Network Performance Specification

DOC No.: DOCUMENT NUMBER

Project: PROJECT NAME

Project code: PROJECT NUMBER

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Printing House Conventions

|  |  |
| --- | --- |
| Sample of notation | Usage comments |
| Setup.exe | Messages, commands, files, folders and other Windows OS info |
| <Enter> | Keyboard key names |
| Start > All Programs | Menu items |
| Interface | Window names, tabs, icons, checkboxes, buttons, radio buttons and text box captions, and other interface elements, important text |
| Note | Notes |
| WARNING | Warnings |
| Auxiliary text | Auxiliary text |
| http://www.amver.com | URL |

# DOCUMENT STATUS

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# CHANGES IN DOCUMENT

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# Introduction

Data of different sensors is used in VTS systems. These data should be transmitted from remote sites to control centers and back. Leased Ethernet or IP network is used for this transmission. Data communication network should meet certain requirements to get actual and correct data from different sensors on control center. The requirements are different for different type of traffic.

Wartsila can work with Layer 2 and Layer 3 data communication network. Layer 2 data communication network is preferable and Wartsila will use own Layer 3 devices for Layer 2 data communication network.

The main parameters are used to determine data network requirement are following:

* Latency. Mean one-way delay, Delay in wire bound environment, delay in wireless environment, delay in IP environment.
* Jitter. Delay due to IP delay variation buffer.
* Packet loss.
* Bandwidth.
* Dead time. Period of no network connection.

# General Network Equipment Specification

1. Have enough physical interfaces to connect all equipment on site / control center.
2. Support different subnet for each location, including Inter-VLAN IP routing for full Layer 3 routing between two or more VLANs.
3. Support of Protocol Independent Multicast (PIM) for IP Multicast routing.
4. IGMP (Internet Group Management Protocol) support for IP Multicasting.
5. Multicast VLAN Registration to efficient multicast distribution in ring networks by dedicating a single VLAN for multicast traffic, thereby removing duplicate multicast traffic in other VLANs.
6. Support Quality of Service features.
7. Ready for multicast service (CCTV Video distribution).

# Sensor List

## AIS Sensor

The AIS Sensor may be the following AIS data sources:

* AIS Base Stations
* Shipboard AIS transponders or AIS receivers
* AIS Network systems which have a standard interface of AIS presentation port in accordance with IALA A-124 recommendations.

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth | 0.128 | 0.128 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link quality criteria

A common criteria used to determine the quality of AIS sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

1. Packet size: 64 bytes
2. 50 continuous pings with 100ms delay with repetition time 10 sec
3. Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

1. Time Exceeded Message
2. Parameter Problem Message
3. Destination Unreachable Message
4. Timeout delay reply more 1 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## DSC Sensor

DSC sensor can perform the following functions:

* Receiving and Transmitting DSC data
* Providing data to the Operator Display Units for processing and displaying to the operators

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth | 0.128 | 0.128 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link reliability criteria

A common criterion used to determine the quality of DSC sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

* Packet size: 64 bytes
* 50 continuous pings with 100ms delay with repetition time 10 sec
* Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

* Time Exceeded Message
* Parameter Problem Message
* Destination Unreachable Message
* Timeout delay reply more 4 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## Electro-Optical Sensor

Electro-Optical Sensor (EOS) allows visual monitoring of the port area in the visible and infrared bands depending on the EOS configuration. The following functionality is provided:

* Manual control of camera’s pan/tilt unit and zoom with the aid of the user interface
* Control of camera’s additional functionality
* Manual or auto focus
* Camera focusing on any electronic chart object or a target with auto-zoom function
* Automatic target tracking
* Predefined areas scanning
* Displaying of the EOS direction, viewing angle and visibility limit lines in the Chart window

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with Full HD required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth  For Long Range CCTV Camera | 0.5 | 8.0 |
| Necessary bandwidth  For Medium Range CCTV Camera | 0.5 | 8.0 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link reliability criteria

A common criterion used to determine the quality of EOS sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

* Packet size: 64 bytes
* 50 continuous pings with 100ms delay with repetition time 10 sec
* Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

* Time Exceeded Message
* Parameter Problem Message
* Destination Unreachable Message
* Timeout delay reply more 4 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## Meteorological Sensor

Weather Sensor is Automatic Meteo Station which receive and provide data to the Operator Display Units for processing and displaying to the operators.

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth | 0.128 | 0.128 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link reliability criteria

A common criterion used to determine the quality of Meteorological sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

* Packet size: 64 bytes
* 50 continuous pings with 100ms delay with repetition time 10 sec
* Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

* Time Exceeded Message
* Parameter Problem Message
* Destination Unreachable Message
* Timeout delay reply more 4 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## NAVTEX Receiver

NAVTEX Receiver can perform the following functions:

* Automated means of receiving this information aboard ships at sea.

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth | 0.128 | 0.128 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link reliability criteria

A common criterion used to determine the quality of NAVTEX Receiver link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

* Packet size: 64 bytes
* 50 continuous pings with 100ms delay with repetition time 10 sec
* Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

* Time Exceeded Message
* Parameter Problem Message
* Destination Unreachable Message
* Timeout delay reply more 4 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## Radar Sensor

The Radar sensor as network device is Radar Processor PC, which connected to Radar. Depending on the connected radar type, the Radar Processor can perform the following functions:

* Digitizing of the radar data from radars
* Primary and secondary radar data processing for suppressing the clutter and extracting radar targets
* Detection of radar targets
* Tracking of radar targets and calculations of their motion parameters
* Control of radars (for radars from the list of those supported with control)
* Operation in the mode without control (for radars from the list of those supported without control)
* Local console to monitor and control the radar.

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth | 0.500 | 2.000 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link quality criteria

A common criteria used to determine the quality of radar sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

1. Packet size: 64 bytes
2. 50 continuous pings with 100ms delay with repetition time 10 sec
3. Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

1. Time Exceeded Message
2. Parameter Problem Message
3. Destination Unreachable Message
4. Timeout delay reply more 1 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## RDF Sensor

RDF Sensor can perform the following functions:

* Receiving RDF data
* Providing the operator with information on the azimuth of the detected transmitting stations
* Controlling the RDF’s

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth | 0.128 | 0.128 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link reliability criteria

A common criteria used to determine the quality of RDF sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

1. Packet size: 64 bytes
2. 50 continuous pings with 100ms delay with repetition time 10 sec
3. Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

1. Time Exceeded Message
2. Parameter Problem Message
3. Destination Unreachable Message
4. Timeout delay reply more 1 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## Voice Radio Sensor

Voice Radio Sensor is VHF or MF/HF Voice Radio Transceiver, which have acoustic signal line outputs can be connected to the system and thus used as sensors for recording of the operators exchange.

Voice communication is very important for VTS application because it is related with safety. Quality of voice communication should be determined using methods of Main Opinion Score (MOS). These methods are described in Recommendations ITU-T P.800.1, ITU-T P.800.2. Quality of voice determined by expert review should correspond MOS rating 5 (MOS=5).

Data network should conform certain requirements to achieve this high-quality level of voice communication.

Network problems are most noticeable in the transmission of voice traffic. Therefore, for this type of traffic, the most stringent requirements are imposed. Codec G.711 is used for VTS application.

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |  |
| --- | --- | --- | --- |
| Link Bandwidth Criteria | Codec | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth for each channel | G.711 | 0.080 | 0.080 |
| G.726 - 32 | 0.050 | 0.050 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link quality criteria

A common criteria used to determine the quality of Voice Radio sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

1. Packet size: 64 bytes
2. 50 continuous pings with 100ms delay with repetition time 10 sec
3. Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

1. Time Exceeded Message
2. Parameter Problem Message
3. Destination Unreachable Message
4. Timeout delay reply more 1 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

## Other Navi-Harbour Family Sensor

Other Navi-Harbour Family (remote) system can serve as a source of navigational situation data, i.e. a sensor. Data received from other systems is passed to the Operator Display Units for processing and displaying to the operators.

### Link bandwidth criteria

Below requirement for inbound and outbound link bandwidth guarantees that data will be delivered with required quality.

|  |  |  |
| --- | --- | --- |
| Link Bandwidth Criteria | Bi, Inbound (to sensor), Mbit/s | Bo, Outbound (from sensor), Mbit/s |
| Necessary bandwidth | 0.500 | 0.500 |

Bi – inbound bandwidth, Mbit/s

Bo – outbound bandwidth, Mbit/s

### Link quality criteria

A common criteria used to determine the quality of Navi-Harbour Family sensor link are:

#### Delay

Result is based on report from ICMP messages according to RFC 792. Delay tests for round-trip and one-way route are based on Ping software with next parameters:

1. Packet size: 64 bytes
2. 50 continuous pings with 100ms delay with repetition time 10 sec
3. Timeout: 1 sec

Also result can be based on report from software which can generate real sensor traffic.

|  |  |  |
| --- | --- | --- |
| Link Delay Quality Criteria | Do, One-way (from/to sensor), ms | Dr, Round-trip, ms |
| Max Necessary Timeout Delay | < 150 | < 300 |

Do – One-way timeout delay, ms

Dr – Round-trip timeout delay, ms

#### Jitter

Jitter meaning is based on RFC 3393.

|  |  |
| --- | --- |
| Link Jitter Quality Criteria | J, Jitter, ms |
| Max Necessary Jitter | < 30 |

J – jitter, ms

#### Packet loss

Packet loss is based on report from ICMP messages according to RFC 792 and use Ping software with parameters from Delay test and use Ping software with parameters from Delay test. Next ICMP messages means that packet was lost:

1. Time Exceeded Message
2. Parameter Problem Message
3. Destination Unreachable Message
4. Timeout delay reply more 1 sec.

Also result can be based on report from software which can generate real sensor traffic.

|  |  |
| --- | --- |
| Link Packet Loss Quality Criteria | PL, Packet Loss, % |
| Necessary Packet Loss | < 1 |

PL – packet loss, %

# Link Bandwidth Calculation

All traffic float in VTS system can be interpreted as point-to-point connection and calculated according to below:

n – quantity of sensors

Bandwidth calculations are made for individual sites. Total bandwidth between sites will depend on sites connectivity.

INSERT TABLES FROM EXCEL SHEET

# Link Acceptance criteria

Network test will be processed to defined links quality and stability. Network test should follow RFC 2680 A One-way Packet Loss Metric for IPPM, RFC 4689 Terminology for Benchmarking Network-layer Traffic Control Mechanisms and RFC 2544 Benchmarking Methodology for Network Interconnect Devices. Every point to point connection must meet specified quality link criteria. Link must meet quality criteria for 99.9% time to be accepted.

If link should provide connection for more then one sensor, link quality criteria must summarize quality criteria for all sensors.

If summarize quality criteria have two or more identical criteria, criteria for test must use criteria with the lowest value

Additional main requirement for each link is Dead time, period of no network connection. This requirement should keep not only in during network test, but in during all period of system working.

|  |  |
| --- | --- |
| Link Dead Time Quality Criteria | DT, Dead Time, s |
| Necessary Dead Time | < 3 |

DT – dead time, s

Network Performance Specification

DOC No.: DOCUMENT NUMBER

Project: PROJECT NAME

Project code: PROJECT NUMBER

Date of issue: June 2023

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