COSMEMOS project WORKSHOP

Smart solutions for data transmission from marine areas

European GNSS Agency

SEVENTH FRAMEWORK PROGRAMME

www.cosmemos.eu

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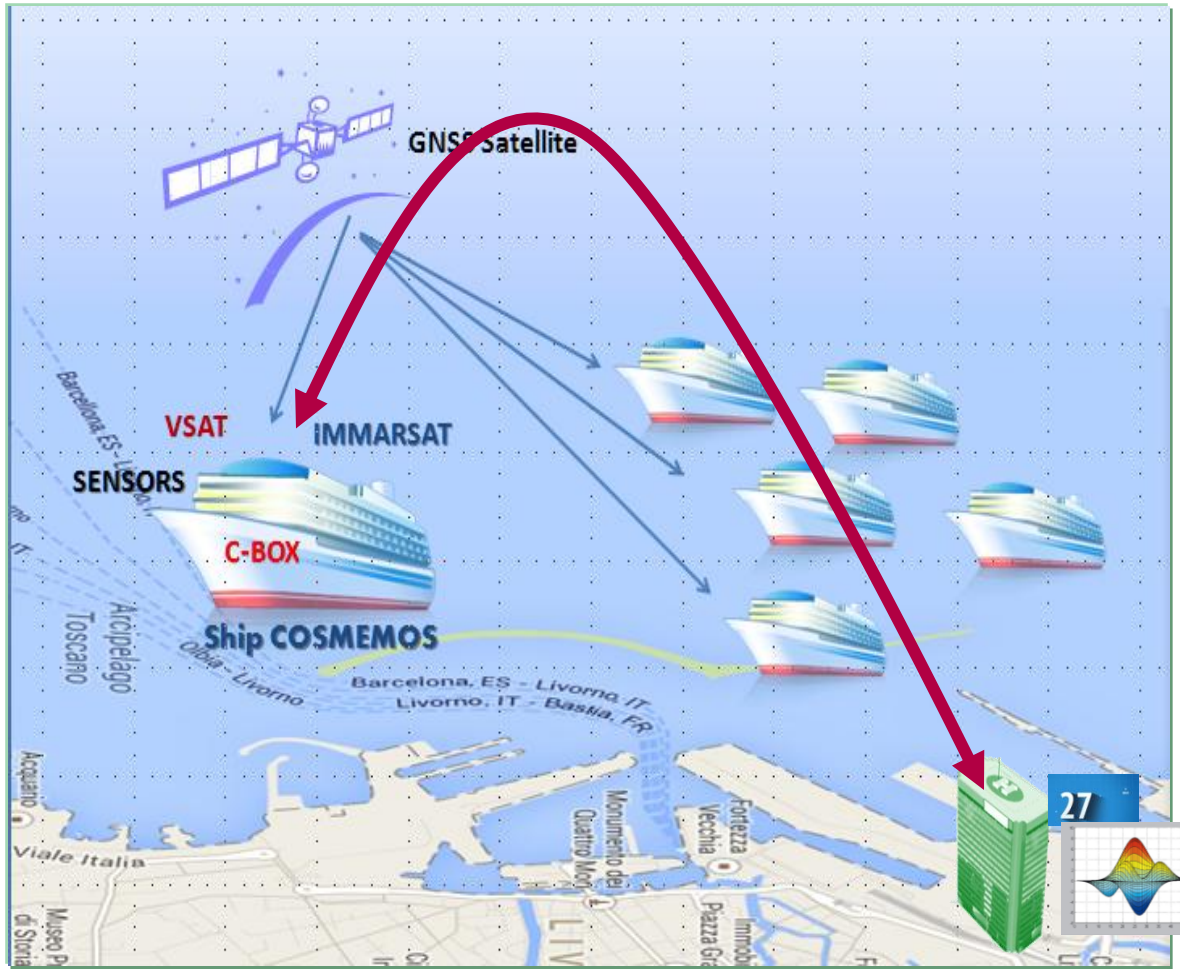
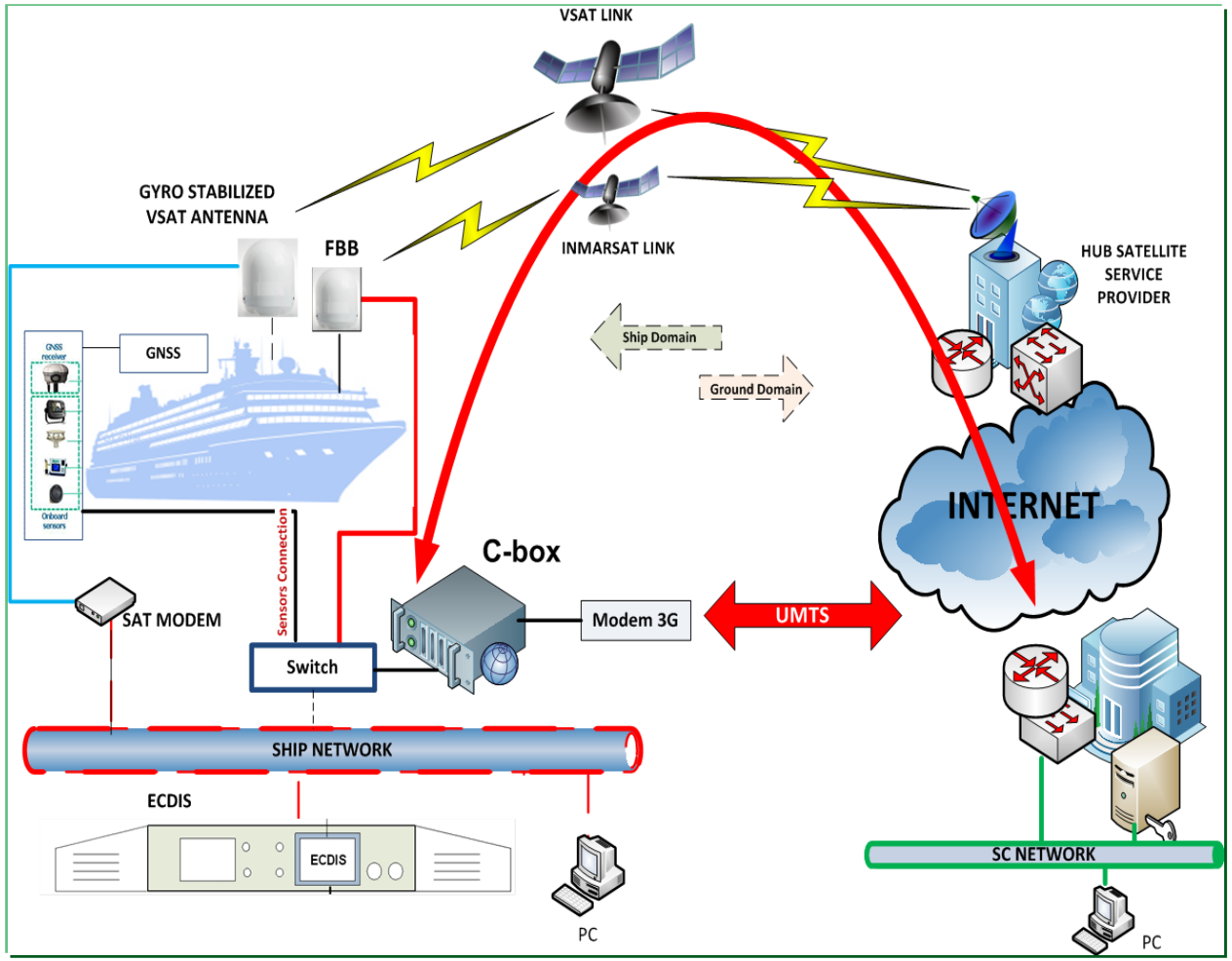
Coopertative Fleet



- Broadband Satellite Communication Systems presents on board
  - ✓ VSAT
  - ✓ Inmarsat
  - ✓ 3G
- Weather sensors on-board
  - Weather
  - GNSS-R
  - Galileo/GPS
- Service Centre.

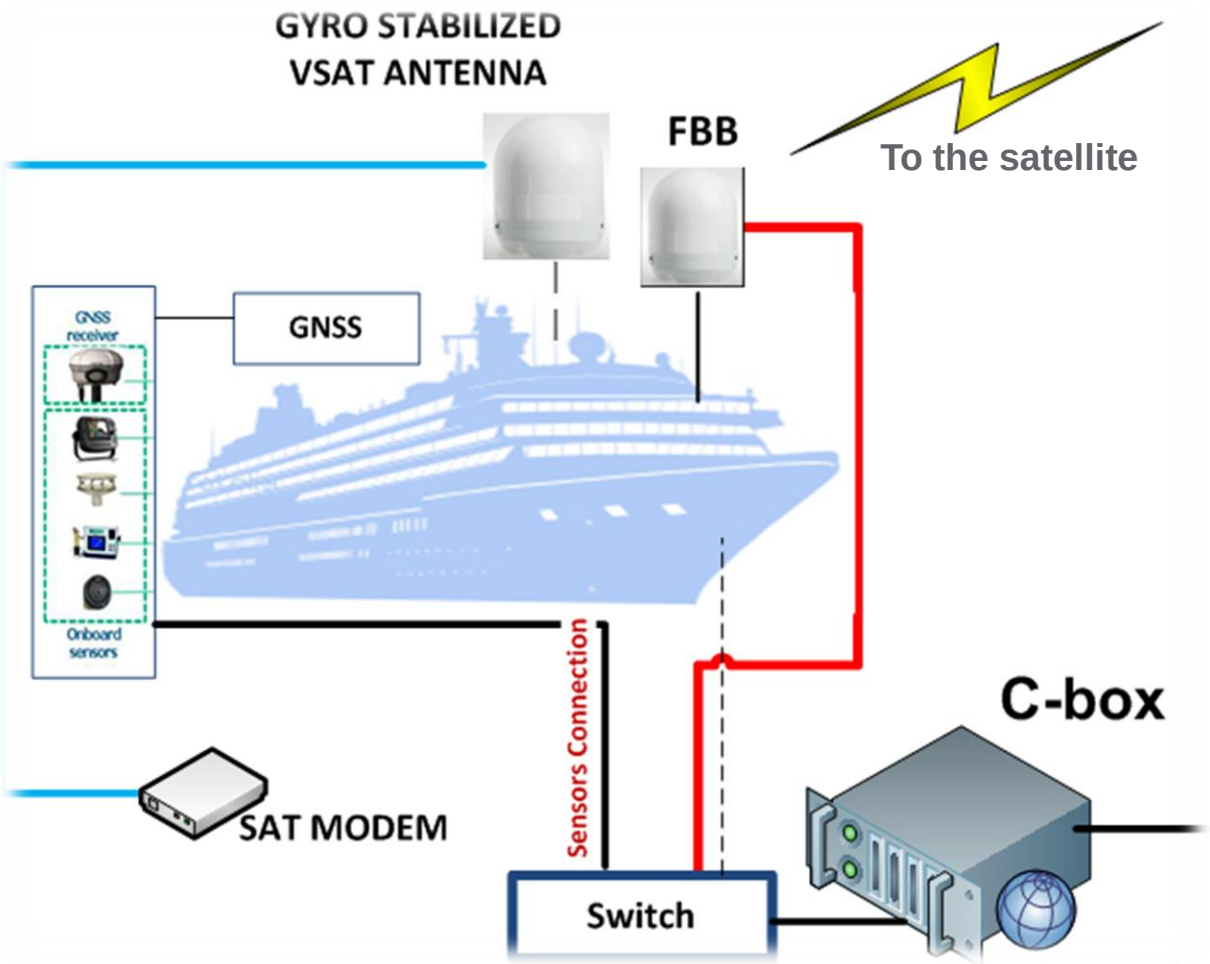
Cosmemos Service Centre

Cosmemos Communication Infrastructure



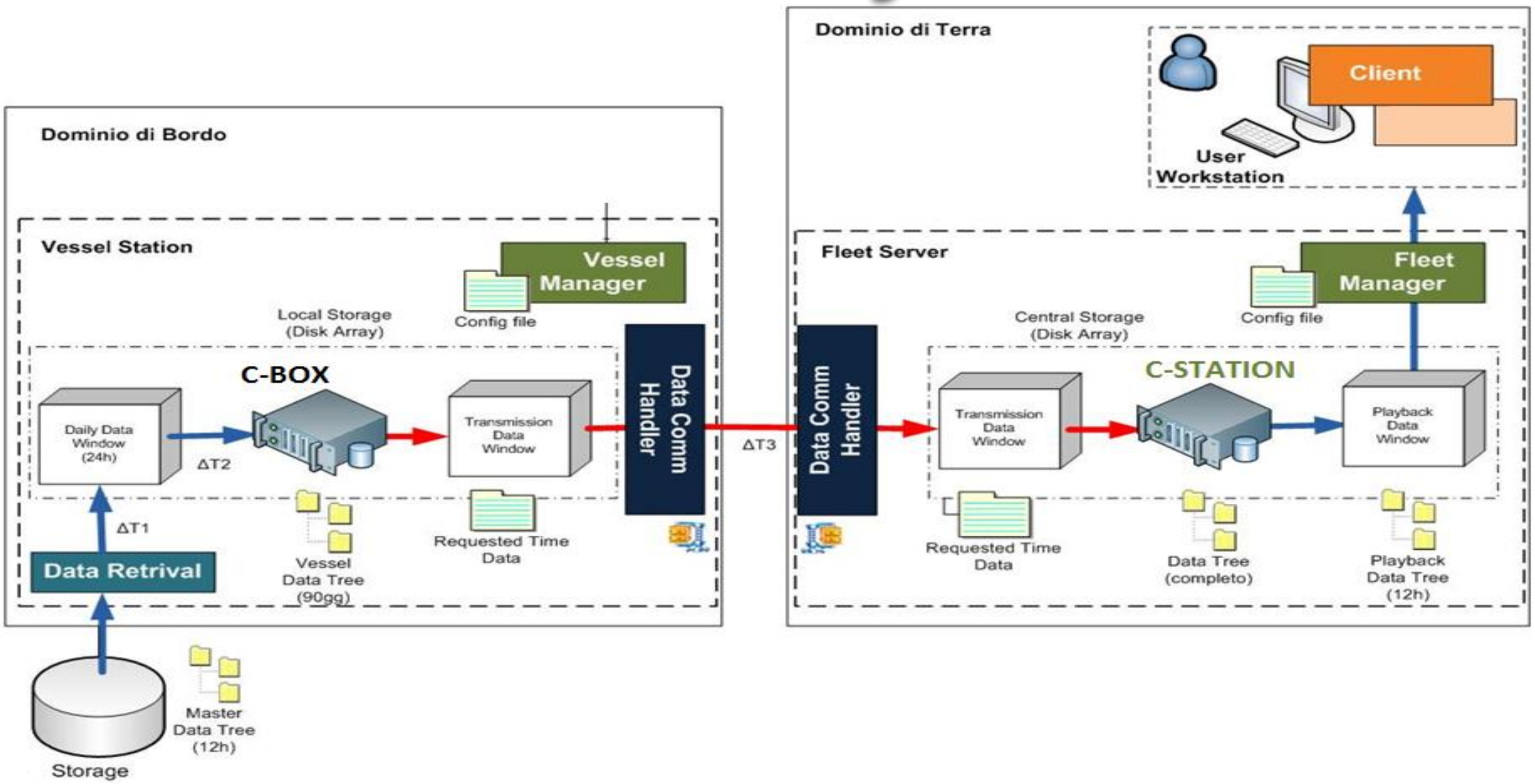
- The ship has different telecommunication systems for communicate to Service Centre.
- The C-Box works as gateway for all communication board-land.
- Performs the collection of data from sensors on board the ship and transmitting it to the COSMEMOS operational centre.

Devices on- board



- Connection on-board to C-Box
- VSAT Antenna
- Inmarsat FBB
- Weather Sensors
- GNSS Devices

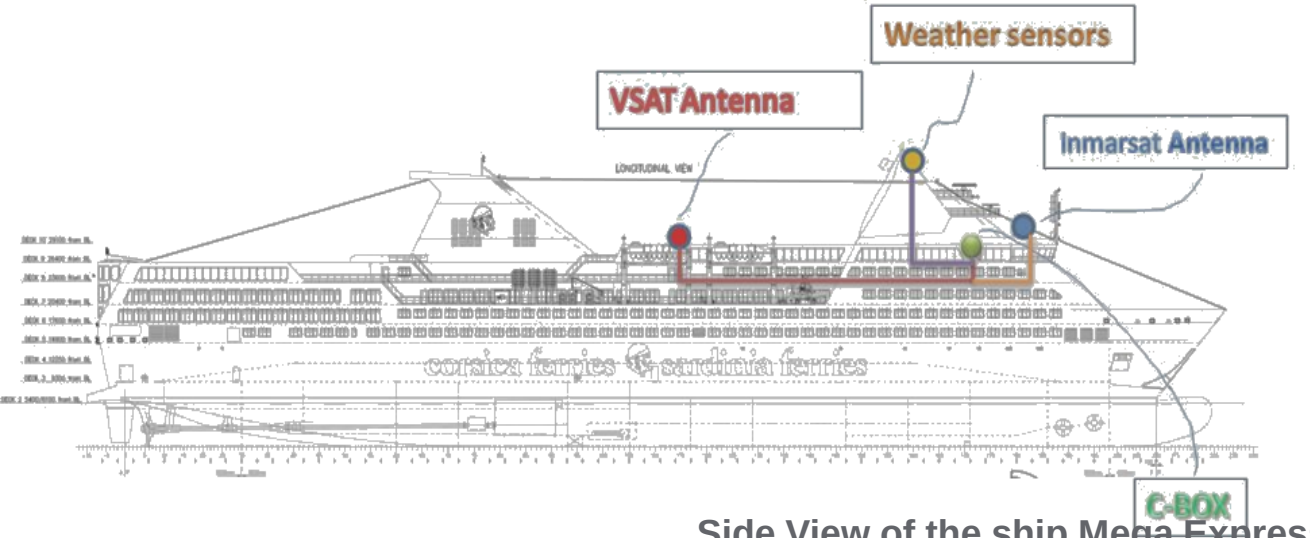
Data Delivery schema



Dominio di Terra
User
Workstation
Client
Fleet Server
Fleet
Manager
Config file
Central Storage
(Disk Array)
C-STATION
Data Comm
Handler
Transmission
Data
Window
Playback
Data
Window
Requested Time
Data
Data Tree
(completo)
Playback
Data Tree
(12h)
Dominio di Bordo
Vessel Station
Vessel
Manager
Config file
Local Storage
(Disk Array)
C-BOX
Daily Data
Window
(24h)
ΔT2
Transmission
Data
Window
Data Comm
Handler
ΔT3
ΔT1
Data Retrival
Vessel
Data Tree
(90gg)
Requested Time
Data
Storage
Master
Data Tree
(12h)

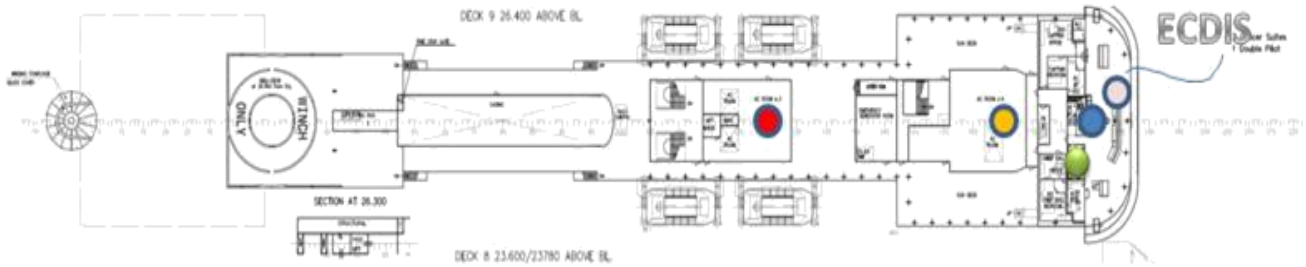
- The output data of the sensors can be stored on a logical tree are kept on the C-box on board or sent directly. While on the ground there there is a component called C-Station that takes care to align data between the ground and onboard.
- The system gathers files and NMEA data from sensors for sending to earth updating to logical a tree structure on the server disk.

Layout Ship



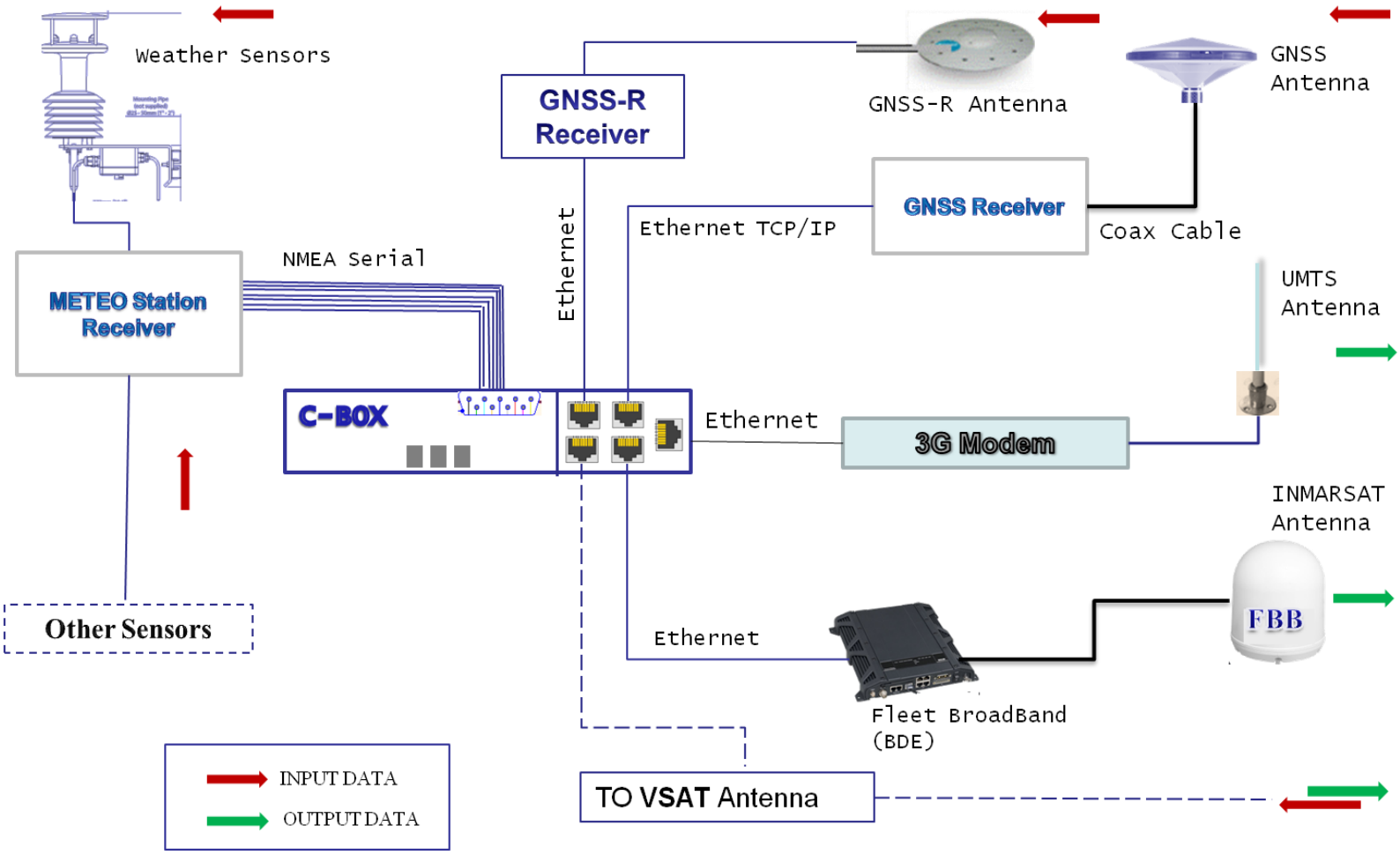
Side View of the ship Mega Express II

- These pictures shows the ship in plan and Longitudinal view. Are indicated on the drawing some communications equipment installed and their location on the ship.

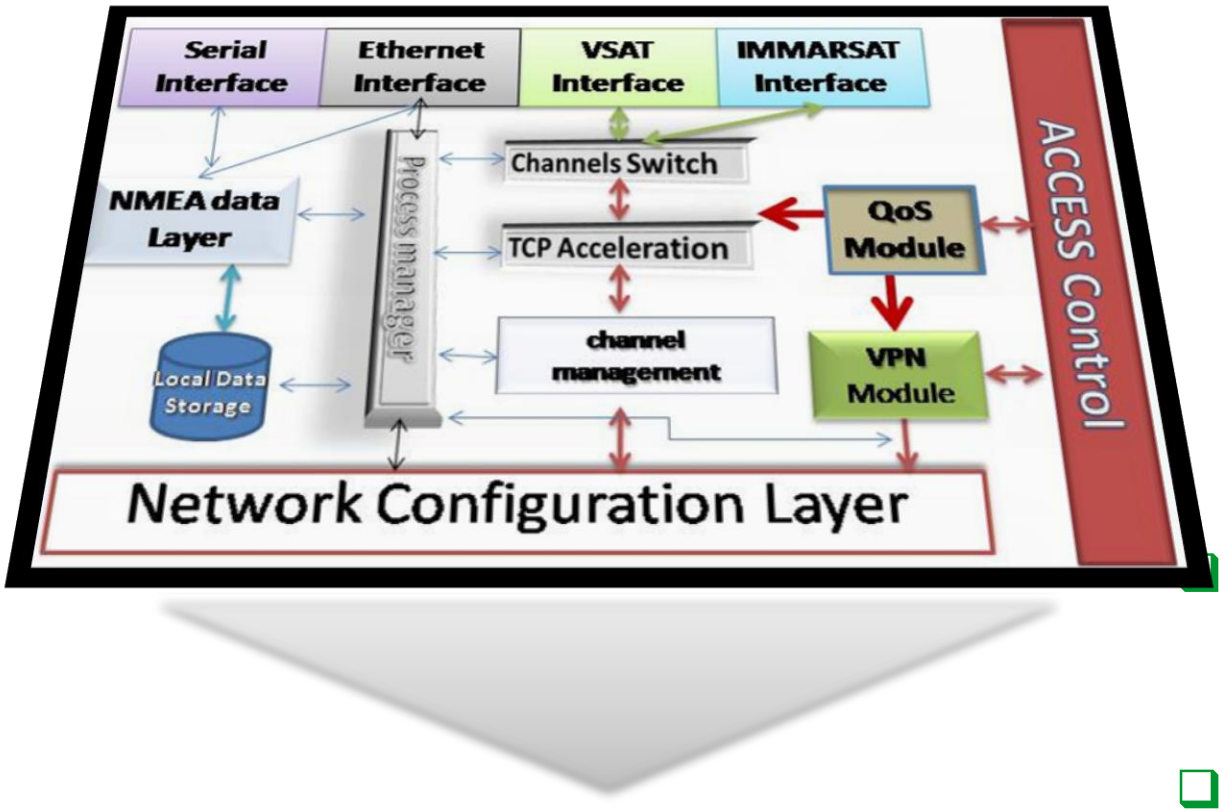


Plan view of the ship Mega Express II

Network schema on-board



C-Box functional architecture



- **Through NMEA protocol, the C-Box can link to on-board instruments:**
  - Maritime GPS;
  - Navigation and weather instruments;
  - sensors and engine monitoring systems.
- **It has Communication channel switching Module.**
- **Tcp Acceleration mod.**
  - Mitigate effect latency

C-BOX Advanced Communication features focus

❑ COSMEMOS Peripheral System (C-BOX) main features

Existing Stand-alone BOX	Advanced Features
Manual switching	Automatic Switching based on Least Cost Routing
QoS	to enhance and make automatic the switching function already available to
Security	*Dynamic VPN*: to allow a secure communication framework among the
Standard NMEA	*TCP/IP acceleration and compression*: to
Local M&C	*Open NMEA*: to allow the collection of data not only from standard navigation

allow Service Centre operators to monitor the status of all the vessels, including devices and links status and to perform remote configuration and, more in general, remote maintenance.

and vice versa

The implementation of some advanced com
use of device to land called C-Station. This c
board through a secure channel.

Utilization of bandwidth

```
     3.01           OBSERVATION DATA    M                   RINEX VERSION / TYPE
ssrcrin-8.1.0                          20121113 030000 LCL PGM / RUN BY / DATE
(0007471119003) Septentrio specific, please ignore.        COMMENT
TEST                                                       MARKER NAME
Unknown                                                    MARKER NUMBER
Unknown             Unknown                                OBSERVER / AGENCY
3001398             SEPT POLARX4        2.3.3              REC # / TYPE / VERS
Unknown             Unknown                                ANT # / TYPE
   4521690.7877   895478.9568  4393665.5814                APPROX POSITION XYZ
         0.0000        0.0000        0.0000                ANTENNA: DELTA H/E/N
G    7 C1C L1C C1W C2W L2W C2L L2L                         SYS / # / OBS TYPES
E    8 C1C L1C C5Q L5Q C7Q L7Q C8Q L8Q                     SYS / # / OBS TYPES
G L2L -0.25000                                             SYS / PHASE SHIFTS
  2012    11    13     3     0    0.0000000     GPS       TIME OF FIRST OBS
                                                           END OF HEADER
> 2012 11 13 03 00  0.0000000  0 14
G15  22787498.315 7 119749120.44407  22787498.315 5  22787497.835 5  93311004.50405  22787497.666 6  93311004.49006
G12  20967053.077 8 110182696.45108  20967052.952 7  20967051.397 7  85856683.24007  20967051.791 7  85856687.24407
G02  25729921.932 6 135211658.27306  25729921.280 2  25729920.303 2 105359723.38402
G26  25925513.452 5 136239495.15005  25925512.911 2  25925514.670 2 106160649.35502
G25  23666883.749 6 124370348.92506  23666883.276 4  23666886.370 4  96911974.12904  23666886.099 6  96911983.13706
G18  24861162.201 6 130646269.36806  24861161.562 2  24861160.380 2 101802273.31402
G14  24056076.602 6 126415538.98106  24056076.142 3  24056075.421 3  98505616.94703
G22  24948655.809 6 131106078.91006  24948654.732 2  24948653.143 2 102160565.90002
G09  19962941.311 8 104905999.07808  19962940.779 7  19962940.178 7   81744949.11607
G17  23327833.975 7 122588648.10607  23327833.837 5  23327832.445 5  95523633.79505  23327832.138 6  95523633.79206
G04  24568970.512 6 129110813.65806  24568970.249 2  24568970.963 2 100605828.76302
E12  24768437.845 8 130159037.31508  24768439.215 8  97196697.47908  24768435.803 8  99732249.33508  24768436.827 8  98464470.41108
G24  20396861.719 8 107186266.90508  20396861.799 7  20396863.189 7  83521784.11307  20396863.190 8  83521786.12108
E11  27662174.307 6 145365720.46306  27662176.124 6 108552337.44506  27662171.639 6 111384123.47306  27662173.079 6 109968228.46506
> 2012 11 13 03 00  1.0000000  0 14
G15  22788114.490 7 119752358.22907  22788114.486 5  22788113.971 5  93313527.45205  22788113.819 7  93313527.43707
G12  20966772.355 8 110181220.90708  20966772.235 7  20966770.611 7  85855533.46507  20966770.925 7  85855537.46607
G02  25729410.813 6 135208970.98906  25729410.152 2  25729408.937 2 105357629.41102
G26  25926278.518 5 136243511.51105  25926277.977 2  25926278.956 2 106163778.97202
G25  23666322.202 6 124367397.69206  23666321.729 4  23666324.778 4  96909674.46704  23666324.630 6  96909683.46906
```

example of the contents of the file produced by the station GNSS

13/12/2012 15:48:02	252	18.8	nan	0.0	282	18.8	992.8	8.6	92	7.4
13/12/2012 15:51:02	254	17.7	nan	0.0	284	17.7	991.1	8.6	92	7.4
13/12/2012 15:54:03	249	16.5	nan	0.0	280	16.5	991.9	8.6	92	7.4
13/12/2012 15:57:03	242	17.1	nan	0.0	272	17.1	991.5	8.6	92	7.3
13/12/2012 16:00:02	251	19.4	nan	0.0	281	19.4	992.9	8.5	92	7.3

example data files - weather

- **Flow data from the weather station:**
  - **532 bytes** every **15 minutes**
- **GNSS station in Default configuration provides:**
  - a data file every hour with a size of 6 Megabytes.
- **Amount of data produced by the GNSS-R sensor:**
  - transmit 10kB of data every 10 minutes.

- **The ship has VSAT Communication System with a data transfer rate of 128 kbps.**
- **Has been installed the terminal Inmarsat a Fleet Broadband 250 (284Kbps) in order to increase the bandwidth.**
- **The Umts Modem has been installed as additional bandwidth.**

C-BOX Compression Techniques

The C-BOX uses compression techniques eliminating redundancy of information in the objects to be transmitted, or directly from the data stream. There are two forms of compression:

- **object compression** - a compression algorithm is applied on the individual objects (files) before they are transmitted. A typical example is the compression of attachments before they are inserted into an e-mail;
- **stream compression** - a compression algorithm is applied on an entire TCP or UDP stream during transmission.

Other Technique of optimization of the channel used by the C-box is:

- **Transmission for differences** - in the transmission of a file will only be transmitted through the differences with that held by the receiver.

Optimization of the transmission channel: some test results

- We performed laboratory tests on sending and receiving emails with attached. The results are shown in the table:

File type	File size (bytes)	Mail size (bytes)	stream size from server to client without compression (bytes)	stream size from server to client with compression (byte)	Compression rate from server to client (%)	stream size from client to server without compression (bytes)	stream size from client to server with compression (bytes)	Compression rate from client to server (%)
.JPG	1208410	1656259	1656259	1245835	24,78%	1658136	1245652	24,88%
.EXE	2162488	2961811	2961811	1355859	54,22%	2963688	1355634	54,26%
.TXT[1]	1092080	2961811	2961811	4946	99,83%	1152657	5164	99,55%
.TXT[2]	161946	164887	164887	32524	80,27%	165847	33031	80,08%
.TXT[3]	32827	35476	35476	11318	68,10%	36439	11735	67,80%
.DOCX	7921399	10842543	10842543	8068335	25,59%	10843496	8066995	25,61%
.DOCX	1667436	2284502	2284502	1729288	24,30%	2285459	1728761	24,36%
.EX_	226304	312337	312337	221482	29,09%	313297	221844	29,19%
.PPT	1908224	2613886	2613886	1767029	32,40%	2615759	1767498	32,43%

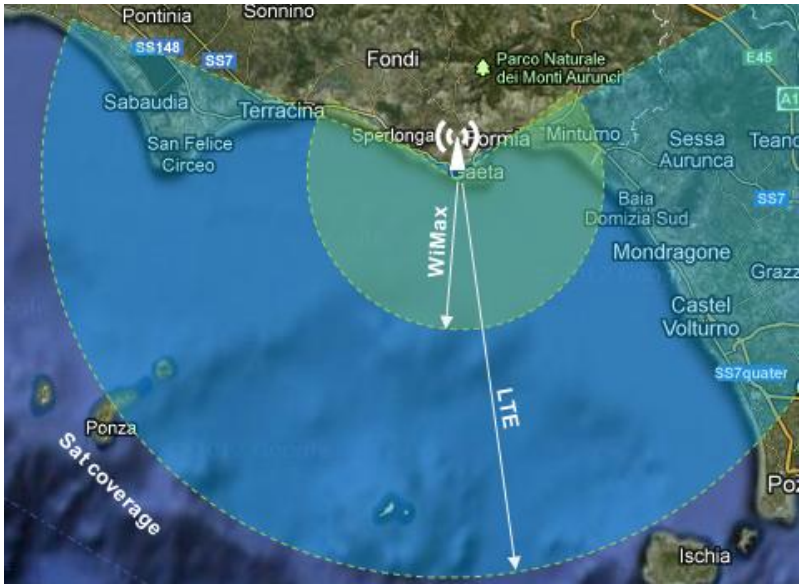
The files with the extension.JPG,. dOCX and .EXE are already compressed by the application that generated them and thus have a redundancy of information is much lower than the normal file as. TXT

The bytes were counted by examining the sequence number field of the TCP connections involved.

Capabilities of Maritime communication systems

C-BOX Multi-Channel Satellite Communication Will allow a seamless always-on maritime Communication, integrated as well with terrestrial Mobile communication means.

Technology	Strengths	Weaknesses
Terrestrial wireless	Equipment Size Equipment Cost Service Price Bandwidth	Service Coverage
Satcom L-band	Antenna size Antenna weight Service Coverage	Service Price Bandwidth
Satcom Ku-band	Service Price Service coverage Bandwidth	Antenna Size Antenna Wight



A least cost routing capabilities has been integrated within the C-BOX, exploiting strengths of available communication means and optimizing communication costs.

Performance characteristics (bandwidth) of FBB

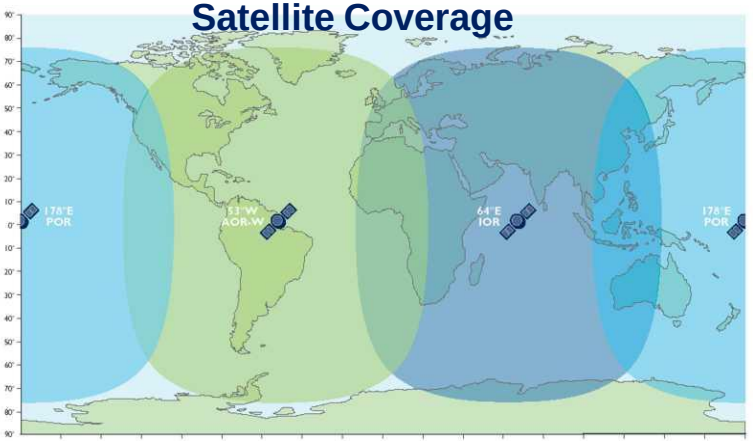
Inmarsat Fleet BroadBand (FBB)

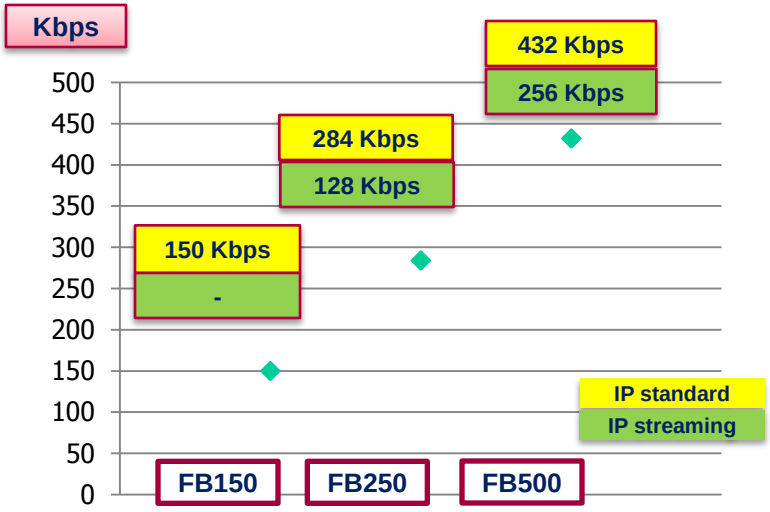
- diameter antennas: up to 60 cm
- weight antennas: up to 17 Kg
- global coverage, excluding the polar regions
- shared satellite channel
- IP service standards, according to consumption [Mbyte]
- IP streaming service: Timed [min]
- voice channel

FB150

FB250

FB500





THANK YOU

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