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TDL Technology

Published by SyntheSys for the Tactical Data Links Community

Issue 4
Spring 2017

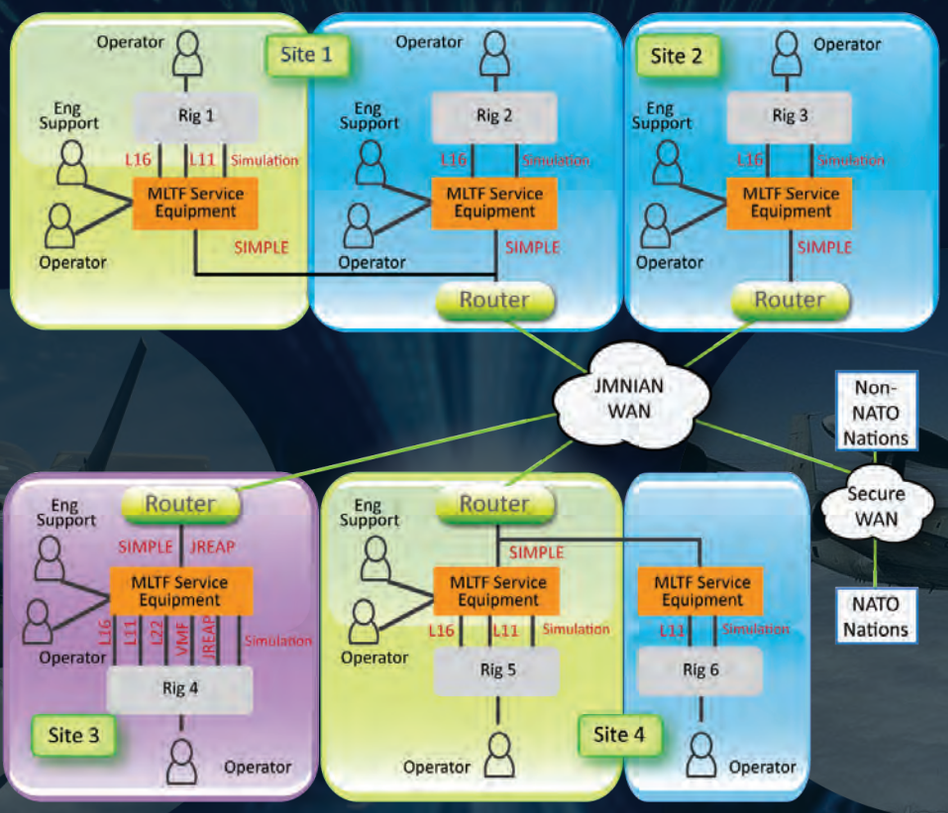
www.synthesys.co.uk

SyntheSys

The SyntheSys Multi-Link Test Facility (MLTF) Service

Seamlessly Manages TDL Interoperability Test & Assurance

- Supports & Aids Operator Training
- Controlled and Repeatable Test Environment
- Through-Life Support



Representative example of a common platform including possible platform configurations and Wide Area Network connections

It's no secret that testing TDL systems using live trials is expensive.

SyntheSys' MLTF service enables TDL Interoperability testing of geographically dispersed equipment over a secure Wide Area Network, thus providing a highly cost-effective solution to standards compliance and interoperability assurance testing.

SyntheSys DEFENCE

Letter from the MD

Dr J S Hartas Managing Director

A Fresh Perspective

Greetings colleagues and customers, and welcome to the fourth issue of TDL Technology.

Thanks to your support, the publication continues to grow in strength, with more articles in both our Technical Knowledge Bank and Community Forum. We are pleased to be able to feature Cobham, MASS and ViaSat for this issue.

Our aim is to build a magazine with an ethos about collaboration and knowledge sharing, and I would like to take the opportunity to reinforce the fact that we don't want TDL Technology to be all about SyntheSys.

The publication is designed to add value to the community and give a platform to share best practices, technical policy and guidance, but also to continue to drive questions and curiosity about where TDLs are now, and where they will be in the future.

With this in mind, if you or your organisation would like to contribute an article to future issues, please do not hesitate to contact us via the editor. As the magazine grows, our team is developing new ways to keep the publication relevant, and more importantly, informed and useful. I am happy to say that the next issue will hold some brand new features to keep you informed and entertained.

You can download a copy of TDL Technology from www.tdl-technology.com or contact: tdltech@synthesys.co.uk for a hard copy.

Please do not hesitate to contact me at john_hartas@synthesys.co.uk. I always appreciate any comments you might have about the features in the magazine.

Very best regards,

John S. Hartas

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Printing:
Illustrated Stationery Ltd

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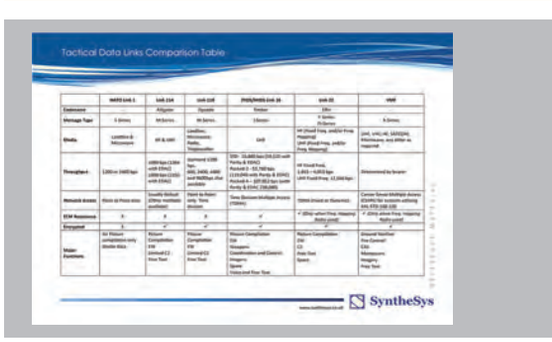

SyntheSys News

New Defence Community Portal - Now Available!

Technical Articles
Reference Guides
Training Material
TDL Technology
Capabilities and Limitations Database

visit http://www.tdl-technology.com/community-portal to register

Top Award for SyntheSys Duo

SyntheSys' consultants, Mark Hudspeth and Sam Southwell, have received a Bronze Award in the BAE Systems Chairman's Awards, for exceeding customer expectations.

The pair received the honour along with BAE Systems' staff who were also nominated and a Thales subject matter expert. The SyntheSys staff supported a trial to de-risk the Type 45 destroyer in participation of the 'At Sea Demonstration'. They installed software for the Joint Range Extension Application Protocol (JREAP) and helped prove the software of the Type 45 at the land based test site prior to using it during the 'At Sea Demonstration' using a real ship system.

Principal Consultant, Mark, said: "We completed the networking tests in a short contract last year. It's nice of the management to recognise the technical team's endeavours in this way".

Mark has over 30 years' technical engineering experience, specialising in Tactical Data Links (TDLs) since 1993. Since 2008 his work focus has largely been on distributed test and trials engineering using the UK's Multi-Link Test Facility (MLTF), with SyntheSys being the service provider.

He has unrivalled experience in this field, having been the technical lead for the MLTF initially, and subsequently the project manager. Mark had the direct responsibility for the installation, integration and acceptance activities for the MLTF, with five UK platform rigs including the Type 45 Destroyer, Type 23 Frigate, Sea King Airborne Surveillance and Control helicopter, the Sentinel aircraft and the Sentry E-3D aircraft.

Mark has also provided support for a wide variety of national and international trials, using his vast experience to ensure the trials' success.

Newly appointed Principal Consultant, Sam, brings over 22 years' experience in the Royal Air Force (RAF), including nine years at a front line Tornado Squadron gaining experience on the full complement of avionics systems as fitted to the aircraft.

Following this, he completed five years' service as an instructor being responsible for avionics training and course design. Finally moving to TDLs, primarily as a Link 16 engineer, he has extensive experience in data collection, analysis and front line engineering support to the RAF, Royal Navy (RN) platforms and Army TDL systems.

Since leaving the Service he continued in TDLs working within the company training team and on Problem Evaluation Services and UK support to the Joint International Configuration Review Board (JICRB) and MIDS International Review Board (MIRB) Link 16 international conferences.

The SyntheSys duo have each received a special certificate presented at a gala dinner presentation.

SyntheSys Kicks off 2017 by Delivering Training to the Swedish Defence Material Administration and BAE Systems Saudi Arabia

SyntheSys hits the ground running for the start of 2017 by delivering MIDS Link 16 training to both the Swedish Defence Materiel Administration and BAE Systems Saudi Arabia.

This introductory course content starts with the features and benefits of MIDS Link 16 before progressing to the operational use of MIDS Link 16. The course concludes with students utilising the Daronmont Link Training Suite (DLTS) which provides each student the opportunity to interact with a simulated MIDS Link 16 network.

SyntheSys provides a variety of TDL training courses. If you would like to know more, please contact us at: training@synthesys.co.uk or visit: http://www.synthesystraining.co.uk/

CLARITY IN THE CHAOS OF COMBAT

LINK 16 CONNECTIVITY AT THE MOST REMOTE EDGES OF THE BATTLEFIELD

World's Only Handheld Link 16 Radio for Dismounted Ground Warfighters

» Digitally Aided Close Air Support » Jam-Resistant Voice + M2M Target Data + PLI » Relative Navigation

Watch Our Video to Learn More

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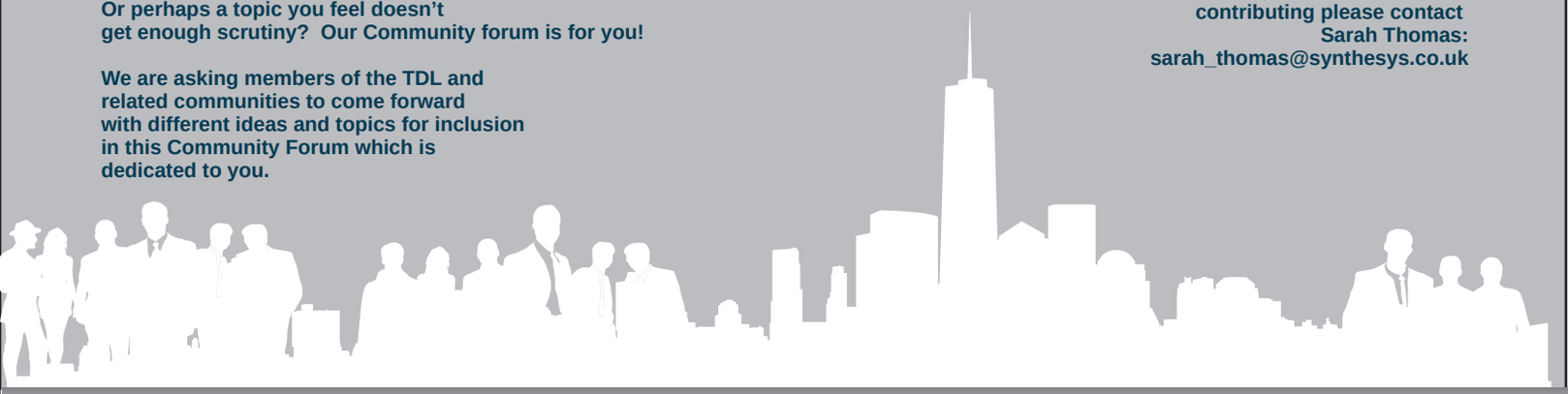
TDL Technology Community Forum

Have you got a burning question to ask? Or perhaps a topic you feel doesn't get enough scrutiny? Our Community forum is for you!

We are asking members of the TDL and related communities to come forward with different ideas and topics for inclusion in this Community Forum which is dedicated to you.

If you are interested in contributing please contact Sarah Thomas: sarah_thomas@synthesys.co.uk



A New Era in Close Air Support

Revolutionary Handheld Link 16 Capability Offering Greater Digital Situational Awareness for Dismounted Ground Forces

In the chaos of combat, you only have seconds to identify a friend from foe before deciding whether or not to engage. Whether you are a single dismounted warfighter or a pilot supporting the fight from the sky, you can now see a complete air/ground common operational picture with all operators and assets accounted for - even at the most remote edges of the battlefield.

For the first time in history, a single dismounted warfighter has the ability to directly interact with incoming aircraft, digitally identify friendly locations, and designate enemy targets for air attack using nothing but a handheld Link 16 radio.

Traditional Close Air Support

Prior to the advent of this capability, communications of this nature required a series of voice communications exchanges that risked confusion or interception, delaying support to forces under fire. The fundamental tools of map, compass and radio remained largely unchanged from World War II through the 1991 Gulf War. Even during the initial stages of Operation Enduring Freedom in Afghanistan, while Global Positioning System receivers had largely replaced the map and compass, critical information was still being passed via voice and recorded manually by grease pencil.

Leveraging an Existing, Field-Proven Network

Close Air Support (CAS) platforms were already using the Link 16 network to maintain Air-to-Air Situational Awareness (SA), but troops on the ground had no way to talk to them. Instead ground forces were forced to radio back to a Joint Terminal Attack Controller (JTAC) support element, which then relayed the information via voice to the planes. A Defense Science Board study on air operations during Operation Iraqi Freedom stated that CAS's "utility was limited by what several called an unreliable and overly complex process for requesting and coordinating fires".

This led the U.S. military to look for a better way.

Next-Generation Link 16

Now with ViaSat's Battlefield Awareness & Targeting System-Dismounted (BATS-D) AN/PRC-161 radio, air and ground SA is fused right in the palm of one's hand. The world's first handheld Link 16 radio, the BATS-D AN/PRC-161 bridges a critical capability gap between air and ground forces and enables Digitally Aided Close Air Support (DACAS) integration, solving the problem of ambiguous analog messages by directly connecting the JTAC into the Link 16 network.

This handheld Link 16 radio offers dismounted users access to both air and ground (friendly and enemy) situational data and can provide secure, reliable target data and position location, identification, and status information to the network.

The radio also features J-Voice capability for direct voice communications with other Link 16 users. This direct link dramatically shortens the kill chain and decreases the risk of fratricide, enabling JTACs to Find, Fix, & Finish targets at an exponentially faster rate and with greater accuracy than ever before.

Game-Changing Capability for the Warfighter

The introduction of ViaSat's BATS-D AN/PRC-161 is comparable to smartphones displacing desktop computers; it holds the potential to completely transform the battlefield.

The BATS-D handheld Link 16 radio is the latest example of ViaSat's unique approach to creating new markets with breakthrough innovations and enabling entirely new concepts of operation for the warfighter.

The ability to digitally transmit messages onto the Link 16 network is crucial for the future of conducting CAS in the 21st century.

ViaSat's AN/PRC-161 answers this long-standing operational need and increases both the warfighter's safety and mission effectiveness.

For more information on ViaSat's BATS-D, click here

Choosing the Optimum Link16 Antenna

Cobham Antenna Systems has designed and manufactured antennas, filters, mounting kits and accessories for over 25 years and in that time has built an extensive wealth of RF expertise and knowledge.

This has resulted in a range of products totalling over 2500. In that time the company has become an established provider of Link 16 antennas and filters. The XVO7-960-1215/1120 high gain omni antenna has been the most popular with over 800 deployed in ten years all over the world and no known in-service failures. So you would think with this raft of knowledge under our belts it would be easy for us to offer a customer the right product? Not exactly.

Questions we often have to ask our customers are:

- Where will you be mounting the antenna?
- What gain or distance are you trying to achieve?
- Is it a land or marine application?
- Do you need all around coverage or a directional/targeted signal?
- Where do you need the signal as well as where do you not want it to go i.e. across borders?

Whether the customer has approached us with a technical specification in mind or just asking about availability, the answers to these questions often change the proposed solutions.

How to Achieve Gain

An analogy we often use is squeezing a balloon. If you press the balloon from top to bottom the result will be like a ring donut. In Azimuth it should be perfectly circular providing an omni-directional pattern and consistent gain in all directions. In order to make that pattern go further (increase gain) the balloon needs to be squeezed more. This results in a further spread of the pattern but a reduced height or Elevation of the beam.

Link 16 Omni-Directional Antennas

By far the most popular type of antennas in our Link 16 range are omni-directional. This means a 360 degree coverage, or azimuth radiation pattern (looking down on the antenna from above). The Figure below shows the azimuth pattern of a high gain omni-directional antenna:

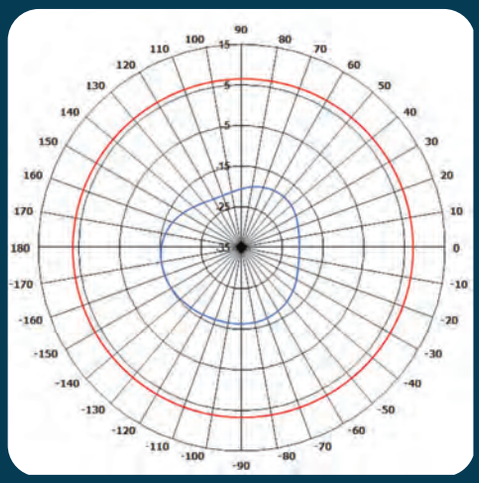


Figure 1 XVO7-960-1215/1120 - Azimuth Pattern

These type of antennas are used in static locations where coverage is needed in all directions and the other end of the link is either unknown or on a mobile platform. The Figure below shows the elevation pattern of a high gain omni-directional antenna.

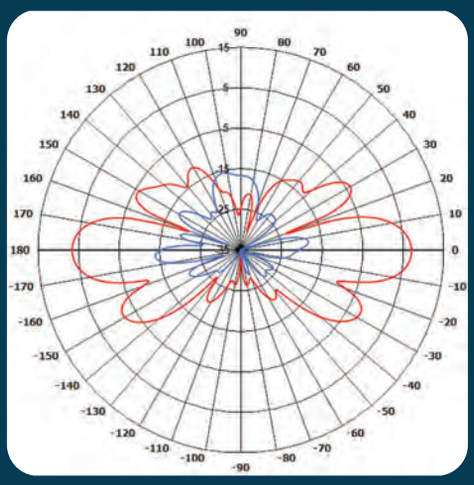


Figure 2 XVO7-960-1215/1120 - Elevation Pattern

Our omni-directional variants cover 2dBi, 4.5dBi, 7dBi and 8.5dBi gains (see Diagram 1 over page). More gain equates to either longer range or higher data rates but comes at a sacrifice in the Elevation beamwidth and often an increase in the physical size of the antenna.

Diagram 1 - Omni-directional variants

Link16 Sector Antennas

Another way to achieve higher gain (and therefore range) from an antenna is to squeeze the pattern in Azimuth as well as Elevation which changes it from an "omni" to a "sector" type antenna.

Sector antennas offer higher gain than omni-directional because the radiation pattern, or beam, is more focused. Whereas an omni-directional antenna has a 360 degree (all around) Azimuth pattern a sector antenna will have more energy in one general direction. Azimuth beamwidths which define the beam shape could be from 60 to 180 degrees.

The figure below shows the azimuth pattern of a sector antenna with 13dBi peak gain and more than 9dBi over a 100 degree solid angle. It also shows that there is a whole region behind the antenna where the energy in that direction is 20dB below the peak. This may be important for particular deployments:

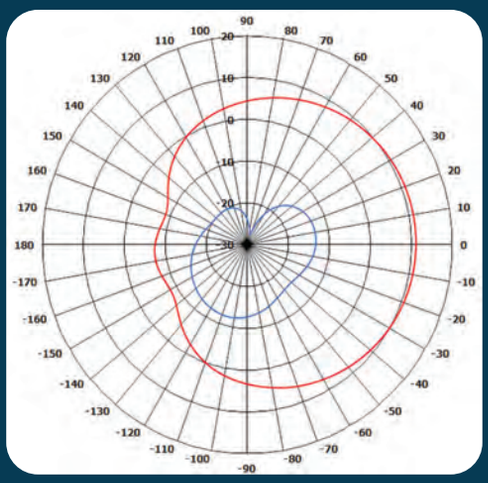


Figure 3 SA13-120-0.96-1.22V/1694 - Azimuth Pattern

Sector antennas can be used where the receiver position is known or where a smaller area of coverage is acceptable. Sector antennas can also be mounted in arrays i.e. three 120 degree sector antennas could be mounted in an array to provide 360 degree (omni-directional) coverage with significantly higher gain than if a single omni-directional antenna was used.

Speciality Applications

There are a number of applications where the type or finish of an antenna may need to be given special attention such as:

Marine

Antennas for marine purposes may need a special paint coating in order to survive salt water exposure. They also need to be extremely rugged, requiring little attention or maintenance so that they can be positioned in often hard to access places.

Handheld

Antennas for use on handheld devices often need to be rugged but do not require a high gain. A gain of 0dBi will, in most instances, be sufficient to meet the needs of the operator, usually over a short range.

Filtering

There may be occasions (particularly in Link 16 bands) where certain frequencies need to either be blocked or passed. Examples are band-pass around the 960-1215 MHz band or to notch-out the IFF bands at 1030 and 1090MHz.

Summary

In summing up there is no one size fits all antenna solution for Link 16 applications. However Cobham is well equipped to ask the right questions to determine which product customers need.

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http://www.european-antennas.co.uk/markets/military/ground-to-air-link16/

Images courtesy of Cobham

mass
a Cohort plc company

Image courtesy of MASS

How the Information Layer Provides a Common Approach to Different Environments

Tactical Data Link (TDL) systems provide vital operational support. TDLs enable the rapid delivery and timely exchange of data, and the passage of command and control information, between multiple assets across the land, sea and air domains.

Demand Versus Supply and Availability of Data and Information

In military operations, time has always been critical and decisions that support the mission need to be made at speed. It is essential that data from the 'information layer', which underpins each successful mission, is shared with the right person, on the right platform at the right time. Yet, Operational Support is undergoing change at an unprecedented rate, driven by a ten-fold increase in the demand for data and its consumption in as many years.

There is no likely change in this level of demand as more complex, information-rich and data-demanding assets enter the battlefield, such as F-35 and the Global Combat Ship, amongst others. Such modern platforms depend on increasingly sophisticated on-board equipment that support the mission, such as intelligence collection capabilities or platform protection systems, which in turn rely on complex data sets to provide mission data sets, threat libraries, tactics and countermeasures.

Without addressing this demand, platform survivability will be placed at risk.

Data and Information Integration

Although Original Equipment Manufacturers (OEM) may be experts in developing various systems, they are not necessarily expert in Operational Support. OEM analysis tools and databases are invariably focused on supporting their own equipment, but fail to support the whole operational lifecycle. One could argue that OEMs are working to an outdated paradigm and, as such, are failing to exploit their own investment in TDLs to deliver integrated and shareable information. As a result, the burden of data integration, and sharing across the operating domain plus the associated risks, remains with the Operational Commander and his staff.

Operations Centre staff also carry the training burden of learning to use different mission support systems that carry out similar functions. Drawing from what is usually an already limited pool of scarce manpower, manning such a labour-intensive, duplicated and manual process can be a real drain on human resource.

Although the process for extracting, analysing and using data is essentially the same for each data source, in practice it is duplicated for each system. Operational staff become locked into standalone processes and switching tasks can take valuable handover time and increase risk and cost. This constraint can impact the ability to respond to peaks in operational demand.

Forming and Exploiting the Information Layer

Consideration of the information layer, how to extract, exploit, manage and distribute data and subsequently form the consistent and coherent information picture, can bring true operational benefits across the battlefield.

The strategy should be about how to achieve coherent data that can be easily shared through a common capability irrespective of the operating domain; a common approach taken for different environments. It is the increasing demand for data and the need to share information between platforms and operating units that should be driving operational thinking.

Informing Capability Procurement

There are also significant benefits outside the operational domains; successfully forming the information layer and subsequently managing and distributing it can allow us to derive capability requirements.

In procuring capability, these requirements can support smart procurement instead of purchasing hardware alone. Allied / collaborating nations will also be able to conduct joint missions more effectively by operating from higher quality common data, thereby helping to lower costs whilst decreasing risk.

The information layer approach can help bring commonality to the battlespace, enhancing mission effectiveness and reducing the time taken to respond to a change in the combat arena.

Supporting and Moving the Information Layer

Data links will be responsible for the movement of the information layer and, as such, must be able to support current and future generation platforms, allowing the sharing of a common battlespace picture. The TDL must also be future-proofed and allow for the passage of all necessary data forms appropriate to the platforms using the link and via a secure means.

The community of interest must consider and debate the concept of the information layer and how to evolve TDL support capabilities to enable timely exchange of data, and the passage of command and control information, between multiple assets across the land, maritime, air and cyber domains.

MASS

MASS is the UK's leading independent provider of Electronic Warfare Operational Support (EWOS) services and solutions.

Building understanding and countering threats in the Electro-Magnetic Environment (EME) is achieved by having a sound information layer based on common data.

MASS has evolved solutions to the EME issues, built on our experience of providing effective and proven EWOS services and solutions across the battlespace.

MASS helps its customers advance their electronic warfare capability across all the operational domains through impartial advice, specialist software applications and the provision of appropriate training. Our expertise includes procurement planning, EW requirements, technical evaluations, EW and intelligence mission data management, mission data production, threat vulnerability analysis and countermeasures development enabling critical platform protection.

Meet the Trainer

SyntheSys Training has recently welcomed a new team member

Roland Kemp, of Limburg province in the southern part of Holland, is a highly experienced Tactical Data Link (TDL) and former Dutch Patriot operator.

Roland served for 37 years in the Dutch Armed Forces, during which time he was a Staff Non Commissioned Officer (NCO) at the Group Operations Centre - responsible for training crews on the Patriot Information Coordination Centre (ICC).

He has also been a Senior Tactical Data Link (TDL) Manager at the National Data Link Management Cell (NDLMC) in the Netherlands responsible for training TDL managers and has been involved in testing weapon systems and platforms equipped with MIDS terminals including F-16, Air Defence Command Frigate and KDC-10.

At the Chief Network Design Facility, he was responsible for training new network designers and the validation and accreditation of newly developed network designs for national and international use.

Roland was also acting Joint Interface Control Officer (JICO) in the JICO cell during exercises such as Joint Project Optic Windmill (JPOW), Roving Sands and in the Joint Combat ID Evaluation Team 2002. During the mission 'Iraqi Freedom' in 2003 he was Link Manager at the Patriot Battalion Level.

His role at SyntheSys is to provide a different viewpoint for our successful Data Link Manager / Interface Control Officer (DLM/ICO) course, tapping into his experiences working with Patriot and the use of Joint Range Extension (JRE) to educate students.

Roland said: "In the last couple of years we have begun moving to Beyond Line Of Sight (BLOS) instead of having only Line Of Sight (LOS) with our terminals in a Radio Frequency (RF) network, so we are using the Joint Range Extension Application Protocol (JREAP) much more these days."

"Tactical Data Links will expand more in the future and we will need more advanced protocols, like JREAP, which give a bigger picture of what's going on in a variety of different situations, whether on the sea, in the air, in space or on land. I also think Link 16 will be around for another 20 years, Link 22 is becoming more common and Variable Message Format (VMF) will be big in the future. There is also a need for a higher throughput of data."

"JREAP enables Tactical Data Link messages to be transmitted over long-distance networks, for instance via satellite links."

Topics Roland will cover in his courses include equipment used, how to set up a network, how to manage a network and how to read and implement an OPTASK Link as defined in the respective NATO documents.

His training style is, he says, "relaxed and informal."
He added: "It's a two-way connection with the students. I try to find out what their basic knowledge is and then add to that."

"Simulation is very important to make everything clear and understandable for the students, something SyntheSys prides itself on."

"To make the picture clear and unambiguous, simulation is vital."

"In daily use of networks you usually only have a few users, but in simulation exercises you have all kinds of resources available. It's much more complex with more ships, fighters, Airborne Early Warning (AEW) and Ground Based Air Defence (GBAD). That is what a DLM/ICO can expect when managing and monitoring a big network. They will be dealing with different implementations, capabilities and limitations of a number of diverse systems, especially challenging when you have to deal with Multi-Link networks."

"Training is where my skillset, experiences and interest lies. It is basically the job I did when I was an officer in the Royal Netherlands Air Force. These courses will be the first of many – that's what I'm here to do!"

Dutch Patriot JRE Provision

Towards the end of 2012 the situation on the NATO border between Turkey and Syria had deteriorated to such an extent that the NATO hierarchy were considering deploying missile defence systems into the area to protect Turkish interests.

The Syrian Ballistic Missile inventory, which comprised weapons supplied by Russia, Iran and North Korea, includes the Hwasong 6, the North Korean version of the Scud C, which boasts a range of up to 500km. This meant that targets well inside Turkey could be hit with ease.

The decision was taken to deploy national Patriot assets, under NATO control, along the Turkish/Syrian border to provide defence against the Syrian threat. Patriot units from the Dutch, German and United States forces were subsequently deployed as a counter to potential Syrian aggression.

During the planning for this deployment the question arose of how the information gathered by the Patriot systems (specifically the Dutch) could be fed back to the higher command for both situational awareness and, potentially, decision making. A local Link 16 network was already operational, but obviously without other means for disseminating this data, it was only available to local operators.

In November 2012 the Dutch military made tentative enquiries to SyntheSys regarding the purchase of JRE to meet the requirement to redistribute the local Link 16 information to higher formations. Having the requisite agreements in place with the US Department of Defence and Engility (the JRE manufacturers), SyntheSys was able to provide JRE systems to authorised end users via Direct Commercial Sales, rather than the usual Foreign Military Sales route. This meant a quicker approval and delivery time, which was especially important considering the operational scenario.

Subsequently, after providing the necessary purchase information, SyntheSys received a purchase order from the Dutch procurement offices in January 2013. The order was for JRE server and client software and hardware, together with the necessary support and training.

The normal delivery time between receiving an order and the systems being delivered to the customer is 160 days. However, by using the Direct Commercial Sales route, close coordination between the Dutch MOD, SyntheSys and Engility, and the operational urgency, it was less than 100 days between receipt of the purchase order and the JRE system arriving with the customer. Installation of the systems and training for the operators was immediately carried out by a combined SyntheSys/Engility team, and the systems and personnel were ready for deployment before the end of April 2013.

Once in theatre, the JRE systems were immediately put to use, and by utilising JREAP-C the Tactical picture provided reachback to NATO's Ballistic Missile Defence Operations Cell (BMDOC) on a 24/7 basis.

Together with the NATO BMDOC the Joint Interface Control Cell was managing and monitoring the network and was manned by personnel from the German DLMC, the Dutch NDMC and RNLA GBAD together with military from the US Army. The BMDOC was always kept up to date on the status of the network. Control and Reporting Centre System Interface (CSI) and Tactical Data Analysis and Connectivity System (TDACS) were used to route data to and from HQ Ramstein. A JRE client was used to manage the JRE at the Dutch Patriot Battalion when no operators were available.

The Dutch Patriot systems remained in theatre starting from the end of January 2013 for a total of 23 months. The JRE systems remained serviceable throughout the whole period. The only maintenance that was done was by cleaning the dust filters. Since returning to The Netherlands, the Dutch JRE systems have been used for exercises, testing and training.

This success story illustrates how close coordination between military and civilian international organisations can lead to results far exceeding initial expectations, culminating in an optimal service for the front line combatants.

Images courtesy of Roland Kemp/Patriot

Ask theTrainer

Can an Operator Strengthen or Weaken a Link 22 Network?

Consultant Paul Czajkowski has had a 22 year exemplary career within HM Royal Air Force and five years' established civilian instructional expertise. He is accredited to both UK military and civilian education & training standards. Paul has a recognised ability as an innovative and adaptable leader, specialising in Multi-Tactical Data Link Network Design, Management, Testing and Instruction. He has provided Multi-TDL training, including VMF and JREAP, to a number of NATO Nations, non-NATO nations and international companies. He has also given specialist Network Design support to a variety of nations and organisations including NATO, UK, Austria, Finland, Italy, Denmark, Hungary and international companies.

In the last edition, we discussed how many Surveillance time slots should be requested for a C2 JTIDS/MIDS Unit (JU) in a Link 16 network. We identified the primary J-Series message being used within Surveillance, the J3.2 Air Track message, and subsequently explored its transmit rules. This information, along with the assigned packing level, allowed us to come to an answer and a realisation of exactly how to improve our overall Link 16 planning and design processes.

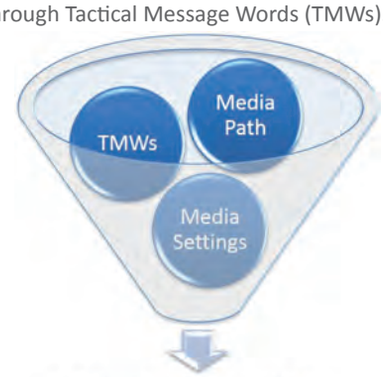
Now the question is, can we apply this methodology to *the new TDL on the block* – Link 22? The answer is 'Yes' but it is arguably much more complicated. Indeed, just like our article on Surveillance capacity in Link 16, the final answer is a *best guess* calculation based upon a set of rules and thus applying an average. Please note that this article will discuss this methodology but the numbers used are to be viewed as an example.

As in all operations, the desire to adopt best practices and the drive for efficient use of capacity is paramount. We have seen a continuous increase in demand for capacity within Link 16 networks; even with the introduction of new initiatives such as Enhanced Throughput, how long will it be before that *extra capacity* is used up?

Link 22 has been designed to try and overcome some of the issues surrounding MIDS Link 16, most notably in Network Design and Management. Link 22 has the capability to be as efficient as possible, for example, by identifying the most appropriate media path. Nonetheless, does that mean we no longer need to educate our data link managers and operators to understand how to calculate capacity and efficiency for Link 22 operations? Simply put, do we solely rely on what the *computer* does? Surely that would create managers and operators who only know how to *push a button!*

The first thing we should appreciate, is that Link 22 has the preliminary and on-going capability to calculate desired capacity for each user inside the Net Cycle Structure (NCS). The initial capacity is calculated by the System Network Controller (SNC). These requirements are detailed within the OPTASK Link 22 Segment through detailed information such as Bandwidth Requirement (NUBWR). Nonetheless, as with most computers, to identify this capacity it must comply with several rules or in the case of Link 22 – a range of values. These rules and distinct values determine NCS efficiency and other parameters that are needed, safeguarding that when the SNC is calculating capacity for the NCS, it does so in the most efficient way. So where does the SNC get these initial values? That's right, they are manager / operator defined. Yes, you could utilise default values but it only continues to result in the ability to *push a button* and doesn't support the operator really understanding the *why.*

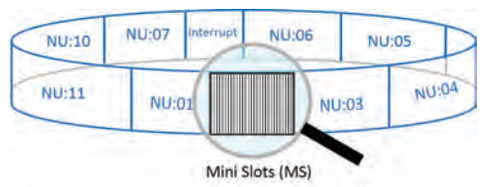
At this point, we could come to an early conclusion on how much understanding really is involved when undertaking effective planning for Link 22! Link 22 fixed format data is transmitted by F & FJ-Series messages through Tactical Message Words (TMWs).



n number of Assignment Slots

These TMWs are sent in a Time Slot known as an Assignment Slot, which each Nile Unit (NU) would be allocated an *n* number of. To make matters worse each Assignment Slot is made up of *n* number of Mini Slots, and how many of these there are varies dependent upon the media path utilised. It also must be noted that, unlike Link 16, Link 22 does not support the concept of Network Participation Groups, i.e. the grouping of specific messages for transmission to be within certain time slots. If data needs to be transmitted, it is transmitted based upon message priority and other factors.

In Link 22 the media paths are High Frequency (HF) & Ultra High Frequency (UHF), and for the case below we shall use HF. ***Please note that the numbers described below are purely to be taken as an example.*** Let's say that an NU has a single Assignment Slot containing 20 Mini Slots and in each Mini Slot we could send 10 TMW. Just like Link 16 we can distinguish what the transmission rules are for both messages, but unlike Link 16, in Link 22 time slots are assigned for the transmission of any data. This results in any number of connotations due to the number of messages defined and varying transmit rules for each subsequent message.



To remain in context with our previous article, we now use a Link 22 Air Track message. Each Link 22 Air Track message requires *two* TMW to send each Air Track, that would allow each Mini Slot to support up to five Air Tracks. Therefore, our single Assignment Slot of 20 Mini Slots allows for the transmission of up to, potentially, 100 Air Tracks.

As previously stated, this is a *best guess*; there are lots of rules applied when transmitting data and if you recall, any data can be sent within an Assignment Slot. Furthermore, for Link 22 an additional capacity of *n%* must be added for technical messages. It is these technical messages that are ultimately ensuring Link 22 is operating in the most efficient way.

All data link planners will understand that there is always a *trade off* somewhere and it's simply just not that easy. A platform requesting the ability to transmit *n* tracks may require *n* Assignment Slots. The more Assignment Slots that are defined, the longer the Operational NCS takes to complete. So our realisation of understanding one area to promote efficiency impacts directly on another area, but we can discuss that at another time.

In summary, Link 22 has been designed to be as efficient as possible and reduce the overheads of Planning, Design and Management. Certainly, features such as Dynamic Time Division Multiple Access greatly improve the management process and positively support active operations. The question organisations now must ask is, do we want our managers and operators to simply *just push a button?*

Do you have a question you would like to ask?

contact:
tdltech@synthesys.co.uk

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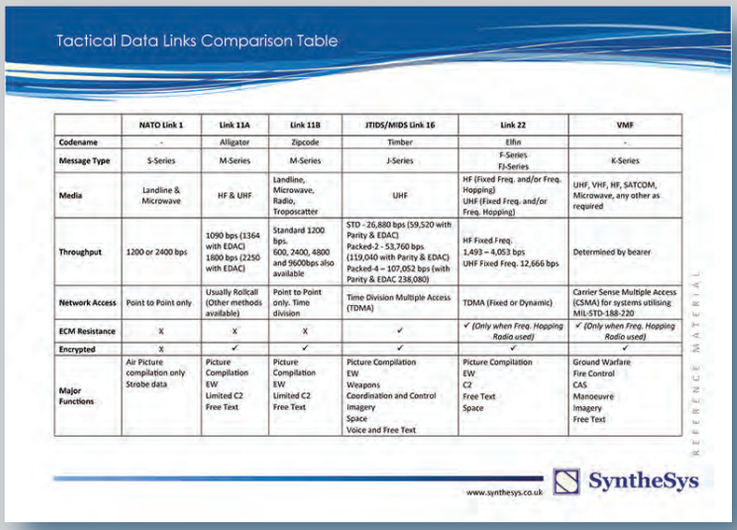

Tactical Data Links Comparison Table

	NATO Link 1	Link 11A	Link 11B	JTIDS/MIDS Link 16	Link 22	VMF
Codename	-	Alligator	Zipcode	Timber	Elfin	-
Message Type	S-Series	M-Series	M-Series	J-Series	F-Series FJ-Series	K-Series
Media	Landline & Microwave	HF & UHF	Landline, Microwave, Radio, Troposcatter	UHF	HF (Fixed Freq. and/or Freq. Hopping) UHF (Fixed Freq. and/or Freq. Hopping)	UHF, VHF, HF, SATCOM, Microwave, any other as required
Throughput	1200 or 2400 bps	1090 bps (1364 with EDAC) 1800 bps (2250 with EDAC)	Standard 1200 bps. 600, 2400, 4800 and 9600bps also available	STD - 26,880 bps (59,520 with Parity & EDAC) Packed-2 - 53,760 bps (119,040 with Parity & EDAC) Packed-4 – 107,052 bps (with Parity & EDAC 238,080)	HF Fixed Freq. 1,493 – 4,053 bps UHF Fixed Freq. 12,666 bps	Determined by bearer
Network Access	Point to Point only	Usually Rollcall (Other methods available)	Point to Point only. Time division	Time Division Multiple Access (TDMA)	TDMA (Fixed or Dynamic)	Carrier Sense Multiple Access (CSMA) for systems utilising MIL-STD-188-220
ECM Resistance	X	X	X	✓	✓ *(Only when Freq. Hopping Radio used)*	✓ *(Only when Freq. Hopping Radio used)*
Encrypted	X	✓	✓	✓	✓	✓
Major Functions	Air Picture compilation only Strobe data	Picture Compilation EW Limited C2 Free Text	Picture Compilation EW Limited C2 Free Text	Picture Compilation EW Weapons Coordination and Control Imagery Space Voice and Free Text	Picture Compilation EW C2 Free Text Space	Ground Warfare Fire Control CAS Manoeuvre Imagery Free Text

REFERENCE MATERIAL

www.synthesys.co.uk SyntheSys

This comprehensive table examines the different Tactical Data Links including NATO Link 1, Link 11A, Link 11B, JTIDS/MIDS Link 16, Link 22 and VMF and gives detail including on message type, network access, encryption, media, major functions, track quality, positional and air speed granularity, documents, examples of users and much more. Message types covered are S-Series, M-Series, J-Series, F-Series, FJ-Series and K-Series. Examples of users include NATO Navies and Air, Australia, the UAE, Brazil, South Korea, the United States, United Kingdom, Germany, Spain, Finland, Canada and the Netherlands.

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Meet Us At

Date	Event	Location	Further Information
7-9 March	JRE Working Group	San Diego, USA	Roland Kemp Attends
27-30 March	NTDLS 2017	Calpe, Spain	'20 years NTDLS - Achievements - Future Challenges'.
30 Oct - 02 Nov	IDLS 2017	Abu Dhabi, UAE	Dates for your diary

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- Requirements Capture & Documentation
- TDL Simulation
- IO Analysis, Tests & Reporting
- Platform Initialisation
- Knowledge of Standards
- Operational Evaluation / Data Analysis
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October 3-5	Link 22
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