INFINET wireless

Application Notes

# Infinet Wireless' solutions for network infrastructure on a sea vessel

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# Introduction

This document serves to demonstrate uses of Infinet Wireless' solutions when building a wireless network infrastructure for sea transport.

## KEY OBJECTIVES

- Providing continuous connection for sea mobile vessels
- Providing seamless switching of sea vessels from one Base Station (BS) to another

## SERVICES

- Nomadic and mobile vehicle connection
- 70 km to sea shore
- Transmission of data, voice, video and other information via one channel
- Seamless coverage for vessels at a distance of 25–30 km from the port terminal

# Unique technologies by Infinet

The problem of maintaining connectivity on mobile vessels is effectively solved by using Infinet Wireless' solutions interacting with each through our own MINT protocol (Mesh Interconnect Network Technology).

**KEY ADVANATGES OF MINT PROTOCOL**

1. Quick switching between Base Stations
2. Backup and fault tolerance
3. Continuous monitoring of communication channel quality

## 1 Quick switching between Base Stations

A special Multi BS mode provides continuous network connectivity. In case of significant decrease of the current connection quality (the signal level falls to the BS by more than 30%), the subscriber terminal on the vessel can forcibly disconnect from the current BS and initiate a search for another one providing a better connection. At the same time, the subscriber terminal does not try to restore the lost connection to the BS, but immediately seeks to connect to other BSs.

## 2 Backup and fault tolerance

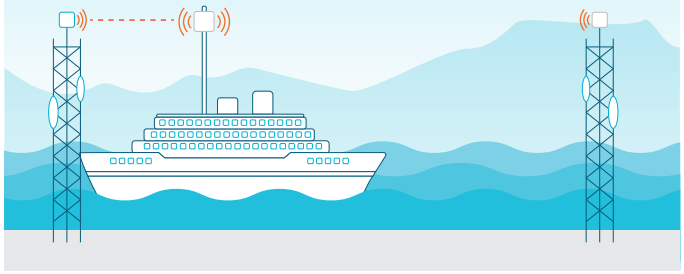
Being able to use more than one route to deliver the data from one unit to another prevents the risk of looping traffic. Installing more than one terminal on a vessel provides backup.

MINT protocol has 'MINT-over-Ethernet' technology which considers factors such as signal-to-noise values, capacity, number of retries, and delays in order to choose the best route from multiple wireless channels.

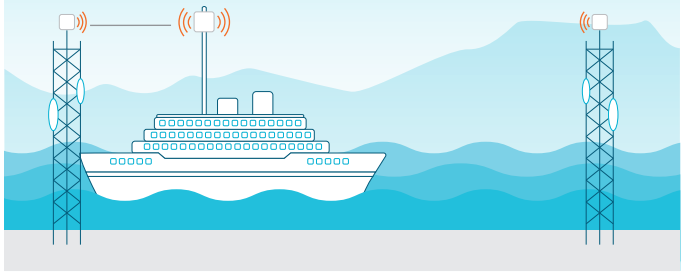
The result of combining several adjacent Infinet devices together by MINT-over-Ethernet technology is known as a 'mesh' infrastructure. Within the mesh, Infinet equipment can switch the traffic of other Infinet connected devices through itself. To build a network with mesh infrastructure you should use an 'InfiMUX switch' with built-in MINT protocol.

## Wi-Fi work examples

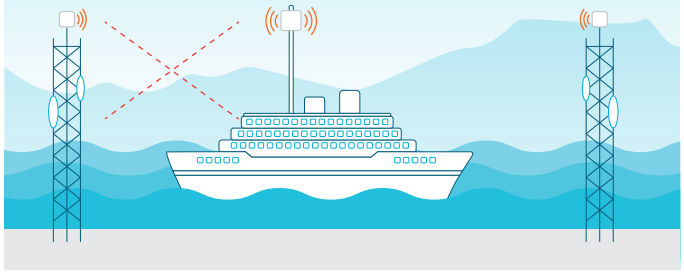
Connection is lost



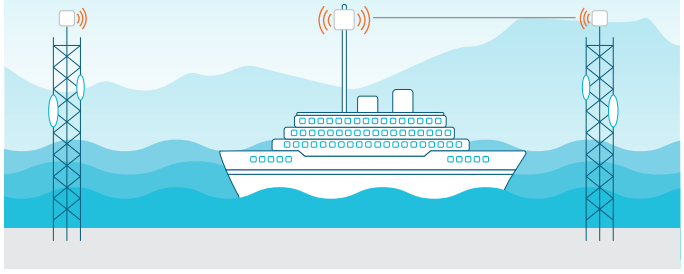
Reconnection to the lost BS



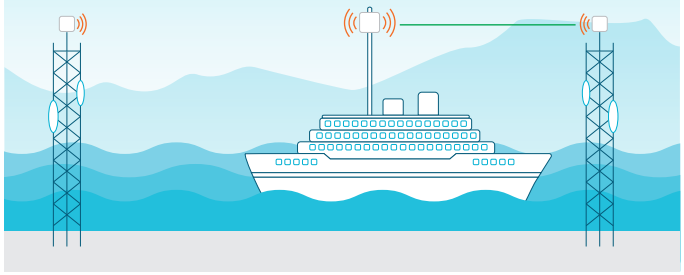
After unsuccessful attempts reconnect to the lost BS



Connection to a new BS

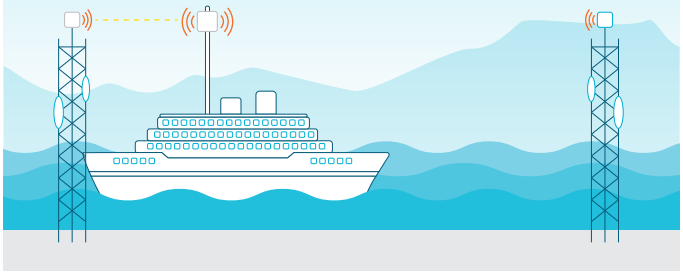


Successful connection to the new BS

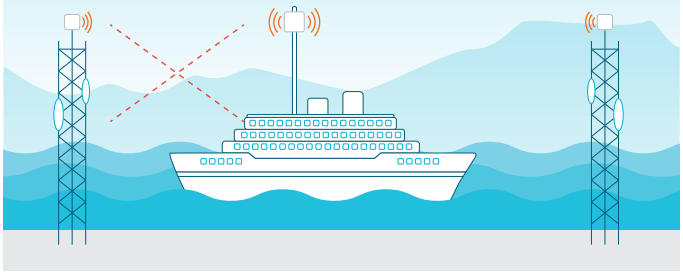


## MultiBS examples

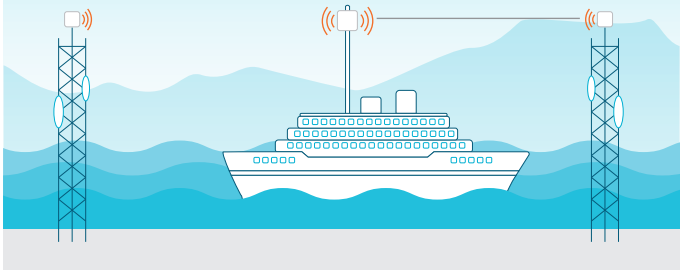
Connection is decreased, but not lost



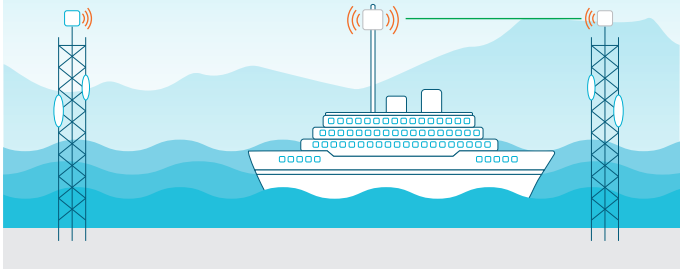
ST interrupts connectivity. Reconnection to BS is excluded



Connection to a new BS



Successful connection to the new BS



*Picture 1. Wi-Fi work example and MINT-protocol with MultiBS option*

## KEY ADVANTAGES OF INFIMUX

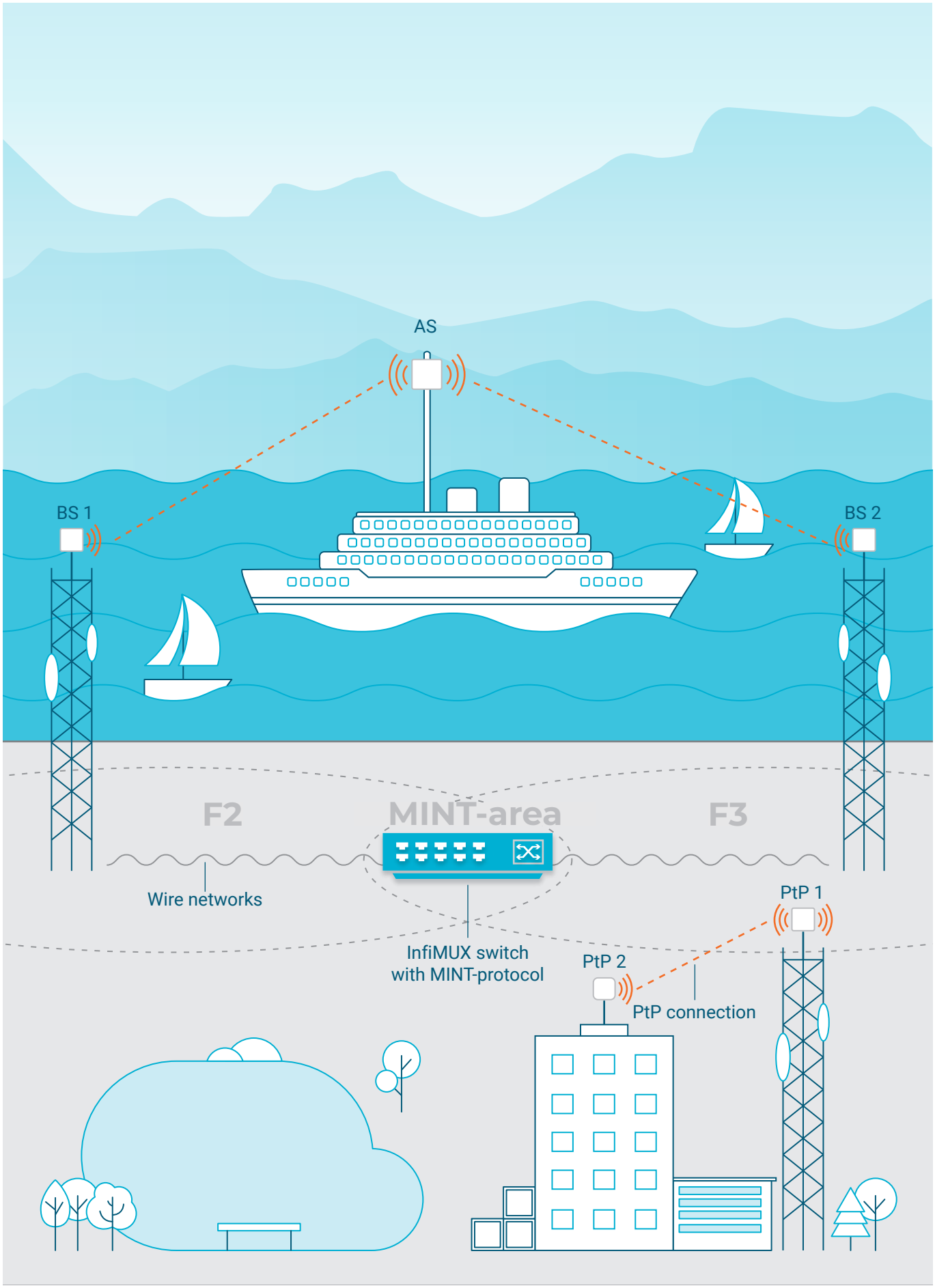
Infimux combines several MINT devices, distributes loads across multiple MINT connections and monitors the quality of each connected communication channel. When using the InfiMUX switch, the service settings are transferred to it, which accordingly requires the configuration of only the wireless communication channel on the Infinet devices. InfiMUX receives data on the status of each wireless communication channel via MINT protocol.

To determine the optimal route, InfiMUX evaluates the following parameters:

- Throughput
- Load level on a connectivity channel
- Number of retries
- Signal\noise ratio

## 3 Continuous monitoring of communication channel quality

The device continuously monitors the quality indicators of each communication channel. If the device has several network routes, then the route for sending data will be determined based on factors such as the signal-to-noise parameters, throughput, delay time, and the number of retries. This is known as the ‘MINT-value’. The decision to change the route used is made every 1-3 seconds, depending on the settings of the MINT protocol.




*Picture 2. Architecture of a solution for sea transport*

# Recommendations for nomadic and mobile projects

Infinet Wireless solutions interact with each other through MINT protocol (Mesh Interconnect Network Technology) - Infinet's own transport protocol that effectively solves the problem of mobile vessels connection.

## PLANNING

Coverage areas of different BSs must overlap. BS's should be placed such that the vessel is always within the coverage area of at least one BS. This will minimize or eliminate downtime caused by disconnected connections during switching between BS.

When planning a BS deployment, it is also necessary to consider:

- The presence of a coverage zone from subscriber terminals installed on ships to the BS. The radiation patterns of BS antennas and subscriber terminals installed on mobile objects.
- Attention should be paid to possible changes in the main radiation lobe of antennas from subscriber terminals when moving in areas with changing terrain.
- It is recommended that mesh topologies consisting of two or more Infinet devices are created. For example, to provide automatic antenna alignment when changing the position of the ship relative to the BS on the shore, four sector antennas with a radiation angle of 120° are used. Thus, the entire space around the ship will be constantly used to track possible connections with BS installed on the shore.

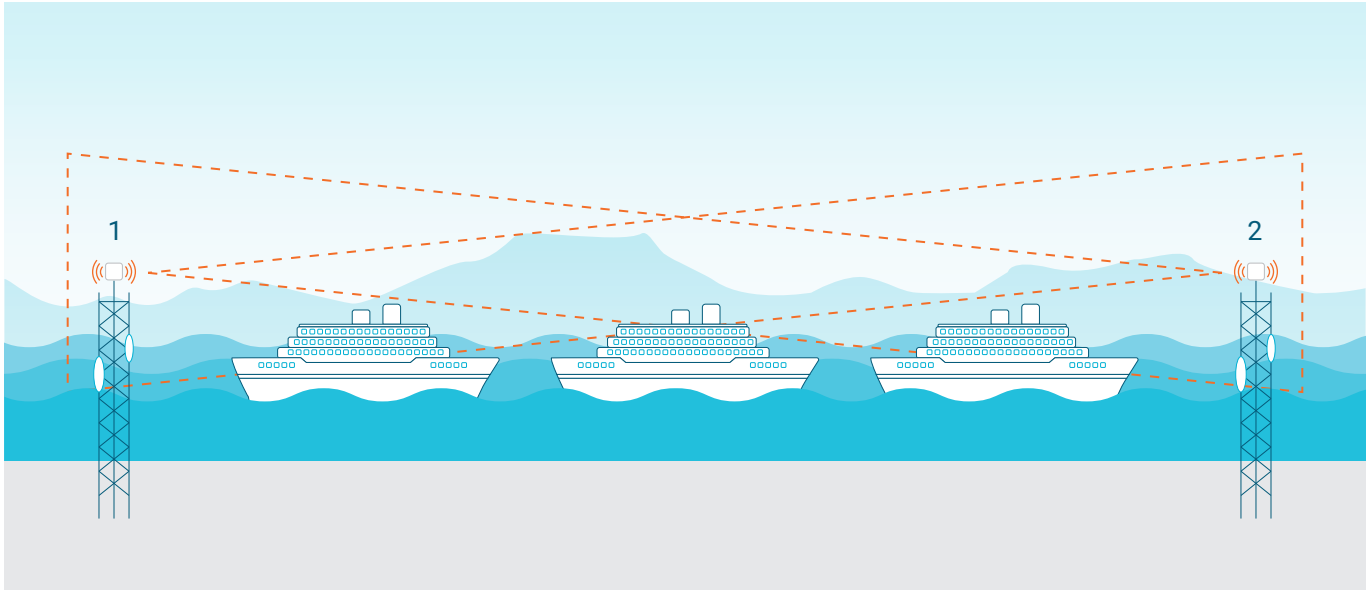
## TRANSMISSION MODE SELECTION

In projects with moving objects, it recommended that you use only the MISO mode (Multiple-Input and Single-Output) and not the MIMO mode (Multiple-Input and Multiple-Output).

In the MISO mode, the same data set is transmitted for both signals spaced in space (vertically and horizontally polarized). While, on the receiving side, it is possible to compensate for data loss in one polarization by a set of the same data received in another polarization. Thus, MISO increases the signal level at the reception and allows it to work with the reflected signal.

## MISO MODE ADVANTAGES

- Redundancy (due to the possibility of using any polarization).
- Back-up of data transmission. If the data is transmitted in a horizontal polarization with a large percentage of retries and in a vertical one correctly, problems with a horizontally polarized signal will not affect the quality of the provided communication services.




*Picture 3. Planning coverage areas example*

# Examples of projects

## ROSMORPORT

Russia

In April 2015, a project to modernize the communication infrastructure of Rosmorport in the eastern part of the Gulf of Finland was completed. The covered territory is more than 10 thousand square kilometers and includes the ports of St. Petersburg and the Leningrad Region: Kronstadt, Ust-Luga, Vysotsk, Primorsk.

The focus areas of the modernization were port administrations, pilotage services, radio engineering posts, customs divisions, icebreakers and ships operating in the Gulf of Finland.

At various facilities of the seaport, 33 BS sectors and 200 stationary subscriber terminals (ST) were installed, which ensured the connection of local wire networks to the BWA network over distances of up to 20 km with a throughput of up to 50 Mbps.

Mobile subscribers are installed on the masts of icebreakers at between 3 and 20 meters above sea level, the throughput of such devices is at least 4 Mbps at a ship speed of up to 12 knots. Ship equipment sets provide stable communication at a distance of up to 30 km from the coast.

## FERRY TRANSFER ON THE ISLE OF WIGHT

UK

Red Funnel is Britain's oldest ferry company providing the first ferry service between the coast of England and the Isle of Wight.

The main technical requirement was to increase the data transfer rate and reduce the signal delay time. In addition, it was necessary to provide passengers with high-speed and uninterrupted Internet access throughout the entire route of 19 km. The result was a continuous transfer of data from the ship to the shore at a speed of at least 20 Mbps through 8 BS installed on the shore.

All ferries were equipped with 6 ST so that at any time there were at least two permanent wireless connections, and the ability to select the most optimal route with maximum throughput and minimum delay time.

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