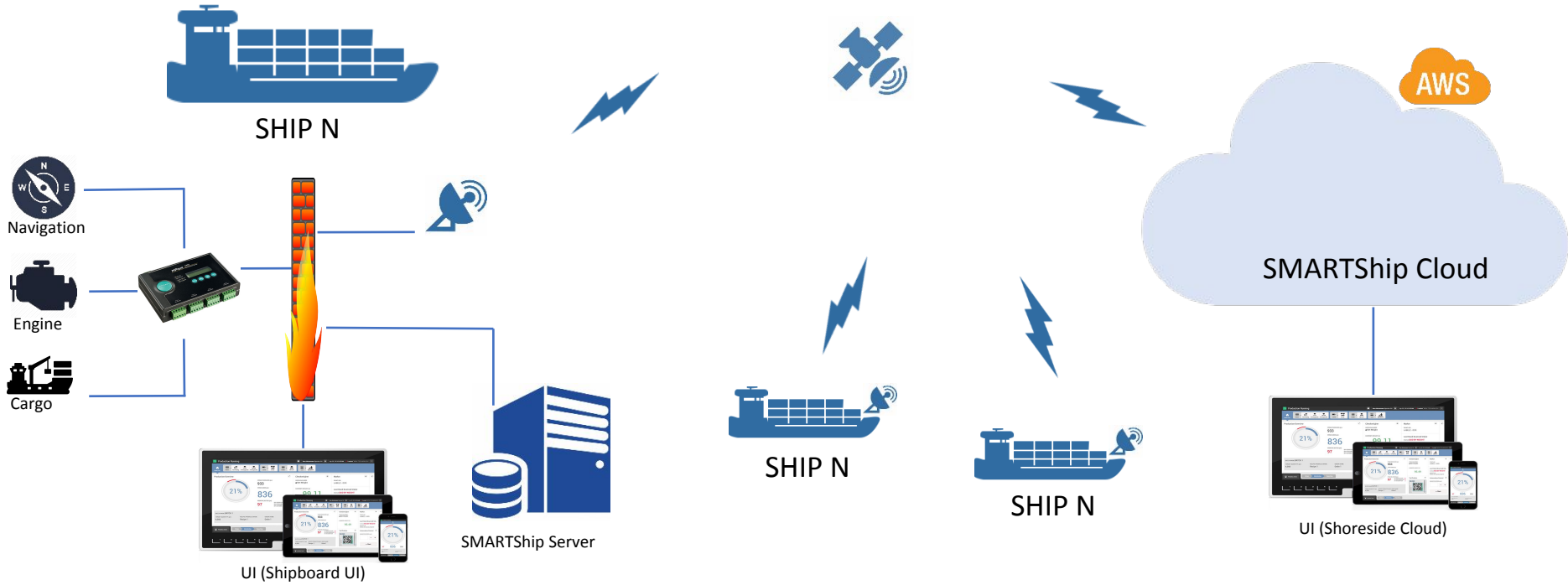
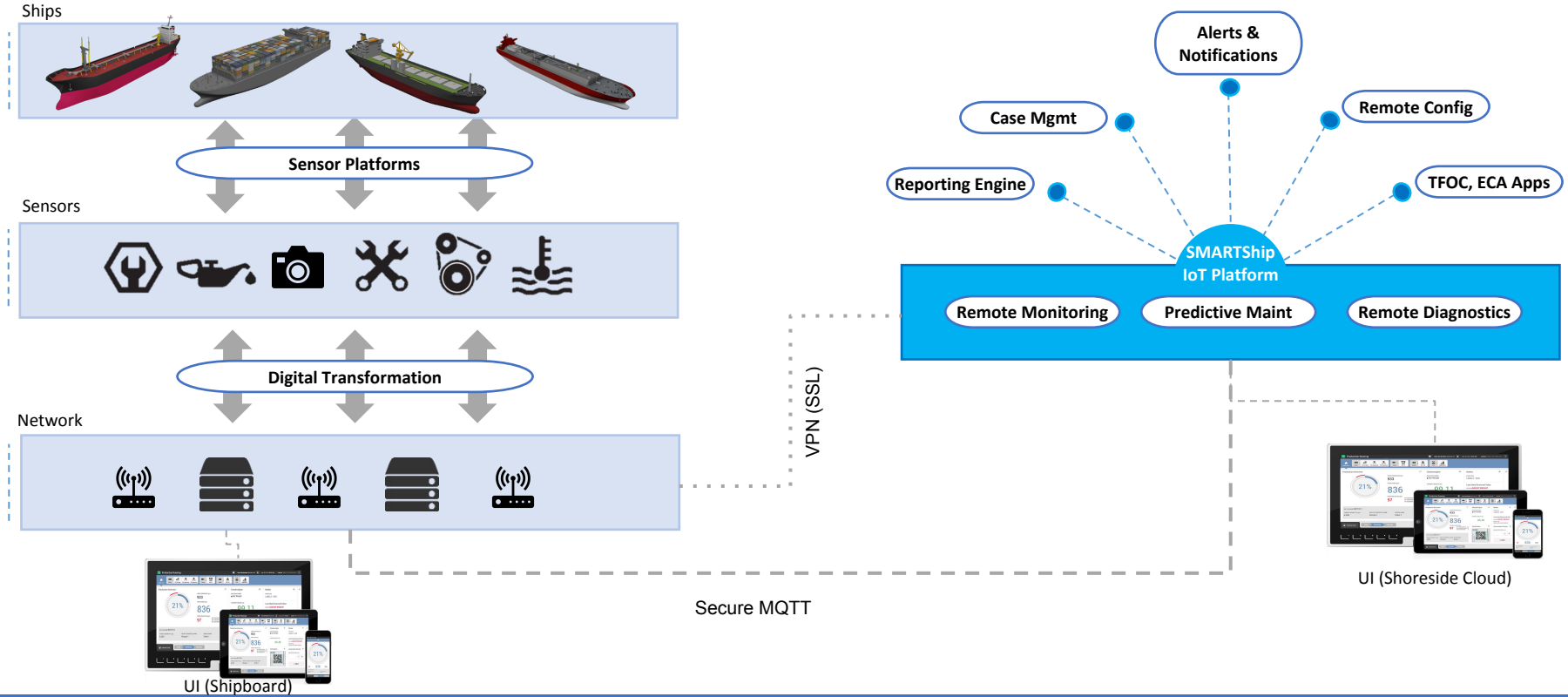
alpha ori
Ship As A Digital Enterprise
SMARTShip Architecture

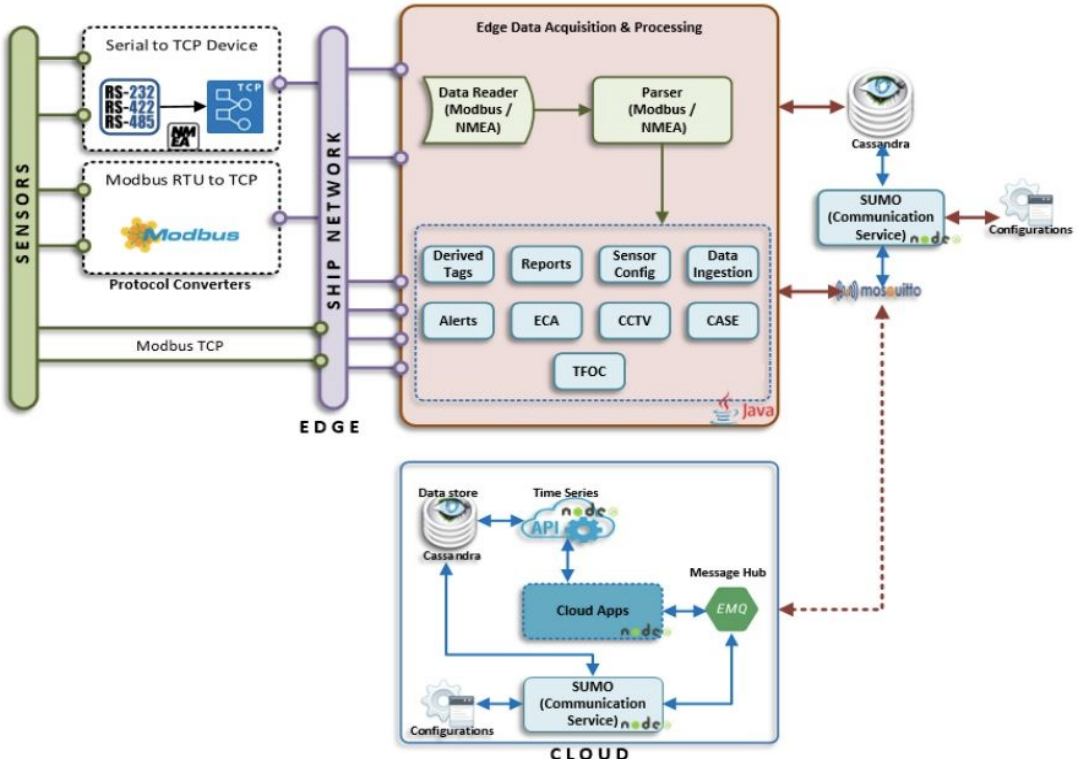
SMARTShip – High Level Solution Architecture



SMARTShip – Blueprint



SMARTShip – Blueprint



SMARTShip – Data Acquisition

GPS

Serial to TCP Converter

```
$GPRMB,A,,,,,,,,,,,,,D*4F
$GPGGA,054810.84,3506.0221,N,12902.9477,E,2,05,02,+0031,M,+024,M,06,0720*41
$GPRMC,054810.84,A,3506.0221,N,12902.9477,E,000.0,109.6,160317,08.,W,D*26
$GPVTG,109.6,T,109.6,M,000.0,N,000.1,K,D*27
$GPZDA,054812.00,16,03,2017,00,00*6C
$GPDTM,W84,,0.0,N,0.0,E,+0.0,W84*44
$GPAPB,A,A,,,N,,,,T,,,T,,,D*62
$GPRMB,A,,,,,,,,,,,,,D*4F
$GPGGA,054811.84,3506.0221,N,12902.9477,E,2,05,02,+0031,M,+024,M,05,0720*43
$GPRMC,054811.84,A,3506.0221,N,12902.9477,E,000.0,109.6,160317,08.,W,D*27
$GPVTG,109.6,T,109.6,M,000.0,N,000.1,K,D*27
$GPZDA,054813.00,16,03,2017,00,00*6D
$GPDTM,W84,,0.0,N,0.0,E,+0.0,W84*44
$GPAPB,A,A,,,N,,,,T,,,T,,,D*62
$GPRMB,A,,,,,,,,,,,,,D*4F
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$GPVTG,109.6,T,109.6,M,000.0,N,000.1,K,D*27
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$GPAPB,A,A,,,N,,,,T,,,T,,,D*62
$GPRMB,A,,,,,,,,,,,,,D*4F
```

NMEA Strings

```
Version 1.5
$GPGGA, hhmmss,ddmm.mmm,a,dddmm.mmm,a,x,x,xx,uxxxx,M,uxxx,M,xx,xxxx<CR><LF>
          1          2        3     4          5 6 7 8    9    10   11 12 13   14
Version 2.1
$GPGGA,hhmmss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,xx,uxxxx,M,uxxx,M,xx,xxxx*hh<CR><LF>
          1          2        3     4          5 6 7   8    9   10   11 12 13 14   15
Version 2.3
$GPGGA, hhmmss,ss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,xx,uxxxx,M,uxxx,M,xx,xxxx*hh<CR><LF>
          1          2        3     4          5 6 7   8    9 10   11 12 13 14   15

 1:      UTC time (hours, minutes, seconds)   Measured UTC [1/100 sec]   (Version 2.3)
 2, 3:   Latitude (deg, min), N / S
 4, 5:   Longitude (deg, min), E / W
 6:      GPS measurement status    0 = No position measurement
                                   1 = GPS positioning
                                   2 = DGPS positioning
                                   8 = Simulation mode (Version 2.3 only)
 7:      Number of satellites used for position fix
 8:      HDDP (0 – 20)
 9, 10:  Antenna altitude above sea level (m), u: sign (+,-)
 11, 12: Geoid height (m), u: sign (+,-)
 13:     Version 1.5 :     DGPS data seconds expired
                           (NULL if not performing DGPS positioning)
         Version 2.1 :     DGPS data seconds expired
                           (00 if not performing DGPS positioning)
         Version 2.3 :     DGPS data seconds expired
                           (NULL if not performing DGPS positioning )
 14:     Version 1.5 :     DGPS reference station ID
         Version 2.1 :     DGPS reference station
                           (0000 if not performing DGPS positioning)
         Version 2.3 :     DGPS reference station
                           (NULL if not performing DGPS positioning)
 15:     Checksum
```

NMEA Sentence as per Maker Manual / IEC document

[{"address":"com.ge.dspmicro.machineadapter.nmea:127.0.1.1","datatype":"DOUBLE","name":"GPS_RMC_UTC_TIME","attributes":{"VesselId":"9497199"},"category":"REAL","value":93953.43,"timestamp":1495791595760,"quality":"GOOD (0) "},{"address":"com.ge.dspmicro.machineadapter.nmea:127.0.1.1","datatype":"STRING","name":"GPS_RMC_STATUS","attributes":{"VesselId":"9497199"},"category":"REAL","value":"A","timestamp":1495791595762,"quality":"GOOD (0) "},{"address":"com.ge.dspmicro.machineadapter.nmea:127.0.1.1","datatype":"STRING","name":"GPS_RMC_LATITUDE_DIRECTION","attributes":{"VesselId":"9497199"},"category":"REAL","value":"N","timestamp":1495791595766,"quality":"GOOD (0) "},{address":"com.ge.dspmicro.machineadapter.nmea:127.0.1.1","datatype":"STRING","name":"GPS_RMC_FAA_MODE_INDICATOR","attributes":{"VesselId":"9497199"},"category":"REAL","value":"D","timestamp":1495791595795,"quality":"GOOD (0) "}]

Tag Values in JSON Form

SMARTShip – Onboard Features

Features

- Up to 5,000 collectable data points
- Multiple Servers with database replication
- Data sampling and transmission to shore at 30 second intervals
- IoT Broker designed for realtime and high latency environments with 60 seconds default client timeouts
- Ruggedized hardware designed for unfavorable and adverse environments
- Selected hardware provides vertical and horizontal scalability including physical or virtual capabilities

Updates, Security, & Patches

- Private repositories provide SMARTShip software patches and updates
- Vendor approved public repositories provide upstream patches and updates
- Automated vulnerability scanning

SMARTShip – Cloud Features

Features

- Dynamic scaling to support increased or decreased traffic
- Distributed Cassandra NoSQL clusters across three availability zones
- Geographically distributed backups residing in object storage
- Able to sustain an entire availability zone outage without disruption
- IoT Broker designed for both realtime and high latency environments with 60 second default client timeouts

Updates, Security, & Patches

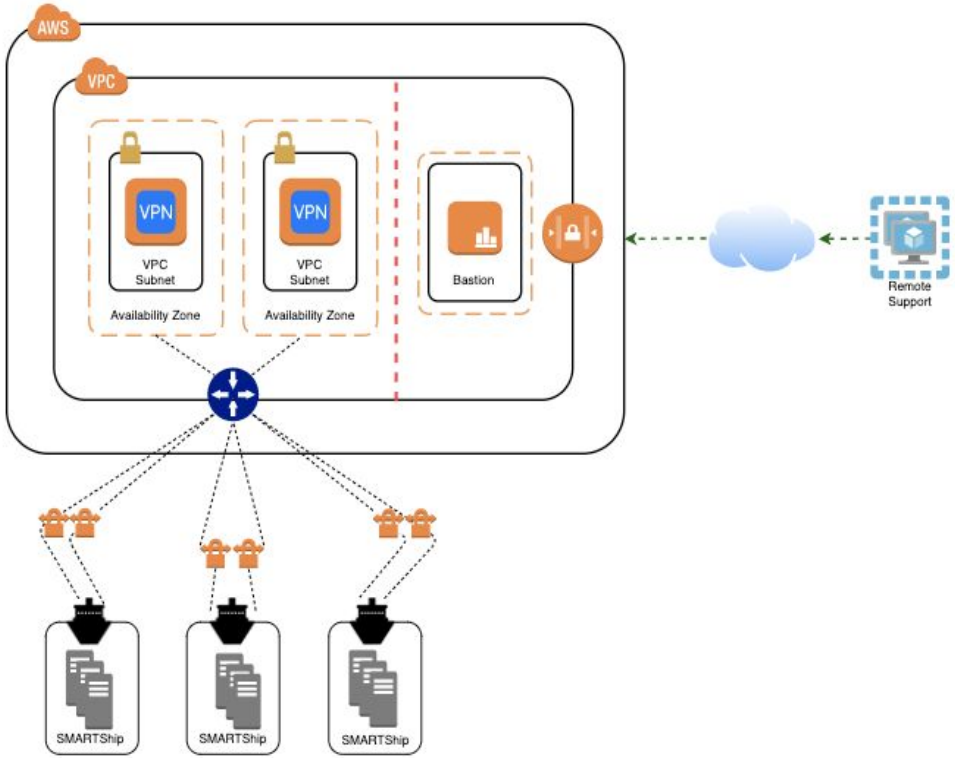
- Private repositories provide SMARTShip software patches and updates
- Vendor approved public repositories provide upstream patches and updates for Operating System
- Automated vulnerability scanning
- Managed services benefit from AWS automated updates and patching

SMARTShip – Cloud Security

Security

- Access to SMARTShip cloud restricted to key trusted personnel through use of AWS IAM
- All VPCs, Subnets, EC2 instances secured by use of Network ACLs, & security groups
- Communications to private subnet restricted from specific ip ranges
- Use of Public & Private subnets
- Leverage NAT Gateway to hide servers inside private subnet
- Access to SMARTShip production network restricted through a bastion host
- All access to various servers are monitored and logged
- All data transmission through public internet is encrypted

SMARTShip – Remote Access



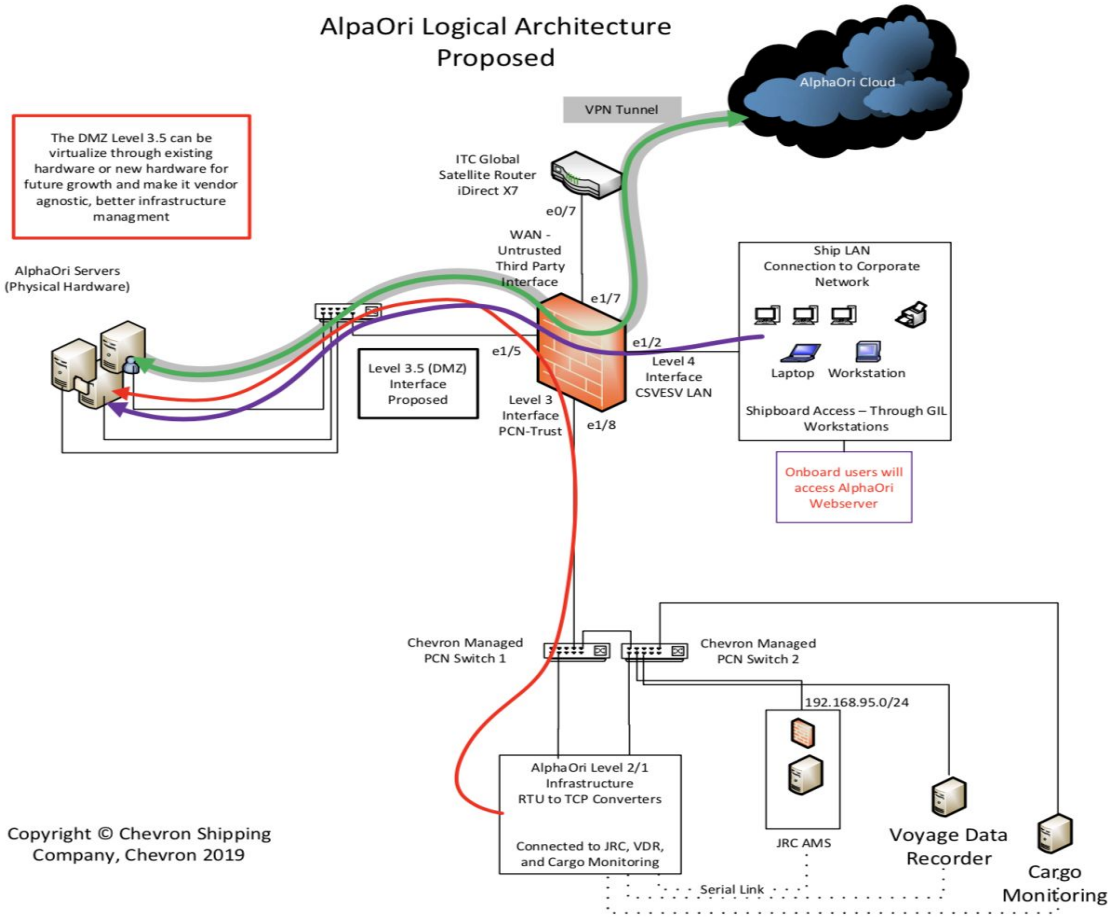
Security & Access Management

- Multifactor Authentication
- Least Privileged
- Audit Log and Monitoring
- Bastion Host for VPC access
- Network ACLs for AOT Operations

AOT Operations

- Remote AOT Operations support is possible via highly available SSL VPN implementations
- Troubleshooting, installations, and local or remote vulnerability scans require remote accessibility by AOT Operations
- The secure VPN provides fluid access to ensure proper automation for packaging and updates

AlpaOri Logical Architecture Proposed



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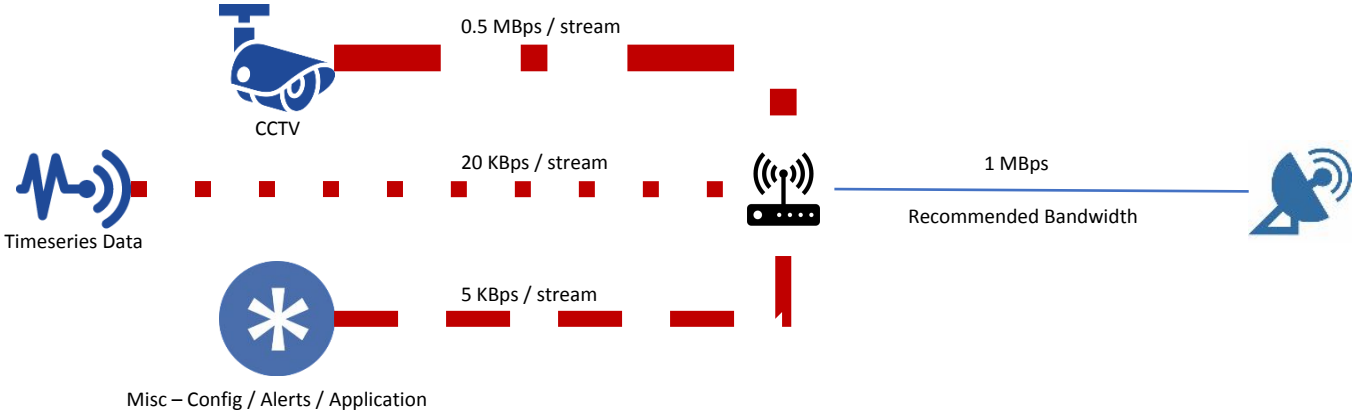
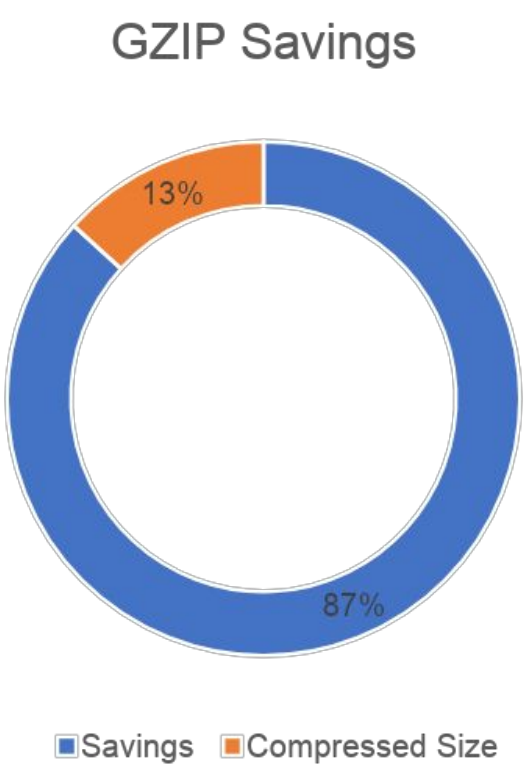
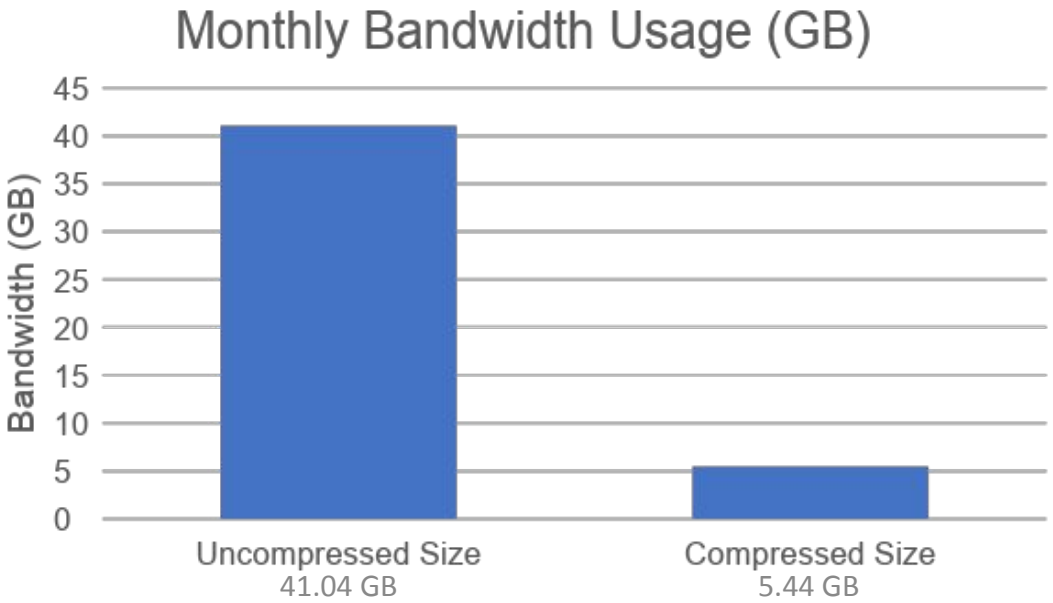
SMARTShip – Bandwidth Usage



1. Total number of data tags = 3000
2. Approx. size of each data tag = 170 bytes
3. Transmission Frequency = 30 seconds
4. Uncompressed file size = 498 kBytes
5. Compressed with GZIP (assuming 85% Compression) = 75 kB
6. Bandwidth Requirement = 2.5 KBytes/sec or 20 KBits/sec

SMARTShip – Data Compression





Monthly Bandwidth Usage (Time Series Data)

1. Assuming a total of 3000 tags at approx. 170 bytes per tag
2. Frequency – once every 30 seconds
3. Monthly bandwidth savings of about 87% or 35.6 GB