Expeditionary Communication Networks:

Going Beyond Cellular

PRESENTED BY xG TECHNOLOGY
It is an absolute requirement that military wireless systems be extremely mobile, scalable, frequency agile, cost-efficient and support highly flexible deployment schemes in hostile electronic environments.

This eBook will discuss the challenges faced by military wireless planners, owing to the limitations of traditional cellular systems in attaining these goals, as well as the obstacles resulting from insufficient availability of wireless spectrum.

We’ll also discuss an entirely new wireless technology that has been called a “potential game changer,” one that is poised to revolutionize battlefield communications due to its flexible deployment models and ability to operate in spectral environments fraught with interference and targeted jamming.

Best of all, this system is highly adaptable, and is capable of operating in tandem and fluidly with existing cellular industry standards and hardware. Alternatively, it can also operate independently of traditional systems as a comprehensive, end-to-end-wireless solution where mission-critical imperatives dictate.
Introduction

When it comes to wireless technology, the military has some of the most exacting requirements due to harsh operating conditions and demanding mission objectives. Long ranges, intentional and unintentional jamming, and the fact that communications infrastructure is often a primary target of enemy elements has placed a premium on the establishment of robust and resilient communications networks.

Military wireless communications must provide maximum access to the fullest array of C2 services. Guaranteed delivery of voice, data, situational display, as well as access to central databases and social media are basic requirements. Specifically, communications systems must be extremely mobile, scalable, frequency agile, and have highly flexible deployment schemes.

New demands such as the ability to affordably and securely integrate commercial smartphones and tablets at the tactical edge are beyond the capabilities of today’s deployed solutions and programs of record. Further complicating the situation is the need to maintain an affordable life-cycle cost in an era of severe budget realignment.

Cellular communications systems have traditionally been developed to address the needs of the commercial/consumer environment. As the following chart shows, the military environment has some similarities with the commercial/consumer side, but also has its own particular specific requirements outside the scope of such systems.

<table>
<thead>
<tr>
<th>Commercial Environment</th>
<th>Military Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massive demand for wireless applications</td>
<td>Issue every soldier a cell phone</td>
</tr>
<tr>
<td>Limited supply of spectrum</td>
<td>No new spectrum – relocate/share existing?</td>
</tr>
<tr>
<td>Lack of spectrum precludes new market entry</td>
<td>Host nation spectrum access</td>
</tr>
<tr>
<td>Expensive service plans</td>
<td>Expensive service plans</td>
</tr>
<tr>
<td>Mobility</td>
<td>On the move</td>
</tr>
<tr>
<td>Smartphone adoption</td>
<td>Smartphone as force multiplier</td>
</tr>
</tbody>
</table>

**ADDITIONAL REQUIREMENTS**

- Security, encryption, LPD, LPI, LPI
- Reduced SWAP
- Expeditionary/tactical networks
- Real-time apps, low latency, future-proof
- Rapid deploy, self organizing networks
- Precedence, flow management
- Apps, C3I, across the operational continuum

In summary, while commercial cellular communications have much to offer the military in their present state, they cannot support all phases of military operations.

**Spectrum: The Great Challenge**

In addition to the capability gap, traditional wireless systems have another crucial shortcoming with respect to military communications. They were simply not designed to optimize the use or carrying capacity of the most precious and scarce
commodity in the mobile communications infrastructure — wireless spectrum.

The spectrum required by U.S. military forces is often inundated with multiple communications systems, weapons systems, reconnaissance sensors and other spectrum-dependent electronic warfare elements. The explosive growth of these disparate systems has also driven a corresponding increase in frequency interference. This element further reduces the available bandwidth — and potentially limits the soldier’s ability to complete his mission.

Lack of available spectrum is a problem facing military and commercial network planners alike. However, unlike in the DoD arena, commercial operators have the wherewithal to spend billions of dollars to secure spectrum licenses to meet growing consumer demand, due to their ability to pass these costs on to their customers. This has created the scenario of increasing demand for commercially licensed, restricted spectrum.

In addition to putting military planners at a real disadvantage, the exploding demand for more spectrum by commercial operators, coupled with the need for governments worldwide to raise revenues, is pressuring politicians and regulators to consider measures to take back and repurpose spectrum already in use by military networks. This could further impact military wireless planning.

Cognitive Radio: New Approach to Wireless

To address these challenges, xGTechnology has developed an innovative wireless networking solution based on cognitive (smart) radio technology. This technology is considered one of the most exciting frontiers in wireless communications. The xG system, called xMax, has patented, designed-in intelligence that allows individual wireless nodes (or even the entire wireless network, for that matter) to change their transmission or reception parameters in order to avoid interference with other devices and communicate more efficiently within the wireless network.

xMax can dynamically access both licensed and free (unlicensed) radio frequencies opportunistically around the globe. This is a dramatically different from traditional radios, which are comparatively unintelligent and constrained to operate within fixed frequencies.
To deal with interference challenges, xMax employs xG’s unique cognitive radio “layered approach”. As a chief underpinning technology, xG utilizes Dynamic Spectrum Access (DSA), which is used to automate the process of managing wireless spectrum on-the-fly. However, xG goes beyond DSA by also incorporating intelligent and active interference mitigation techniques and MIMO smart antenna functions. This is a first in radio design. Working in concert, these technologies add a high level of flexibility and sophistication to network management, and allow xMax to greatly increase the carrying capacity of both existing private and unlicensed spectrum several-fold when implemented in crowded radio bands.

xMax can also help maximize network throughput, as well as supporting significantly more devices operating concurrently in the same frequency range than a standard network. The latter can free up valuable spectrum that will be usable for additional devices and applications. The result is a highly adaptable, extremely efficient wireless network that is very difficult to jam, and one that can contribute greatly to assuring mission success.

**xMax: Key Features and Benefits**

xMax delivers robust, rapidly deployable wireless services whenever and wherever needed. The system offers the following key benefits to the military:

- **Frequency agnostic:** xMax can be adapted to a wide array of commercial, military and unlicensed frequency bands, and can operate independently from commercial frequency bands if necessary;

- **Self-optimizing:** DSA technology maximizes throughput and reliability, delivering a licensed spectrum experience in unlicensed spectrum;

- **Self-frequency planning:** the system initiates automatically and finds available frequencies; no manual frequency coordination is required;

- **Supports all COTS devices:** The all-IP xMax architecture support for any WiFi enabled device, including COTS smart phones, tablets, laptops, video cameras and unmanned sensors to receive the COP digitally via high-resolution graphics, streaming video, and VoIP.

- **Tactical and scalable deployments:**
rapidly deployable size and weight, proven integration with satellite and point to point backhaul radios;

- **Expeditionary transport layer:** Can serve as either permanent wireless infrastructure for an FOB or temporary wireless transport layer that can follow and support BCTs in the field; flexible access point deployment options support a mix of ground-based and airborne mobile platforms;

- **Cognitive interference avoidance & mitigation and encryption support:** Jamming attacks and penetrations are far more difficult than with traditional radio systems;

- **Cost-effective:** Provides a resilient and redundant pipe with low operational cost over the service life of the equipment.

**Leveraging Commercial Cellular Technologies**

A key advantage of the xMax solution is the ability to leverage legacy communications systems while also delivering extended capabilities that are not available in those systems alone. As a result, xMax allows the full use of commercial wireless systems when desired, with the ability to also take advantage of xMax-specific attributes when required.

xMax is interoperable with 2G, 3G, and 4G networks (including LTE) as well as other existing infrastructures (PSTN, WiFi, etc.). Moreover, xMax can provide seamless, advanced connectivity to commercial smartphones, tablets, and laptops in both garrison and tactical "communications on the move" configurations, without requiring changes in hardware or operating system software.

Furthermore, xMax is designed around an end-to-end IP architecture which simplifies integration with existing networks via industry standard interfaces and protocols. For example, voice can be tagged and prioritized end-to-end throughout the network for high reliability.

**Field-Tested in Military Environments**

The xMax system has been proven in challenging conditions for both fixed and tactical deployments. xMax equipment and technology was deployed and trialed extensively by soldiers in both garrison settings at Fort Bliss during day-to-day operations, as well as during a 6-week NIE 11.2 (Network
Integration Evaluation) event in austere desert conditions at White Sands Missile Range (WSMR).

At WSMR, xMax was evaluated as a system that could provide connectivity where none exists.

Commenting on the xMax trial, Mike McCarthy, Director of Operations, Brigade Modernization Command at the Fort Bliss Mission Command Complex, stated:

“It (xMax) uses something that’s radically different from other solutions that we’ve looked at, and it’s been exceptionally impressive. Their combination of cognitive radio and frequency hopping — as opposed to a fixed-frequency base station — has shown tremendous operational capabilities. The solution has proven to operate very reliably, even when confronted by intentional jamming.”

In September 2014, xG again demonstrated the superiority of its patented interference mitigation capabilities in a demanding communications environment. During testing that was conducted in conjunction with the USSTRATCOM Joint Electronic Warfare Center, xMax was subjected to deliberately-generated interfering signals that were applied at power levels nearly twenty times that of the xMax system. xMax was able to withstand the interference and continue delivering flawless voice and video transmissions.

xG Selected to Improve the Effectiveness of Tactical Communications

Because of xG’s substantial experience in pioneering, developing and deploying new paradigms in RF communications and cognitive radio solutions, the company was chosen to participate as a subcontractor by two prime contractors on a $497 million multiple-award contract to provide communications and networking services to the U.S. Army in 2014.

Under the terms of the subcontract, xG Technology will provide research, development and evaluation in support of communications and networks systems under the U.S. Army’s Communications-Electronics Research, Development and Engineering Center (CERDEC) Space and Terrestrial Communications Directorate’s (S&TCD) five technology areas (antennas, system engineering, satellite communication, cybersecurity, and communications networks).
**Summary**

Until recently, military wireless planners have been forced to choose between conventional wireless systems, which have only been able to address some of their operational requirements, and highly targeted solutions that have been, for the most part, highly unwieldy, and lacking in cost efficiencies.

xMax represents a scalable, flexible and fully expeditionary architecture that can operate seamlessly and in concert with commercial cellular systems. However, xMax also goes beyond these systems, filling in the gaps in coverage and capabilities inherent in their design.

The ability of xMax to provide a dedicated, affordable and fully expeditionary all-IP communications layer adds a level of resilience and continuity of operations that is an acute requirement in military wireless communications, and is something not found in current commercial cellular offerings. This makes xMax an ideal way to vastly expand the deployment potential of wireless installations on a global basis.

---

*xMax Edge Information Services*
About xG Technology

xG Technology is the developer of a broad portfolio of intellectual property designed to enhance wired and wireless communications. Leveraging elements of its portfolio, xG has become a market leader in introducing a range of spectrum agnostic, cognitive radio solutions that span numerous industries and applications. These solutions enable communications providers in commercial, government, and military sectors to deliver robust mobile services using licensed and/or unlicensed spectrum.

xG’s mission is to deliver cognitive radio network technology that meets the world’s rising demand for reliable and affordable wireless broadband, while making the most efficient use of scarce spectrum assets.

To find out more about xG Technology, please visit www.xgtechnology.com.

xG Technology, Inc.
240 South Pineapple Ave., Suite 701
Sarasota, FL 34236
T: 941 953 9035
F: 941 954 8595

© 2014 xG Technology, Inc. All Rights Reserved. xG and xMax are registered trademarks of xG Technology, Inc. No part of this document may be reproduced in any form without the written permission of xG Technology, Inc. All contents of this document are subject to change without notice. xG Technology, Inc. shall incur no liability for any error, omissions, or damage of any kind resulting from the use of this document.