CISTECH SOLUTIONS

Interoperability Specialists

AUTONOMOUS WARRIOR REPORT

NOVEMBER 2018





1. THE SCENARIO

Autonomous Warrior 2018 was an opportunity for a variety of unmanned air (UAV), surface (USV) and ground (UGV) vehicles to be integrated into one strategic control network while being assigned tasks remotely. CISTECH Solutions partnered with Ocius (Bluebottle USV), Silvertone (Flamingo Mk II UAV) and Praesidium (M.A.P.S UGV) to provide a standalone network throughout the Jervis Bay area allowing access to view and control all platforms from anywhere within the network without a strategic backhaul required. This was network was created solely using the Persistent Systems MPU5.

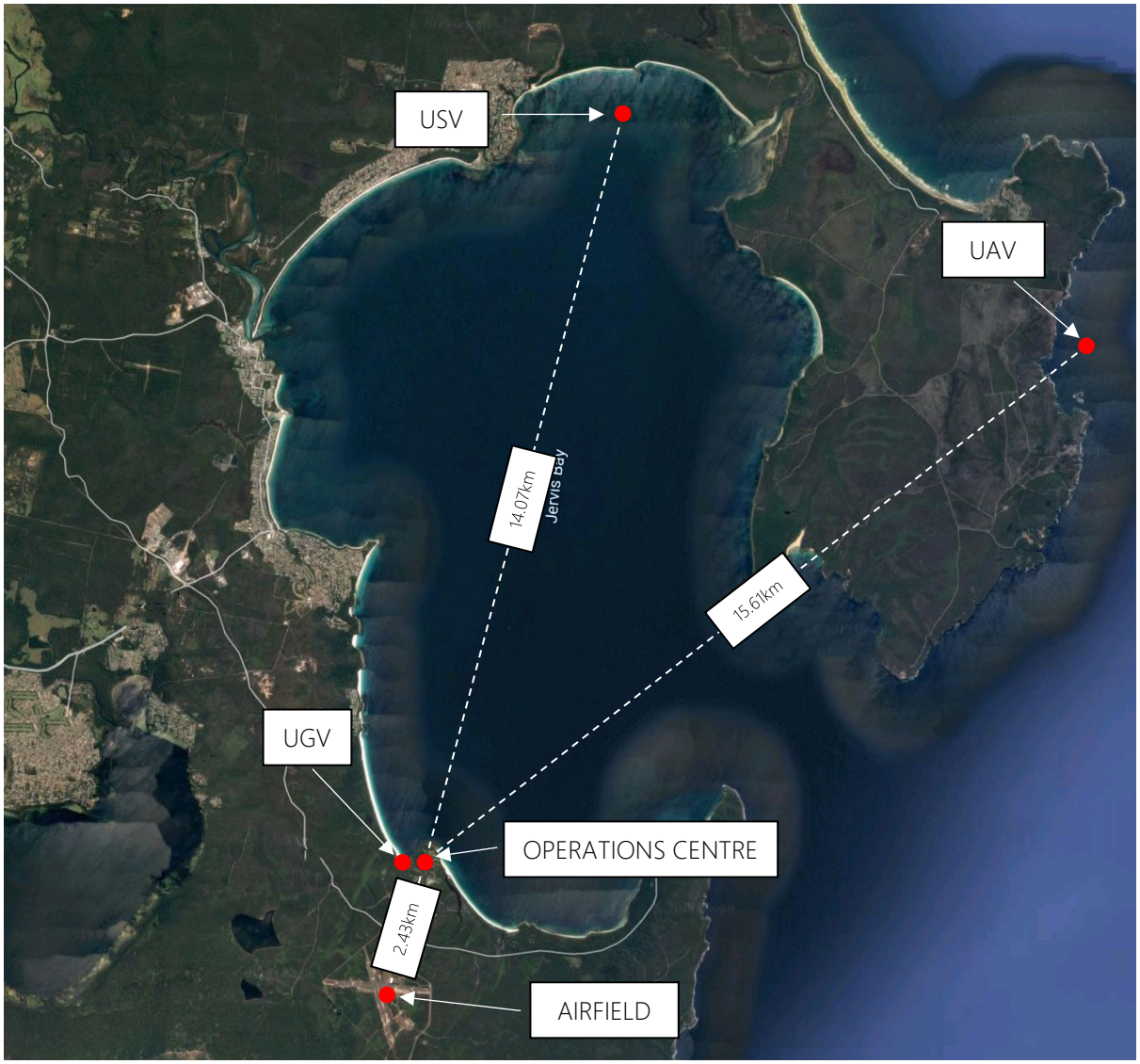


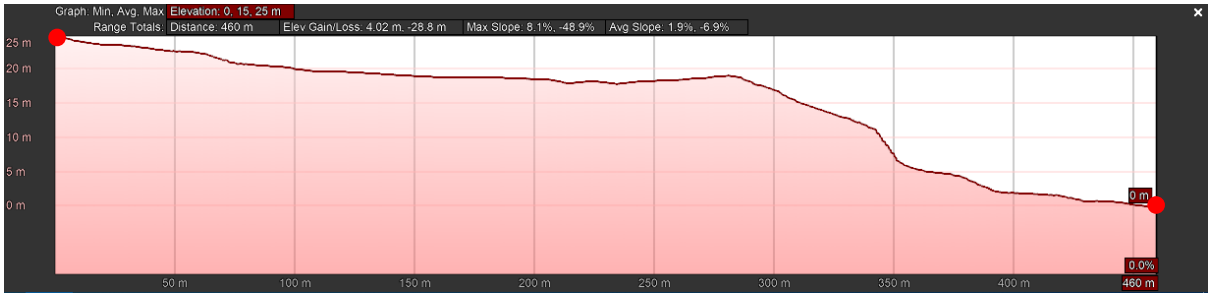
Figure 1. Platform and Control Locations

OPERATIONS CENTRE

Figure 2. Elevation Profile Between Operations Centre and Airfield

AIRFIELD

Figure 2. Operations Centre, Lower Sports Ground and Wharf



OPERATIONS CENTRE

Figure 2. Elevation Profile Between Operations Centre and USV Launch (Wharf)

WHARF

OPERATIONS CENTRE

Figure 2. Elevation Profile Between Operations Centre and UGV Launch

LOWER SPORTS GROUND

The elevation profile analysis shows that critical locations do not have line of sight, introducing complications for sustained and reliable communications.

2. THE EQUIPMENT

Due to the Wave Relay® MPU5 MANET (Mobile Ad-hoc Network) capabilities, high-speed networks can be created over multiple hops and through difficult terrain, providing voice, video, situational awareness and data throughout a Beyond Visual Line-Of-Sight (BVLOS) area of operations.

The Wave Relay® MPU5 is the world's first smart radio. The MPU5 is the most advanced, most scalable, and most efficient Mobile Ad Hoc Networking (MANET) radio in the world. Built to create powerful, secure networks anywhere, the MPU5 unites all your critical data sources in real time – giving you and your team the confidence to make difficult decisions in the heat of the moment. Data, video, voice, and a fully integrated Android™ computer system makes the MPU5 the world's first Smart Radio.

MPU5 Key Features include;

- Android Computer – 1GHz Quad Core CPU, 2GB RAM, 128GB Storage
- Integrated HD Video Encoder – 3G-SDI, Composite, HDMI Inputs
- HD Video Decoder – Hardware-based H.264 decoding
- 16 Channels of Push-To-Talk Voice
- RoIP Radio Interface – Tether legacy radios into the MANET network
- Full Duplex voice communication
- 3 x USB Ports
- 10/100 Ethernet
- IP68 Rated to 20 metres of depth for 30 minutes
- Wide Temperature Range -40°C to 85°C
- Integrated GPS Module
- Four times the range of the previous generation Wave Relay® product range
- Over 100 Mbps throughput
- One radio chassis – multiple interchangeable radio modules
- 3 x 3 MIMO Technology
- Up to 10W output power

Figure 3. Wave Relay®

3. THE SETUP

The scenario was completed using 7 Wave Relay MPU5's (1 x Operations Centre, 2 x Mast Relay Nodes, 1 x Airfield Controller, 1 x UGV, 1 x UAV and 1 x USV).

3.1. Operations Centre Setup

The Operations Centre radio was deployed as a static node, using a directional antenna to create a high-speed, long distance link between the UAV and USV deployed in Jervis Bay.

Inside the Operations Centre, a Windows application developed by CISTECH Solutions - MaCE (MANET Command Environment) - was being used to display Situational Awareness, monitor the status of the MPU5 network, stream live video from each of the platforms, and access 16 voice TalkGroups from the MPU5 network. The ability to monitor the MPU5 network provides a visual representation of the signal strength between each radio and allows for advanced network planning from a single access point.

The MaCE application also provides height, speed and track information for each of the platforms, for real time awareness of each platform.

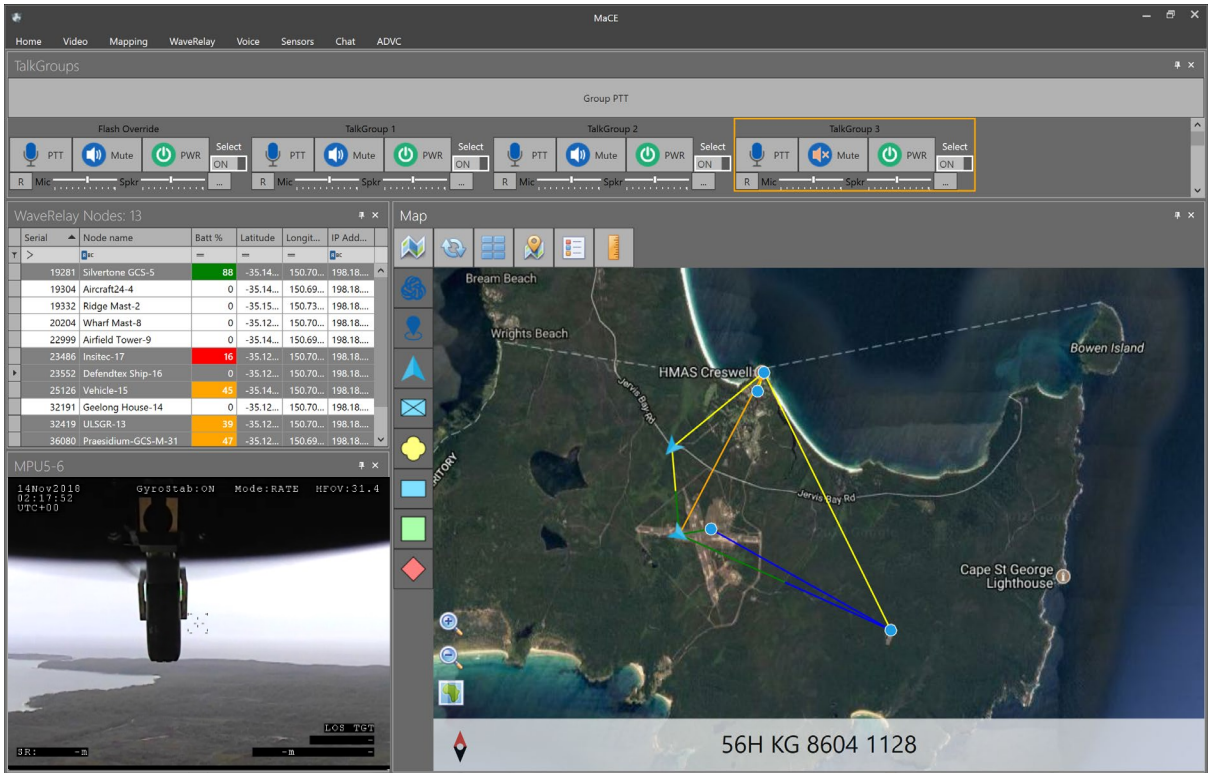


Figure 6. MaCE Screenshot showing UGV and UAV during the Exercise

3.2. Mast Relay Nodes

The Mast Relay nodes were installed on a 15 metre hydraulic mast mounted on an easy-to-tow trailer. Inside this trailer were 2 lead acid batteries which were paired with a solar panel mounted to the front of the trailer, providing 24 / 7 power to the MPU5 for persistent and sustained communications. These mast relay nodes also provided an advantaged link to overcome terrain obstacles between the wharf and the Operations Centre.

Figure 7. Photo of a Mast Relay Node

3.3. Unmanned Ground Vehicle (Praesidium's M.A.P.S)

The M.A.P.S. (Mission Adaptable Platform System) is a medium sized semi-autonomous unmanned platform capable of supporting a variety of missions. Rugged, flexible and easy to operate, the MAPS UGV can conduct ISR missions, prove routes, extract and transport casualties, support tactical resupply and accurately employ heavy weapons.

The M.A.P.S was sent mission packages from the Operations Centre and carried out ISR tasks by either known GPS markers or used the 'follow' function to track behind a user.

Figure X. Praesidium's M.A.P.S with MPU5 Mounted

3.4. Unmanned Air Vehicle (Silvertone's Flamingo Mk II)

The Flamingo Mk3 is delivering high-value solutions in asset monitoring, agriculture and agribusiness, emergency services, energy supply, research and military operations. A fixed wing aerial vehicle, with a typical take-off weight of 25kg, it is capable of carrying large payloads and completing multiple tasks in one mission.

For autonomous and long-endurance missions, the Flamingo Mk3 is hard to beat - providing an efficient and cost-effective means to access large, remote or dangerous areas of land for surveillance, intelligence gathering, site or equipment monitoring, surveying, security and safety.

During the Autonomous Warrior exercise, the Flamingo Mk3 was launched from the remote airfield and given orders from the Operations Centre, communicating via the on-board MPU5 radio. Due to the radio's ability to hop through other radios to communicate, Flamingo can be used as communications extension, and due to its long-endurance can maintain this communication as well as provide ISR until your mission has been completed.

Figure X. Silvertone's Flamingo Mk II with MPU5 Mounted

3.5. Unmanned Surface Vehicle (Ocius's Bluebottle)

Bluebottle USVs are autonomous data gathering & communications platforms being like 'satellites of the sea'. They offer multiple economic and operational advantages over conventional methods of ocean surveillance such as:

- Continuous coverage
- Wide coverage
- Greatly reduced capital costs
- Greatly reduced operational costs - no fuel, food or crew
- Elimination of errors due to human fatigue
- No people or expensive assets in harm's way

Other persistent USVs carry only small payloads, have low power for the payload and often have low performance to manoeuvre, avoid collisions and 'make way' out of currents. Bluebottle can carry 200-300kg payloads for customer's sensors and modules, with 50W average power for the payload, with kW bursts.

Bluebottle harvests all the weather on the ocean; the sun, the wind and the waves so they can advance under all conditions and can remain at sea for months at a time. Bluebottle has more power, payload and performance in the one USV than any known persistent USV.

Figure X. Ocius's Bluebottle with MPU5 Mounted

4. THE SOLUTION

4.1. Using Wave Relay® MPU5s

The exercise took place using MPU5s over RF with no strategic backhaul or beyond line-of-sight bearer.

Channel Frequency: 1372MHz
Channel Bandwidth: 10MHz
Link Distance: 14.9mi (24km)
Power: 2W per Chain
Encryption: 256-bit AES-CTR with HMAC-SHA-256 (Suite B)

The Mast Relay Nodes were extended to 15m above ground level, with the MPU5 mounted to the top of the mast. Bluebottle and Flamingo Mk II were free to travel to the northern point of Jervis Bay, as well as up to 10km off the shore line beyond the heads. M.A.P.S could travel around the Lower Sports Ground and through the dense vegetation surrounding without any disruption to communications

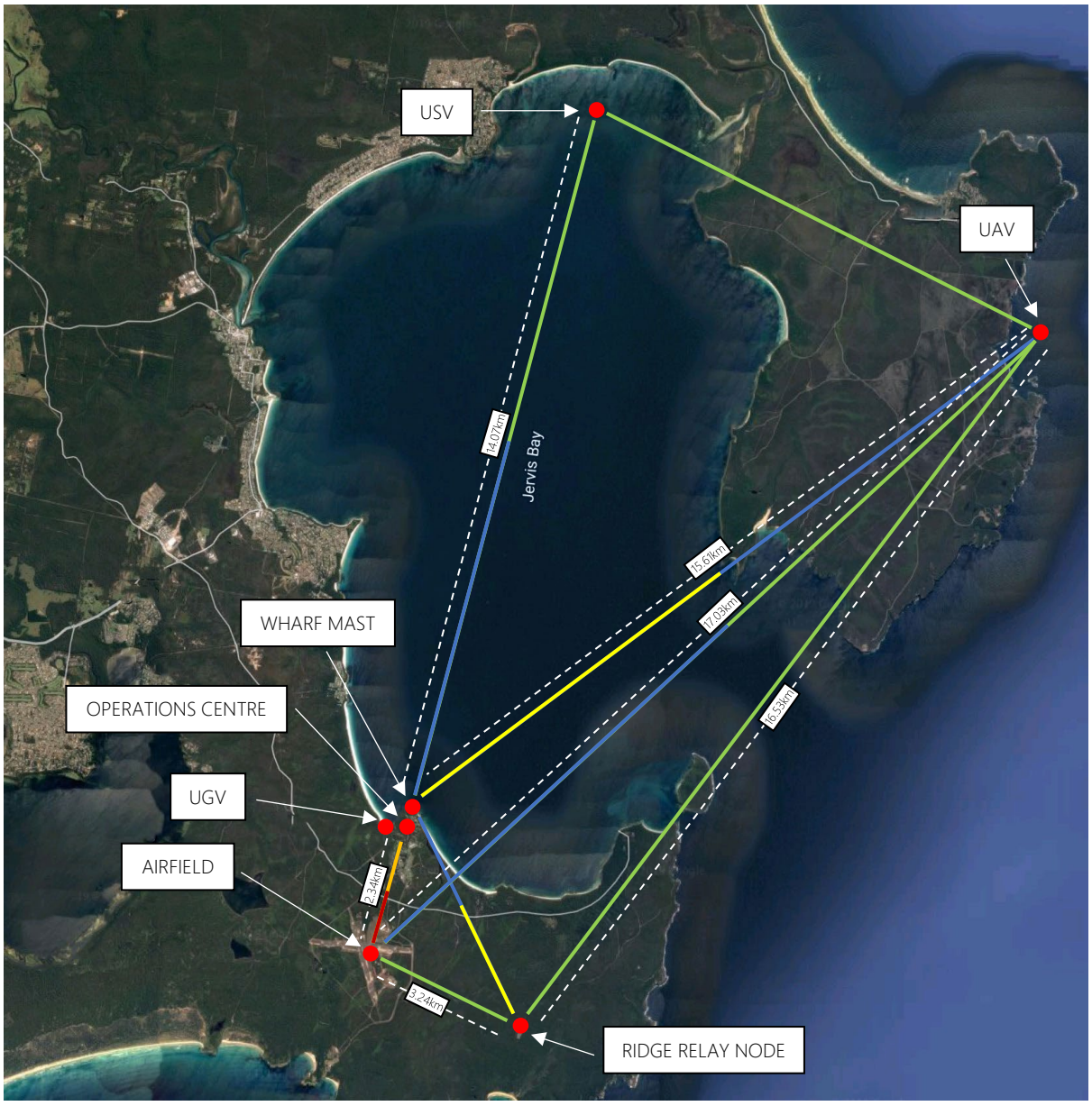


Figure 9. Overview of MPU5 Solution showing SNR Inteconnectivity

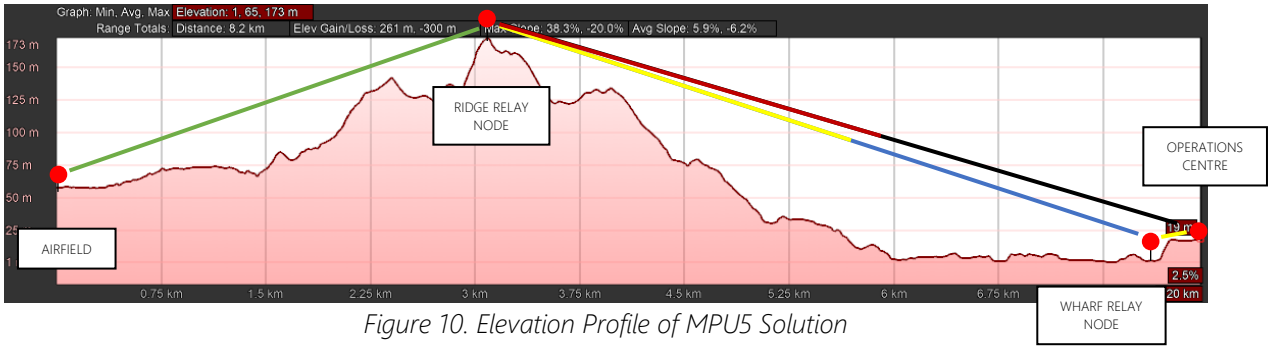


Figure 10. Elevation Profile of MPU5 Solution

Figure 11. Capture of Gimble from UAV

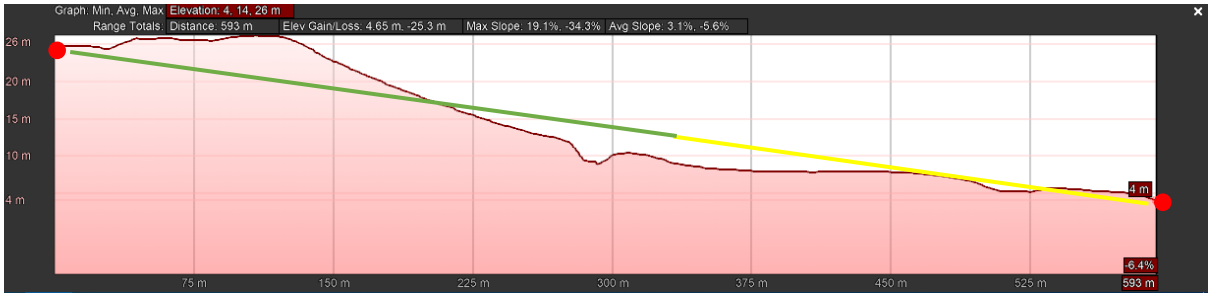
Figure 12. Capture of Tailcam of UAV

Figure 2. Operations Centre, Lower Sports Ground and Wharf

OPERATIONS CENTRE

Figure 2. Elevation Profile Between Operations Centre and USV Launch (Wharf)

WHARF



OPERATIONS CENTRE

Figure 2. Elevation Profile Between Operations Centre and UGV Launch

LOWER SPORTS GROUND

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