

OpenSky2™

700 / 800 MHz Solution Overview



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The Harris OpenSky2™ Trunked Radio Network harmonizes the power of Internet Protocol (IP) with the efficiency of Time Division Multiple Access (TDMA) technology to deliver a solution far superior in capacity with unmatched performance for both voice and data communications. An OpenSky2 network is *at its best in the worst of times*, providing mission-critical users the *assured communications®* they need to respond, restore, serve and protect.

Architecture, Technology and Major Benefits

One of the tremendous advantages of the OpenSky2 architecture is that digitized voice is transmitted through the network as IP packets, also known as Voice-over-IP (VoIP). Traditional radio systems employ circuit-switched technology, meaning that a specific circuit (or path) must be available and established before communications may begin. VoIP allows the voice to be digitized and stored as packets, then transmitted as capacity is available. This increases the efficiency of the radio system by utilizing available idle communication paths. Further, unlike other radio systems, OpenSky2 uses commercial off-the-shelf networking and server equipment. The IP backbone on which OpenSky2 is built offers a more secure, robust, efficient and highly scalable architecture with virtually unlimited addressing capacity—we call this VIDA: Voice, Interoperability, Data and Access.

Harris' OpenSky2 radio system and applications are designed to work together enhancing performance and interoperability, while providing greater flexibility and choice. One of the biggest advantages of the system is its unmatched ability to support both voice and data on the same channel. OpenSky2 employs voice-over-IP technology, while meeting the RF standards defined by the FCC for the 700 MHz and 800 MHz frequency bands. Communications is accomplished at a bit rate of 19.2 kbps on 25 kHz channels using either two or four TDMA time slots. In an OpenSky2 system, each time slot can either be a voice or data slot as allotted by the control messages. Hence, the OpenSky2 system is by default voice and data capable.

Additionally, the VIDA architecture of the OpenSky2 system offers the capability of seamless interoperability with other analog or P25 systems.

Harris' OpenSky2 Trunked Radio Network supports a host of advanced trunking features:

- 9.6 kbps on all channels (12.5 kHz)
- Alarm subsystem
- Group, selective, and emergency calls
- Automatic call sign
- Transmission or message trunking
- Patch / SimulSelect
- Call queuing
- Activity reporting
- Talkgroup merge
- Telephone Interconnect
- Emergency alert and Ruthless Preempt
- Over-the-Air-Programming
- Dynamic regroup
- Home Group
- Unit enable/disable
- Request-To-Talk
- 256 levels of priority
- All Call
- AES Encryption
- Over-the-Air-Rekeying
- Transmit abort
- IP/UDP Header Compression
- Dispatcher/supervisor override
- Proxy Registration
- Caller ID display
- Enhanced Vocoder
- Mutual Authentication
- Late entry
- Dynamic Channel Allocation
- Multiple Level Group Priority scan
- Wide Area Roaming
- Continuous channel updating
- Control and Status Service
- Talkback scan
- Alarm Paging
- Activity logging
- Remote provisioning
- Point-to-Point Protocol

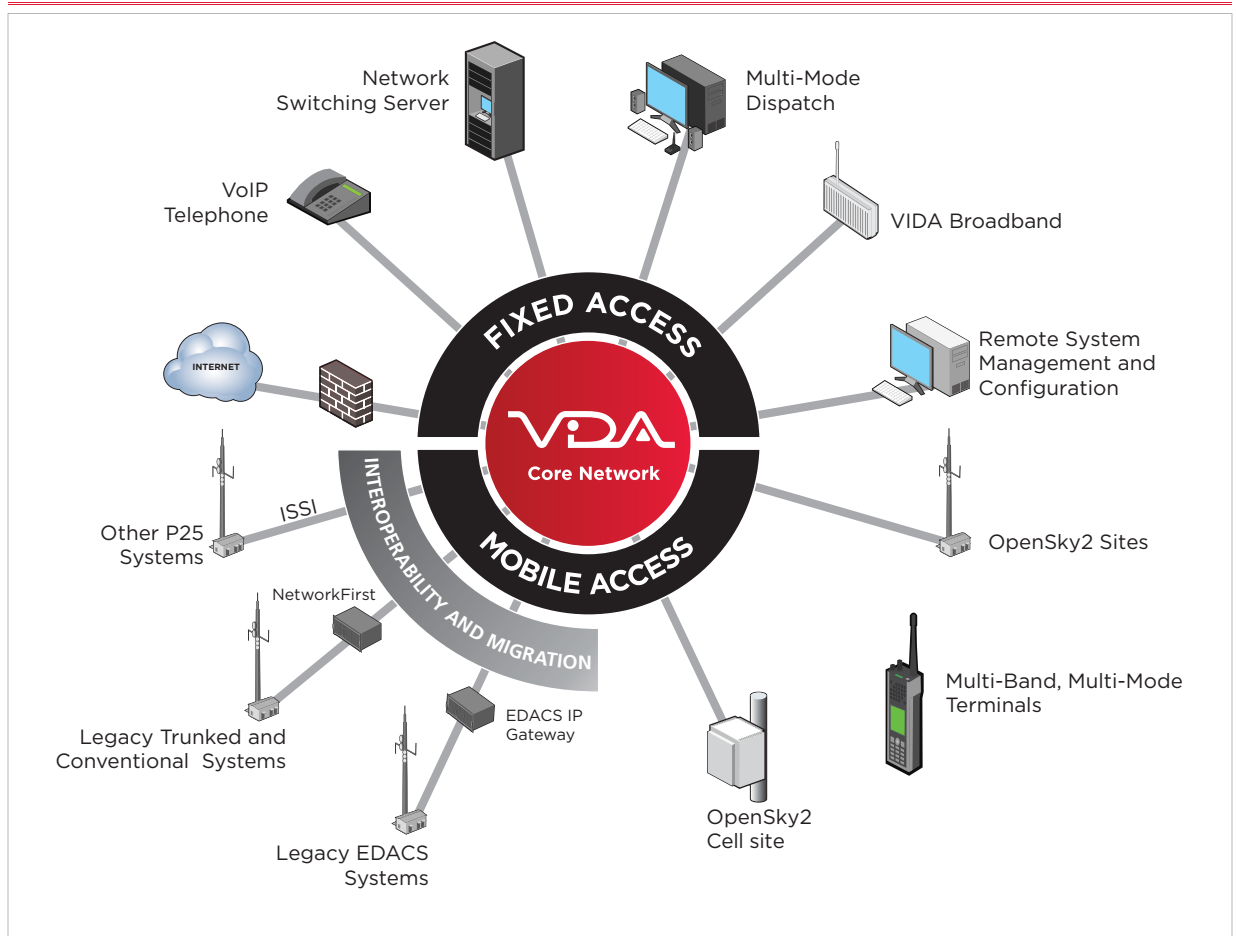
Highlights of the OpenSky2 network are:

- **Spectrum efficiency** – OpenSky2 utilizes Time Division Multiple Access (TDMA) technology to provide either 2 or 4 talk paths on one 25kHz channel, or 2 talk paths over a 12.5kHz channel.
- **Embedded Control Channel** – OpenSky2 technology uses embedded control messages in each time slot, thereby eliminating the need for a dedicated control channel. The result is that a single, 4-slot OpenSky2 channel can support the equivalent load of up to a five-channel trunked FDMA system that operates with one control and four working channels.
- **Integrated voice and data services** – Each OpenSky2 channel utilizes an airlink that supports integrated voice, data, and control. This eliminates the need for dedicated data channels or a separate network dedicated to data. Voice is given priority over data. Both voice and data can be encrypted.
- **Digital audio clarity** – OpenSky2 radios feature the Advanced Multi-band Excitation (AMBE) vocoder, which is the next generation beyond the IMBE vocoder mandated for APCO P25. The AMBE vocoder encodes human speech at a lower bit rate, allowing more head room for error correction. This results in better voice quality, reduced background noise, improved dynamic range and better effective coverage.
- **Request-to-Talk** – For many agencies the protocol for field unit communication to the dispatcher is through Request-To-Talk (RTT). OpenSky2 offers RTT with multiple RTT indexes to provide a variety of status messages to dispatch.
- **Industry-standard, off-the-shelf equipment** – The VIDA network architecture utilizes high volume IP routers and workstations.
- **Control and Status Service** – provides an Application Programming Interface (API) to the mobile radios. This allows a computer or other third party device to control the radio and execute and receive call traffic in support of third party applications that can operate over the OpenSky2 network along with the default voice services.
- **Over-the-air programming and upgrades** – The software-driven nature of OpenSky2 allows for remote software updates or radio programming through the IP network and/or over the air. Users no longer have to experience “downtime” while radios are being upgraded, and technicians don’t need to touch radios for changes/upgrades. This offers a significant savings in routine operational and maintenance cost.
- **A choice of Rack-mounted 100W repeaters or self-contained Cell Sites** – OpenSky2 cell sites are compact, 25W repeaters designed for outside mounting on rooftops, utility poles or wherever they’re needed. They represent an excellent and economical solution for difficult coverage areas or in-building coverage. And, of course, a single cell site provides the same capacity as a 3-channel trunked analog site in 2-slot TDMA or a 5-channel trunked analog site in 4-slot TDMA.

System Design and Topology

A typical OpenSky2 system diagram is shown below. Sites communicate through microwave, fiber, broadband or leased-line communications systems via internet protocol (IP) to the Network Switching Server (NSS). The NSS intelligently routes call traffic to the radio units or dispatch consoles as needed, while maximizing network throughput.

Typical OpenSky2 System Diagram



Site Equipment

SkyMASTR Base Station

The OpenSky2 architecture affords operators a unique and flexible framework for implementing a wide-area network and also provides the essential features of inter-site roaming and frequency re-use. The SkyMASTR Base Station combines modular design and state-of-the-art technology to provide multi-channel trunking capability. Each station consists of a digital controller/transceiver (DCX) and 100W amplifier. Intra-site connectivity between base stations occurs over an RS-485 control bus, and an industry-standard network router provides interconnectivity between the site and the Regional Network Manager (RNM) for diagnostic monitoring. Interfaces are included for media, such as broadband (optional), T1 (or other WAN medium) or Ethernet to allow for inter-site communications.

FEATURES

Base Stations include the following functions:

- **Channel Efficiency** – As a digital trunked system, a 700 MHz or 800 MHz base station site provides superior channel efficiency through TDMA operation and distributed control channel architecture.
- **Simultaneous Digital Voice and Data** – Another efficiency enhancing feature is the Base Station's ability to support both voice and data over a 19.2 kbps airlink.
- **Remote Diagnostics Software** – Through the RNM, off-line diagnostics can be run to identify site equipment failures such as the landline/microwave link, high power amplifier, antenna line VSWR, power failure and other site alarms.
- **Real-Time Control** – Also through the RNM, the following base station functions can be controlled: enabling a hot-standby station, setting frequencies, disabling an active station, or enabling/disabling local controls.
- **Alarms** – Alarms for reflected power, input voltage, power loss, and output power are generated and sent to the RNM.

Site Access Server

The Site Access Server (SAS) is a commercial off-the-shelf Cisco router. It connects the site equipment to the Network Switching Center (NSC) via IP links. These IP links can take advantage of the variety of standard interface modules available from Cisco providing choices for IP backhaul communications.

Cell Site Base Station

The OpenSky2 Cell Site Base Station offers full OpenSky2 functionality to provide a cost-effective solution for enhancing coverage in areas with difficult terrain. The Cell Site provides a low-profile deployable site that can address environmental concerns for site placement and offers significant reduction in cost for site procurement and maintenance. Designed to mount on a pole, pad, or wall, the Cell Site Base Station is built into a weatherproof enclosure. The Cell site operates in the same modes and has an identical feature set presented to the terminals as a full base station. The Cell site delivers 25W of continuous rated output power and, since it can be pole mounted, it offers less antenna line loss, so the effective radiated power is greater. Backhaul options supported include broadband, T1, Ethernet or DSU landline modem.



FEATURES

Cell Site Base Stations support all standard OpenSky2 features including:

- **Channel Efficiency** – As a digital trunked system, a cell site provides superior channel efficiency through (2:1 or 4:1) TDMA operation and non-dedicated control channel architecture.
- **Simultaneous Digital Voice and Data** – Another efficiency enhancing feature is the Cell Site Base Station's ability to support both voice and data over a 19.2 kbps airlink.
- **Real-Time Control** – Through the Regional Network Manager (RNM), the following base station functions can be controlled: setting frequencies, customizing programming or disabling an active station.
- **Alarms** – Alarms for reflected power, input voltage, power loss, and output power are generated and sent to the RNM.

- **Integrated Transport** – Unlike other trunked systems that require microwave circuits between sites, the Cell Site Base Station is equipped with either a broadband interface or DSU wireline modem. The broadband solution can operate in the licensed 4.9 GHz band or the unlicensed 2.4 GHz band. For a landline connection, a DSU modem is used to establish a synchronous 56 kbps data link to the network through a leased line.
- **Cost Efficiency** – The self-contained Cell Site Base Station provides localized coverage without the expense of a traditional radio site (e.g., tower and shelter) and associated transport medium (i.e., microwave hop).

Network Equipment

Network Switching Center

The Network Switching Center (NSC) is the heart of the OpenSky2 packet-switched network and is made up of three main components: the Network Switching Server (NSS) that routes voice and data calls, the Regional VIDA Manager (RVM) that provides management and administration, and standard LAN/WAN networking equipment.

The components in the Network Switching Center are commercial off-the-shelf (COTS) computer and networking equipment, which:

- Leverages continual technological advancements of the computing and networking industry. Each new generation of equipment has more memory, more processing power, and often a smaller footprint.
- Reduces impact of equipment obsolescence. Old models of workstations, routers, and Ethernet switches can be replaced with the latest model without requiring whole-scale system replacement.
- Allows for commercially available replacement parts from a wide variety of sources, ensuring competitive pricing.

NETWORK SWITCHING SERVER (NSS)

The Network Switching Server (NSS) is a workstation hosting two applications: the Voice Network Controller (VNIC) that performs routing functions for digital trunked voice messages and the Mobile Data Intermediate System (MD-IS) that routes data calls between end users and host computers. In addition, the NSS controls access of subscriber units, limiting access to only those subscribers that are authorized to use the system based upon the database provisioned by the Unified Administration Server.

The highly scalable design of the NSS allows IP networks of various sizes to be supported. One NSS can be used to support a single region network serving the communication needs of city or county agencies, while multiple servers can be connected to support a multi-region network accommodating voice traffic capacity demanded by statewide or even nationwide organizations. The NSS is also engineered to support a wide range of interfaces for third-party products, including dispatch consoles and logging recorders.

HIGH AVAILABILITY NETWORK SWITCHING CENTER

A “High Availability” NSC configuration can be provided that offers a redundant network switching center to provide immediate backup in case the primary switching server fails. The secondary backup switch continually polls the primary switch for its status, and if it detects a failure, it automatically assumes full control of the switching operations for the entire network. The change is transparent to the users and results in no degradation of network

capabilities. The “High Availability” NSC configuration can be geographically separated to provide more system resiliency for natural or man-made situations.

Interoperability Gateway

The Interoperability Gateway is a software-based multi-channel codec module designed to interface the IP digital network with analog equipment. Applications include connection to dispatch console equipment and to analog voice base station equipment. In both cases, control of the Interoperability Gateway is implemented in software and may be customized easily for specific requirements.

Each Interoperability Gateway receives and transmits packetized digital voice over an Ethernet interface for connection through a switch to the VIDA network. Interoperability Gateway modules offer a 4-wire balanced line level interface for the audio connection. Audio amplitude may be adjusted under software control, and signaling lines are opto-isolated and may be operated in ‘open collector’ mode.

When used to provide interoperability with other communications systems, network users are automatically connected to legacy system users by selecting them as designated voice groups. This provides capabilities for cross-band inter-system operation.

DIGITAL VOICE CODING

Digitized voice within the digital network is coded using Advanced Multiband Excitation (AMBE®). AMBE digital voice is encapsulated into IP packets and sent along with control messages into the IP digital network. Additionally, the Interoperability Gateway supports the use of Adaptive Differential Pulse-Code Modulation (ADPCM) for transmission of analog inputs to other VIDA products which support ADPCM, such as the C3 Maestro[®] and V^{IP} Consoles.



HARDWARE DESIGN

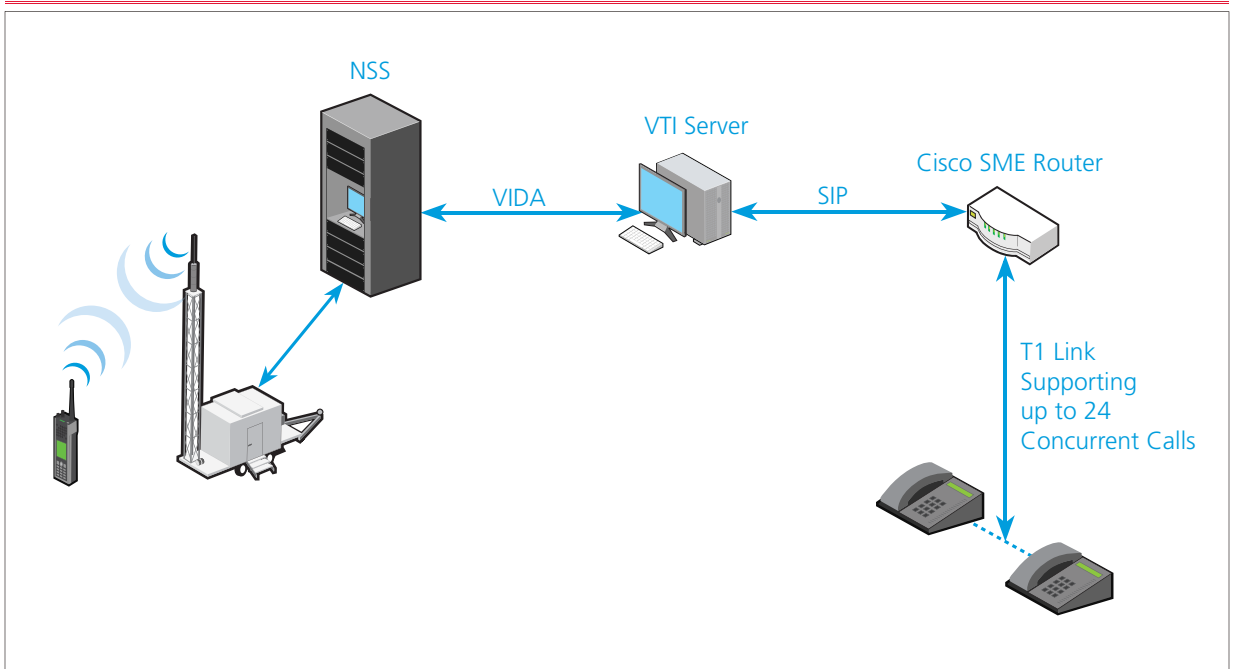
The Interoperability Gateway is a rack-mounted card cage (above) designed to accept multiple VME circuit cards. It contains redundant integrated power supplies and provides forced ventilation for up to 3 Interoperability Gateway cards. Each card provides 4 audio interfaces for a total of 12 interfaces per chassis. The Interoperability Gateway uses a VME-based backplane design for power and signal routing, and offers rear mounting expansion slots for additional interface expansion. The Interoperability Gateway is typically co-located with the Network Switching Center.

VIDA TELEPHONE INTERCONNECT (VTI)

VIDA Telephone Interconnect (VTI) comprises a VTI Server and a VTI Router. The VIDA Telephone Interconnect equipment is installed in the Network Switching Center. Both the VTI Server and Router are typically mounted with the NSS in the same cabinet.

As shown below, the VTI Server communicates with the Voice Switch (VNIC) software application inside the Network Switching Server through a proprietary protocol, which handles call setup and exchanges voice frames between the two devices. The other end of the VTI Server communicates with the Cisco router running the Call Manager Express software through the Session Initiation Protocol (SIP). That portion of the VTI Server converts voice streams from the PSTN in G711 μ law format into the appropriate coding format for the radio network and vice versa.

PSTN Radio Call Flow through the VTI



VTI Telephone Interconnect (VTI) for OpenSky2 systems supports basic telephone interconnect, with inbound and outbound calls, inbound group calls, DTMF over-dial, automatic line clearing (clear the telephone line and radio system channel when a call is ended, even if the call is ended before it is picked up on the other end). VTI also supports authorization code disable for inbound calls (do not connect a telephone-originated call that is placed to a unit that is not allowed to receive an interconnect call), reporting of call activity to the network manager and reporting of faults to the RNM using SNMP. VTI supports priority service channels (dedicated line/priority lines), site-based call routing (call routing based on originatwing site), call progress prompts and last number redial.

Subscriber Equipment – 700 & 800 MHz

An assortment of available mobile and portable radios provides a wide range of capability on 700 MHz and/or 800 MHz OpenSky2 networks. All are software-defined radios, allowing over-the-air reprogramming or feature additions. All support OpenSky2, conventional analog and the EDACS protocol (for ease of migration from EDACS systems). Two models also support the APCO P25 protocol. All available radios are built to the rigorous MIL-STD-810F (supersedes 810C, D and E).

Mobiles

M5300 MOBILE RADIO – 800 MHZ

The M5300 mobile radio is available at 800 MHz with an external speaker in both front (dash) mount and rear (trunk) mount configurations. The M5300 mobile uses a new high-speed digital signal processor and the latest RF components to support multiple applications and operational features in one package.

FEATURES

- OpenSky2 trunked mode
- Conventional analog mode
- EDACS mode

The control head display is designed to maximize readability and ease of use. It features a 3 line, 12 character alphanumeric display that shows the names of systems/groups/individuals or conventional channels. The photo sensor sets the display to accommodate ambient lighting. In addition, the vacuum fluorescent display improves visibility and readability in all lighting conditions compared to liquid crystal display (LCD) technology. Large buttons, volume knob, and channel knob, provide a user-friendly interface. The M5300 radio is, of course, also capable of supporting data calls and can be furnished with an optional GPS receiver.



M7300 MOBILE RADIO – 700/800 MHZ

The M7300 mobile radio follows the same form factor as the M5300, but adds the 700 MHz band and APCO P25 capability as an option.

Portables

P5300 PORTABLE – 800 MHZ

As a software-defined radio, the P5300 portable family provides reliable communications with a range of features designed to excel in challenging environments. The P5300 is the lightest weight portable offered by Harris, and yet it still meets stringent MIL-STD requirements. Ergonomic knobs and buttons, an enhanced-clarity display, light weight, durable exterior, and a range of features make the P5300 an ideal choice for critical communications users.

The P5300 uses a new high-speed digital signal processor and the latest RF components to support multiple applications and operational features in one package:

- OpenSky2 trunked mode
- Conventional analog mode
- EDACS mode



P5400 PORTABLE – 800 MHZ

The P5400 portable radio is built on the same platform and provides all of the features of the P5300, but also adds APCO P25 capability within the 800 MHz band as an option.

P7300 PORTABLE – 700/800 MHZ

As our top-of-the-line OpenSky2 portable, the P7300 adds 700 MHz coverage and offers the option of immersion for challenging environments. Like the P5400, it is also capable of P25 operation.

FEATURES

- The knobs and buttons of the P5300/P5400/P7300 portables are designed to maximize ease of use, even when users are wearing gloves. The large push-to-talk (PTT) button, and talkgroup and volume knobs can be easily identified and operated by touch, avoiding the need to visually check the individual knobs. In addition, the talkgroup and volume knobs are specially shaped to minimize contact with items such as clothing and belt straps, thus reducing the risk of accidental switching. The recessed emergency button maintains accessibility in case of emergency while preventing accidental activation.
- The large speaker is particularly useful in high-noise environments. Its high volume capabilities allow it to overcome background noise and emit clear sound.
- The large 3-line alphanumeric liquid crystal display (LCD) supports system and group information, status icons, and menu operation, including a battery-level gauge. A backlight illuminates the display and the keypad for low-light environments. In addition, a cover minimizes the risk of damage to the LCD and increases its clarity.

TERMINAL FEATURE MATRIX

The M7300, M5300, P5300 and P5400 radios support numerous features across the VIDA technologies, including:

Feature	OpenSky2	EDACS	P25
Standard No. of Groups/System	256	1,024+	1,024+
Low Power Transmit	Std	Std	Std
Emergency Calls	Std	Std	Std
Group Calls	Std	Std	Std
Agency/Fleet Calls	NA	Std	Std
Individual Calls/Private Calls	Std	Std	Std
Telephone Interconnect Calls	Std	Std	Std
All Calls / Broadcast Calls	Opt	Std	Std
Calling Unit ID Display	Std	Std	Std
Talkgroup ID Display	Std	Std	Std
Auto Login	Std	Std	Std
Registration/Authentication	Std	Std	Std
Mutual Authentication	Opt	NA	NA
Proxy Registration	Std	Std	Std
Console Patch/ Simulselect Support	Std	Std	Std
Remote Radio Enable/Disable	Std	Std	Std
Carrier Control Timer	Std	Std	Std
Home Group	Std	Std	Std
Group Scan	Std	Std	Std
Priority Group Scan	Std	Std	Std
Dynamic Regroup	Std	Opt	Std
Status Message	Std	Opt	Opt
Over-the-Air Programming (OTAP) / Provisioning	Std	Opt	Opt
Wide Area Auto Roaming	Std	Opt	Opt
AES Encryption	Opt	N/A	Opt
FIPS-140-2 and FIPS-197 for AES Encryption	Future Option	Std	Opt
Over-the-Air Rekeying (OTAR)	Opt	NA	Opt
Data	Std	Opt	Opt
Enhanced Vocoder	Std	Std	Std
Point-to-Point Protocol (PPP)	Std	Future Opt	Future Opt
IP/UDP Header Compression	Std	NA	NA

P5300/P5400/P7300 ACCESSORIES

A full complement of accessories is available, including:

- NiCad, NiMH, and Lithium Ion batteries
- Carrying Cases
- Tri-Chemistry Single unit and Multi-unit desk chargers
- Speaker/Mic Selection, Earpiece

Vehicular Tactical Network

The Vehicular Tactical Network (V-TAC) is a unique mobile radio system product that operates on a 700 MHz or 800 MHz OpenSky2 digital voice and data network. V-TAC provides extended network coverage for portables. Operating modes support voice and data, voice only, and a localized off-network scene-of-incident capability for both mobiles and portables. A single V-TAC in a vehicle serves as a user's mobile radio while doubling as a mobile network repeater.

The V-TAC operates in the same band as the rest of the OpenSky2 network. From a spectrum standpoint, a single itinerant channel is all that is needed.

COMPONENTS

The photo illustrates a typical V-TAC configuration. The V-TAC itself, consists of three building blocks:

- Vehicle Radio Mobile (VRM)
- Vehicle Radio Base (VRB)
- Combiner



The VRM is used to communicate with the fixed OpenSky2 network sites. The VRB is used to communicate with portables. The active Combiner/Duplexer permits the VRM and VRB to utilize a common antenna. In Mobile Radio Mode, the V-TAC can support full-duplex operation for data, allowing it to transmit and receive at the same time. The transmit power of the VRM, which communicates with the fixed OpenSky2 network, is 15W. When providing Extended Coverage, the V-TAC allows portable radios to operate on the network, even if the fixed infrastructure only provides mobile coverage in the area. The V-TAC is a powerful tool in providing continuous, reliable communications when and where it is needed.

MODES OF OPERATION

The V-TAC has four distinct modes of operation:

- In Mobile Radio Mode, the V-TAC operates as a standard mobile radio.
- Extended Coverage Mode relays voice and data from portables which are no longer in range of the RF network. When a portable loses network coverage, when entering a building, for example, it automatically roams onto the V-TAC and maintains it's connection to the network. Three versions of Extended Coverage Mode are available (see chart below).
- In Scene of Incident Mode, the V-TAC provides 2 voice slots of capacity to local portables and mobiles while separated from the network. It essentially becomes a standalone trunked RF system.

Extended Coverage Modes			
VTAC Mode	Clients Supported	Groups	Data Services
XCOV	2	32	Yes
XCOV-TG	30	1	No
XCOV PROF	30	16	No

CS7000 Desktop Control Station

The CS7000 Desktop Control Station, configured with an M5300 or M7300 mobile radio, provides a convenient method to equip offices, shops and other remote locations with radio communications. The mobile for the CS7000 provides a fixed audio level to the remote interface that is not affected by the front volume control. It employs a new high-speed digital signal processor and the latest RF components to support OpenSky2 trunked mode and conventional analog operations in one package



A USB port and RS-232 serial connectors allow external connections to the station such as auxiliary audio inputs, external PTT, etc. The CS7000 control station can be configured to accommodate local or remote control operations.

REMOTE CONTROL

For remote control, a CS7000 control station is also equipped with industry standard RJ-11 LINE input connector, standard CAN interface, and RJ-45 Ethernet Local Area Network (LAN) jacks to support multiple connectivity options, including:

- Tone controlled line input (2-wire or 4-wire line)
- LAN-based Voice over Internet Protocol (VoIP) connection – utilizes an existing Wide Area Network (WAN) or Local Area Network (LAN)
- Controller Area Network (CAN) link connection up to 250 feet. A fiber optic kit can provide up to 1500 feet of connectivity.

A variety of Tone Remote Controllers can be interfaced to the CS7000 Control Station.

Ruggedized Hand-Held Controller

The Ruggedized Hand-Held Controller (RHHC) has been introduced as a new controller for mobiles in addition to the Front and Remote mount control heads.

As the name implies it is both a control head and a microphone in a single unit form factor that is slightly larger than a standard microphone. The RHHC provides similar controls to a system control head and allows for a low profile of installation in a vehicle, as is often desired by some users. The M7300 and M5300 mobiles support the RHHC.



Dispatch Consoles

C3 Maestro^{IP} Console

The C3 Maestro^{IP} console is Harris' latest offering in IP dispatch technology based on the Microsoft Windows operating system. Built upon a proven platform, it is simple, organized, and efficient. The screen layout is easy to learn and operate—maximizing productivity while minimizing training time. Large buttons and intuitive, customized layouts make maneuvering through the console functions easy and straightforward.

A single network connection to a PC replaces the traditional audio switches found in older systems. With less equipment and complexity, the Maestro^{IP} Console is a more robust solution. The core package of the C3 Maestro includes a Central Processing Unit (CPU), monitor, microphone, mouse, and speakers, and can be placed on any standard furniture that has space to accommodate a monitor and accessories. Flat screen LCD monitors are available in sizes of 15" through 21". Touch screen option is also available.

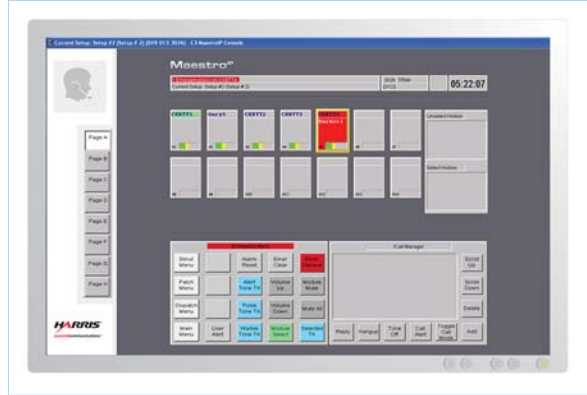
The C3 Maestro^{IP} console is an integral part of the VIDA network and does not require any "back room" electronics equipment, as for other systems—a significant savings in terms of installation cost and space requirements. Because the console is IP based and only requires a network connection to tie into the VIDA network, ad hoc backup dispatch centers can be quickly established as needed.

C3 Maestro[®] Standard Features

Feature Name	Feature Explanation
Select and Unselect Modules	Any programmed module can be selected as the 'select' module for direct communications from the dispatcher. Other programmed modules will be the 'unselect' modules.
Emergency	The consoles are equipped to both declare and clear an emergency. When an emergency is declared from a radio unit, there is both an audible and visual indication on the module. The audible indication is in the form of an alert tone. The visual indication involves both changing the color of the module to "red", as well as the text "EMER" displaying on the module. The console can be set up so a dispatcher can clear the alarm, to stop the noise and then service the emergency.
Alert Tones	Pulsed, warbled, and alert tones can be transmitted to alert radio units of specific emergency conditions.
Individual Calls (Selective or Unit to Unit Calls)	In a trunked radio system the console is treated like any other unit and has a unit ID. The console can both make and receive I calls. The I Call Panel and I Call Manager Panel under the Special Calls Menu assist with several features associated with making and receiving I Calls and other statistics.
Intercom Call	Allows two way personal console to console communications.
Call History	Displays the last five select and unselect module call history.
Extended Call History	Displays the last hundred select and unselect module calls and other programmed module calls.
Patch	Modules patched together can communicate with one another.
SimulSelect	Dispatcher can communicate to the modules simulselected, but the cannot communicate with one another.
Instant Transmit	Instant transmit allows the dispatcher to communicate with groups that are a part of the unselected modules.
Encrypted Calls	Encrypted calls between the dispatcher and field units are only un-encrypted at the source and destination, ensuring secured communications as the voice packets travel through the radio network.
Cross Mute	Reduces unnecessary receive audio at the local console by preventing transmissions from other consoles from being heard and prevents audio feedback problems when two or more consoles are placed in nearby vicinity with each other and at least one is equipped with speakers.
Supervisory Control	Any console can be configured as the supervisor, allowing additional functionality such as disabling other consoles, automatically programming modules for declared emergencies, and eavesdropping on individual calls.
User Definable Screen	User Definable Screen is an option that allows the user to have great flexibility in arranging their screen as it suits them. Users configure their working environment with graphics, and the features and functions that work best for them. Console screen setups can be configured to improve efficiency and productivity. Screen configurations can be created for scenarios ranging from crisis situations to shift/staffing changes. In addition to the standard mouse, dispatchers may select the trackball or touch screen options.

OPTIONAL C3 MAESTRO^{IP} FEATURES

- Default Select Entity
- Patch/Simulselect Mirroring
- Priority Group
- Radio Status Message
- Request To Talk
- Enhanced Request to Talk



V^{IP} Console

The V^{IP} Console was designed as a powerful, yet compact network dispatch radio solution. Essentially a “console on a CD”, the V^{IP} Console can be deployed on any reasonably-equipped PC with password-protected network access and provides a flexible solution for tracking radio system communications. It can monitor up to four talkgroups simultaneously. The V^{IP} Console uses state-of-the-art Internet Protocol (IP) technology to connect directly to VIDA networks, providing fast, efficient, and secure connections. For all its performance, it is simple, organized, and efficient to use.

The V^{IP} Console supports basic dispatch functions such as selected and unselected talkgroup monitoring, and independent volume and mute controls for each monitored talkgroup. Additional features include group and selective/individual calling and caller alias display. Enhanced functionality includes emergency status as well as the capability to clear and create Patches and Simulselects. Calls in the Call History display can be instantly replayed via the built-in call check recorder.

V^{IP} User Interface and Main Console Window Descriptions

- 1 Talk Group Module panels (4)
- 2 Patch Activate/Deactivate button
- 3 Simulselect Activate/Deactivate button
- 4 Unselected Talk Group speaker volume level control
- 5 Cross Mute link
- 6 Call History panel
- 7 Call History playback button and progress bar
- 8 Individual calls panel
- 9 Selected Talk Group transmit volume level meter
- 10 Status message display bar
- 11 Select Transmit button

System Management and Administration

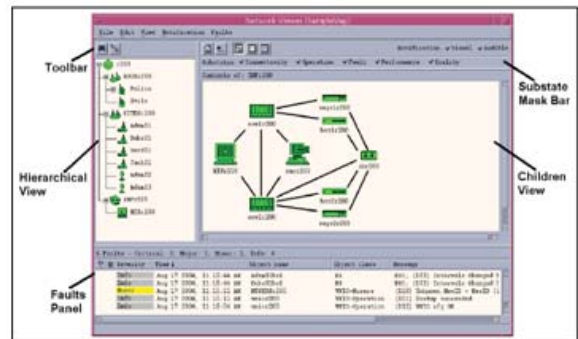
Regional VIDA Manager (RVM)

The Regional VIDA Manager (RVM) is a feature-rich platform for accessing two applications critical to the management and administration of the VIDA network. The two components are the Regional Network Manager (RNM) and the Unified Administration System (UAS). The RNM is the consolidated point for monitoring the health and performance of VIDA network components. The UAS is the centralized access point from which the network is provisioned. These two applications reside in an off-the-shelf Sun server which runs on a Unix Operating System, an OS proven to provide high reliability and processing speed.

REGIONAL NETWORK MANAGER (RNM)

The RNM provides four integrated subsystems that enable comprehensive network status, fault, performance, and configuration management. A graphical user interface assists the network management station operator in network supervision, event notification, and problem resolution. Customizable security schemes allow the definition of operation privileges on a user basis.

An important characteristic of the RNM is that it automatically and continuously polls all managed devices as often as necessary. The RNM also displays fault and performance information, allowing quick location of trouble spots in the system. It can also be set up to emit an audible alert or send remote notification. As an option, the RNM may also be configured to generate email and alpha-numeric paging when problems occur, thus making it possible to quickly and effectively recover from problem situations. The RNM provides a user friendly topology map feature showing all of the managed objects registered on an OpenSky2 network (i.e., base stations, routers, etc.). The hierarchical relationships between the objects are displayed graphically and the real-time status of each object, and any related components, is shown using color coding.



The primary functions of the RNM are:

- Call activity monitoring
- Call activity reporting
- System configuration management
- Call data archive and restore
- Relay control
- Channel rotation
- Alarm monitoring and notification

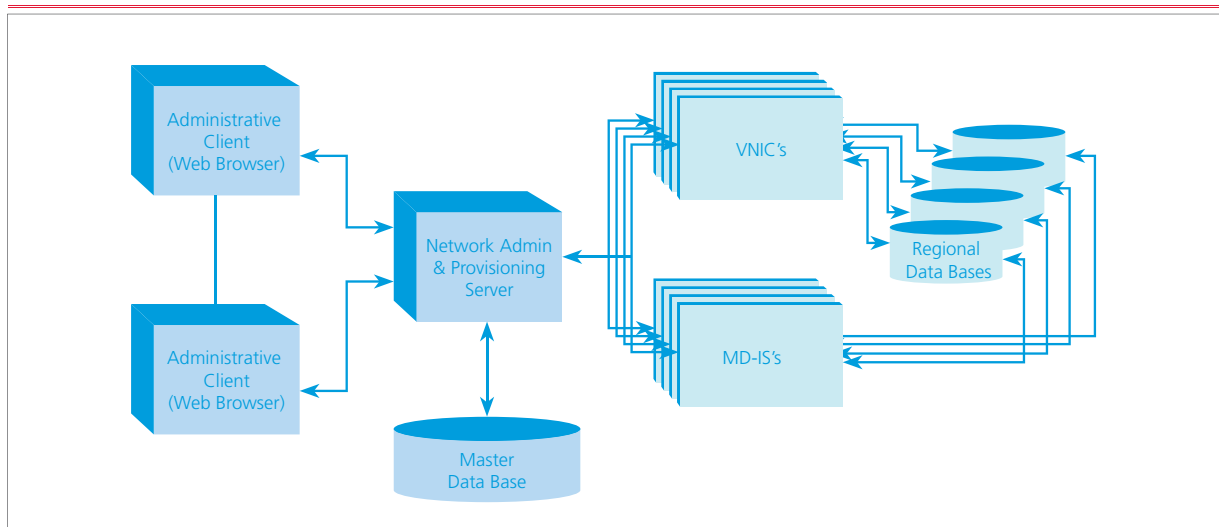
UNIFIED ADMINISTRATION SYSTEM (UAS)

The Unified Administration System (UAS) provides an open system interface to the difficult radio system task known as Fleet Mapping. Fleet Mapping is performed through different levels of administration classified as Resource Pooling, Resource Allocation, or Resource Provisioning. The design of the UAS eases the burden of radio system administrators by providing a tool with intuitive interfaces, integrity checking, and utilities. Customizable security schemes allow operation privileges to be defined on a user basis. Access to the UAS is via a commercial off-the-shelf (COTS) web browser that has network connectivity to the system. The UAS is the centralized access

point from which the system is administered. It is an integrated real-time administration tool based on a client-server architecture that allows multiple authenticated users at any Network Switching Center or remote location. Authenticated users administer network elements including IP broadcast domains, voice gateways, end users, and mobile radios.

The architecture of the Unified Administration System consists of the Unified Administration Server (UAS) and Network Administration Clients as shown below. The UAS manages the master administrative database. Each time a change is completed in the master administrative database, the UAS distributes the changes to the Network Switching Server (NSS), which in turn updates its databases. The database is distributed so that in the rare event the

Unified Administration System Architecture



UAS becomes isolated from the sites; the system is able to continue to operate. In addition, it provisions the radios.

Radio users are organized in the UAS by agency and home region. Because the OpenSky2 network is scalable for growth to include multiple Network Switching Centers and their respective sites, a “region” is defined as the geographic area served by a particular NSC and its sites. Agencies are a collection of users within a particular Region. A subscriber’s User ID is a 10-digit identifier that identifies the region and agency from which the radio user is dispatched, as shown to the right.



In order to allow system administrators to segment administration responsibility of the system, the UAS allows many levels of access. This allows high-level administrators of the system to focus on high-level parameters of the system such as priorities and call distribution while allowing individual agencies to control their own user equipment.

Data Over OpenSky2

Data Capacity is the Key

When evaluating wireless data performance, it's important to understand the difference between data rate and data capacity. Consider a race car and a bus. The race car can travel at perhaps 200 mph, but only carries one passenger. The bus only travels at a fraction of that speed, but delivers as many as 60 or 70 people to their destination on a reliable basis.

The raw over-the-air data rate of OpenSky2 on 700 MHz or 800 MHz, 25KHz channels is 19.2 kbps. That is fast enough to deliver data messages up to hundreds of bytes in the blink of an eye. More importantly, OpenSky2 can carry a very large quantity of such messages without compromising the important voice traffic on the network. OpenSky2's data performance is impressive for a number of reasons.

- First, voice is significantly compressed in OpenSky2, which adds to the overall voice capacity of a channel.
- Even after voice capacity has been reached, there is still considerable room between the voice packets for data packets to be sent. This is because voice packets must be streamed and reassembled in a properly timed fashion in order to reproduce intelligible voice at the other end, and voice capacity is dictated by busy hour Grade of Service and queuing limitations. Data packets can be placed in the resultant spaces between voice calls. Note that the transmittal and reassembly of data packets is not nearly as time-critical as voice.
- This substantial capacity is the result, not only of the significant voice compression, but also of the very robust channel access protocol used by OpenSky2 for both voice and data. This reservations protocol minimizes data "collisions" and maximizes the density of users on the channel, helping to prevent channel "collapse" under heavy load.
- Field experience has clearly demonstrated that data capacity trumps raw data rate when comparing radio data performance—every time.

How many users can be supported?

Using a typical voice user traffic profile for a day's typical "busy hour" and a typical work order dispatch mobile data application message model, we can predict the capacity of an OpenSky2 site. A single-channel, 4-slot 700 MHz or 800 MHz OpenSky2 site offers 4 talk-paths. To run the analysis, we first load that single-channel site to the point where the "busy hour" voice users see 5% of their calls getting queued beyond 1 second. That point occurs with about 540 such voice users. As described above, additional capacity remains between the voice call packets. That additional capacity can host more than 150 mobile data users with the work order dispatch application without impacting the ~540 voice users on the channel. Again, this remarkable capacity is available due to the unique channel access protocol employed by OpenSky2.

OpenSky2 provides the following data features:

- **End-to-End Internet Protocol (IP)** – UDP/IP (or TCP/IP) interface to the data messaging application software. Each radio has an Internet Protocol (IP) address.
- **Voice and Data on the Same Radio** – Because OpenSky2 is TDMA, the same radio is used for voice and data calls. A TDMA radio is always listening. If a radio is involved in a data call when a voice call comes in, the voice call immediately comes over the speaker. The data session will either remain in place or re-try, but no voice call is missed.
- **Internal GPS Receiver** – OpenSky2 mobile radios are available with an optional internal GPS receiver enabling mobile units to be tracked using Automatic Vehicle Location (AVL) technology with or without on-board Mobile Data Computers (MDC).

- **Robust Protocol** – The OpenSky2 radio channel protocol is robust under heavy load and provides efficient support of both long messages, such as file transfers, and short messages, such as AVL.
- **Over-the-Air (Network) Reprogramming** – Radios can be loaded with profile changes or software upgrades over-the-air.
- **Standards-based Mobile Data Architecture** – OpenSky2 mobile data is based on the time-proven IS-732 standard and utilizes high volume IP network equipment such as routers and workstations. Software applications are basically “Plug-and-Play.”
- **IP/UDP Header Compression** – Improves efficiency of network data traffic in a number of ways.
- **Proxy Registration** – Reduces the amount of data traffic needed to establish and maintain data and voice registration over the RF link. This improves: power-on timing, roaming and channel loading
- **Data Encryption** – OpenSky2 has the capability to enable data encryption to help protect application data payload.
- **SLIP/PPP Support** – For data applications OpenSky2 supports either SLIP or PPP connections to the terminals.

Summary

The Harris 700/800 MHz OpenSky2 platform provides state of the art function, capacity and flexibility with unmatched security and reliability. And its IP architecture assures that any OpenSky2 network can and will evolve easily and economically to meet the challenges of tomorrow.

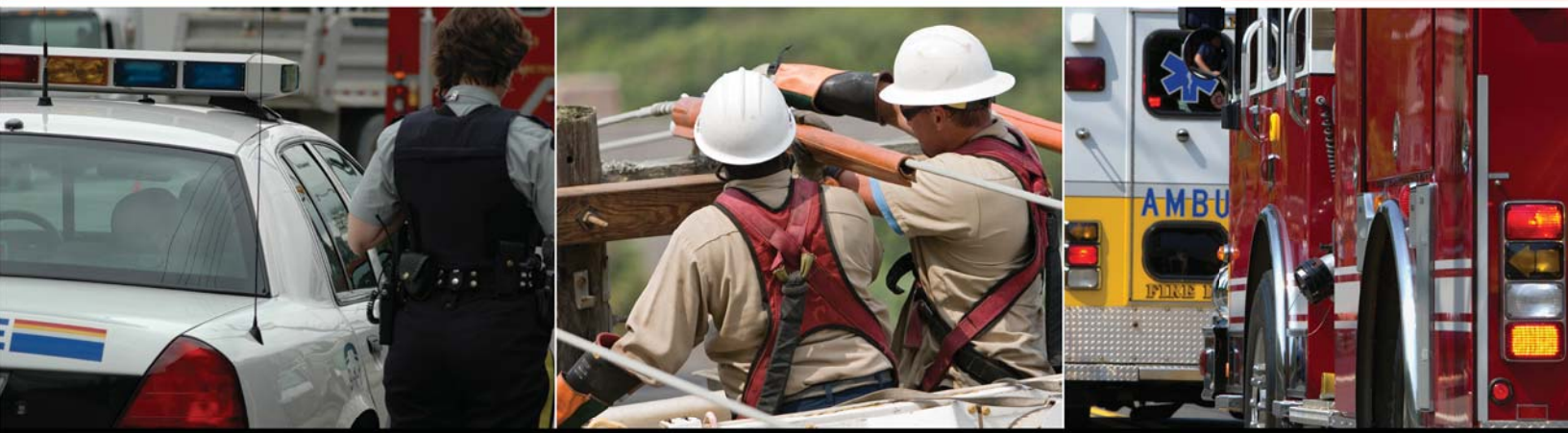
Contact your Harris representative for further information.

Public Safety and Professional Communications

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Harris is an international communications and information technology company serving government and commercial markets in more than 150 countries. Headquartered in Melbourne, Florida, the company has approximately \$5 billion of annual revenue and more than 16,000 employees — including nearly 7,000 engineers and scientists. Harris is dedicated to developing best-in-class Harris is an international communications and information technology company serving government and commercial markets in more than 150 countries. Headquartered in Melbourne, Florida, the company has approximately \$5 billion of annual revenue and more than 16,000 employees — including nearly 7,000 engineers and scientists. Harris is dedicated to developing best-in-class *assured communications*[®] products, systems, and services. Additional information about Harris Corporation is available at www.harris.com.



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