Introduction to Tactical Voice Communication Systems

For a naval or coast guard ship, full tactical services delivery is foremost along with steadfast attention to security, survivability, availability, and suitability for the platform environment. L3’s MarCom® IVCS fully supports performance, safety of ship, and mission critical requirements while being affordable across a range of ship and crew sizes.

The communication system designer must fully understand the mission, how the users of the system operate, and the platform environment. This and other Solution Briefs describe important elements of tactical communications, crucial differences between commercial organizations and tactical organizations, and approaches to addressing these differences.

The most important features for tactical applications do not exist in commercial PBXs. Tactical and administrative systems use different terminology. A small subset of the administrative PBX feature set is needed in tactical applications, but adding more administrative features cannot make up for a lack of tactical capabilities. Solution Briefs SB001 and SB003 introduce tactical voice terminals and netted communications. Tactical users at each position should have a voice instrument that intuitively and fully supports their needs, environment, and operating methods. They may participate in nets, handle secure communications, report emergencies, make announcements, monitor radios, and initiate and receive intercom calls as part of their watchstanding duties. All these features and services depend upon the tactical system infrastructure, as well as the terminals themselves. (Users may also make and receive telephone calls.)
Achieving Tier 3 tactical features requires a tactical architecture

The tactical features provided by communication systems can be categorized in three tiers.

**Tier 1 Administrative** — Commercial phone systems are designed around two-party calls, billing, and privacy. There is no assurance of a call being answered. Since calls can be busy, features like voice mail and call waiting are added. The only built-in conferencing is three-way calling. Business conference calls are usually handled as a service available on the network.

**Tier 2 Limited Tactical** — Some systems introduce tactical voice terminals but still rely on commercial phone systems (PBX or Call Manager). Conference bridges are typically added in order to accommodate large Meet-Me nets. These systems often claim to support intercom services, but what is offered is actually an auto-answer telephone call. Limited tactical systems are dependent upon the features of their commercial PBX or Call Manager. Their tactical features are limited and they are difficult to administer since the COTS call processing and management software does not recognize the tactical elements or features.

**Tier 3 True Tactical** — Systems at this level are built with an architecture incorporating tactical elements, services, and features from the ground up. Architectural elements not found in commercial telecommunications enable the distinctly tactical characteristics such as multi-channel monitoring, always available intercom, robust security measures, dominance of net and conference operation, operation of radio nets, and flexibility to adapt any of these features to meet special requirements or interfaces. A system at the True Tactical tier is configured and administered as an integrated tactical system.

A tactical architecture (Tier 3) treats netting, multiple circuit monitoring, push-to-talk, and security controls as central requirements. Forcing a business system to handle these (Tier 2) results in tactical features that are not robust, are difficult to administer, and may not be secure. In contrast, a proper architecture ensures these features are robust, easy to administer, available in abundance, and intuitive.

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**When judging whether a system is Tier 2 or 3 consider:**

- Administration terminal menus that do not explicitly show tactical terminals, radios, cryptos, nets, and conferences indicate a Tier 2 system.
- Intercom calls that can never get a busy signal are only available at Tier 3.
- Only a Tier 3 system does not limit the number of circuits the terminal can monitor simultaneously while conducting an active conversation on another channel.
- Integral control signals such as Push-To-Talk (PTT), Crypto Mode Select, Mode Indicate, and Cipher Detect exist in Tier 3 systems.
- Minimization of latency in voice paths beyond commercial standards is a Tier 3 characteristic.

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**Ease of operation**

Features will not be used unless they are easy to use. Tier 2 systems often provide a feature with an awkward implementation due to the limitations of the commercial hardware and software. In both military and commercial systems, features which require training to master go unused. A Tier 3 system should have consistent HMI and operating sequences that are picked up naturally as the operator uses the terminal.

**Ease of operation**

Ships often require unique interfaces to special, purpose-built systems which have non-standard protocols or interfaces. A tactical communications integrator should have adaptable embedded hardware and software to easily deal with these custom interfaces. If each tactical interface requires an external box or card, this is an indication of an administrative system trying to do a tactical function. A tactical system tool bag should include support for standard interfaces (e.g. POTS, ISDN BRI, ISDN PRI, and VoIP) as well as both standard and custom tactical interfaces (Sound Powered Telephone, Alarm & Announcing, radios, cryptos, and speakers).
Security features must be part of the architecture

A Tier 3 tactical system architecture ensures that each voice channel is isolated from every other voice channel. Each terminal’s access to services and other terminals must be controlled. Special care will be taken to minimize crosstalk and to prevent and detect misconceptions. Voice terminals will enable the user to display and control the security state of circuits. The communications management terminal should prominently reflect the security features in the configuration database parameters. Administrative systems built on business PBXs are designed with security features only in terms of access controls and password protection. They are not designed with features required for or certified to handle classified traffic.

System administration menus reveal the true nature of a system

The System Administration Terminal is a great place to evaluate a tactical system. In a truly integrated tactical system, the administrative menus will be full of tactical terms — Integrated Terminals, Sound Powered Telephone ports, radio nets, Plain & Secure, Meet-Me nets, etc. Each interface will be transparently named. These tactical terms will be absent in a system built on a business PBX. An integrated terminal will not be in the database as a single device; instead multiple individual commercial telephone entries will be used to configure it. The software will not know that an integrated terminal exists. Conferences will often be administered in a separate database because they are supported by a special set of hardware and software, not by the main PBX itself.

Diverse satisfied customer base broadens tactical feature set for all

A shipboard communication integrator will have extensive experience across platform types and sizes and customers. Pre-installation testing will enable the installation and check out to go smoothly. The system will be available to support ship operations during construction, sea trials, and over the entire life of the ship. Over time, this success will lead to a diverse customer and platform base. Each new customer and platform will likely require some interface or feature not previously provided. With flexible architecture and integration tools, a good tactical integrator constantly adds to the set of services, features, and interface designs available for application to any other platform. Experience matters.

A tactical system must work when it counts - always

All aspects of the system architecture, including power distribution and backup, and cable plant must be designed, configured, installed, and maintained to support an “always available” capability. From the time of initial light-off through the life of the system, the communication system must support the mission and operations of the platform at all times. The system cannot be taken down for troubleshooting. Failures should be rare and when they do occur, they should only impact a small portion of the system. Any failure that would otherwise take down a majority of the system must be protected by redundant elements. Battery backup must mitigate loss of power for at least an hour, until emergency power can be established. The survival of the ship as well as the success of its mission depends upon tactical communications.

Capacity and scalability for a wide range of platforms

A tactical communication system should always be based upon modular elements able to be cost effectively applied to a wide range of ship types. Capacity is measured in such terms as the number of ports, card slots, time slots, and networked switches. The best indication of capacity and scalability is a vendor’s repeat order history over a range of ship sizes.

Look for terms in the configuration menus!

- Plain/Secure
- Alarms
- Integrated Terminal
- Meet-Me-Nets
- Radio Net
- Emergency Net
- Sound Powered
- Responsible Terminal
- Announcing
- Ship State

Ask About:

- Number of Communication Engineers
- Years of Supplying Integrated Communications Systems
- Number Complete Systems Installed on Ships
- Repeat Business with Same Customers
- Recent Contract History
- Sea Trial Findings

Consider:

- Redundant Core Elements
- Central Source of Backup Power
- Adequate Cooling
- Continued Operation During Scheduled and Casualty Maintenance
- Failure Impact Analysis
- Obsolescence Management
Operational security requires controlled access

A tactical voice system requires a powerful database of access permissions and restrictions. A tactical system may contain sensitive nets and classified circuits, and is subject to a chain of command hierarchy. Mechanisms must stipulate and enforce each user's access to other terminals and services. This is not a feature of administrative PBXs. In the tactical communications community these are usually called Class of Service (COS) and Classmarks (CM). Class of Service restricts the access out from a particular terminal. Classmarks are used in conjunction with COS to restrict access to terminals or services.

Environmental stress mitigation requires more than empty assertions

A naval communications integrator must have a history of resolving challenges that include stresses induced by the natural environment (temperature, humidity, sunlight, and salt fog); stresses induced by other systems such as radar (EMI) and steam pipes (temperature); and motion (attitude and vibration). Shock comes from the pounding of the ship when it encounters heavy seas, the impact of weapons fire from the ship, and the impact of incoming fire. Mitigation of these stresses is a multi-disciplinary challenge that is addressed in a number of ways. Experience provides cost effective solutions. An extensive environmental test history means so much more than claims to have designed the system to accommodate the environment.

Certifications are a major hurdle

The specific certifications needed for a particular platform vary depending upon the customer and the country of the user organization. Certification topics include security related to classified traffic (emanations, crosstalk, grounding, and bonding), interoperability, and information assurance related to IP networks (access controls, authentication, and network administration). Too often the need for these certifications is ignored until acceptance of the system when they are prohibitively expensive. A good communication system integrator will have been through the certification processes before and provide a cost-effective approach to achieving certification for the new application.

Technology is only a tool to achieve requirements

The tactical comm system integrator works with the procurement organization to ensure that user needs are thoroughly understood and addressed. Technologies should be considered after the requirements are firm. Commercial technologies are designed to address the needs of a business and consumers. They generally will not address the additional characteristics critical to tactical platforms, such as security, survivability, netted communications, and latency. The tactical communication system integrator must identify a mix of commercial technologies which can be used and adapted as necessary to fulfill the tactical needs efficiently and without compromise.

Users depend upon ease-of-use, dependability, and quality of service. The mix of underlying technologies which provide the service is irrelevant to the user.
MarCom IVCS provides each user access to the communication services needed for the mission

Providing integrated services at the system level has benefits

In MarCom IVCS, every audio source interfaces to the integrated system rather than to individual terminals. The integrated system makes all audio sources available to all voice terminals. The system also responds to all requests from terminals and external interfaces to implement connections, conferences, and specialized services. Intelligence, rules, and database entries exist to enforce access restrictions, security requirements, comm plans, and individual preferences. Advantages of this approach include:

**Efficiency** — Each external system interfaces to the core system with enough capacity to serve the desired number of users, but without any dependence on which terminal requires service at any given time.

**Effectiveness** — Any user terminal can access any authorized service with no additional cabling from the terminal to the system.

**Interoperability** — Connectivity for individual calls or nets is independent of the interface technology used for each of the participants. Calls or conferences containing a mix of ISDN, analog, VoIP, and custom interfaces is normal.

**Situational Awareness** — The fact that a user terminal can access any number of simultaneous circuits allows the user to maximize his awareness of activities on his own platform and at remote locations, remarkably improving his responsiveness to mission demands. Users have experienced 200—400% improvement in performance while simultaneously reducing training.

**Reduced Manning** — The effectiveness of getting all necessary information directly to those who need it enables fewer crew to perform the mission. The intelligence of the system makes administration of the system easier in terms of actions required and less reliant on experienced crew members.

**Future Proofing** — When additional communications are added to a ship, it only requires one connection to the IVCS which then provides access to all users who need access. This greatly reduces the cost and weight impact of the alteration.

<table>
<thead>
<tr>
<th>All voice sources</th>
<th>IVCS System</th>
<th>All voice sinks</th>
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<tr>
<td>Terminals</td>
<td>Call Processing</td>
<td>Terminals</td>
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<tr>
<td>External Systems</td>
<td>Multiple Circuit Monitoring</td>
<td>External Systems</td>
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<td></td>
<td>Nets and Conferences</td>
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<td></td>
<td>Security</td>
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<td></td>
<td>Administration</td>
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MarCom provides tactical platforms with tactical and administrative services

Tactical organizations require both administrative and tactical personnel. Administrative personnel rely primarily on normal telephone calls, characterized by their point-to-point and episodic nature. Tactical personnel use administrative services but they rely heavily on netted communications, characterized by multiple members, net discipline, and long duration. Administrative personnel make one telephone call at a time, whereas tactical personnel monitor multiple circuits simultaneously and actively jump between circuits without terminating any of the calls. MarCom IVCS provides these services in a mixed security environment. Some users are authorized to handle classified communications while others are not. Further complications involve multiple security levels and circuits which are sometimes encrypted and sometimes plain. Those who are authorized for classified information must also use unclassified circuits, sometimes at the same time. MarCom IVCS, as a tactical voice system, provides the services of a commercial PBX, a radio switch, and an intercom simultaneously via a single terminal per user.
MarCom IVCS provides distinctly tactical services and features

Tactical organizations rely heavily on communication services and features which are not needed in administrative organizations and are not supported by commercial PBXs. MarCom IVCS integrates support for these tactical services and features along with administrative features with a consistent and intuitive Human Machine Interface (HMI) for each type of terminal. The most important classes of tactical services and features supported by MarCom IVCS include:

**Net communications** — groups of user terminals communicate in a net dedicated to a particular function.

**Radio nets** — a net which includes an external communication circuit and is thus extended to multiple platforms, each with its local net of participating terminals. These nets have Push-to-Talk (keyline) and control and monitor of cryptos.

**Security** — Terminals and MarCom hardware and software allow classified and unclassified traffic to be safely carried within the systems and via external communication circuits.

**Multichannel monitoring** — MarCom IVCS allows the tactical terminal user to simultaneously monitor as many channels as desired. The user easily selects an Active channel among the pool of channels being monitored. Each channel can be a tactical or administrative circuit.

**True Intercom** — In conjunction with multichannel monitoring, the intercom function allows direct communication to be achieved at all times without any interference from other channels. This never-busy capability ensures that the critical information is delivered without delay. This is not an auto-answer telephone call which could be busy; it is a Tier 3 distinct call type that is always available.

**Specialized conferences such as Emergency Reporting Nets and Pre-Set Conferences** — Emergency Reporting Nets provide 911-like capability tailored to the tactical ship environment. Pre-Set Conferences enable any member of a pre-defined group to call all others for coordination. These are typical examples of the distinct ways in which tactical organizations rely on their comm system.

**MarCom IVCS can provide access to all other voice systems and services**

MarCom IVCS interfaces with virtually any audio system to provide access to all authorized terminals. Examples of widely used external systems:

**Alarm & Announcing Systems**— MarCom IVCS terminals can serve as microphone control stations for cost savings and the convenience of making announcements from any location.

**Sound Powered Nets** — Roving crew can access a particular MarCom IVCS net from any Sound Powered phone on that same net. All terminals can monitor SP nets and integrated terminals can monitor multiple nets, which is particularly helpful during training.

**Wireless Systems** — MarCom IVCS interoperates with wireless systems as DECT-based handhelds, HYDRA trunked radio, and submarine Damage Control wireless (WIFCOM). This allows every wireless system to be reached by every wired device, reducing the number of wireless devices required. On some ships, officers and senior enlisted will carry multiple wireless devices because they are not interoperable. This is unnecessary when an IVCS, developed for tactical purposes, is available.

**Voice Recorders** — MarCom IVCS systems support multiple voice recorder models and interfaces.

**PSTN Access** — MarCom IVCS supports access via cellular, shoreline, SATCOM, and ISDN or VoIP PBX.

**Multiple types of tactical terminals match user needs**

As detailed in SB001, a single voice terminal should be located at each operator position and chosen to support the features and services needed to support the functions of that position. In some cases, a ruggedized or militarized phone is sufficient. In other cases, a Dual Digital Jackbox, a KITE terminal or a touchscreen terminal is necessary to support multiple tactical circuits. The architectural advantage of MarCom IVCS is that all the tactical and administrative features are supported by the core hardware and software and are available, as applicable, to any of these very different terminals. The consistent, intuitive HMI of these terminals is, in itself, an important tactical feature.
Administrative services and features are also available

Business PBXs typically have a list of hundreds of call features. Many of these were created specifically for a particular large business customer but are included in the standard package. Most users rely on a small subset of the available features. MarCom supports all administrative features important to tactical platforms. An important value added by L-3 is the resolution of conflicts that arise on feature interaction in the tactical environment.

<table>
<thead>
<tr>
<th>Administrative Features Most Useful in a Tactical Platform</th>
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<tbody>
<tr>
<td>• Point-to-Point Calls</td>
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<tr>
<td>• Call Hold and Transfer</td>
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<tr>
<td>• Call Forward</td>
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<tr>
<td>• Caller ID</td>
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<tr>
<td>• Progressive Conference</td>
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<tr>
<td>• Alternative Route Groups</td>
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<tr>
<td>• Call Groups</td>
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<tr>
<td>• Autoanswer</td>
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<tr>
<td>• Hotline Calls</td>
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<tr>
<td>• Speed Dial</td>
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<tr>
<td>• Discriminating Ringing</td>
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</table>

Important tactical call types

A commercial PBX makes telephone calls. MarCom IVCS supports telephone calls and supports other call types important to tactical organizations, such as:

**Intercom** — Limited to tactical terminals, this call type allows the calling party to immediately talk to the calling terminal in its Monitor channel without any action on the part of the called party. The called party may answer on the same circuit if needed.

**Radio calls** — MarCom IVCS directly supports radio nets consisting of tactical terminals who choose to join the net and a trunk to a specific external communication circuit. It also supports calls over a trunk to a remote radio switch which hosts the radio net.

**Emergency Reporting Net (ERN) calls** — This is a specialized function for shipboard platforms with specific terminals designated as responsible for receiving emergency calls depending upon the state of the ship. Analogous but not identical to a 911 system, the MarCom ERN protocols ensure multiple calls are handled, automatically forming a net.

**Preset Conference calls** — A predefined group of terminals or phones comprise a preset conference. At any time, any member may dial the conference number causing all the other members to be dialed. Any member who answers joins the conference. When the last remaining member hangs up, the conference is terminated.

**Meet-Me Net calls** — Any authorized terminal may join a particular Meet-Me Net. Each net is dedicated to a particular function and community, such as Damage Control or Weapons Coordination. There are no ringing or busy signals. Individual users participate throughout their watch period, for the duration of an evolution, or just briefly, as needed, to report in.

**Override and Multiple Priority and Preemption** — An organization can choose which of these alternatives supports their needs for letting certain calls take priority over others.

A carefully chosen mix of tactical and administrative services is tailored for tactical organizations
A robust control mechanism provides discipline

<table>
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<tr>
<th>Focus Areas</th>
<th>L-3 Approach Includes</th>
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<tr>
<td>Security</td>
<td>Unencrypted voice in the system may be classified or unclassified and must be restricted to authorized users. Voice terminals display circuit security status so users know definitively if a circuit is authorized for classified traffic. Access to system resources, networks, and databases must be controlled to prevent connection of channels at different security levels.</td>
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<tr>
<td>CM/COS</td>
<td>Classmarks and Classes of Service allow database entries to be the basis upon which access to services and other terminals is authorized or denied.</td>
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<tr>
<td>SAT</td>
<td>A System Administration Terminal software package allows the entire system to be configured and modified. Alerts, logs, and reports are all available to the system administrator.</td>
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<tr>
<td>Dial Plans</td>
<td>An integrated numbering plan (Common Dial Plan) is generated to guide the processing of calls both within the MarCom IVCS administered system and with any local PBX-administered terminals. This allows abbreviated dialing, typically 3 or 4 digits, within the platform.</td>
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<tr>
<td>Conference</td>
<td>Net names, members of preset conferences, security level of the net or conference, and directory numbers are assigned.</td>
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<tr>
<td>Definitions</td>
<td>Tactical terminals have great flexibility. SAT database entries, guided by convenient GUIs, determine the configuration of each terminal and what circuits appear on the terminal screens.</td>
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<tr>
<td>Terminal</td>
<td>Each platform needs an approach to handling incoming shoreline calls. Auto Attendant is one available method of directing incoming calls.</td>
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<tr>
<td>Personalities</td>
<td>While the MarCom IVCS can free run off its internal clocks, it can also synchronize to an external clock by utilizing the timing on an external trunk.</td>
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<tr>
<td>Auto</td>
<td>Call processing software is the heart of MarCom IVCS allowing the system to respond to requests from all the system terminals and trunks. Call processing must deal with all the “what ifs” and make sure the system always remains stable and handles all exceptions.</td>
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<tr>
<td>Attendant</td>
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<td>Network</td>
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<td>Synchronization</td>
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<td>Call Processing</td>
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Conclusions

- MarCom IVCS allows tactical users to communicate naturally as they concentrate on their mission duties, not on communications.
- Integration of all services, features, and interfaces at the system level is far superior to trying to bring specific needed interfaces to each terminal position.
- A long list of administrative features does not help a tactical organization. Tactical platforms depend upon an easy-to-use core set of tactical and administrative features and services which can be tailored to their specific needs.
- The mission performance of the entire platform is improved by the situational awareness and responsiveness made possible by a MarCom IVCS communication system.
- MarCom is cost effective over a wide range of ship and crew sizes.