

Best Practice Guide

for Maritime Peplink Certified Engineer (mPCE)

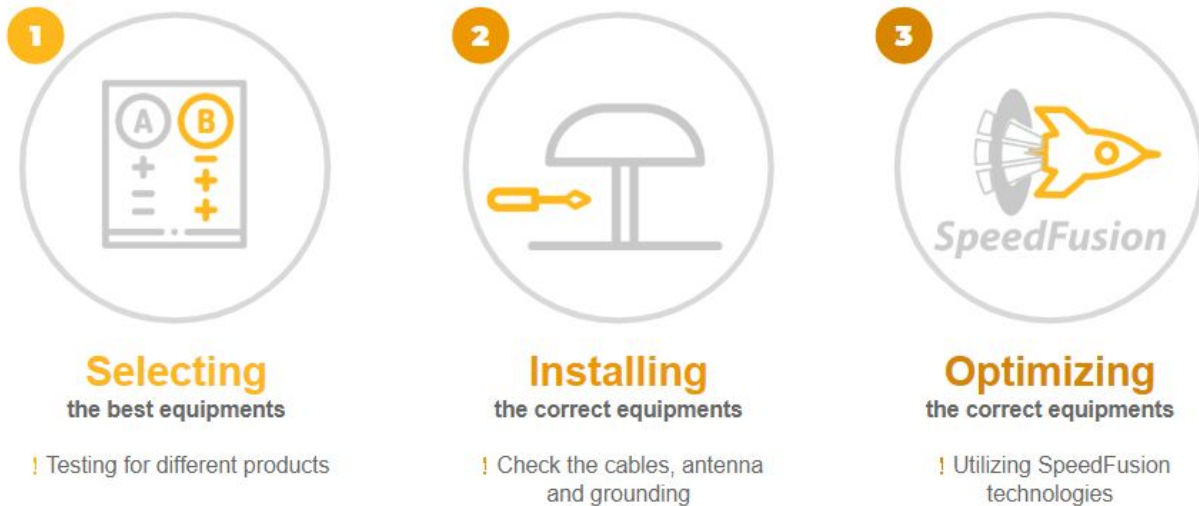
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Intro



The aim of this manual is to allow partners to select, install and operate Peplink equipment in a maritime environment to get the best out of Peplink's hardware and software offerings. We will break this down into three main areas:

1. **Selecting the equipment** - this session will provide information on how to get the best out of Peplink equipment in the difficult marine environment.
2. **Installing the equipment** - topics to cover would include things like router and antenna placement, cable types and lengths, Wi-Fi AP locations for coverage (for example, vessels made of carbon fiber need lots of APs, fiberglass yachts need less).
3. **Optimizing the equipment** - this session covers the services like SpeedFusion, SpeedFusion Cloud (TotalFusion) and SIMCloud and how to integrate them within the maritime space.

Selecting the equipment

Selecting the equipment used for a maritime installation is a complicated process. Every installation will bring different challenges. To select the best equipment for installation you must consider the following challenges;

- Clients' needs and expectations
- Available space
- Budget
- Equipment capabilities
- Ongoing operating costs

Managing Client Expectations

Different clients will have very different requirements and expectations. Some clients want basic connectivity via cheap cellular plans. For these vessels we would recommend a Transit DUO, UBR Rugged or HD2 Dome. For more demanding clients, a more powerful device such as an MBX HD2, HD4 or even an HD6 will be required. The most demanding clients will require EPX. There is no fixed rule which shows the relationship between the size of the vessel and the model required but we recommend the following as a guideline for luxury yachting industry;

- Up to 40m Minimum Transit Duo
- 30m to 50m MBX HD2 or HD4
- 45m to 90m MBX HD4 or HD6
- 80m+ EPX

One of the most important things is to find out what the client expects from the system. If they want connectivity as they have at home, a BR1 or Transit DUO will not be sufficient for most situations.

Available Space

Space on board vessels can seriously affect how a high-quality solution is achieved. Every vessel is going to have different installation requirements. Some vessels have a nice air-conditioned rack near the mast which is perfect for the equipment. Others have very limited spaces that are not necessarily waterproof which can mean installing the router further away from the antennas than ideal.

Budget

Usually, the client will have an idea or budget of how much they want to spend on a solution and this must be taken into consideration when selecting the equipment utilized. Giving a client multiple solution options can allow the client to select a solution that meets their requirements.

Equipment Capabilities

Peplike has a large range of products with a solution for every situation. Throughput and available WANs are the main features that will determine which model you chose but other factors such as IP rating, Wi-Fi capabilities, SpeedFusion throughput, FusionSIM compatibility and size will also impact your decision.

Ongoing Operating Costs

Many factors can influence the cost of operating a solution including but not limited to; location of the vessel, internet connection availability, remote support & monitoring, SpeedFusion, warranty & other subscriptions. This must be factored in from the start.

Installing the equipment

The Installation of the equipment needs to be completed to high standards to achieve the expected results. Using high-quality components throughout the system is important. One substandard component or incorrectly selected piece of hardware can reduce the performance of the whole system e.g. low-quality coaxial cable or low gain antennas.

- Antenna Cable
- Router Location
- Lightning Protection
- Grounding
- Antenna Location

Antenna Cable

Antenna cables should be as short as possible and utilize high-quality coaxial cable of adequate specifications. Whenever possible, the router should be located as close to the antennas as possible. It is much easier to run network cables than multiple coaxial cables. If a long coaxial cable is utilized, the gain from the antenna can be lost on the cable run. For example, a 6dBi gain antenna (at 1800MHz) with a 30m of LMR400 would have around 6.2dB of loss on the cable¹.

- **LMR²** is the newer generation of RF coaxial cables. They provide greater flexibility, ease of installation and lower cost. They are used as transmission lines for antennas on missiles, airplanes, ships, satellites and communications.
- **LMR 200** is an outdoor rated flexible low loss communications coax. It has an impedance of 50 Ohm, and is great for short antenna feeder runs. This also has a feature of low PIM.
- **LMR 240** is also an outdoor rated flexible low loss communications coax with an impedance of 50 Ohm. It is designed for short feeder runs for a variety of applications including GPS, WLAN, and Mobile Antennas.
- **LMR 400** is a flexible communications coax with an impedance of 50 Ohm. It is used for jumper assemblies in wireless communications Systems and short antenna feeder runs. If you need a cable that requires periodic or repeated flexing, choose this one. LMR 400 was designed to replace the RG-8 cables.
- **LMR 600** “Half-Inch” is designed for outdoor use as well. It is more flexible than air-dielectric and hardline cables in terms of bending and handling. It also has an impedance of 50 Ohm.
- **LMR 900/1200/1700** are larger cables designed for medium antenna feeder runs with any application requiring an easily routed, flexible low loss cable.

¹ Calculated via [Coaxial Cable Attenuation & Power Handling Calculator](#)

² Learn more at [Understanding Coaxial Cables - The Complete Guide](#)

Router Location

Locating the router near the antennas allows for much better signal strength and quality due to shorter cable runs. However, this can create an issue for accessing the router for *changing SIM cards*. The SIM Injector helps in this situation by allowing the SIMs to be remotely placed on the router from anywhere on the local network. Current devices that support FusionSIM and are relative to the Maritime Industry are; HD4 MBX, HD1 Dome, HD2 Dome, HD2 Mini, UBR Rugged and HD2 IP67.

Two things to consider when locating the router nearer the antennas are the power source and water ingress. If you are installing the router in a location close to the antennas, chances are that there was not electrical equipment operating there in the past so consideration must be made for power sources and *protecting the equipment from water ingress*. Some Peplink products are able to solve both of these problems by being powered by PoE and having an IP rating e.g. BR1 IP55, BR1 IP67, HD2 IP67, HD1 Dome, HD2 Dome and the HD4 IP67.

Lightning Protection

Lighting is a threat which is more common in some areas and more likely to affect certain types of vessels e.g. catamarans are much more susceptible to lightning strikes than a monohull. Lightning arresters should be used between the router and antenna cables. Proper earthing of the chassis of the router will further protect the equipment.

[Learn more](#)

Here is a selection of some of our preferred reading resources on lightning/surge protection, including for the marine industry from Australia.

- <https://www.lpi.com.au/services/earthing-calculator>
- https://www.ldu.com.au/basics_of_power_surge_protection.html
- http://www.lightningman.com.au/lightning_safety_procedures.html
- <https://www.clubmarine.com.au/exploreboating/articles/24-5-When-lightning-strikes>
- <https://www.cbgsystems.com/antennas/lightning-protection-systems>
- <https://www.eit.edu.au/cms/resources/books/lightning-surge-protection-and-earthing-of-electrical-electronic-systems-in-industrial-networks>
- You can also search in your favorite search engine for “marine lightning protection”.

Short note:

- Boats make a terrific conduit for lightning, so putting protection into the equipment is essential.
- With a metal hull boat, you can earth to the hull.
- For fiberglass, you will need to get a suitable brass plate on the outside of the boat fitted as far as possible below the waterline that you can earth to.

Grounding

Proper grounding has two benefits. The first is to help mitigate the effects of lightning mentioned in the previous section and the second is to improve signal strength. Using the ground (or earth) from the electrical source is generally not sufficient. The equipment should be earthed directly to the hull of a steel vessel. If it is fiberglass, there should be a metal plate on the hull used for grounding.

Antenna Location

The location of the antenna is very important. We have come across many units that are installed in a cupboard with the factory-supplied antennas. This will work while in port and close to cell towers but the moment the vessel ventures further out to sea, you would lose connectivity a few miles out. By placing your antennas up as high as possible with a 360° view of the horizon, you will be able to extend the range at seeing up to and beyond 50km / 31miles (depending on the location and local networks).

Cable & Antenna Installation Checklist

<i>Dos</i>	<i>Don'ts</i>
<p><i>Cables</i></p> <ul style="list-style-type: none"> • No splitters • Short cable runs • High-quality cables • Few connectors <p><i>Antenna</i></p> <ul style="list-style-type: none"> • Good antenna placements (360° unobstructed) • Good antenna selection <p><i>Grounding</i></p> <ul style="list-style-type: none"> • Correct grounding 	<p><i>Cables</i></p> <ul style="list-style-type: none"> • Passive splitters • Long cable runs • Low-quality cables • Lots of connectors <p><i>Antenna</i></p> <ul style="list-style-type: none"> • Bad antenna placement (blind spots) • Bad antenna selection <p><i>Grounding</i></p> <ul style="list-style-type: none"> • No grounding

Optimizing the equipment

The initial configuration of the equipment onboard the vessel is not where the solution ends. It is very important to get the best out of the equipment for the benefit of all onboard. To do this, we utilize all the features provided by Peplink. These include;

- SpeedFusion
- FusionSIM Cloud
- InControl2
- Notifications

SpeedFusion

SpeedFusion is Peplink's proprietary multi-WAN VPN Bonding solution which combines multiple connections into one reliable and fast connection. Cellular connections can be flakey and unreliable especially while a vessel is at sea and moving between different cells. By using SpeedFusion with multiple different cellular providers, we are able to maximise reliability and speed by creating a single connection utilizing multiple different connections.

Learn more from SpeedFusion and Best Practices Whitepaper :

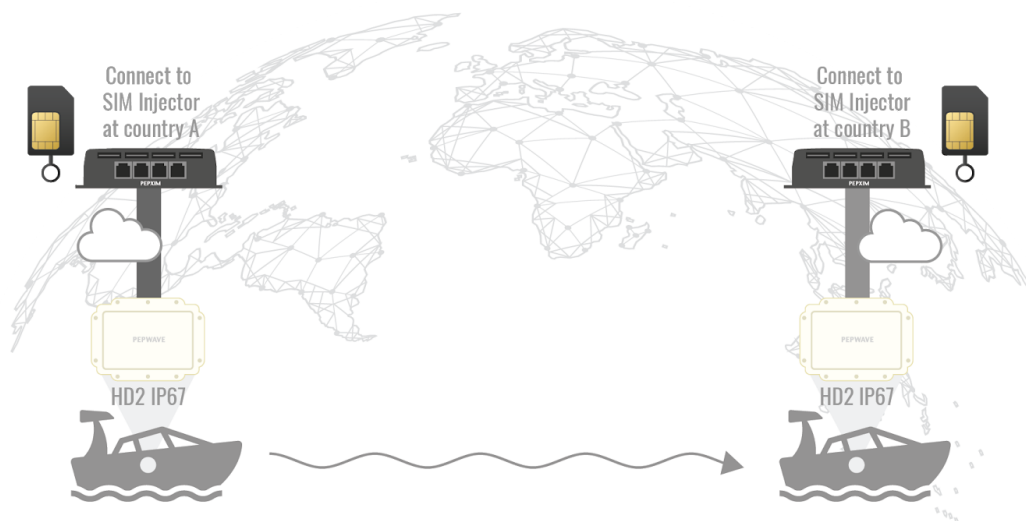
<http://download.peplink.com/resources/whitepaper-speedfusion-and-best-practices-2019.pdf>

SIM Injector

The SIMInjector, also referred to as a SIMBank, allows for SIM cards to be placed on a compatible router from a remote location within the local network. This means a router can be installed up the mast, near the antennas and the SIM injector installed on the LAN of the router somewhere else on the vessel. This allows for easy and safe swapping of SIM cards. This is a great solution if a router is installed in an area that requires safety equipment or a permit to work to access the router. The SIM Injector also supplies PoE for devices that can be powered by PoE e.g. HD Dome & HD2 IP67.

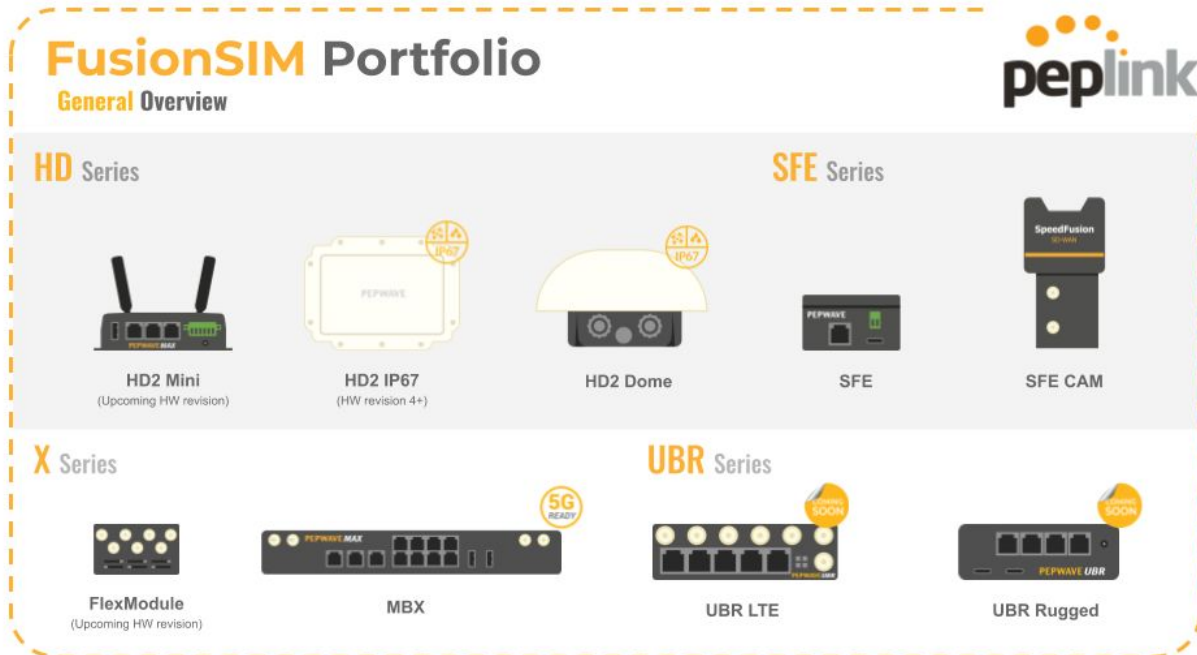
FusionSIM Cloud

FusionSIM Cloud allows for SIM cards to be remotely placed on routers using preset triggers like geo-fences and data usage. This is not an e-SIM technology, a physical SIM card is still required but this can now be located in a SIMBank located anywhere in the world. The router requires an internet connection to first connect to the FusionSIM Cloud and acquire remote SIMs. This initial connection can be made using a SIM card in the router or another connection such as WiMAX. The router does not store the SIMs during a reboot or if all internet connections are lost. (As long as there is a connection to the internet, FusionSIM goes on)



One of the massive advantages of FusionSIM is the ability to use local SIM Cards on a vessel that is constantly traveling through different countries without having to physically deliver the SIMs to the vessel. These SIM cards can be used on one vessel for a period of time and when they are no longer required (due to going out of a geo-zone or over a data limit for a particular SIM or data package) they are returned to the FusionSIM Cloud and are immediately available to another FusionSIM capable device. This allows SIM cards to be reused on a different device almost immediately and more importantly, automatically.

SIMInjector & FusionSIM Cloud Compatibility



Models which compatible with SIM Injector & FusionSIM include:

- HD2 Mini (upcoming HW version)
- HD2 IP67 (HW4+)
- HD2 Dome
- SFE
- SFE CAM
- FlexModule (upcoming HW version)
- HD2 MBX / HD4 MBX / MBX Pro
- UBR LTE
- UBR Rugged

InControl2

InControl2 is Peplink's powerful cloud monitoring and control environment which should be central to your on-going support for vessels. The main features of InControl2 are remote monitoring, access and bulk configuration.

Remote monitoring allows for multiple devices to be monitored in a central location. Some of the vitals that can be monitored are; device online/offline status and history, WAN online/offline status and history, data usage, SpeedFusion status, Event logs, cellular signal history, device location and connected clients.

Remote access is possible as though you are onboard the vessel utilizing a simple but secure system. This makes configuration changes and troubleshooting very simple, secure and efficient as the likelihood of having to visit the vessel is greatly reduced.

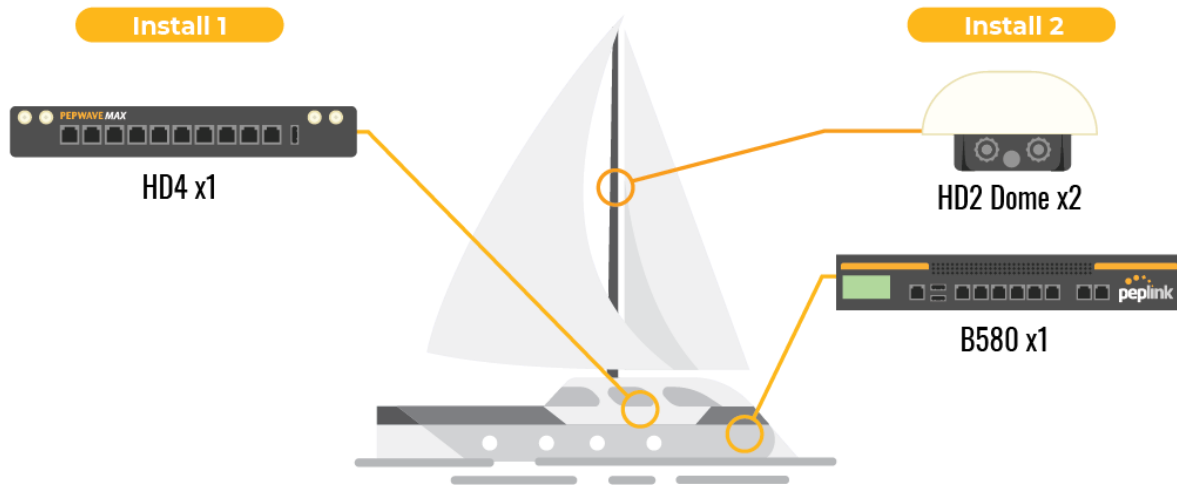
Configuration for multiple devices can be deployed and modified simply and efficiently. Firewall rules, outbound policies, VLANs, SpeedFusion connections, captive portals and wifi configurations are some of the features which can be managed from InControl2

Notifications

Notifications allow for real-time alerts if preset conditions are met. Examples of this are WAN and SpeedFusion connection monitoring. You can enable notifications to be sent if a WAN or SpeedFusion connection is offline for a period of time. This allows for proactive monitoring of a client's device. Third-party integrations can also be achieved utilizing API's with InControl2 or directly with devices and also with SNMP.

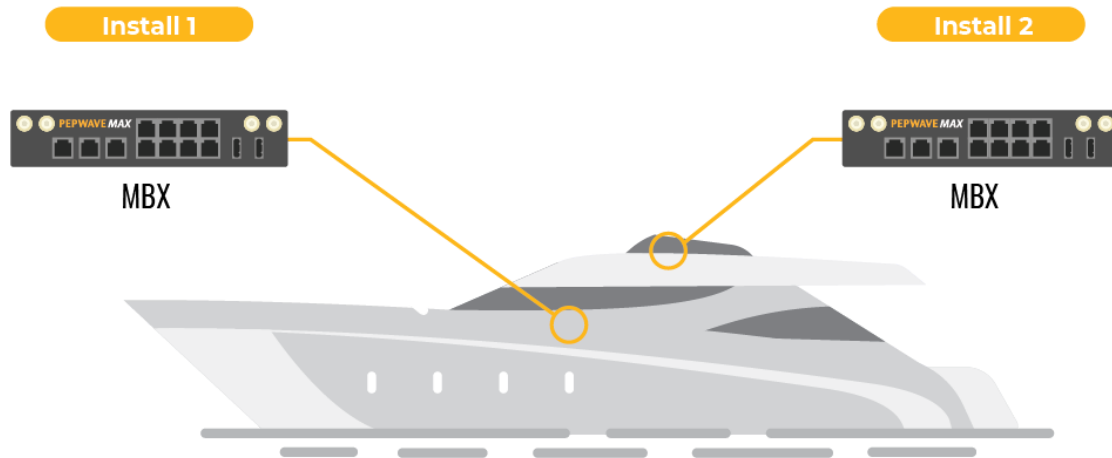
Scenario studies

Scenario A: Sailing Yacht (45 meters)



	<i>Install 1</i>	<i>Install 2</i>
Devices	<ul style="list-style-type: none"> 1x MAX HD4 	<ul style="list-style-type: none"> 2x MAX HD2 DOME 1x Balance 580
Pros	<ul style="list-style-type: none"> Easy SIM access Coaxial cables probably already exist in mast High gain antennas up mast 	<ul style="list-style-type: none"> Zero signal loss Easy SIM access if SIMInjector is used
Cons	<ul style="list-style-type: none"> Long antenna runs (+/-30m) Large signal loss on antenna cable 	<ul style="list-style-type: none"> Multiple routers to manage Additional switch required to split HD2 into individual modems Hard to access SIMs if SIMInjector is not used Might have to run the network cable

Scenario B: Motor Yacht (55 meters)



	<i>Install 1</i>	<i>Install 2</i>
Devices	<ul style="list-style-type: none"> 1x MAX HD4 MBX in bridge rack Long coaxial cable run to mast High gain antennas installed up mast 	<ul style="list-style-type: none"> 1x MAX HD4 MBX installed within the mast High gain MIMO-omnidirectional antennas
Pros	<ul style="list-style-type: none"> Easy SIM card access 	<ul style="list-style-type: none"> Very little loss on cables due to shore coaxial cable run Single network cable required from mast to main rack (usually present)
Cons	<ul style="list-style-type: none"> Massive loss on antenna cable (loss can even cancel out the gain of the antenna) Lots of coaxial cables required 	<ul style="list-style-type: none"> Power required within the mast (sometimes present) Not easy to access SIM cards - can be overcome by installing a SIMInjector

Scenario C: Motor Yacht (95 meters)



	<i>Install 1</i>	<i>Install 2</i>
Devices	<ul style="list-style-type: none"> • 2x MAX HD4 installed in the main rack behind the bridge • 4x Omnidirectional antennas • 4x Passive Splitter (1 in, 4 out) • 4x 30m coaxial cable run 	<ul style="list-style-type: none"> • 1x EPX Installed within the mast • 15x Omnidirectional antennas (mix of MIMO-omnidirectional antennas and ANT-107) • Fiber connection between mast and the main rack
Pros	<ul style="list-style-type: none"> • Easy SIM card access 	<ul style="list-style-type: none"> • Very short antenna cable runs • Easy to change modems and antenna configuration in the future as technologies advance • Reduction of antenna footprint by using 4x4 antennas (ANT-107) • Fast connection to the main rack - not limited by 1Gbps network connection
Cons	<ul style="list-style-type: none"> • Long Coaxial cable runs • Passive splitters are reducing signal strength by % • Two separate routers to manage 	<ul style="list-style-type: none"> • Not all antennas are long-range marine antennas • Not easy to access SIM cards (RemoteSIM features will be introduced with new FlexModules)