-eNB handover and for intra-3GPP mobility
  - - is responsible for packet forwarding, routing, and buffering of downlink data for UEs that are in LTE-IDLE state
  - - provides default EPS bearer termination and IP address allocation
  - - provides dedicated non-GBR/GBR EPS bearer termination
- HSS/AuC (Home Subscriber Service, Authentication Center)
  - - providing the user authentication and authorization information to the MME
  - - managing user profiles
  - - preserving user location at MME level
  - - storing of mobility and service data for every subscriber
  - - permanent and central subscriber database
- Policing Control and Charging Rules Functions (PCRF)
  - - responsible for brokering QoS Policy and Charging Policy on a per-flow basis
  - - Priority and preemption
  - - Data usage
  - - Access RAN network type
  - - Access to APN
  - - Uplink and downlink GBR & non-GBR
  - - Subscriber ID such as IMEI, IMSI and MSSISDN
  - - Class of subscriber
  - - Time of day

The Mobility Gateway is structured to include a network management (O&M) module that supports:

- Configuration Management;
- Performance Management, and;
- Fault Management

eNodeBs

The LTE Deployable eNodeBs are Nokia Flexi Multiradio 10 Base Station installed in the COW (Cell On Wheels) trailers. The COWs can be deployed within INLs fiber backbone. There are 2 Band 14 eNodeBs and 1 Band 13 eNodeB.

The eNodeBs host the following functions:

- Radio Network Layer 1 (Physical Layer)
  - error detection on the transport

channel and indication to higher layers

- FEC encoding/decoding of the transport channel
- hybrid ARQ soft-combining
- rate matching of the coded transport channel to physical channels
- mapping of the coded transport channel onto physical channels
- power weighting of physical channels
- modulation and demodulation of physical channels
- frequency and time synchronization
- radio characteristics measurements and indication to higher layers
- 2x2 MIMO (Multiple Input Multiple Output) antenna processing
- transmit diversity (TX diversity)
- RF processing

- Radio Network Layer 2

- PDCP: robust header compression (RoHC); Ciphering
- RLC: RLC segmentation; Automatic Repeat Request (ARQ)
- MAC: MAC multiplexing
- Hybrid Automatic Repeat Request (HARQ)
- uplink timing alignment
- packet scheduling

- Radio Network Layer 3

- Radio Resource Control:
- Radio Bearer Control
- Radio Admission Control
- Idle and Connected Mode Mobility Control
- Inter-cell Interference Coordination
- Load Balancing
- Inter-RAT RRM

- Network related functions

- routing of U-plane to S-GW
- uplink QoS support at transport and bearer level
- connection to the internet

LTE Cellular on Wheels (COWs)

- There are a total of three COWs. Two of them have Band 14 eNodeBs and the third a Band 13 eNodeB.
- COWs are mobile and can be towed to an approved testing location.
- Each COW Mast extends up to Approx. 60 feet high.
- Each Antenna has a 0-16 degree elevation beamwidth and 65 degrees azimuth beamwidth.
- Each COW has an on-board diesel generator or will run on commercial power.
- There is one panel antenna mounted on each mast of each COW. The antennas have electric down-tilt and azimuth control.

Management and Configuration Capabilities

The LTE deployable network can be accessed locally and remotely via the management PC inside the EPC cabinet. The management PC can be administered locally using the credentials created on it and it can be accessed remotely via VPN. Both the mini EPC and the eNodeBs can be administered thru the management PC. The mini

EPC uses a web based application while the eNodeB uses the Nokia BTS Manager software installed in the management PC.

System Resources

Personnel

The LTE deployable network was designed, installed and implemented by NGWTB engineers and commercial vendor teams. The network is operated and maintained by NGWTB engineers and technicians.

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum.

NGWTB LTE deployable network operates at the following channels/frequency bands:

- LTE Band 13
  Downlink: 746 - 756 MHz (10 MHz) &
  746 - 751 MHz (5 MHz)
  Uplink: 777 - 787 MHz (10 MHz) &
  777 - 782 MHz (5 MHz)
- LTE Band 14 :
  Downlink: 758 - 768 MHz (10 MHz) &
  758 - 763 MHz (5 MHz)
  Uplink: 788 - 798 MHz (10 MHz) &
  788 - 793 MHz (5 MHz)

LTE Band 13 (10 MHz Bandwidth) emissions as approved and coordinated with Verizon and LTE Band 14 (5 MHz Bandwidth) emissions as approved by FirstNet and as coordinated with Clark Communication if required) and approved through FCC
and NTIA STA/TAs.

Physical Location

The LTE deployable Band 13 & 14 network is on the 890 square mile INL reservation located approximately 45 miles west of Idaho Falls, ID.

The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

The EPC is located at Gate1 Shelter 3 and the eUTRAN which are installed in the 3 COWs (Cell on Wheels) can be deployed within INL's fiber backbone. When the COWs are not in use they are located at STF for storage.

System Capacity

The LTE deployable network has the following capacity:

- Supports 1,000 sessions (registered subscribers)
- Supports 500 attached subscribers at any given time
- Supports 100 active subscribers transferring data at any given time
- Supports "10" S1 interfaces (eNodeB and MME) License based limitation only.

GSM and UMTS

The NOKIA GSM & UMTS Cellular Network consists of a full MSC/HLR/BSC/RNC switching center which controls six cell sites. Three of these sites are mobile cells, or Cell-on-Wheels (COWs), and three of these sites are fixed cells.

The GSM & UMTS network was configured with four PLMNs namely INLOFF/PLMN1, INLTST/PLMN2, INLICE/PLMN3 and INLLUX/PLMN4. The GSM & UMTS Cell Sites

located at INL facility were configured as INLTST/PLMN2 and the GSM & UMTS Cell Sites outside INL facility were configured as INLOFF/PLMN1. The other 2 PLMNs (INLICE & INLLUX) can be configured to the GSM & UMTS Cell Sites as needed. Below are the information for each PLMN and the subscribers configured on each PLMN works in all four PLMNs.

	PLMN1	PLMN2	PLMN3	PLMN4
PLMN Name	INLOFF	INLTST	INLICE	INLLUX
LAC Name	INLIDH200	INLTS200	INLIC300	INLLU400
LAC Number	10200	20000	30000	40000
Mobile Country Code (MCC)	103	103	274	270
Mobile Network Code (MNC)	68	10	05	77
MSISDN Range	1208	1222	1333	1444

The network switching Hub is located at CFA-609 and is the central equipment core of the network.

The cellular system is operated from one of four (4) Network Operation Centers (NOC), which are currently located in the CFA-1609, CFA-699 and UB-4 buildings. WTB engineers control and monitor the network from the NOC.

Network Elements

The following sections include detailed information for the GSM and UMTS cellular network elements (see Figure 4)

WTB GSM and UMTS Equipment Located at CFA-609

- Standalone Open Mobile Softswitch (oMSS)
  - Based on the M17 Release DX200 SW platform and commercial off-the-shelf Advanced Telecommunications Computing Architecture (ATCA) hardware platform.
  - Provides call control and mobility management by performing signaling and call and connection control. The user plane switching and routing, performed by Multimedia Gateways (MGWs), implement the user plane interworking between the packet-switched and the circuit-switched networks.
  - The maximum capacity figures in a Nokia 8 million subscriber profile for the oMSS 17 are:
    - 8 000 000 subscribers in the VLR
    - 8 000 000 Busy Hour Call Attempts (BHCA)
    - 8 000 000 short messages/busy hour
    - up to 300 000 simultaneous calls
    - power consumption: 2621 BHCA / W
  - Full support for GSM, WCDMA, and CS over HSPA access networks. It has interfaces to the LTE Evolved Packet Core (EPC) to function as a CS Mobile Softswitch in 3GPP CS Fallback architecture, and interworks with the 3GPP IMS All-IP communication networks as a Media Gateway Control Function (MGCF).
- Open Multimedia Gateway (oMGW)
  - NOKIA software version 16 on Advanced Telecommunications Computing Architecture (ATCA) hardware platform.
  - Handles the User Plane transportation and switching for both GSM and UMTS, where the oMSS handles the control plane
  - IP backend connectivity to the oMSS instead of costly PCM E1s
  - Up to 9M Busy Hour Call Attempts (BHCA)

- Up to 150,000 Erlang
- 64 E1 Ports for (BSC/PSTN) via ADX201
- Connectivity to the "simulated" Public Switched Telephone Network (PSTN)
- Provide Full Transcoder capability, decreasing the amount of T1 between the BSC and MGW
- Supports Adaptive Multirate (AMR), Enhanced Full Rate (EFR), AMR Half Rate (HR), and AMR Full Rate (FR) speech codecs

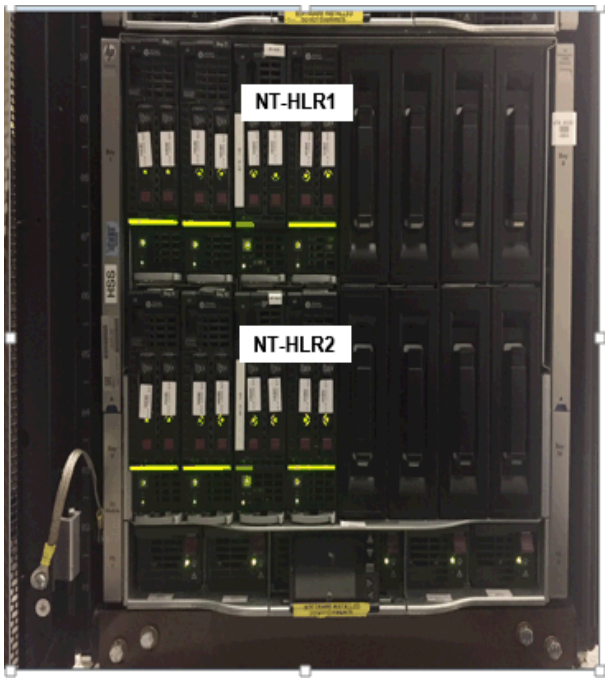
- New Technology - Home Location Register (NT-HLR) Front End

  NOKIA software version 17.5 on the HP Blade System Gen9 hardware solution, high performance dual CPU (6 Cores)

  Runs on the high availability CMS-8200Telecommunication Service Platform 7000 (TSP7000)

  Acts as a flexible point of access to the data stored in the subscriber repository (One-NDS).

  - Handles authentication, encryption, and over-the-air ciphering of voice and data
  - Traffic is shared between 2 NT-HLR front end
  - Supports GSM, GPRS, EDGE, UMTS



- GSM Base Station Controller (BSC)
  - Base station subsystem switching and control
  - NOKIA software Version RG40 on the DX200 hardware platform
  - Performs radio resource allocation to a mobile station, frequency administration, handover handling, and power management
  - Supports up to 150 TRXs = 1200 full rate channels.

UMTS Equipment Located at Gate 1

- Radio Network Controller (RNC)
  - Nokia RNC 2600 HW platform running software Version WCDMA17 Performs radio resource management and telecommunications management for the Radio Access Network (RAN).
  - Can support up to 680,000 subscribers and 1,440 Node B's.
  - IuCs over IP connection to the oMSS/oMGW

Figure 5 INL WTB CFA-609 Cell Site

WTB Fixed Cell Sites located at Gate-1, EBR-1, and CFA-609

The Gate 1 & EBR 1 Cell sites consist of equipment enclosures and a monopole. The enclosures measure 10 feet by 10 feet by 20 feet and have racks to facilitate most any equipment, HVAC and a battery backup system. The CFA-609 Cell site monopole is near the CFA-609 equipment hub.

- Each of the three fixed cell sites has the following infrastructure components:
  - 60 ft Monopole
  - 50 ft & 60 ft platforms
  - 3rd platform possible
  - GSM 1900/1800/900 BTS
  - UMTS 2100 MHz Node B
  - Point to point microwave links to & from Hub
  - 3 sectorized antennas
  - Remote electrical down tilt capable
  - Multiple RF coaxial transmission lines to support multiple diverse antennas
- GSM Base Transceiver Stations (BTS)
  - NOKIA Ultrasite Edge, software version CX8.
  - The BTS contains the equipment for transmitting and receiving of radio signals (transceivers), antennas, and equipment for encrypting and decrypting communication with the BSC
  - (3) 1900 MHz GSM/EGSM/GPRS TRXs
  - (4) 1800 MHz GSM/EGSM/GPRS TRXs
  - (4) 900 MHz GSM/EGSM/GPRS TRXs
- UMTS Node B
  - NOKIA Flexi Node B, software version WN9.1
  - The Node B performs the radio interface Layer 1 processing as well as some basic Radio Resource Management.
  - (3) 2100 MHz RF transceiver modules
  - (1) System module

GSM and UMTS Base Configuration

The NOKIA GSM and UMTS cellular network is placed in a default or base configuration between test events. This configuration is represented in a logical state of the network elements as well as a physical state of the cell site base stations. The base state of the cell site base stations is described below.

Fixed Cell Sites:

- Physical Configuration:
  - 3・120° sector cells with individual transmission lines feeding each of 3 antennas
- Logical Configuration:
  - GSM – Single Broadcast Control Channel (BCCH) carrier per frequency/sector (9 total BCCH carriers per Fixed cell site).
  - UMTS – Single Common Pilot Channel Signal (CPICH) per frequency/sector (3 total CPICH's per Fixed cell site).

Mobile Cell Sites (COWs):

- Physical Configuration:
  - Stowed position at PER-623 dock stations where commercial shore power is available and routine maintenance performed
  - 1・360° sector cell with RF power divider feeding 3 antennas to form an OMNI directional RF footprint
- Logical Configuration:
  - GSM – Single Broadcast Control Channel (BCCH) carrier per frequency/sector (3 total BCCH carriers per COW).
  - UMTS - Single Common Pilot Channel Signal (CPICH) per frequency/sector (1 total CPICH per COW).

GSM and UMTS Management and Configuration Capabilities

The cellular network can be configured and operated remotely from any point attached to the Local Area Network (LAN). The NOC is the primary facility for network operations and test conductance providing personnel space and supporting resources. Centralized network control of the cellular system is achieved through the NOKIA Network Management System (NMS) NetAct.

The base configuration for network operation can be utilized for testing with minimal preparation effort. Upon request, the network configuration can be customized to meet specific test requirements. The physical and logical setup can be altered to replicate most any commercial network or to replicate a specific RF environment to meet test objectives.

All configuration required of the cellular network can be setup, tested and verified in advance of client arrival on range to insure correct system operation and seamless testing. Post-test practices return the system to original base configuration.

The current software version of the NOKIA NMS system is NetAct 18.

GSM&UMTS System Resources

WTB GSM & UMTS Personnel

The NOKIA GSM & UMTS cellular network was designed, installed and implemented by WTB engineers and commercial vendor teams. The WTB cellular engineers are trained to fully operate, configure, upgrade, troubleshoot and maintain the cellular network.

All WTB engineers and supporting team members possess TS/SCI security clearances.

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum. INL has "experimental station" authority granted by DOE-HQ & NTIA, which allows communications testing at INL.

The NOKIA GSM & UMTS cellular network operates in four frequency bands. Hundreds of GSM Absolute Radio Frequency Channel Numbers (ARFCNs) and two UMTS UTRA Absolute Radio Frequency Channel Numbers (UARFCN) have been approved for WTB use on the INL site. Specific ARFCN and UARFCN usage is coordinated through the INL Spectrum Manager.

The following are the GSM and UMTS bands approved to be utilized by WTB test customers:

- GSM 1900 MHz
  - 1850 – 1910 MHz Uplink
  - 1930 – 1990 MHz Uplink
- GSM 1800 MHz
  - 1710 – 1785 MHz Uplink
  - 1805 – 1880 MHz Downlink
- GSM/EGSM 900 MHz
  - 880 – 915 MHz Uplink

  - 925 – 960 MHz Downlink.
- UMTS 2100 MHz
  - 1922.4 MHz Uplink
  - 2112.4 MHz Downlink
  - 1927.4 MHz Uplink
  - 2117.4 MHz Downlink

Physical Location

All cellular network facilities are on the INL range. The fixed cell sites provide RF coverage over the southern end of the 890 square mile range. The mobile cell sites can be positioned to provide RF coverage from the Central Facilities Area to the Northern border of the reservation. This coverage terrain provides hundreds of square miles of testing environments over paved and unpaved roads, building campuses, and open desert.

The RF Coverage is dependent on frequencies, transmit powers, attenuations and antenna downtilts, which are all configurable parameters. They can be configured based on the coverage objective and other requirements.

GSM System Capacity

The cellular subscriber load capacity is defined per network element. Each element described in section "Network Elements" lists the volume of channels (voice calls) currently supported. The overall system capacity is best defined by the physical radio resources provided by each BTS. When configured for Full Rate channel coding and a single TRX per cell sector, there are 7 bearer channels available to subscribers for voice channels.

See Tables 2 and 3 for the subscriber capacities of the WTB Fixed and Mobile Cell Sites.

Table 2 Current GSM System Subscriber Capacity – Fixed Cell Sites

Frequency	# of TRXs	Bearer Channels	Fixed Cell Sites	Total # of GSM Subscriber Calls
1900 MHz	3	7	3	63
1800 MHz	4	7	3	84
900 MHz	4	7	3	84

Table 3 Current GSM System Subscriber Capacity – Mobile Cell Sites

Frequency	# of TRXs	Bearer Channels	Mobile Cell Sites	Total # of GSM Subscriber Calls
1900 MHz	1	7	3	21
1800 MHz	1	7	3	21
900 MHz	1	7	3	21

UMTS System Capacity

The UMTS system subscriber load capacity is defined per Node B. The capacity is defined by the

number of channel elements per Node B. A conversational call requires one channel element for the uplink and one channel element for the downlink. Channel elements are a NOKIA capacity license key and are upgradeable to 224 Channel Elements per Node B.

See Table 4 and 5 for the subscriber capacities of the WTB Fixed and Mobile Cell Sites.

Table 4 Current UMTS System Subscriber Capacity – Fixed Cell Sites

Frequency	# of RF Transceivers	Channel Elements	Fixed Cell Sites	Total # of UMTS Subscriber Calls
2100 MHz	3	192	3	288

Table 5 Current UMTS System Subscriber Capacity – Mobile Cell Sites

Frequency	# of RF Transceivers	Channel Elements	Mobile Cell Sites	Total # of UMTS Subscriber Calls
2100 MHz	1	192	3	288

GSM and UMTS Terminals, Radios and Handsets

Please see Appendix B for a list of the cellular devices available for testing.

Customer provided terminals or radios can be programmed for use on the system if they are GSM/UMTS compliant and will accommodate a SIM card. The WTB has access to additional SIM cards as well as the programming equipment to program the SIM Cards.

GSM Authentication & Encryption

The WTB NOKIA cellular equipment supports and utilizes the A3 & A8 GSM algorithms. These algorithms are used to generate the keys used in the encryption process. The WTB NOKIA cellular equipment also supports and utilizes the A5/1 & A5/2 GSM algorithms used to encrypt over-the-air communication channels between the BTS and the handset.

UMTS Authentication & Encryption

The WTB NOKIA UMTS cellular network supports the 3GPP standard for UMTS Security. UMTS authentication is based on mutual authentication which utilizes an Authentication and Key Agreement (AKA). The AKA utilizes a 128 bit Ciphering key (CK) and an Integrity Key during the authentication process. The WTB UMTS network supports the following CK algorithms: UEA0 (no encryption) and UEA1 (Kasumi).

GSM and UMTS Billing and Record Keeping

The current WTB MSC generates Call Detail Records (CDR) and other call tracing utilities that can be accessed through the Network Management System (NMS) NetAct.

Signaling and traffic communication between network elements is monitored and recorded through the NetHawk protocol.

The WTB cellular Core network can facilitate a converged billing system but does currently employ a billing management server to facilitate charging practices typical to a commercial provider.

GSM Network Traffic Logging

Real time monitoring and recording of data exchange between GSM network elements is capable through a NetHawk M5 protocol analyzer.

The M5 is located in the equipment hub at CFA-609. The M5 interfaces to the Digital Signal Cross-connect (DSX) board which acts as a patch panel for network element circuits. These interfaces passively monitor all uplink and downlink communication transferred on the A, Abis and Ater circuits as well as the IP control plane protocols.

Collected data can be provided in text file format or played back through an M5 viewer utility. The playback viewer provides filtering capabilities and a graphical user interface similar to the M5 Analyzer.

UMTS Network Traffic Logging

UMTS real time monitoring and recording of data between UMTS network elements is achieved through a Viavi Distributed Network Analyzer (DNA) protocol analyzer. The Viavi DNA provides full filtering functions, Key Performance Indicator (KPI) analysis and call and session analysis.

The Viavi SART Analyzer is located at the Gate-1, Shelter 3 remote cellular hub. The Viavi SART Protocol Analyzer passively monitors all uplink and downlink protocol messages on the IuB and Iu-CS interfaces of the UMTS Network.

All data is recorded and can be saved in a comma delimited text (CSV) format or the original Viavi SART Protocol Analyzer recording file can be saved and played back at a later time with a Viavi Decode viewer program.

PSTN Simulation & Traffic Generation

The WTB NOKIA cellular network is an isolated network with no physical interfaces to systems outside of the WTB. A GL Communications Digital Central Office Switch Simulator (DCOSS) has been integrated into the MSC (Mobile Switching Center) to simulate the Public Switched Telephone Network (PSTN). The DCOSS appears to the MSC as the PSTN and will route signaling and traffic calls to and from the simulator. The DCOSS also provides traffic generation/loading capability.

<u>DCOSS Features</u>

- Windows 2000/XP Operating System
- Portable system with digital E1/T1 trunks, BRI ISDN and POTS (Plain Old Telephone Set) Interfaces
- Available Protocols Include:
  - T1 CAS: R1, Loopstart, Ground Start, Feature Group D, Immediate Start
  - E1 CAS: R1, MFC-R2, Digital E&M, European Digital CAS
  - PRI ISDN - includes USA ISDN, Euro ISDN, Asian ISDN, T1 NFAS
  - SS7 - includes support for ISUP, TUP, TCAP, SCCP, SCP
  - SS5
- Support for up to 16 T1's and/or E1's
- Generates and Receives Manual or Automatic Calls Simultaneously on any or all Timeslots
- Record and Playback of PCM Voice Files simultaneously over all timeslots. Includes Voice Quality Testing using PAMS, PSQM, PSQM Plus, and PESQ.
- Real-Time FAX Call Generation/Reception (V.29, V.27, V.17, V.33) simultaneously over all timeslots. Includes Fax Quality Assessment.
- Send/Receive Modem Traffic (V.21, V.23, V.34, V.90, V.92) simultaneously over all timeslots. Includes Modem Quality Assessment.
- Transmit and Detect DTMF/MF digits simultaneously over all timeslots
- Transmit and Detect Single- or Dual-Frequency Tones simultaneously over all

timeslots

- Switches Calls among Timeslots/Trunks with Protocol Conversion capability
- Pass/Fail Calls using User-Defined Pass Criteria
- Real Time Status of Each Call
- Real Time Statistics with Hourly Information
- Save and Load Protocol, Trunk and Dialing Parameters as User Defined Configurations
- Multiple 2-Wire (RJ11) -> (up to 64 interfaces) Standard Telephone Interfaces (8, 16, 24)
- BRI ISDN European ST-Interface (16 port)
- Manual or Automatic ANI (Caller ID) Generation
- Remote Access Capability (Client/Server) using GUI or Command Prompt. Access to OCX/DLL to develop user-defined client.
- Automatic Bulk Call Generation/Reception for load testing digital/analog trunks
- Bulk Call Scripting with simple point-and-click script setup. Allows for conditional commands as well as script looping.
-

INL Cellular Test Bed Current & Future Components

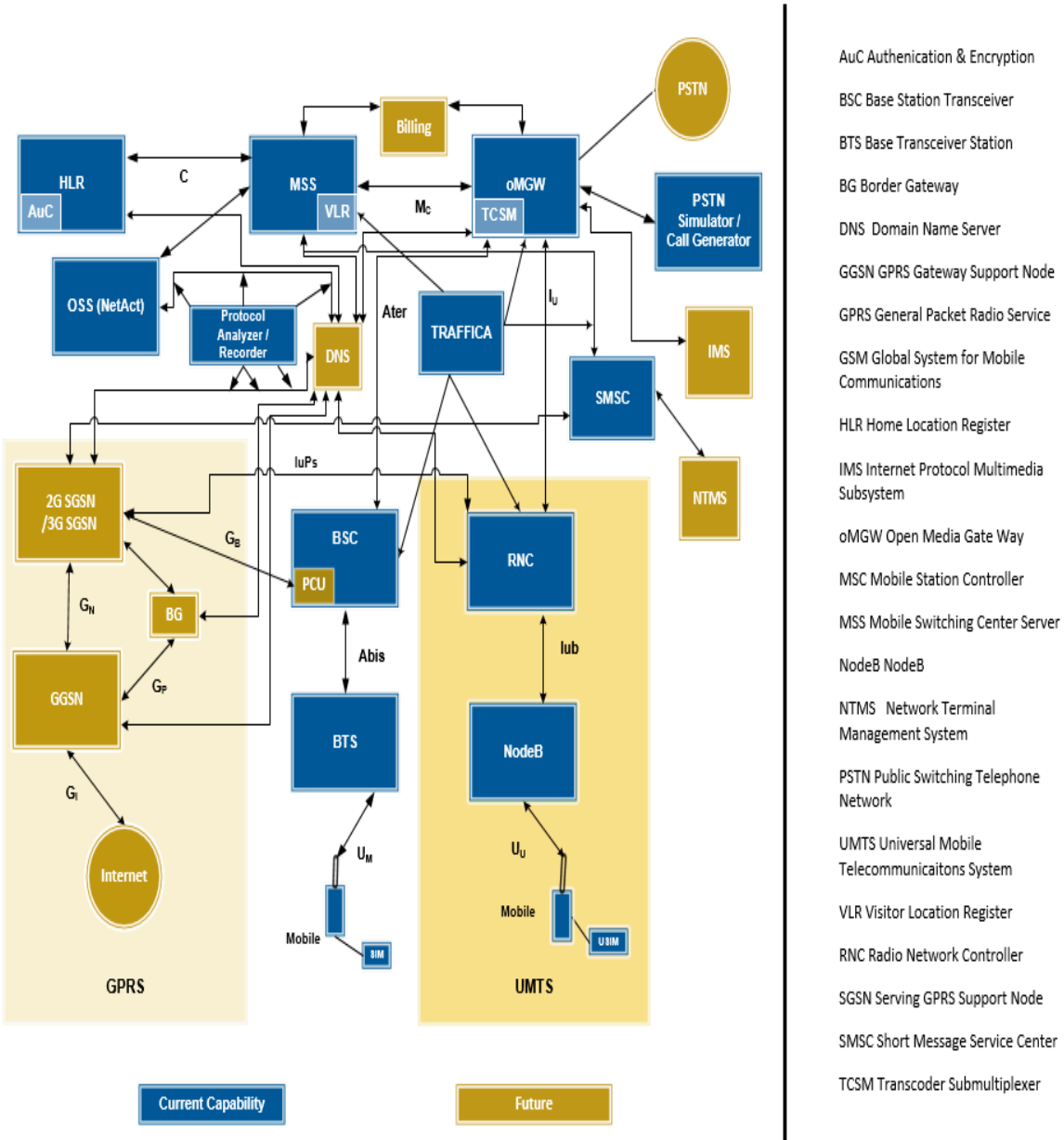


Figure 6 Overview of the cellular assets installed at the WTB

CDMA

Overall System Description

The WTB CDMA cellular assets consist of three Qualcomm Deployable Base Station (QDBS) systems: two which support 800 MHz operations and one which supports 1900 MHz operations.

Each QDBS is:

- A compact, easily deployable, self-contained CDMA2000 1xRTT Rev 0 compliant system.
- A complete cellular base station and switch packaged in transit cases for ease of shipping, storage, setup and operations; i.e., network-in-a-box (NIB).
- Able to operate stand-alone or interconnected (for 1900 MHz NIB) to public or private communications networks.

QDBS Standard Features

- Coverage area of 3-10 miles (depending on antennas, mast height, terrain, etc.)
- Voice mobile calls
- Packet data (up to 153 kbps)
- PSTN/PBX interconnectivity (1900 MHz QDBS only)
- Standard voice services (Caller ID, Call Waiting, Call Forwarding, Three-way Calling).
- Supports many commercial-off-the-shelf (COTS) phones, air cards and PDAs.
- Operates in pico-cell (100 mW) or macro-cell (17W) modes.

QDBS Optional Features

- Secure voice
- QSec-2700 Type-1 Certified FNBDT secure handset
- Asynchronous data (clear and secure).
- Clear->Secure & Secure->Clear transitions.
- Short Message Service (SMS)
- Position Determination System (GPS data) (800 MHz QDBS only)
- Picture Upload server (800 MHz QDBS only)
- Three Sector Expansion Kit (1900 MHz QDBS only)

QDBS Capacity/Expandability

- Base Transceiver Station (BTS)
  - Up to 45 users per sector
  - Up to 3 RF sectors per BTS
  - Packet data rates up to 153 kbps/user in clear mode
- Base Station Controller (BSC)
  - Up to 12 RF sectors per BSC
  - Supports hand-over between BTS sectors
  - Power control for mobile units
- Mobile Switching Center (MSC)
  - Supports multiple BSCs
  - Supports inter-BSC handoffs
  - Home Location Register (HLR) supports 2500 devices
  - Media Gateway (MGW) has four T1 interfaces and is expandable
  – Each T1 supports 45 mobile-to-land or land-to-mobile calls.

Base Configuration

All components of the CDMA system, when not in use, are shutdown, packed in their transit cases and stored in the NGWTB warehouse (CFA-661).

When deployed, base configuration consists of:

- Physical configuration
  -
- Logical configuration
  -

Management and Configuration Capabilities

Each QDBS includes a laptop computer which provides the interface to operate, administer and maintain the system:

- System startup and shutdown
- Transmit power adjustment (0 – 17 W per sector in 1% increments)
- Subscriber database management
- Dial plan management
- Call Detail Record review
- System log review
- System configuration management.

The 800 MHz QDBS systems include a second laptop computer to provision the included mobile devices.

Figure 7 INL WTB CDMA QDBS NIB

System Resources

CDMA Personnel

The CDMA system is operated and maintained by WTB engineers and technicians.

CDMA Spectrum

INL has "experimental station" authority granted by DOE-HQ & NTIA. At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum.

CDMA WTB operations are allowed in the following channels/frequency bands:

- 800 MHz: This spectrum is owned by Verizon, the local commercial CDMA carrier; however, Verizon has agreed to allow INL/NGWTB to operate at specific hours of the day on the following channels/frequencies:
  - 507 (840.21 MHz uplink, 885.21 MHz downlink)
  - 548 (841.44 MHz uplink, 886.44 MHz downlink)
  - 630.(843.90 MHz uplink, 888.90 MHz downlink)
- 1900 MHz: The NGWTB has spectrum manager approval to operate in CDMA 1900 Block F
  - Channels 825 – 875
  - 1891.25 – 1893.75 MHz uplink
  - 1971.25 – 1973.75 MHz downlink.

CDMA Location

As the CDMA QDBS NIBs are very portable, they can be set up and used anywhere on the 890 square miles INL range, with approval.

Isolated Satellite Backhaul Network

Overall System Description

The ISBN consists of a fixed 5.6m Andrew ground station, iNetVu 1.2m field terminals and associated routing, switching, encryption and PBX units. This system can operate as a stand-alone isolated network, or it can be connected to external teleports for outside connectivity.

Base Configuration

Andrew 5.6m Teleport:

The Andrew ground station dish and associated transport equipment is located at the Fillmore Test Facility (FTF). The dish is outfitted with heating elements to support year round KU band connections to commercial satellites. Encrypted voice and data is accomplished through isolated routers, switches, encryption units and redundant PBX systems. The ground station can interface with other INL terrestrial networks including voice, internet and external VPN connected networks for various test scenarios.

iNetVu 1.2m Field Kits:

The iNetVu auto deploy drive and fly away field kits consist of a 1.2m dish, antenna controller, modem, switch, encrypotion unit and VOIP phone. The current configuration supports five drive away units that mount in the back of a truck, and two fly away units that are ground mounted. These kits can be deployed anywhere in the world with the proper KU satellite coverage and/or transport back to the United States. With a mere push of the button the field kits will track and lock onto the pre-programed satellite; immediately establishing an encrypted connection to the ground station. Powering the field kits is typically done through the use of a Honda 3K generator. Customers are able to connected their system under test to the field kit switch and pull power from the 3K generator.

System Resources

Personnel

The Isoloated Satellite Backhaul Network is operated and maintained by Wireless Test Bed staff.

Spectrum

The ISBN operates in the commercially available KU band :

- Transmit: 13 - 14.5 GHz
- Receive: 11 - 12.5 GHz

Radio Frequency spectrum coordination is conducted with the INL Spectrum Manager before satellite deployment to ensure spectral harmony with other test events.

Physical Location

The ground station is located in the CITRIC area

of the INL site which is approximately 45 miles east of Idaho Falls, ID. The iNetVu auto deploy field kits can be operated with in INL's 890 square mile test range or anywhere within satellite coverage. Voice and data connectivitiey of the ISBN can be extended through WTB terrestrial networks to reach various campus facilicies on the INL desert site.

System Capacity

The ISBN is typically operated under equal path balance allowing for 100 KBps up & down to each field location, expandable to T1 speeds to each location. Utilizing the integrated ground station PBX system calls and bridge conferencing are unlimited. As required external voice connections are as low as $500 / month for unlimited calling to the US and Canada.

•

High Frequency (HF) Radio

Overall System Description

The HF radio system facilitates communications testing and consists of several fixed and mobile radio systems and an HF Monitoring system. Fixed radio systems are located at HFTB. A variety of field expedient fixed antenna assets are located at:

ARA (on INL reservation)

INL Administration Building (Idaho Falls)

North Yellowstone Complex (Idaho Falls)

There are five ICOM radio systems packed into mobile kits to enable the radios to be easily deployed in a vehicle and operated from a remote location. Each kit contains the radio itself in addition to equipment necessary for remote operation (i.e., antenna, amplifier, cables, power supply, SWR meter, tool kit, first aid kit and other miscellaneous items).

Base Configuration

The base configuration of the HF radio system is with all radio systems shutdown. Fixed radios remain in place in the access controlled radio room at HFTB. Mobile radios are packed into their respective kit containers and stored at the HFTB Facility.

Management and Configuration Capabilities

Each asset is configured on a per-device basis; however, ICOM provides a software program that allows the creation of multiple configurations that can be transferred to the radio via a serial port. Devices can be reconfigured to suit customer requirements within the capabilities of the equipment.

System Resources

Personnel

The HF radio system was built and is operated and maintained by engineers on the WTB/INL staff. In addition, the staff is experienced with:

- Current commercial and military tactical HF radios
- Multiple platform tests
- Supporting regional testing (NVIS)
- Fast test setup and reconfiguration

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum.

INL has "experimental station" authority granted by DOE-HQ & NTIA, which allows communications testing for government customers at all, but the specifically excluded bands, of the frequencies listed below. In some cases, these excluded frequencies may also be used, but this requires a special filing with the NTIA and a more rigorous approval process outside the INL's Spectrum Manager's office.

Physical Location

The majority of HF radio facilities are on the 890 square mile INL reservation located approximately 45 miles east of Idaho Falls, ID. In addition, there are antenna facilities in Idaho Falls at the INL Administration Building and the North Yellowstone Complex.

The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

HF Radio Facilities

HFTB

4. ICOM IC-F7000
5. RFSpace SDR-14 Spectrum Analyzer.
6. Work Station to monitor Flex 6700 radios at 4 other locations

Portable Antennas

1. Diamond BB7V Whip w/SGC Smartuner 230
2. Barker & Williamson BWD-90 Folded Dipole
3. Barker & Williamson BWD End fed "Vee"
4. CODAN Vehicle Mounted NVIS Whip

5. Camelian EMCOMM II HF Long Wire

Satellite Simulator

Overall System Description

The Satellite Simulator phone network (SatSim) consists of a single base station and radio network controller located at the EBR-1 fixed cell site. The SatSim provides satellite phone carrier coverage to capable devices on the range throughout the CFA and CITRC areas, and the areas between them. Remote operation of the system is performed at the CFA-1609 NOC.

SatSim Features

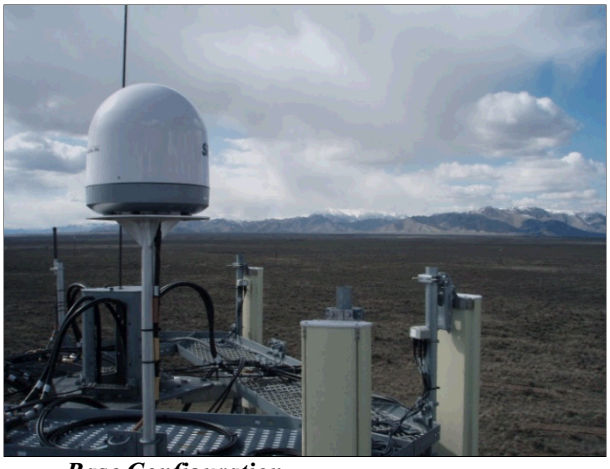
- Voice mobile calls
- Encrypted or non-encrypted traffic
- Short Message Service (SMS)
- Mobile Station registration and call functions
- Supports many commercial-off-the-shelf (COTS) phones
- Downlink power control range from 11 dBm to 30 dBm
- Selectable Base Station antennas (LHCP OMNI directional or Patch)
- Coverage area of 6 to 9 miles (OMNI Antenna) and 15 to 18 miles (Patch Antenna) depending on direct line of site visibility with EBR-1 tower

SatSim Components

- One (1) Control laptop computer with required software and licensing
- One (1) SatSim system with four (4) TRX units and supporting amplifiers
- Two (2) Beacon Beam TRXs
- Two (2) Traffic Beam TRXs
- One (1) Patch – Directional antenna with supporting RF transmission components
- One (1) OMNI – Directional antenna with supporting RF transmission components
- One (1) RF Switching unit
- One (1) Radome
- Six (6) Mobile Stations – Three (3) each of two (2) makes/models
- Six (6) SIM cards
- Three (3) GPS antennas to be used with supplemental equipment while testing
- Three (3) OMNI antennas to be used with supplemental equipment while testing

SatSim Capacity

- A total of four (4) carrier beams are broadcast
- Two (2) Beacon (BCCH) beams
- Each BCCH beam supports over 50 MS registrations at any given time
- Two (2) Traffic (TCH) beams
- Each TCH beam supports eight (8) MS voice calls, however the current software version in the WTB system allows a single active voice call per TCH beam



Base Configuration

The SatSim is connected to either an OMNI or Patch antenna residing on the 60 foot platform of

the EBR-1 cell site tower. The antennas are mounted inside a weatherproof radome with the OMNI positioned above and behind the Patch. The desired antenna to be used can be selected via an RF switch inside of the EBR-1 cell site equipment shelter.

All components of the SatSim system are shutdown when not in use.

Management and Configuration Capabilities

The CFA-1609 NOC is the control center for the SatSim. The SatSim is configured to allow remote connectivity for system operations.

- Simulator start-up and shut-down
- RF transmission enabling and disabling
- Output power control of each beam
- Real-time monitoring of network traffic and system performance (no logging or recording capabilities in current software version)

System Resources

Personnel

The SatSim system is operated and maintained by INL engineers and technicians.

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum. INL has "experimental station" authority granted by DOE-HQ & NTIA, which allows communications testing on many frequencies.

SatSim operations are allowed in the following channels/frequency bands:

- 1.5 – 1.6 GHz:
  - 987 (1657.34375 MHz uplink, 1555.84375 MHz downlink)
  - 1002 (1657.81250 MHz uplink, 1556.3125 MHz downlink)
  - 991 (1657.46875 MHz uplink, 1555.96875 MHz downlink)
  - 1006 (1657.93750 MHz uplink, 1556.43750 MHz downlink)

Physical Location

All SatSim facilities are on the 890 square mile INL reservation located approximately 45 miles west of Idaho Falls, ID. The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

-

WTB Backhaul

Overall System Description

The backhaul network supports the connectivity for all WTB cellular and non cellular networks along with various support components. The core of the backhaul network is comprised of fiber optic cable and Marconi ATM switches. The following facilities support the backhaul infrastructure:

7. CFA-609 – Fiber
8. Gate-1 – Fiber
9. EBR-1 – Fiber
10. RTMF - Fiber
11. CFA-1609 - Fiber
12. CFA-699 - Fiber
13. RTMF – Fiber
14. Mobile Cellular Assets – Fiber

Base Configuration

The base configuration of the backhaul network is to support all systems and devices in and around the CFA area; however, connectivity to TAN can be added based on customer requirements.

Management and Configuration Capabilities

All devices support the backhaul infrastructure can be configured and operated remotely from any point attached to the network. There is no centralized configuration facility; each asset must be configured on a per-device basis. Devices and services can be reconfigured to suit customer requirements within the capabilities of the equipment.

System Resources

Personnel

The backhaul network was built and is operated and maintained by network engineers on the NGWTB staff.

Physical Location

All backhaul facilities are on the 890 square mile INL reservation located approximately 45 miles east of Idaho Falls, ID. The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

Marconi ATM Equipment Interfaces

- T1
- E1
- DS-3
- E3
- Ethernet (10/100, Gigabit Ethernet)
- LANE Services
- Frame Relay
- CEM (N x 64 Kbps)
- 155 Mbps SONET/SDH (Category 5 UTP copper, OC-3c/STM-1, and STM-1e)
- OC-12c/STM-4
- OC-48c/STM-16
- T1/E1 IMA
- Channelized DS-3
- Channelized OC-3/DS-1/0/E1 CEM
- Channelized OC-3/DS-1/E1 ATM/IMA
- Serial CEM (DTE/DCE, 75 bps to 19 Mbps; EIA/TIA 232/422/423/449/530/V.35)
- Serial cell-bearing (DTE/DCE, 56 Kbps to 24 Mbps; EIA/TIA 530)

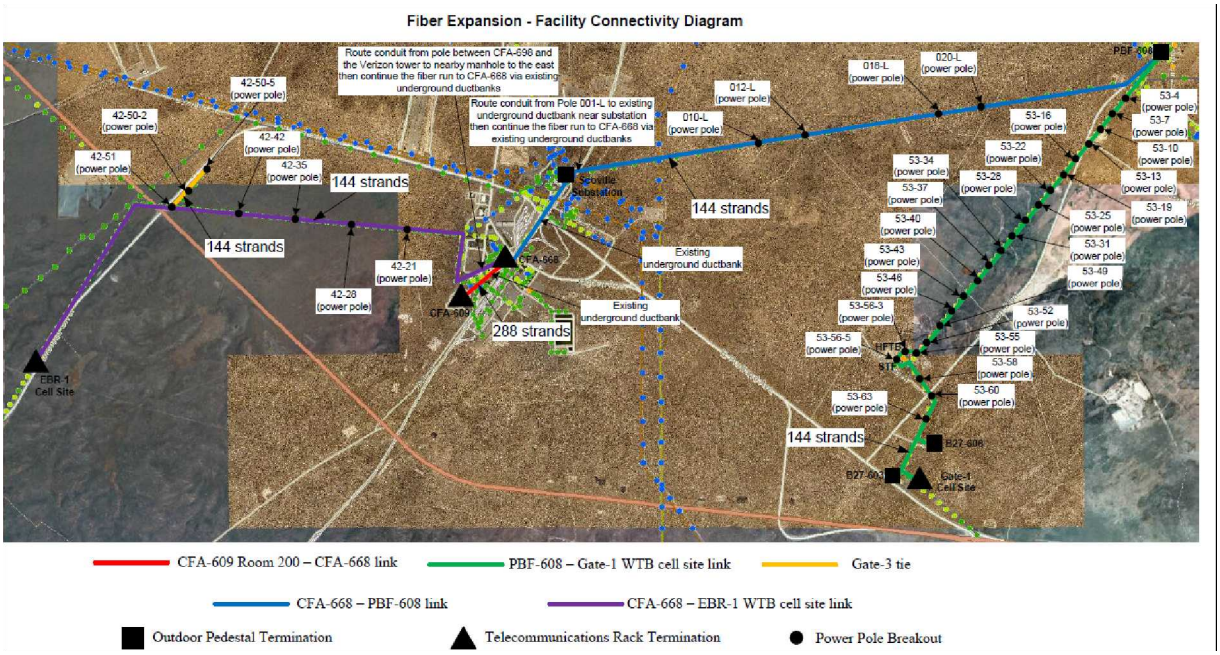


Figure 7 Overview of the fiber network installed at the WTB

Fiber Network

Overall System Description

WTB provides an independent fiber optic network interconnecting and establishing communication pathways between various WTB site facilities and test areas.

Operational Overview:

- 288 separate strands
  - Single mode (SM) optical fiber
  - Standard/square (SC) terminations
- Forty-eight (48) fibers pairs providing direct end-to-end connectivity between Cell sites (e.g. CFA 609 to Gate 1 and CFA 609 to EBR1)
- Ninety-six (96) fibers pairs facilitate point-to-point communications links between any of the INL WTB access points and Cell sites (e.g. CFA 609 to Gate 1 and CFA609 to EBR1)
- Thirty-five (35) access points to dynamically establish temporary or long-term point-to-point communications links between any of the facility endpoints or connecting COWs.

WTB Local Area Networks (LANs)

Local Area Network #1 (LAN1) - GSM/UMTS

Overall System Description

LAN1 is an isolated TCP/IP Ethernet network providing wireline network access at five facilities all of which are located on the INL reservation. The purpose of LAN1 is to provide TCP/IP connectivity for all WTB cellular network elements and support components located in fixed network sites in addition to the Network Operations Center (NOC). The facilities served by LAN1 are:

15. CFA-609, Room 200
16. Gate1, shelter-1
17. Gate1, shelter-3
18. EBR1 shelter
19. RTMF

The links between the facilities are:

20. CFA-609 to RTMF: Ethernet bridge over ATM; single-mode fiber.
21. CFA-609 to Gate1: Ethernet bridge over ATM; 23 GHz Microwave link (2.85 miles).
22. CFA-609 to EBR1: Ethernet bridge over 23 GHz Microwave link (2.57 miles).
23. Gate-1, Shelter-1 to Shelter-3: TCP/IP over multi-mode fiber.

Base Configuration

The base configuration of LAN1 is with all devices and systems operational. LAN1 is normally connected to LAN2, however the two LANs can be separated to suit customer requirements.

Management and Configuration Capabilities

All devices and services on LAN1 can be configured and operated remotely from any point attached to the LAN. There is no centralized configuration facility; each asset must be configured on a per-device basis. Devices and services can be reconfigured to suit customer requirements within the capabilities of the equipment.

System Resources

Personnel

LAN1 was built and is operated and maintained by network engineers on the NGWTB staff.

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum.

INL has "experimental station" authority granted by DOE-HQ & NTIA, which allows communications testing for government customers at all, but the specifically excluded bands, of the frequencies listed below. In some cases, these excluded frequencies may also be used, but this requires a special filing with the NTIA and a more rigorous approval process outside the INL's Spectrum Manager's office.

LAN1 operates in following frequency band:

- 23 GHz (microwave links).

Physical Location

All LAN1 facilities are on the 890 square mile INL reservation located approximately 45 miles east of Idaho Falls, ID. The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

Network facilities at each location:

24. CFA-609
    - Cisco 3845 Router
    - Cisco 3560 48 port Layer 3 PoE switch
    - Cisco 3560 24 port Layer 3 PoE switch
25. Gate1, Shelter-1
    - Cisco 3560 24 port Layer 3 PoE switch
    - Fiber patch panel
26. Gate1, Shelter-3
    - Cisco 3845 Router
    - Cisco 2960G 24 port Layer 2 switch
    - Cisco 2950 24 port Layer 2 switch
    - Fiber patch panel

27. EBR1
    - Cisco 2960 24 port Layer 2 switch
28. RTMF
    - Cisco 3560 24 port Layer 3 PoE switch.

Local Area Network #3 (LAN3) – WiFi/VoIP

Overall System Description

LAN3 is an isolated TCP/IP Ethernet network providing wireless network access at three facilities and wireline network access at five facilities all of which are located on the INL reservation. The purpose of LAN3 is to support testing wireless bridge links, access points and Voice over IP (VoIP) communication systems in addition to providing data and IP voice communications between facilities. The facilities served by LAN3 are:

- CFA-609, Room 200
- Gate1, shelter-1
- EBR1 shelter
- RTMF
- Cell Site #6 (CS6).

The links between all facilities are wireless:

- CFA-609 to RTMF: 802.11g Wi-Fi bridge (4.75 miles).
- CFA-609 to CS6: 802.11g Wi-Fi bridge (5.95 miles).
- PER-641 to CS6: 802.11b Wi-Fi bridge (1.91 miles).
- CFA-609 to Gate1: Ethernet over T1 Bridge on 23 GHz Microwave link (2.85 miles).
- CFA-609 to EBR1: Ethernet over T1 Bridge on 23 GHz Microwave link (2.57 miles).

Base Configuration

The base configuration of LAN3 is with all devices and systems operational. Wireless bridge links and access points operate on assigned channels as shown in the above drawings. Wireless bridge links and access points are unencrypted.

Management and Configuration Capabilities

All devices and services on LAN3 can be configured and operated remotely from any point attached to the LAN. There is no centralized configuration facility; each asset must be configured on a per-device basis. Devices and services can be reconfigured to suit customer requirements within the capabilities of the equipment.

System Resources

Personnel

LAN3 was built and is operated and maintained by network engineers on the WTB staff.

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum.

INL has "experimental station" authority granted by DOE-HQ & NTIA, which allows communications testing for government customers at all, but the specifically excluded bands, of the frequencies listed below. In some cases, these excluded frequencies may also be used, but this requires a special filing with the NTIA and a more rigorous approval process outside the INL's Spectrum Manager's office.

LAN3 operates in three frequency bands:

- 2.4 GHz (802.11b/g bridge links and access points)
- 5 GHz (802.11a access points)
- 23 GHz (microwave links).

Physical Location

All LAN3 facilities are on the 890 square mile INL reservation located approximately 45 miles east of Idaho Falls, ID. The INL location has the advantage of not being near any major

metropolitan areas, airports or military bases.

Network facilities at each location:

29. CFA-609
    - Cisco 3560 Layer 3 PoE switch
    - Cisco 2811-VG Voice gateway/router
    - Cisco 1200 internal access point, w/ 2.4 GHz dipole antennas
    - Cisco 1200 external access point, w/ 1W amp, 2.4 GHz omni antenna
    - Cisco 1300 bridge for link to PER-641, w/ 1W amp, 2.4 GHz parabolic antenna
    - Cisco 1300 bridge for link to Cell Site , w/ 1W amp, 2.4 GHz parabolic antenna
    - RAD RICi-T1 Ethernet over T1 bridge for link to Gate1
    - RAD RICi-T1 Ethernet over T1 bridge for link to EBR1
30. Gate1
    - Cisco 2950 Layer 2 switch
    - RAD RICi-T1 Ethernet over T1 bridge for link to CFA-609
31. EBR1
    - Cisco 2950 Layer 2 switch
    - RAD RICi-T1 Ethernet over T1 bridge for link to CFA-609
32. RTMF
    - Cisco 3550 Layer 3 PoE switch
    - Cisco 1200 internal access point, w/ 2.4 GHz dipole antennas
    - Cisco 1200 external access point, w/ 1W amp, 2.4 GHz omni antenna
    - Cisco 1300 bridge for link to CFA-609, w/ 1W amp, 2.4 GHz parabolic antenna
    - Cisco 350 bridge for link to CS6, w/ 1W amp, 2.4 GHz parabolic antenna
33. CS6
    - Cisco 3550 Layer 3 PoE switch
    - Cisco 1200 external access point, w/ 1W amp, 2.4 GHz omni antenna
    - Cisco 1300 bridge for link to CFA-609, w/ 1W amp, 2.4 GHz parabolic antenna
    - Cisco 350 bridge for link to PER-641, w/ 1W amp, 2.4 GHz Yagi antenna.

VoIP facilities at each location:

34. CFA-609
    - Cisco Call Manager v4.1(3)
    - Cisco Unity Voicemail server v4.0(5)
    - Brekeke OnDO SIP Server v1.5
    - Net Integrator Email Server v3.75b #1
    - Cisco 7940 phone (SCCP)
    - Cisco 7940 phone (SIP)
35. Gate1
    - Cisco 7940 phone (SCCP)
36. EBR1
    - Cisco 7940 phone (SCCP)
37. RTMF
    - (2) Cisco 7940 phones (SCCP)
    - (1) Cisco 7940 phone (SIP)
    - Dell Optiplex GX280 workstation with:
    a. Clarisys i750H USB phone
    b. Cisco IPC softphone (SCCP)
    c. eyeBeam softphone (SIP)
38. CS6
    - Cisco 7940 phone (SIP)
    - Dell Optiplex GX280 workstation with:
    a. Clarisys i750H USB phone
    b. Cisco IPC softphone (SCCP)

c. eyeBeam softphone (SIP).

39. Mobile Equipment

- (4) Cisco 7920 phones (SCCP)
- (1) ZyXEL P2000W phone (SIP)
- (2) Dell D810 Laptops with:

a. Clarisys i750H USB phone

b. Cisco IPC softphone (SCCP)

c. eyeBeam softphone (SIP)

- (3) HP iPAQ 6320 SCCP/SIP capable (not currently configured).

Cellular Network Management

Overall System Description

NOKIA NetAct is an operation support system that consists of many tools for operating and maintaining the elements of the WTB cellular network. It allows the WTB to automate many of the tasks associated with configuring, operating and monitoring the cellular networks and thereby reduce errors, improve efficiency and availability.

The NetAct system is integrated with and supports the following operations on the WTB GSM (2G) , UMTS (3G) & LTE (4G) cellular networks:

- Radio network configuration
- Alarm and status monitoring
- Performance reporting
- System administration

Base Configuration

The base configuration of NetAct is with all systems and applications operational.

Management and Configuration Capabilities

All NetAct applications can be accessed and operated locally at the NetAct cabinet and remotely from any point attached to the LAN1 with a PC that has the NetAct client software installed. In addition, all NetAct servers and devices can be administered locally or remotely from any point attached to LAN1.

System Resources

Personnel

NetAct was installed and integrated by INL and NOKIA engineers. NetAct is operated and maintained by INL engineers and technicians.

Spectrum

At the INL, the INL Spectrum Manager, under a charter from DOE's NE-ID Chief Information Officer, controls Radio Frequency (RF) spectrum.

INL has "experimental station" authority granted by DOE-HQ & NTIA, which allows communications testing for government customers at all, but the specifically excluded bands, of the frequencies listed below. In some cases, these excluded frequencies may also be used, but this requires a special filing with the NTIA and a more rigorous approval process outside the INL's Spectrum Manager's office.

NetAct does not directly operate in the wireless spectrum; however, the cellular equipment managed by NetAct operates in the following frequency bands:

- 900 MHz
- 1800 MHz
- 1900 MHz
- 2100 MHz

In addition, NetAct related network traffic is carried over microwave backhaul links operating at the following frequencies:

- 10.5 GHz (microwave links)
- 23 GHz (microwave links).

Physical Location

All NetAct facilities are on the 890 square mile INL reservation located approximately 45 miles east of Idaho Falls, ID. The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

NetAct facilities at each location:

All components of the NetAct system are collocated in a single cabinet that is installed at Gate-1 Shelter-3.

The components of the NetAct system are:

40. Hewlett Packard BL460c Gen8 and Gen9 CTO Blade Server
41. Hewlett Packard BL460c Gen8 2658 Core CPU1 & HP BL460c Gen9 E5-2680v3 CPU
42. Hewlett Packard HI 5500-24G-4SFP switch
43. Hewlett Packard B-Series 8/24 Blade System SAN switch
44. EMC VNX 5200 2.5 4x600GB + 8x1TB

storage

45. EMC VNX 5100 6x2TB 3.5 RTF backup storage
46. Hewlett Packard TFT7600 KVM console
47. EMC Fast Suite for VNX5200 performance and storage efficiency
48. Cisco 2951 K9 Router

Traffica

Overall System Description

Nokia Traffica is a real-time traffic monitoring tool designed to facilitate the monitoring and analysis of network traffic. Traffica allows you to see how the network functions from the network element level down to individual subscriber information. It visualizes network traffic both via pre-defined and user definable real-time graphs. The tool also stores records for each call attempt, SMS delivery and data session into a database for further use in troubleshooting and historical analysis.

The Traffica system was integrated with and supports the following operations on the WTB GSM (2G) , UMTS (3G) & LTE (4G) cellular networks.

Each Network Elements (oMSS, oMGW, BSC, & RNC) are connected to a Traffica Network Element Server (TNES) to collect and process the data. All TNES are aggregated to the Traffica Server (TS) which serves a mediator between the Traffica Client and TNES.

Base Configuration

The base configuration of Traffica is to monitor the traffic in GSM, UMTS and LTE Network Elements namely the oMSS, oMGW, BSC, RNC, Flexi NG & Flexi NS then analyze the data and output it on a graphical view

Management and Configuration Capabilities

Traffica applications can be accessed and operated locally at the Traffica cabinet and remotely from any point attached to the LAN1 with a PC that has the Traffica client software installed. In addition, all Traffica Server (TS) and Traffica Network Element Server (TNES) can be administered locally or remotely from any point attached to LAN1.

System Resources

Personnel

Traffica was installed and integrated by INL and Nokia Networks engineers. Traffica is operated and maintained by INL engineers and technicians.

Spectrum

Traffica does not directly operate in the wireless spectrum; however, the cellular equipment monitored by Traffica operates in the following frequency bands:

- 900 MHz
- 1800 MHz
- 1900 MHz
- 2100 MHz

Physical Location

All Traffica facilities are on the 890 square mile INL reservation located approximately 45 miles east of Idaho Falls, ID. The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

Traffica facilities at each location:

All components of the Traffica system are collocated in a single cabinet that is installed at Gate-1 Shelter-3.

The components of the Traffica system are:

Traffica Computing Platform

1. HP 636 36U i-Series Shock Rack
2. TFT7600 Rack Mountable Monitor
3. KVM CAT5 8-port Switch

4. Cisco 3750X 48 port Switch

Traffica TS HW

1. HP DL360p Gen8 8-SFF CTO Chassis
2. HP E5-2680 DL360 Gen8 FIO Kit First CPU
3. HP 9.5mm SATA DVD RW Jb Kit
4. 4x1G Ethernet Adapter
5. HP 750W HotPlug AC Power Supply Gen8
6. HP 8GB Memory 12800R-9 Kit for Gen8
7. HP 600GB 6G 10k 2.5in SFF SAS for Gen8
8. HP 2GB FBWC for P-Series Smart Array

Traffica TNES HW (oMSS, oMGW, RNC, & BSC)

1. HP StorageWorks D2700 NoDisks
2. HP DL360p Gen8 8-SFF CTO Chassis
3. HP E5-2680 DL360 Gen8 FIO Kit First CPU
4. HP 9.5mm SATA DVD RW Jb Kit
5. 4x1G Ethernet Adapter
6. HP 750W HotPlug AC Power Supply Gen8
7. HP 2GB FBWC for P-Series Smart Array
8. HP 8GB Memory 12800R-9 Kit for Gen8
9. HP 600GB 6G 10k 2.5in SFF SAS for Gen8
10. HP P822 Controller
11. HP 600GB 6G 10k 2.5in SFF SAS for D2700

Nelmon Hardware

1. HP 32GB SD Mainstream Flash Media Kit
2. HP DL380p Gen8 8 SFF CTO Chassis
3. HP E5-2620 DL380p Gen8 Kit Second CPU
4. HP 16GB 2Rx4 PC3-12800R-11 Kit
5. HP 300GB 6G SAS 15K 2.5 SC ENT HDD Gen8
6. HP 12.7mm Slim SATA DVD RW JB
7. HP 4x1G Ethernet Adapter
8. HP 2GB FBWC for P-series Smart array
9. HP 460W CS Plat PL Ht Plg Pwr Supply Kit
10. HP E5-2620 DL380p Gen8 FIO Kit First CPU
11. HP 600GB 6G 10k 2.5in SFF SAS for D2700

SMSC- Short Messaging Service Center

Overall System Description

The Tecore Short Messaging Service Center (SMSC) is fully integrated with other Core products. It provides simultaneous SMS operations for GSM and UMTS wireless networks. It delivers full SMS services including:

Standard Services:

• Mobile Originated (MO) and Mobile Terminated (MT) short messages

• All supported GSM text formats: 7 bit alphabet (default), 8 bit, and 16 bit encoding

• Message storage if recipient is unavailable

• Message delivery report

• Message forwarding and redelivery if recipient becomes available

• Standard SS7 MAP 1, 2, 3 for GSM MAP and ANSI-41 Rev A, B, C, D for CDMA

• SIGTRAN Support

• Message Waiting Notification support

• Log reports and Operational

Measurements:

• Successful MOs

• Successful MTs

• Failed MOs

• Failed MTs

• Delivery Reports Generated

• Re-attempts completed

• SMPP Connection status

• SS7 Connection status

• Fully configurable via a GUI client

Extended features:

• SMPP interface for a single or multi ESME destinations

• Gateway functionality (SMPP & SS7) to manage connections to one or more SMSCs for roaming networks. This will make it easy to switch between different roaming networks with message delivery problems.

• Custom Message Delivery to any subscriber

• SMSC Multiplexer/SMPP Server for message routing to networks without direct connection

Base Configuration

The base configuration of SMSC is to provide SMS feature for NGWTB subscribers in GSM (2G) and, UMTS (3G) Cellular networks.

Management and Configuration Capabilities

SMSC applications can be accessed and operated locally at CFA609 Rm200 and remotely from any point attached to the LAN1 with a PC that has the VNC software installed.

System Resources

Personnel

SMSC was installed and integrated by INL and Tecore engineers. SMSC is operated and maintained by INL engineers and technicians.

Spectrum

SMSC does not directly operate in the wireless spectrum; however, the cellular equipment associated to SMSC operates in the following frequency bands:

- 900 MHz
- 1800 MHz
- 1900 MHz
- 2100 MHz

Physical Location

SMSC is located in CFA609 area of the 890 square mile INL reservation located approximately 45 miles east of Idaho Falls, ID. The INL location has the advantage of not being near any major metropolitan areas, airports or military bases.

SMSC facilities at location:

All components of the SMSC system are collocated in a single rack that is installed at CFA609 Rm 200

The components of the SMSC are:

1. Dell Power Edge R610
2. Dell MD3200i
3. Cisco 2960s Switch
4. Cisco 3750x Switch

Appendix A
Frequently Asked Questions

1) What is the process for conducting work with the WTB?

The process of conducting work at the WTB typically starts with a detailed requirements discussion with the customer test team and the WTB Test Manager. The Test Manager will pull on the appropriate subject matter experts within INL to ensure we understand all the requirements and can facilitate your request. An advance test range visit is strongly encouraged for a site survey of the facilities and testing infrastructure. INL will then generate a ROM Cost Proposal based on these discussions/requirements. Once the work scope and ROM are accepted by your team, we can initiate the funding mechanism through 1 of 2 ways. The first path is through a Military Interdepartmental Purchase Request (MIPR) with DOE. This process is the most efficient way to transfer funds. The second path is through INL's Work for Others (WFO) program which allows us to conduct work for universities, private industry and others. This process can take considerably more time (2 - 3 months) and may require Nondisclosure Agreements.

2) How do you handle scheduling?

Scheduling range time is handled directly through the WTB Test Manager. In most cases first in first on (FIFO) is implemented, unless there are conflicts for facilities or spectrum. The WTB Test Manager schedules efforts to avoid simultaneous testing; although, if necessary will work with all customer groups to see if simultaneous testing is a possibility.

3) What kind of scheduling lead time do you need?

The lead time required will vary depending upon your scope and funding mechanism. If you can process MIPRs, we can likely begin pre-test work within 3 to 6 weeks of funding initiation. We can tentatively "hold" a spot on the range calendar for your effort until you are ready to commit, preferably 3 months in advance of the test.

4) Do you have any restrictions on testing (time of day or calendar)?

There are no restrictions on test days/times unless driven by your spectrum requirements. We typically work 7 AM to 6 PM, Mon - Fri but can accommodate off shifts if needed and when resources are available.

5) What fees/payments are required for testing/services?

The INL is a not-for-profit Federally Funded Research and Development Center (FFRDC). We are a total cost recovery organization and require funds in house at INL prior to performing work. The WTB will charge against your funds for time, materials, and a Service Center range use fee. Typical total test costs can vary from $50K to $700K per 5-day week depending on the individual requirements.

6) What types of range services are available?

INL provides a full suite of range services available for use to include: small/large portable generators, gas/diesel fueling services, Land Mobile Radio (LMR) communications, high bay and warehouse storage, shipping services, fire and medical

emergency response teams, technical and administrative support.

7) How do you handle RF spectrum allocation?

The WTB is authorized to support RF testing for government customers through an NTIA Experimental Radio status. This authority was granted on the basis of experimental RF testing which does (1) not cause harmful interference to a local spectrum owner and (2) does not provide an operational or commercial service. For government customer RF transmit requirements, we will submit a spectrum request form to our DOE appointed Spectrum Manager. The Spectrum Manager will process this request through FCC and Government databases, and provide approval/disapproval conditions based on the characteristics of the request. The request must be complete with all transmitter and antenna characteristics in order to process.

All INL N&HS Industry or Academia Customers will be required to submit a request to the FCC for a FCC Special Temporary Authority for spectrum emission for their test activities with the INL on INL property. Please see addendum for commercial customers and WNUF Users spectrum use requirements.

8) Does INL have restricted airspace?

Airspace is unrestricted above 1000' AGL, though there are some limitations placed on flight paths within 1 NM of certain range campus areas. The INL coordinates overflights that are conducted in support of laboratory efforts but does not alleviate any FAA regulations.

9) Do you have portable power available on range?

Portable power is available on range. Gas or diesel generators from 2 to 100 KW are typically used in field locations. Fueling/maintenance of the generators are also available. We have a stock of 12V batteries, and additional can be purchased/used as needed.

10) Would any of the potential sites have power available?

There are several sites on range that have commercial power. These sites are typically situated near the campus areas and may or may not be conducive to the specified test environment.

11) How do you handle communications for test participants?

INL operates a trunked radio (LMR) network with repeaters on nearby mountain tops. Coverage is available anywhere on range and into Idaho Falls. Pagers are also provided to the customer point of contact.

12) How are personnel transported to the site?

The INL WTB staff utilize the INL bus services, along with GSA vehicles. We can supply transportation of customer personnel if required through our GSA vehicle fleet, though it will be more cost effective for your team to drive rental cars to (and while on) the range.

13) How is equipment transported to and from the site?

The INL utilizes WestOne Logistics, a third party shipping company, for the transportation of equipment to and from the INL site location. Both Fed-Ex and UPS incoming shipments will be automatically routed through WestOne Logistics. Outgoing shipment costs are applied to the total test effort costs, or against the customers' direct shipping account.

14) What kind of space and topography are available for test environments?

The INL desert range generally consists of relatively flat rolling hills with grass and sage brush vegetation. Near the edges of the range there are mountains, hills and ridgelines. The INL WTB will also work with state and local land owners to obtain further areas of testing

Appendix B
Supporting Test Equipment

GSM Only Phones

Item #	Qty	Phone Model	Phone Type	Frequency Band (MHz)
1	8	LG KG130	Commercial	GSM 900 / 1800
2	9	LG MG160a	Commercial	GSM 850 / 1900
3	10	Motorola C139	Commercial	GSM 850 / 1900
4	13	Motorola L6	Commercial	GSM 850 / 900 / 1800 / 1900
5	9	Motorola RAZR V3	Commercial	GSM 850 / 900 / 1800 / 1900
6	2	Motorola T720	Commercial	GSM 850 / 1900
7	1	Motorola T725	Commercial	GSM 850 / 1900
8	8	Motorola V620	Commercial	GSM 850 / 900 / 1800 / 1900
9	10	NEC e132	Commercial	GSM 900 / 1800
10	7	Nokia 1200	Commercial	GSM 900 / 1800
11	9	Nokia 1208	Commercial	GSM 900 / 1800
12	10	Nokia 1600bNOK SV	Commercial	GSM 850 / 1900
13	2	Nokia 3230	Commercial	GSM 900 / 1800 / 1900
14	1	Nokia 3310	Commercial	GSM 900 / 1800
15	10	Nokia 3500c	Commercial	GSM 900 / 1800 / 1900
16	3	Nokia 6170	Commercial	GSM 900 / 1800 / 1900
17	2	Nokia 6190	Commercial	GSM 1900
18	2	Nokia 6230	Engineering	GSM 900 / 1800 / 1900
19	2	Nokia 6230b	Engineering	GSM 1900
20	12	Nokia 6651	Engineering	GSM 1900
21	4	Nokia 6820a	Engineering	GSM 900 / 1800 / 1900
22	2	Nokia 7260	Engineering	GSM 900 / 1800 / 1900
23	2	Sagem OT430	Engineering	GSM 900 / 1800 / 1900
24	2	Sagem OT438	Engineering	GSM 850 / 900 / 1800 / 1900
25	7	Samsung SAM-T519	Commercial	GSM 850 / 900 / 1800 / 1900
26	2	Samsung SGH-X450	Commercial	GSM 900 / 1800 / 1900
27	1	Siemens CX70	Commercial	GSM 900 / 1800 / 1900
28	10	Sony Ericsson T610	Commercial	GSM 900 / 1800 / 1900
29	1	Sony Ericsson T610 TEMS	Engineering	GSM 900 / 1800 / 1900

UMTS and GSM Phones

Item #	Qty	Phone Model	Phone Type	Frequency Band (MHz)
1	5	LG KU250	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
2	5	Motorola RAZR V3XX	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
3	7	Motorola V1100	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
4	3	Motorola V975	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
5	5	Nokia 6120c1	Commercial	GSM 850 / 900 / 1800 / 1900 UMTS 850 / 2100
6	2	Nokia 6650	Engineering	GSM 900 / 1800 UMTS 2100
7	5	Sony Ericsson K530i	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
8	1	5800D-1	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
9	2	LG GC900	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
10	1	MOTOROLA A3100	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
11	4	NOKIA 3120C	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
12	1	SONY ERICSSON G900	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
13	3	NOKIA 5230	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
14	1	NOKIA 5630D	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
15	2	SAMSUNG SGH-U900	Commercial	GSM 900 / 1800 / 1900 UMTS 2100
16	1	SAMSUNG SGH-U900v	Commercial	GSM 900 / 1800 / 1900 UMTS 2100

GSM, UMTS, CDMA and LTE Phones

Item #	Qty	Phone Model	Phone Type	Frequency Band (MHz)			
				GSM	CDMA	UMTS	LTE
1	2	Alcatel OneTouch POP S3	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 2100 MHz	1/3/7/8/20
2	1	Apple iPhone 5c	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1900/ 2100 MHz	1/2/3/5/7/8/20 /38/39/40
3	1	Apple iPhone 5s	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1900/ 2100 MHz	1/2/3/5/7/8/20 /38/39/40
4	2	Google Nexus 5	Commercial	850/ 900/ 1800/ 1900 MHz	800/1900 MHz	850/ 900/ 1700/2100/ 1900/ 2100 MHz	1/3/5/7/8/20
5	2	HTC Desire 816	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 2100 MHz	3/7/8/20
6	2	HTC One mini	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/1900/ 2100 MHz	3/7/8/20
7	7	HTC One E8	Commercial	850/ 900/ 1800/ 1900 MHz		850/900/2100 MHZ	1/3/7/8/41
8	2	Huawei Ascend	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1900/ 2100 MHz	1/3/7/8/20
9	2	LG G2	Commercial	850/ 900/ 1800/ 1900 MHz	800/ 1900 MHz	850/ 1900/ 2100 MHz	1/3/5/7/8/20
10	1	Nokia Lumia 1520	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1900/ 2100 MHz	1/3/7/8/20
11	1	Nokia Lumia 930	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1900/ 2100 MHz	1/3/7/8/20
12	1	OnePlus One	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1700/2100/ 1900/ 2100 MHz	1/3/4/7/17/38/ 40
13	1	Oppo Find 7a	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1800/ 1900 MHz	1/3/7/20/40
14	1	Samsung Galaxy S5	Commercial	850/ 900/ 1800/ 1900 MHz		850/900/1900/2100MHz	17/5/4/3/2/1/7
15	2	Sony Xperia SP-M35t	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 2100 MHz	1/3/5/7/18
16	2	Sony Xperia Z1 C6906	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1700/2100/ 1900/ 2100 MHz	1/2/4/5/7/8/20
17	2	ZTE Nubia Z7	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1900/ 2100 MHz	1/3/7/38/39/4 0/41
18	6	ZTE Nubia Z7 Max	Commercial	850/ 900/ 1800/ 1900 MHz		850/ 900/ 1900/ 2100 MHz	1/3/7/38/39/4 0/41

CDMA Phones

Item #	Qty	Phone Model	Phone Type	Frequency Band (MHz)
1	20	Motorola V710	Engineering	CDMA 800
2	8	Kyocera KX444	Engineering	CDMA 1900
3	2	Motorola RAZR V3M	Engineering	CDMA 1900

SatSim Phones

Item #	Qty	Phone Model
1	6	SG-2520

Wireless IP Phones

Item #	Qty	Phone Model	Phone Type	Frequency Band (MHz)
1	4	Cisco 7920		2.4 GHz
2	1	Zyxel P2000W_V2		2.4 GHz

Analyzers

Item #	Qty	Make	Model	Type
1	1	VIAVI	PacketInsight / SART	LTE Protocol Analyzer
2	1	VIAVI	SART	UMTS Protocol Analyzer
3	3	Tektronix	RSA 6114A	Real Time Spectrum Analyzer
4	1	VIAVI	JD748B	Cell Advisor Signal Analyzer (LTE/Fiber)

LTE Tier III Band 13 & 14 Phones

Item #	Qty	Make	Model	Band
1	2	Sonim	XP7	14
2	4	Bittium (was Elektrobit)	EB Tough Mobile	13 & 14
3	2	Motorola	LEX L10	13 & 14
4	2	Motorola	UM1000 Dongle	14

LTE Tier I Band 3 & 7 Devices

Item #	Qty	Make	Model	Band
1	1	APPLE	APL-iPhone6S	3&7
2	1	LG	LG-H815 (G4)	3&7
3	1	LG	LG-H860 (G5)	3&7
4	1	LG	LG-H961 (V10)	3&7
5	2	Netgear Aircard	Netgear-AC790S	3&7
6	1	Samsung Galaxy	CSA-A5	3&7
7	1	Samsung Galaxy	CSA-A7	3&7

8	1	Samsung Galaxy	CSA-S6	3&7
9	1	Samsung Galaxy	CSA-S6-Edge	3&7
10	1	Samsung Galaxy	CSA-N915G	3&7
11	1	Samsung Galaxy	CSA-A8	3&7
12	4	Samsung Galaxy (w/ HANDY PRO NEMO)	SM-N910F	3&7

Appendix C
NTIA Red Book Section 7.11

USE OF FREQUENCIES BY CERTAIN EXPERIMENTAL STATIONS

Except as provided in the following paragraph, Federal experimental radio stations at the locations listed below are authorized to use any radio frequency for short or intermittent periods without prior authorization of specific frequencies provided that a) such operations are confined to the immediate vicinity of the station; b) the nature or duration of the requirement is such that the assignment of specific frequencies is impracticable; and c) all reasonable measures are taken before such frequencies are used to ensure that harmful interference will not be caused to authorized services, and, in this regard, consideration should be given to the propagation characteristics of the frequency to be utilized and to the operational nature of the services normally operating on frequencies of the order of that selected.

This authority is limited to radio frequency usage which is an integral part of an experimental operation and shall not be construed as authorizing frequency usage for administrative or operational use related thereto. No priority rights shall derive from the use of a specific frequency for an operation conducted pursuant to this authority nor shall any specific frequency usage constitute a bar to the authorization of other uses. The following frequency bands are specifically excluded from this authority:

Appendix D
Unmanned Aerial Systems (UAS) Parameters for INL Flight Operations

UNMANNED AERIAL SYSTEMS (UAS) PARAMETERS for INL FLIGHT OPERATIONS

An unmanned aerial system is an aircraft operated without the possibility of direct human intervention from within or on the aircraft.

INL has almost 3,100 square miles of approved airspace to use for UAS operations. Current Certificate of Authorizations (COAs) authorize UAS flights up to 4,500' above ground level (AGL). Per Federal Aviation Administration (FAA) regulations, the ceiling for UAS flights is 18,000' mean sea level (MSL), with proper coordination and a chase plane (a plane that will help ensure the UAS does not interfere with manned aviation).

INL UAV Airstrip can accommodate UAVs up to 600 lbs. It is 100' wide and 1000' long.

Pilot Qualifications

The pilot must have passed 14 CFR Part 107 training and possess a Remote Pilot License from the FAA. A certification from a military training program may be acceptable as equivalent. Credentials must be provided to INL Chief UAS Pilot.

Platform Weight

UAS up to 55 lbs (including payload): INL has a COA in place for any UAS under 55 lbs., either fixed wing or multi-rotor, for flights up to 4,500' AGL. Visual line of sight (LOS) of the UAS is required; however, a "daisy chain" of visual observers is an acceptable tactic.

UAS over 55 lbs: INL will need to generate a new COA for the specific platform. Lead time for a new COA is based on the complexity of the platform and operation—45-60 days for low to moderately complex operations (i.e., over 4,500' AGL and within visual line of sight); up to 90 days for complex operations (multiple UASs or beyond visual line of site). New COAs are not guaranteed and require approval from the FAA.

Beyond Visual Line of Sight (BVLOS) Operations

Requirements of operations beyond visual line of sight are dependent upon the intended flight objectives and test goals.

Visual observation along the flight path (daisy chain of observers) is a consideration that will be explored with BVLOS operations.

Single or Multiple UAS Operations

INL can support multiple UAS operations; however, all desired flight operations must be evaluated prior to conducting operations.

One pilot per UAS platform is required, and there are no exceptions. Additionally, an INL Pilot in Charge (PIC) must be present and co-located with the UAS pilots, during all UAS operations.

INL COA Boundaries

INL Points of Contact

Primary:
Matthew Balderree
INL Chief Unmanned Aircraft Systems (UAS) Pilot
Mobile: 208.599.4324
Desk: 208.526.2940
Matthew.balderree@inl.gov

Secondary:
Chris Forsgren
christopher.forsgren@inl.gov
Office: 208 526-0752

Customer Questionnaire for INL UAS Flight Operations

1. **Pilot Qualification (must show your credentials)**

☐ FAA Part 107
☐ Military
☐ Other _____

2. **Platform Type/Description**

☐ Make _____
☐ Model _____
☐ Color _____

3. **Platform Weight (including payload)**

_____

4. **Flight Altitude (AGL)**

_____

5. **Number of UASs**

_____

6. **Visual Line of Sight**

☐ Yes
☐ No

7. **Additional UAS Information (optional)**

_____

_____

_____

_____

_____

_____

RETURN COMPLETED FORM TO YOUR INL TEST LEAD FOR COORDINATION WITH INL PILOT IN CHARGE.

Appendix E (OUO Separate) INL Electronic Warfare Modelling & Simulation (EWM&S)

Appendix F Transferring Collateral Clearances

Visitors Transferring Collateral Clearances to INL

INCOMING COLLATERAL CLEARANCE TRANSFERS:

Collateral Clearances: **Secret (L) or Top Secret (Q)**

ATTN: **DOE-ID Visitor Control - Joyce Jenks, (208) 526-9521**

Unclassified FAX: 208/526-5918 or 1184

Address: U.S. Department of Energy
Idaho Operations Office
850 Energy Drive
Idaho Falls, ID 83401-1170

List your POC and their phone number at Idaho National Laboratory (INL) on the visit request.

Address to pick-up Visitor Badge(s) at Front Guard Desk:

Willow Creek Building (WCB)
Idaho National Laboratory
1955 Fremont Avenue
Idaho Falls, ID 83401

Appendix G Transferring SCI Clearances

INCOMING SCI CLEARANCE TRANSFERS:

SCI Clearances: **Send Visit Request Certifications to one of the following:**

Unclassified E-mail:

INLSSO@INL.GOV

Unclassified Fax:

(208) 526-9981

SSO M3 Message Channel:

Contact your SSO and give them the Plain Language Address (PLA) for M3 Messages:

SSO DOE//INL//

IC E-mail:

INLSSO@doe.ic.gov

Idaho National Laboratory - SSOs:

Cindy Garner 208-526-8563

Jeanne Jensen 208-526-9373

Alfonzo Rivera 208-526-1766

Ken Mecham 208-526-1167

Drew Kimmey 208-526-5165

ON THE VISIT REQUEST:
VISITOR(S) FULL (First, Middle, Last) NAME
SS#
DOB
DATES OF VISIT / PERM. CERT. DATES – ONE YEAR
PURPOSE OF VISIT AT IDAHO NATIONAL LABORATORY (INL)
INL POC

NOTE: **For an INL picture badge, your clearance needs to be transferred for a one year period (permanent certification) otherwise a Visitor Badge will be issued.**