Task Force Dragon Builds Regional Communications Network

CPT Maxwell E. Fuldauer

Task Force Dragon demonstrated how Signal Soldiers are getting the job done in the field.

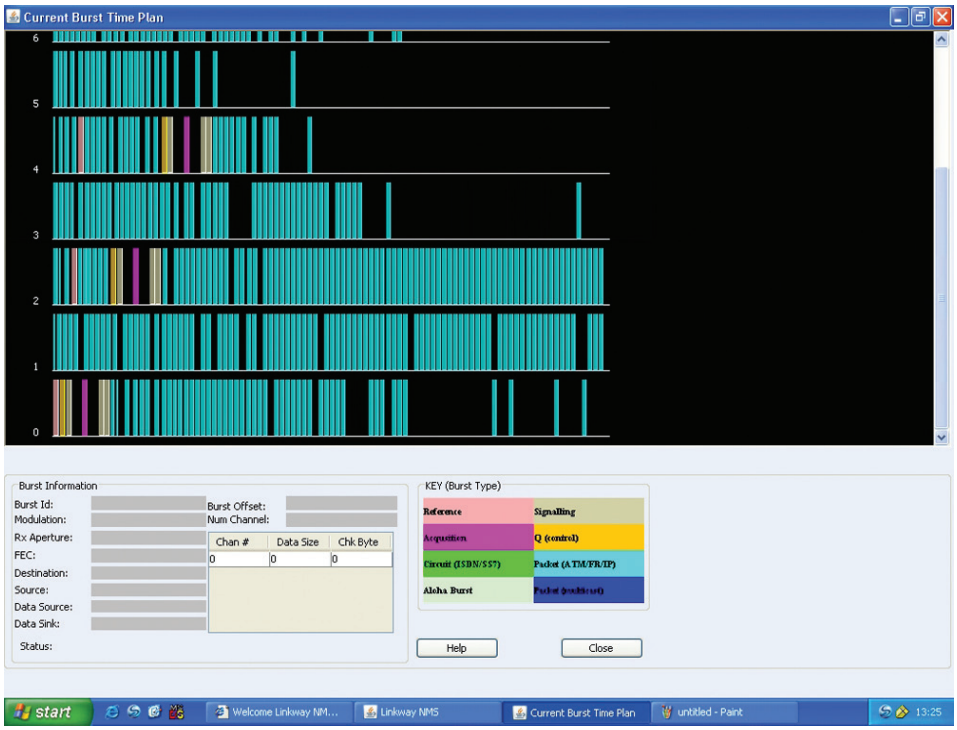
Task Force Dragon deployed to Afghanistan as a part of the 2010 Presidential Force Uplift, in support of the expansion of the Regional Command – North area of operations. TF Dragon was composed of the Headquarters and Headquarters Company from the 307th Expeditionary Signal Battalion from Hawaii, B/44th Expeditionary Signal Company from Germany and A/151st Expeditionary Signal Company from the South Carolina National Guard. Since the start of Task Force Dragon's deployment, the customer requirements for the RC-N's U.S. contingent has grown from less than 100 customers to a now staggering number of over 8,000 customers.

As the network grew and changed there were many hurdles that had to be overcome to provide the customers with the high quality of service expected from the Army Signal Corps.

One of the first hurdles that TF Dragon had to overcome was the lack of communications infrastructure throughout the RC-N area of operations. Not just the infrastructure between Forward Operating Bases and Contingency Operation Posts but the infrastructure on the bases as well. At the time, many of the bases were still under construction; this meant construction teams were still clearing mines, building HESCO Barriers, tents and work places. At most sites the layout changed monthly if not weekly, making planning for communications very difficult, if not impossible. This level of non-predictability combined with the slow supply chains of Afghanistan left the TF Dragon Engineer's to develop new and inventive ways to extend services to the ever increasing number of customers.

The first solution was to provide customers access to enterprise services via SIPR, NIPR Access Points, Command Post Nodes, and Joint Network Nodes. In RC-N these nodes provide a relatively basic level of service thru either a shared mesh of seven, five mega symbol time division multiple access carries; or thru a dedicated three or four Mbps frequency division multiple access link (JNNs only).

This is the unit patch for Regional Command (North). RC (N) is the German led coalition and joint headquarters commanding operations in the Northern Region of Afghanistan. RC (N) covers over 61,000 square miles from Afghanistan's border with Turkmenistan in the west through the Wakhan (Warrior) Corridor in the east bordering Tajikistan, China and Pakistan. This region's strategic location and diverse terrain has made it key in the support of the security and stability of the Government of the Islamic Republic of Afghanistan.



This burst time plan shows a snapshot in time of the traffic traversing the RC (N) TDMA Network supporting over 60 Terminals and over 8000 customers on the tactical network. This snapshot was taken prior to the introduction of the Harris 7800W Radio infrastructure and Area Distribution Nodes (ADN), when the network was at a constant 95% utilization rate.

This solution was logical and appropriate for the expansion, because by doctrine, that is how an expeditionary signal battalion deploys.

However, with continuously growing customer requirements and lack of base infrastructure, multiple tactical terminals on the same base were needed to cover all of the customer's requirements. It wasn't that the number of customers was too great for one node to handle in most cases; it was because of their dispersed location. In today's changing battle field, customers are forced to setup their locations where ever possible, which means the communications have to come to the customer. Because of this dispersion, multiple tactical nodes may be used to support geographically separated customers with much fewer requirements than the node is capable of supporting.

From the outside this may appear to be overkill to provide support to several company command posts with a CPN, but in today's COIN fight there is a requirement to provide enterprise services down to the company and sometimes platoon level. Because of the increasing number of tactical nodes in the TDMA mesh, the network began reaching a constant state of 95% saturation (See time burst plan old) which was causing network instability and poor quality of service to the customers. The saturation wasn't due to the number of customers; it was due to the number of nodes in the mesh. Reducing the dependency on the TDMA network was TF Dragon's next big challenge to solve. The question was how to reduce the demand on the TDMA mesh network but still provide a high quality of service to the customer sites with even the smallest requirements.

TF Dragon's network engineers were able to work out a couple of courses of action to combat the taxing of the TDMA network and increase customer quality of service. The first was to interconnect the TDMA dependant nodes with the nodes capable of using a higher bandwidth, lower latency link, such as, FDMA or to Microwave Line of Site circuits. This interconnection virtually took the TDMA nodes out of the timeslot requesting cycle for the TDMA mesh but left the satellite link in place in case the interconnected FDMA/MLoS link failed.

This type of interconnection is not too uncommon since it's been designed into the WIN-T architecture with the HCLoS system and Tactical Fiber Optic Cable Assembly runs.

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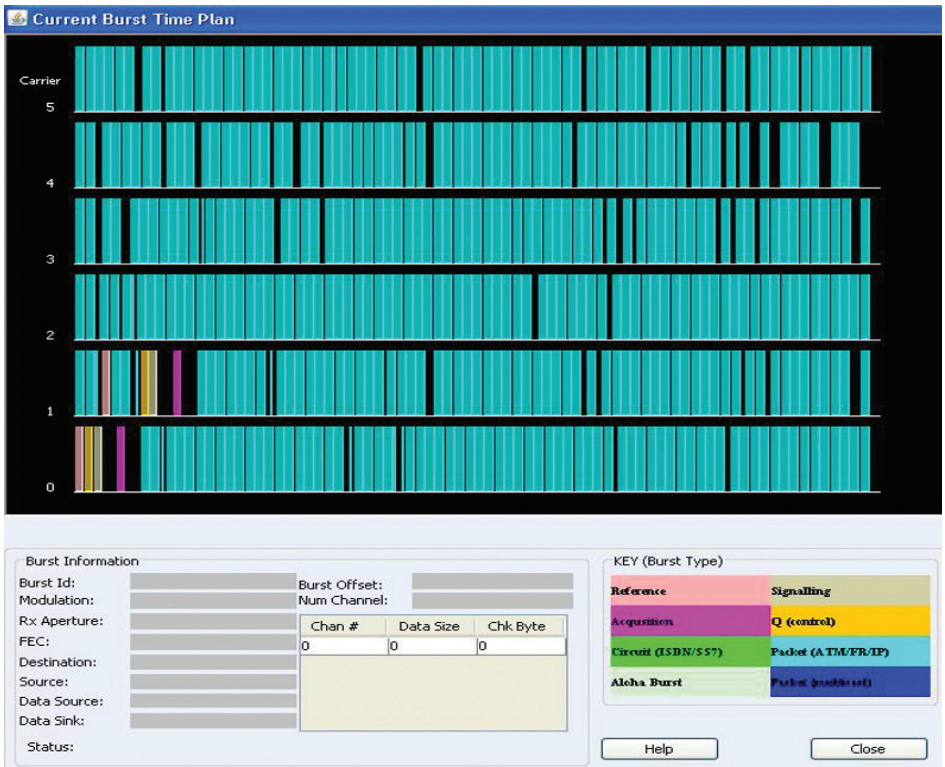
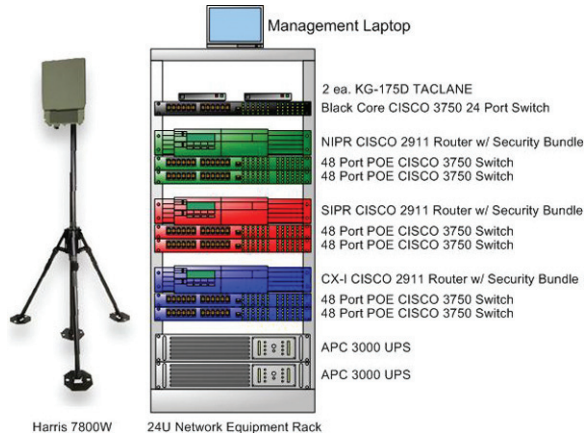


This burst time plan shows a snapshot in time of the traffic traversing the RC (N) TDMA Network supporting approximately 50 Terminals and still over 8000 customers on the tactical network. This snapshot was taken after to the introduction of the Harris 7800W Radio infrastructure and Area Distribution Nodes. The network is currently at a well reduced 60% utilization rate.



This is an example of how the Harris 7800W Radio was used in Point to Multi-Point configuration to link separate Tactical Nodes and Area Distribution Nodes together, in order to best utilize the highest bandwidth, lowest latency node on an FOB (JNN with FDMA). By utilizing this infrastructure it allows for the virtual removal of TDMA nodes from the congested TDMA mesh in turn improving the quality of service to the customer.

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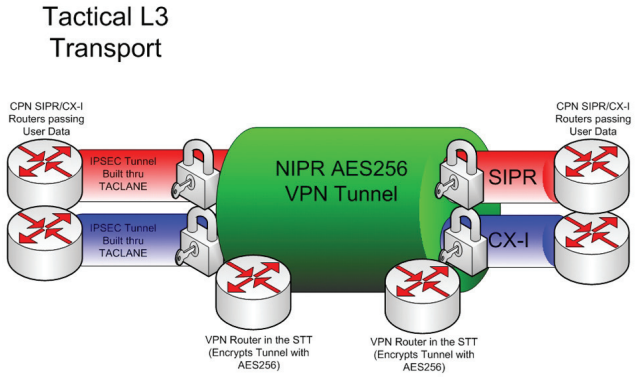
However due to the limited land and material available and the layout of the FOBs and COPs; the laying of tactical fiber or the emplacement of the large WIN-T HCLoS shelters was not always an option. As a result, the interconnection was accomplished using a newer IP radio system.

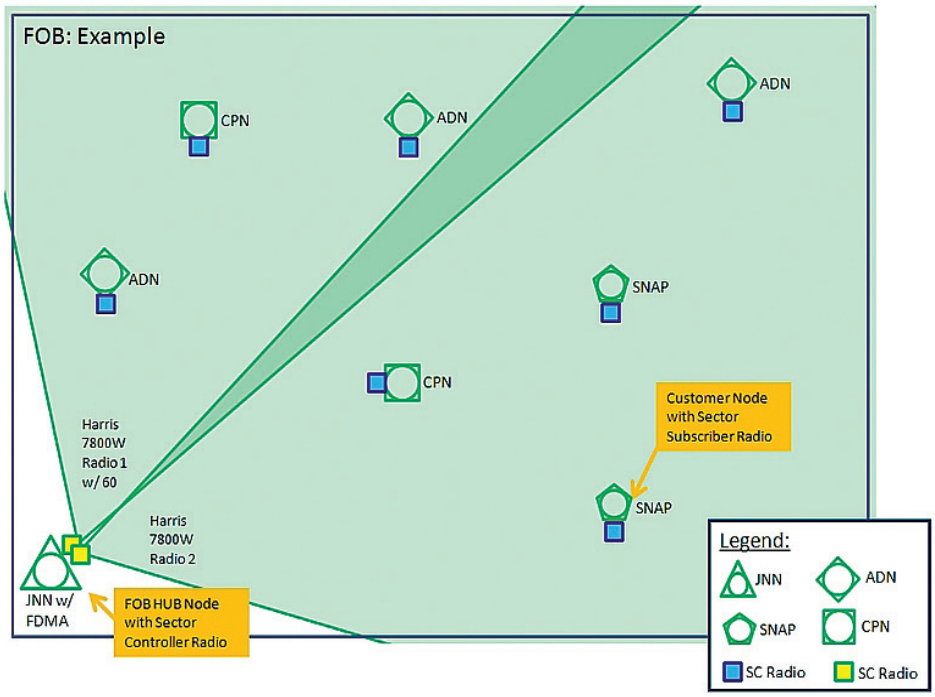
The Harris 7800W IP Radio system has been used throughout theater in a Point to Point configuration for quite some time with a high rate of reliability. Because of its small size and efficiency, up to 108Mbps thru put in PtP mode, it has become a staple for Line of Sight communications in the theater, up to 54Km. However, in the North we were able to use it in its more versatile mode, Point to Multi-Point. Using the PtMP configuration and the sixty degree sector panel antenna we were able to build robust base infrastructure networks with just a few radio sets. In PtMP configuration the Harris 7800W IP Radio is capable of a maximum thru put of 54 Mbps at distances up to 24 KM. In this configuration the Sector Controller radio can control up to 20 Sector Subscriber (SS) radios, in turn allowing for an economy of force, by conserving the limited number of radios available for use at other high priority sites. For Example, on FOB Dehdadi II, by utilizing a setup of both a PtP and a PtMP radio network, the tactical node footprint has been reduced from nine tactical nodes down to two JNNs utilizing FDMA. These two JNNs now provided communications to over 500 customers on NIPR, SIPR and CX-I.

Besides just utilizing the standard tactical node interconnects, TF Dragon needed to find a way to extend service to customers without having to emplace an entire tactical node in order to interconnect. The solution was to build Area Distribution Nodes. These ADNs come in two forms tactical and strategic.

The initial tactical ADN design utilized the standard "Everything over NIPR" architecture (see Tactical Tunnel Design). It consisted of an AES256 capable router and switch for NIPR connected to a set with a TACLANE, router and switch for both SIPR and CX-I. Due to a shortage of networking equipment, we found a way to reduce the equipment requirements of this ADN by removing the SIPR and CX-I routers and terminating the Generic Routing Encapsulation Tunnel on the Layer 3 enable switch. This worked for all tactical sites because the number of users was low so it wouldn't over tax the switch's CPU. If the site was off of a PtP radio link you could also use the AES256 encryption offered by the 7800W radio only in PtP mode and remove the NIPR router and just trunk the NIPR switch.



TACTICAL TUNNEL DESIGN This is a diagram of Tactical tunnel design used in WIN-T Tactical Nodes throughout the Army.



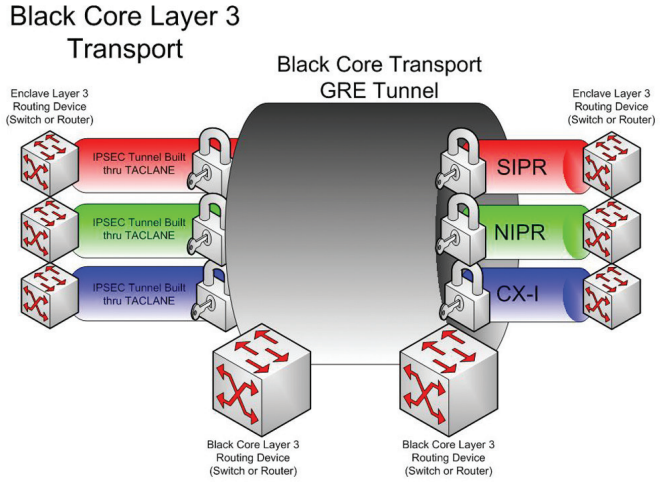
TF DRAGON ADN DESIGN: This is the Area Distribution Node design diagram developed by RNCC-N engineers. This system is able to extend enterprise services via the black core transport network (strategic) or everything over NIPR (tactical). The ADNs utilizes Harris 7800W radios or Fiber/Copper cable to connect back to communication nodes.

This method even further saves equipment, but only with a PtP radio link.

The original strategic ADN looked very similar but with one difference. Strategic uses a Black Core transport network that consists of an open switched network to allow any end to end encrypted traffic to flow to any point that it was needed. The strategic ADN stack consisted of a Black Core switch, NIPR router and switch, SIPR & CX-I TACLANE and switch. Or because of the Black Core infrastructure, if a site just required one of the services all that was required was the Black Core switch and the appropriate switch/router/TACLANE combination to provide the required service.

A prime example of this combination of ADN and 7800W radio network infrastructure is on Camp Marmal. By utilizing two SC Radios setup with overlapping fans TF Dragon was able to support the entire FOB with 18 current SS radios ADNs at customer sites offering full strategic services from the strategic point of presence; with the expansion capability to support up to 40 ADN sites (see FOB Example Layout).

By utilizing both of these solution sets, TF Dragon was able to reduce its TDMA footprint from a peak of 72 tactical terminals to the current 50, with the current 50 having 12 interconnects 8 from TDMA nodes to an FDMA capable node and the remaining two connected to the MLoS back to Camp Marmal. This reduced the TDMA network burst time plan from a constant 95% utilization to an ideal 60% utilization over a seven carrier TDMA mesh (see time burst plan new). This in turn left room for the ever increasing customer base which from start of implementation increased by over 50%. By implementing these creative "economy of force" architectural changes to the RC-N network infrastructure, TF Dragon and its network engineers have ensured a manageable and stable network for the future expansion of customer service throughout the North.



STRATEGIC TUNNEL DESIGN This is a diagram of strategic tunnel design used in the RC-N.

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Acronym QuickScan

ADN - Area Distribution Nodes
COP - Contingency Operation Posts
CPN - Command Post Node
CENTRIX - Combined Enterprise Regional Information Exchange
CX-I - CENTRIX – ISAF
ESB - Expeditionary Signal Battalion
ESC - Expeditionary Signal Company
FDMA - Frequency Division Multiple Access
FOB - Forward Operating Base
GRE - Generic Routing Encapsulation
HCLoS - High Capacity Line of Sight
HHC - Headquarters and Headquarters Company
ISAF - International Security Assistance Force
JNN - Joint Network Node
Mbps - Mega-Bits Per Second
MLoS - Microwave Line of Sight
NIPR - Non-secure Internet Protocol Routing
POP - Point of Presence
PtP - Point to Point
PtMP - Point to Multi-Point
RC (N) - Regional Command (North)
RHN - Regional Hub Node
RNCC-N - Regional Network Control Center - North
SC - Sector Controller
SIPR - Secure Internet Protocol Routing
SS - Sector Subscriber
TDMA - Time Division Multiple Access
TSEC - Telecommunications Systems Engineer Course
TF - Task Force
TFOCA - Tactical Fiber Optic Cable Assembly
WIN-T - Warfighter Information Network – Tactical