



Atlas VMS for Maritime Surveillance

WHITE PAPER
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Introduction



Satellite internet is the primary means by which ships stay connected while at sea. Connectivity speeds have improved over time with the adoption of better technology, including use of higher frequency bands by satellites. However, internet speed available to a ship at any point of time is dependent on its location and the weather. Cloudy/Rainy conditions impact satellite communication adversely, more so at higher frequency bands.

Juxtaposed with this, to secure personnel, passengers and cargo, there is increasing demand from ship owners to be able to view high quality, low latency, live and archive ship surveillance video. Often, there is need to view video from multiple ships, by viewers in multiple locations, simultaneously.

Any solution must satisfy owners needs under satellite internet constraints while being constantly bandwidth intelligent.

Satisfying Maritime Surveillance Needs

Remote Live Video

Live video demands low latency and high quality. So, each second, the ship must produce for dispatch exactly as much video as can be sent in a second. Any more increases latency. Any less reduces quality.

There are several challenges in meeting this requirement.

1. Satellite internet speed is dependent on ship location and weather.
2. Each camera produces more bytes per second when the scene activity is high than when it is not.
3. There is no collaboration between cameras to achieve a total bytes per second budget.

Any viable solution that overcomes challenges, must manage bandwidth, i.e. it must keep track of internet speed/allocation for video while simultaneously managing each camera stream so that the total video produced for dispatch per second equals that which can be sent in a second.

Managing Multiple Remote Clients

Each new request needs one or more additional video streams from the moving ship. Since bandwidth is precious, it is not wise to produce a new stream from the ship to the user, for each new request.

This mandates the use of a storage/buffer location outside the ship and servicing simultaneous requests from that location.

Cloud storage suggests itself as the outside location.

Remote Video Playback and Export

Ideally, a remote user needs to be able to:

1. **Quickly** playback and view the **highest quality** archive video
2. **Quickly** export archive video of the **highest quality**

The internet bandwidth at the ship needs to be shared by different applications, live streams, playback requests and export requests. Meeting ideal playback and export needs cannot always be guaranteed.

A viable solution must satisfy ideal requirements when possible. When not possible, it must satisfy these in a piecewise manner. In this case, a possible solution is:

1. Quick playback viewing with best effort quality.
2. High quality export with best effort latency.
3. Ways to offload all archived high-quality video at port for playback and export later.

Atlas VMS

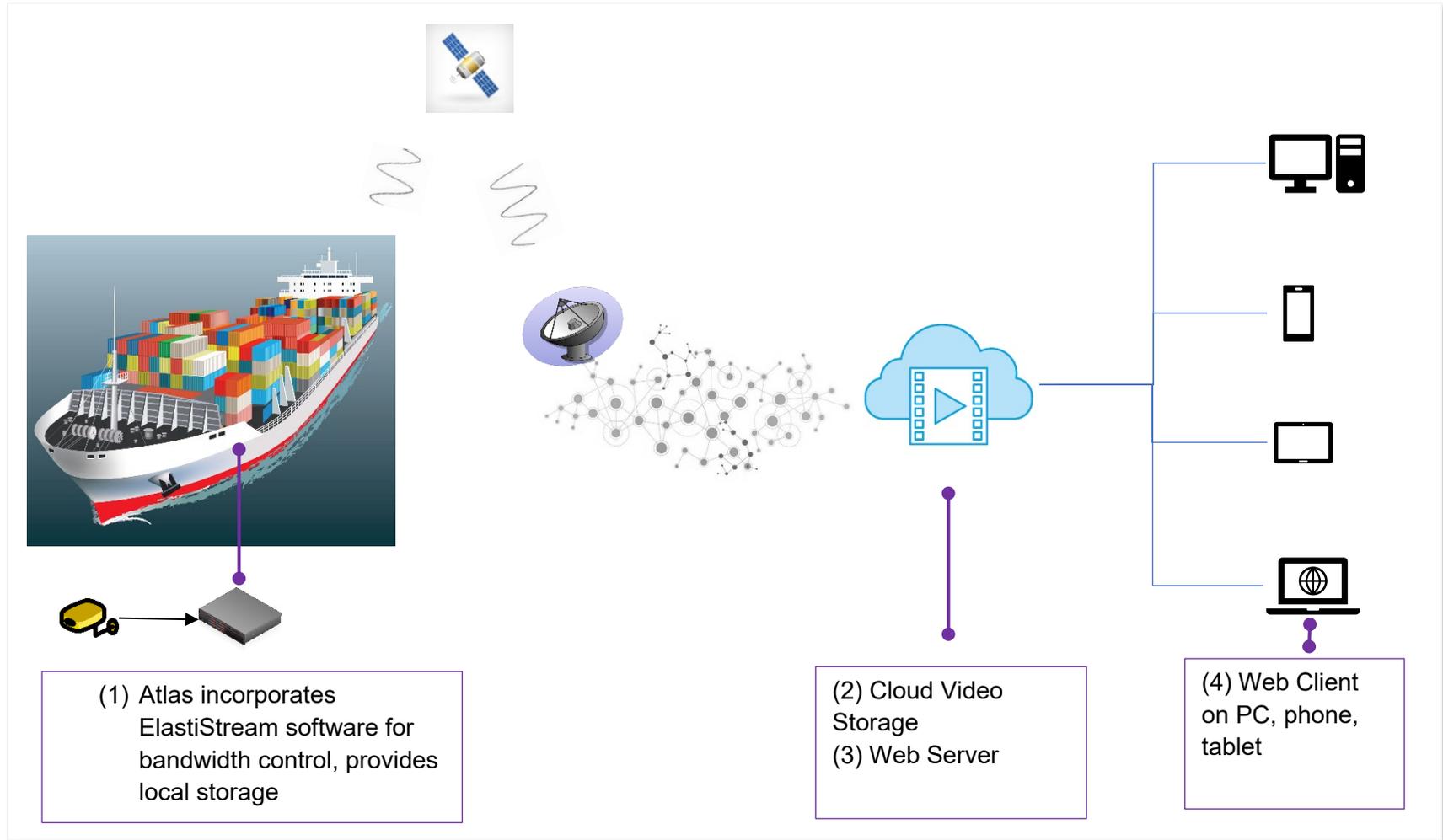


Figure 1: Atlas VMS Schematic for Maritime

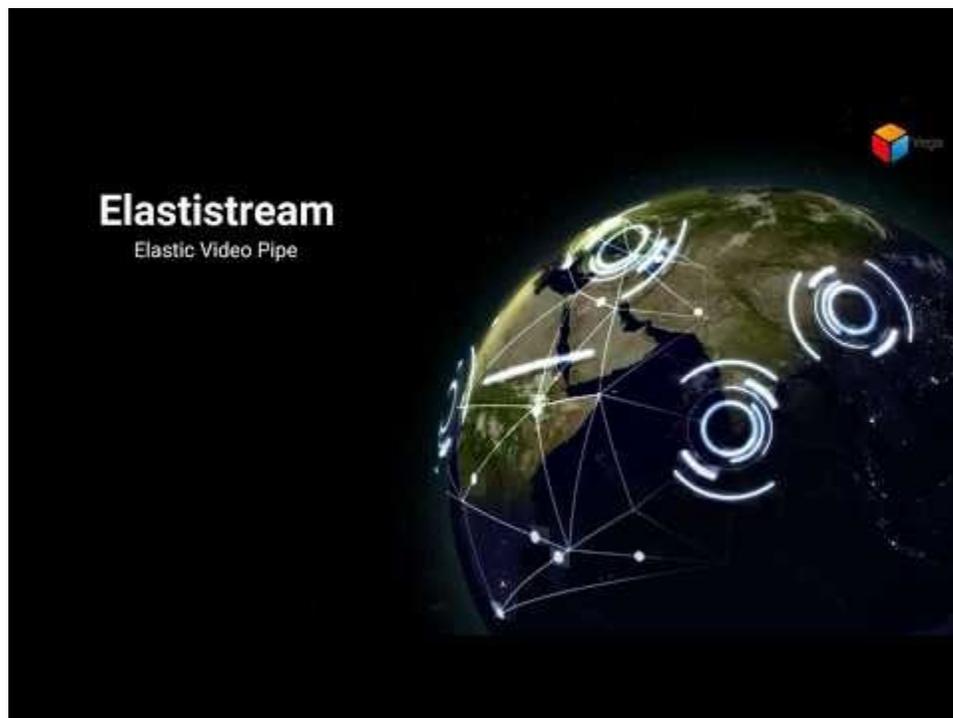
The Atlas VMS solution consists of 4 components shown in Figure 1.

- Onboard software that runs on maritime certified COTS hardware.
- Cloud storage.
- Web Server to serve clients.
- Web Client.

Key Capabilities

Hands free - Dynamic Camera Bandwidth Adaptation and Management

Onboard software performs surveillance bandwidth management. It adapts each outgoing live, playback or export video stream to available/allocated bandwidth so that end users get best experience possible.



No need for Port Forwarding/Reverse Proxy setup

Atlas VMS software is architected to eliminate need for cumbersome remote proxy or port forwarding set up on each ship.

Cloud Storage Integration

It integrates to Microsoft Azure Blob Storage. This enables simultaneous support of multiple clients.

Remote Management

Through a single browser-based web interface, the Atlas VMS web client, a user with appropriate permissions can manage onboard software on multiple ships. Depicted in Figure 2.

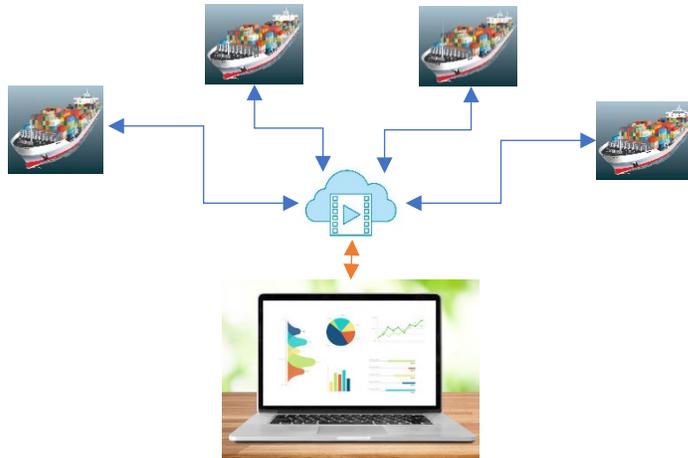


Figure 2: Remote Management

On-demand Remote Live and Archived Video

Through the web client, users with appropriate permissions can play live and archived streams from one or more ships on one or more devices in parallel.

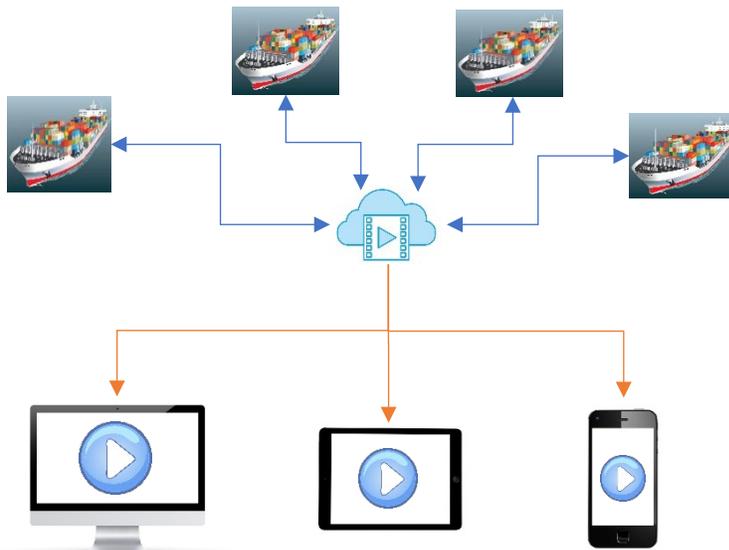


Figure 3: Remote Video Play

Remote High-Quality Evidence Export

Atlas VMS offers a way to obtain high resolution clips remotely, though bandwidth-controlled uploads from the ship, collaboratively with other parallel live and/or playback uploads from the ship.

High Resolution Video Live and Playback on Ship

The Web client supports on ship live and archived video viewing.

High Resolution Video Offload at Port

A remote user can initiate upload of high-resolution video to the cloud when the ship is at port and connected to high speed internet.

Appendix A – Brief overview of satellite data bands and service

#	Band	Frequency Range	Service Provider/service/sat type/max speed
1	L (Mobile Satellite Services)	1 – 2 GHz	<ol style="list-style-type: none"> 1. Inmarsat (Fleet Broadband/GEO/432kbps) 2. Iridium (Certus/LEO/704kbps eventually 1.4Mbps)
2	S	2 – 4 GHz	<ol style="list-style-type: none"> 1. Other Uses (ISM band, airport surveillance radar, weather radar, marine radar, NASA comm satellites, India Navigation Satellites) 2. Inmarsat's (European aviation inflight Wi-Fi/GEO/75 Mbit/s DL and 20 Mbit/s UL/airplane)
3	C (VSAT)	4 – 8 GHz	<ol style="list-style-type: none"> 1. Intelsat
4	X	8 – 12 GHz	Marine Radar
5	Ku (VSAT)	12 – 18 GHz	<ol style="list-style-type: none"> 1. Intelsat (Flex Maritime/GEO/20 Mbps DL, 3Mbps UL) 2. Starlink (1Gbps? /100Mbps?)
6	K	18 – 27 GHz	Unused due to high water vapor caused attenuation.
7	Ka (VSAT)	27 – 40 GHz	<ol style="list-style-type: none"> 1. Inmarsat (Global Xpress/GEO/50Mbps DL – 5Mbps UL) 2. Starlink (1Gbps? /100Mbps?) 3. ViaSat (GEO/50Mbps UL 5Mbps DL)
8	V	40 – 75 GHz	<ol style="list-style-type: none"> 1. Starlink (1Gbps? /100Mbps?)
9	W	75 – 100 GHz	Unused yet.