White Paper

TELEGRID
Technologies, Inc.

WZRDnet Tactical Kit

Enhancing Operations of a

Rapid Response Tactical Router

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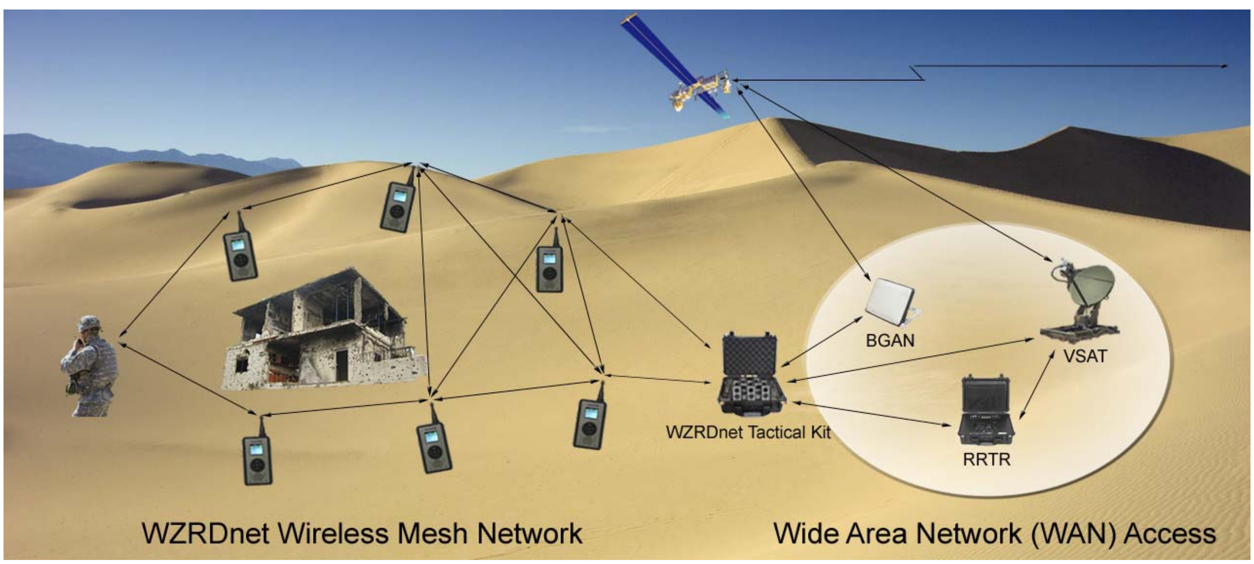
1.0 Abstract

This white paper describes the benefits of using the TELEGRID WZRDnet™ Tactical Kit (WTK) as an enhancement to the various versions of the Rapid Response Tactical Router (RRTR) developed and deployed by the US military. Like the RRTR which can be deployed in any global environment and provide Wide Area Network (WAN) access to local users, so too the WTK can be deployed in any global environment and provide a fully functional voice and data Wireless Local Area Network (WLAN) to support the RRTR. Interconnection between the WTK and the RRTR can be done either wirelessly (e.g., Wi-Fi) or by cable (e.g., Ethernet, analog POTS, etc.) allowing any user on the WLAN to gain direct access to the WAN. This multiplier effect extends RRTR access to a broad contingency of users spread over a large area and not in direct line-of-sight.

The WTK is based on the WZRDnet technology developed and patented by TELEGRID Technologies, Inc. This technology provides peer-to-peer direct dial connection between low-power handsets in a true mesh architecture for infrastructure-less operation. The low-power handsets, which can operate for 38 hours between battery charges, provide a range of 2 km per hop and up to 32 hops per call, creating a sizeable network of thousands of potential users over a considerable area. The WTK is a lightweight assemblage housed in a rugged man-transportable case which includes all networking components and handsets necessary to establish a WLAN and connect to the WAN. It uses the same AC and DC power sources as an RRTR and is designed to be deployed simultaneously during an operation.



Potential WTK Deployments

2.0 Introduction

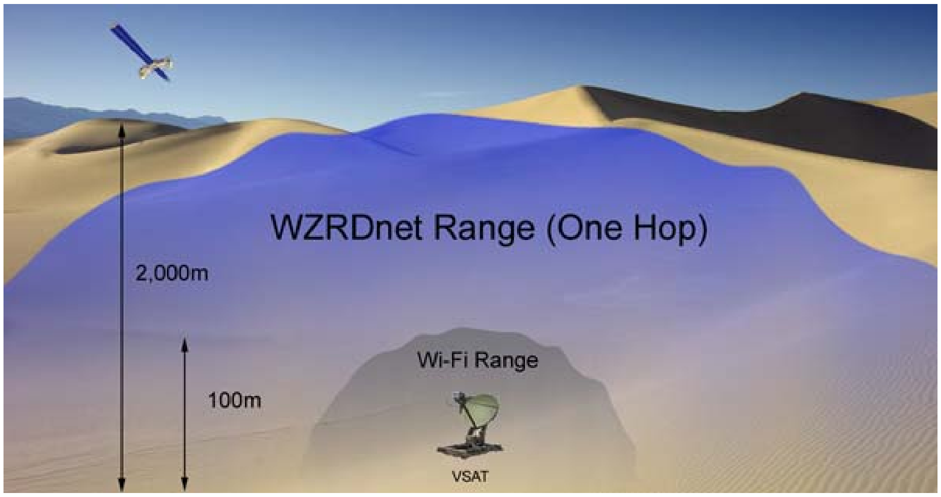
RRTRs are an important tool for the US military in providing lightweight, rapidly deployable WAN access to remote users in austere environments. Several versions of RRTRs have been developed and are currently being deployed globally including:

- The Initial Entry Package (IEP) developed by the Joint Communications and Support Element (JCSE)
- The Rapid Response Kit (RRK) developed by the Deployable Joint Command and Control (DJC2)
- The Global Rapid Response Information Package (GRRIP) developed by the US Army's Program Executive Office for Command, Control, and Communications - Tactical (PEO C3T)
- The Expeditionary Command and Control Suite (ECCS) developed by the Marine Corps Systems Command (MARCORSYSCOM)
- The Special Operations Forces Deployable Node-Lite (SDN-L) developed by the United States Special Operations Command (USSOCOM)

An RRTR can be deployed anywhere in the world on short notice and provide C2 capabilities to a small team of users particularly during the initial entry phase of a military operation. Due to the varied nature of these missions RRTRs are designed to fit in ruggedized man-transportable cases that can be carried on a commercial aircraft or by hand into remote areas. Since RRTRs are expected to be deployed and operated by personnel with varying levels of technical expertise, they are designed so that set up and operation require minimal level of training.

The basic services provided by an RRTR include voice and data communications over a WAN backhaul operating, in most cases, over a satellite link through a Very Small Aperture Terminal (VSAT). In order to provide these services each RRTR is equipped with a tactical router unit which is capable of supporting local devices like laptops, VOIP handsets and analog POTS phones using several IP and analog interfaces. A major drawback in the common RRTR architecture is that it restricts users' flexibility by requiring physical connection to the router and limits access by providing ports to only a subset of users. Recognizing this, some developers have been looking to existing wireless technologies as a means of providing user flexibility and increasing the foot-print and utility of the RRTR.

One approach involves adding a wireless router and Wi-Fi phones/ PDAs to the assemblage thus creating a WLAN in the vicinity of the RRTR. This, however, presents several operational issues. The first is that commercial Wi-Fi routers have only a limited range of approximately 100m and require direct line-of-sight in order to achieve optimum performance. This presents a problem when users are on-the-move around the RRTR. Another issue is related to the fact that Wi-Fi handsets expend a large amount of power and therefore can not operate for a long period of time without being recharged or having batteries replaced, a serious drawback in an austere environment with limited recharging facilities. A still more important issue is that all local WLAN activities are routed through the RRTR's tactical router. This slows down the RRTR and obstructs WAN calls. It also makes the router a potential single point of failure which can bring down the entire WLAN.



Wireless Range – Wi-Fi vs. WZRDnet

A second approach to increasing user flexibility involves erecting a temporary cell tower attached to the RRTR. While this creates a wider area of wireless coverage than Wi-Fi, it is once again a single point of failure. Additionally, since a RRTR is deployed in austere environments where the size, weight, and power requirements of equipment is of major importance, the transportation and deployment of a temporary cell tower is untenable. As a final issue, network designers will need to worry about licensed spectrum and interfering with local telecommunications carriers.

A third approach to support users on-the-move and work independently of the RRTR involves use of satellite phones. While this seems like an ideal solution, the wide scale distribution of satellite phones increases usage costs and pushes local area network communications over the satellite thereby consuming valuable satellite bandwidth.

It is clear therefore that a different approach, using a new technology, must be developed which would not be affected by the austere environment, extend coverage beyond what is currently available and maintain long battery life. Such a new technology was recently developed and patented by TELEGRID Technologies, Inc. and named WZRDnet. This technology employs low-power wireless mesh network architecture to provide voice and data communications without the need for any infrastructure. It utilizes small form factor handsets that act as both user interface devices and routers in the mesh network. It allows messages to be wirelessly relayed several kilometers away from a transmitting device while maintaining low power of transmission. Since the WZRDnet is based on an IEEE standard and employs packet switching it can easily interoperate with the RRTR in order to access remote voice/ data networks and users. As an added benefit, a WZRDnet-based WLAN acts independently of the RRTR thus removing concern of a single point of failure. The WZRDnet technology forms the foundation of the WTK. This kit, which contains ten

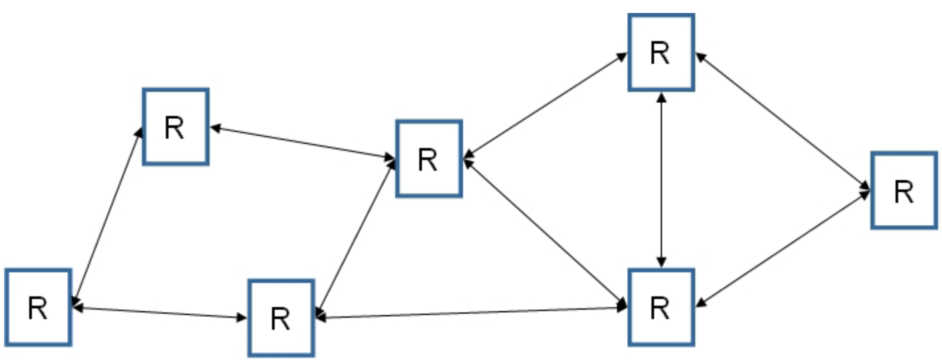
(10) WZRDnet handsets, a light weight tactical gateway unit and needed power supplies, can be deployed wherever the RRTR is deployed and provide an enhancement in terms of increasing service area and service offerings.

3.0 WZRDnet

The low-power wireless mesh network technology known as WZRDnet was designed to provide voice and data connectivity to users with low-power handsets in an austere environment. It does not require any infrastructure (e.g. cell towers, satellites, base stations) and can operate anywhere in the world at a moment's notice. The essential requirements that drove the design of WZRDnet hardware were small Size, low Weight, and low Power (collectively known as SWAP). WZRDnet can function as a standalone WLAN or access external networks using the WZRDnet Gateway (WZRDgate).

WZRDnet employs mesh architecture in which each node functions as a router in the network. If a destination is not in the line-of-sight of the originating node, the message hops through intermediary nodes in the network via the most efficient path to reach its target. By allowing messages to hop over intermediary nodes, mesh architecture removes line-of-sight issues and distance limitations without requiring additional infrastructure or boosting transmission power.

WZRDnet provides a self forming, and self healing wireless mesh network with true ad-hoc characteristics. As nodes power up they perform a RF scan to locate available networks and independently join. In turn as intermediate nodes in the path of a call leave the network, communication is redirected without impacting the call. As opposed to other networks WZRDnet is scalable meaning an increase in users enhances communications by adding routing paths. This, in effect, improves the reliability and Information Assurance (IA) qualities of the network by providing multiple communications paths between any two nodes. This also eliminates the need for additional overhead and external monitoring.



Mesh Networking

WZRDnet's mesh network is ideal for rapid deployment because it is based on low-power portable handsets. As opposed to other mesh networks, which rely on large fixed access points with central routing tables, WZRDnet routes messages through the handsets themselves. Each handset maintains and updates its own routing information thereby removing the need for access points and the possibility of a single point of failure. In order to establish a mesh network in an austere environment a network designer would simply need to distribute handsets to the users. With each handset weighing only 0.6 pounds, WZRDnet creates a lightweight ad-hoc solution to austere environment communications.

Routing communications through handsets rather than access points requires a large amount of processing and routing transmission which can quickly drain a handset's battery. WZRDnet is able to achieve handset routing due to its focus on low-power design which includes employing the standards-based low-power IEEE 802.15.4 standard. The critical underlying technology supporting WZRDnet is its patent-pending low-latency voice coding/ decoding method which supports real time multi-hop communications over low-power networks.

4.0 WZRDnet Tactical Kit

4.1 **Basic Architecture**

The WTK is a lightweight, man-transportable, fully-operational assemblage which includes all the components necessary for the rapid establishment of a mesh WLAN in an austere environment. Network installation is simple and does not require special training beyond basic understanding of networking technology. WTK includes the following components:

WTK-350 – WZRDnet Tactical Kit

1. Ten (10) WZRDnet handsets (P/N WHD-310(V)1)

2. A WZRDgate wireless gateway (P/N WGW-330(V)2) which provides connectivity and network interoperability with an RRTR

3. An internal power supply which, like an RRTR, operates with either an AC input of 88-264V AC or a DC input of 18-36V DC. The same power sources can be used to charge the handsets inside the case

4. A ruggedized carrying case weighing roughly 20 pounds.

Other configurations of the WTK are available which include additional handsets, relays, and sensors depending on the network designer's key performance parameters.

4.2 WTK connection to the RRTR

Connecting the WTK to an RRTR augments peer-to-peer voice and data communications by providing connectivity to a larger set of users over a wider area. For instance, an individual several kilometers from an RRTR can access the WAN by hopping over intermediate users through the mesh. Rather than necessitating a physical connection or staying within range of a Wi-Fi hotspot a user can now travel multiple hops from an RRTR. WZRDnet's range is 2 km per hop with up to 32 hops per call allowing users to travel a significant distance from an RRTR. Previously WAN access for inaccessible users would require additional RRTRs or the distribution of satellite phones. Both options present the network designer with prohibitive up-front equipment costs and monthly satellite access charges, which must be paid even when the equipment is not used. The WTK removes these costs by allowing all dispersed users to access the same RRTR.

Another benefit of the WTK is its ability to act as a standalone WLAN which can help maintain C2 operations even if an RRTR fails. This allows communications between users in an austere environment without satellite backhaul or connection with an RRTR. Additionally, routing WLAN communications through the mesh rather than the satellite reduces traffic load and usage costs which can range from $1-$2 per minute. The WTK combines the independent network features of two-way radios with the WAN access of satellite phones.

The WTK's low-power design is a benefit to network designers as well. WHD-310 handsets can operate for 38 hours between battery charges (this considers operation at 5% talk, 5% listen and 90% idle – an industry standard), which compares favorably to commercial two-way radios that operate for 8-10 hours assuming the same 5/5/90 duty cycle. This eases recharging requirements and eliminates the need for deployment of expensive power sources.

The WZRDnet operates in the Industrial, Scientific and Medical (ISM) frequency band of 2.4GHz. As opposed to other ISM bands 2.4GHz is internationally unlicensed. This means users can operate the equipment or train with it in any country without local spectrum licensing issues.

WZRDnet Handset P/N WHD-310(V)1

Finally, by employing a mesh network, where messages hop through intermediaries, it is possible to keep transmission power low. This is beneficial in a tactical environment where a focus is Low Probability of Intercept/ Low Probability of Detection (LPI/LPD).

4.3 WTK connection options

The WZRDgate unit inside the WTK establishes a presence for WZRDnet on the WAN and provides the physical layer connection to the RRTR. WZRDgate's design supports a simple connection to an RRTR via a multitude of connection options depending on the available access including:

- RJ-45 Ethernet
- Wi-Fi
- RS232 Serial
- USB Host
- Mini USB Client
- RJ-11 Analog

These options allow the WZRDgate to connect to multiple networks, for example, a tactical IP router via RJ-45 or Wi-Fi. Alternatively WZRDgate can attach to a PBX directly via simple RJ-11 analog connection. In addition to connecting to the WAN the RS-232 serial and mini-USB can be used as data inputs for the attachment of sensors.

WGW-330(V)2 Front Panel

WZRDgate allows flexible power input selection including 88-264 VAC or 18-36 VDC. These are the same options available with most popular RRTRs. As an added benefit, if WAN data rates are insufficient for voice communications WZRDgate's embedded LINUX processor can buffer messages to maintain Quality of Service much like many RRTRs' TCP/IP Accelerator.

5.0 Conclusion

The WTK enhancement to an RRTR introduces a new operational capability. It provides the means for forming a large wireless mesh network in the vicinity of an RRTR which can function as an independent voice/ data network and also use an RRTR's WAN access capabilities to establish calls between local users and users on remote worldwide networks. This, in effect, "stretches" an RRTR's coverage area by providing multi-hop connectivity to a large group of users over a considerable area. The WTK achieves this through low-power handsets which operate for 38 hours between battery charges. The WZRDnet technology underlying the WLAN is self healing, self forming and scalable which allows rapid deployment and nominal maintenance while at the same time avoiding a single point of failure. WZRDnet's unique design lets network operators cut costs by increasing the utility of an RRTR.

For more information or to schedule a demonstration please call (973) 994-4440 or email sales@telegrid.com.