Projects in Electrical & Computer Engineering 2007-2008

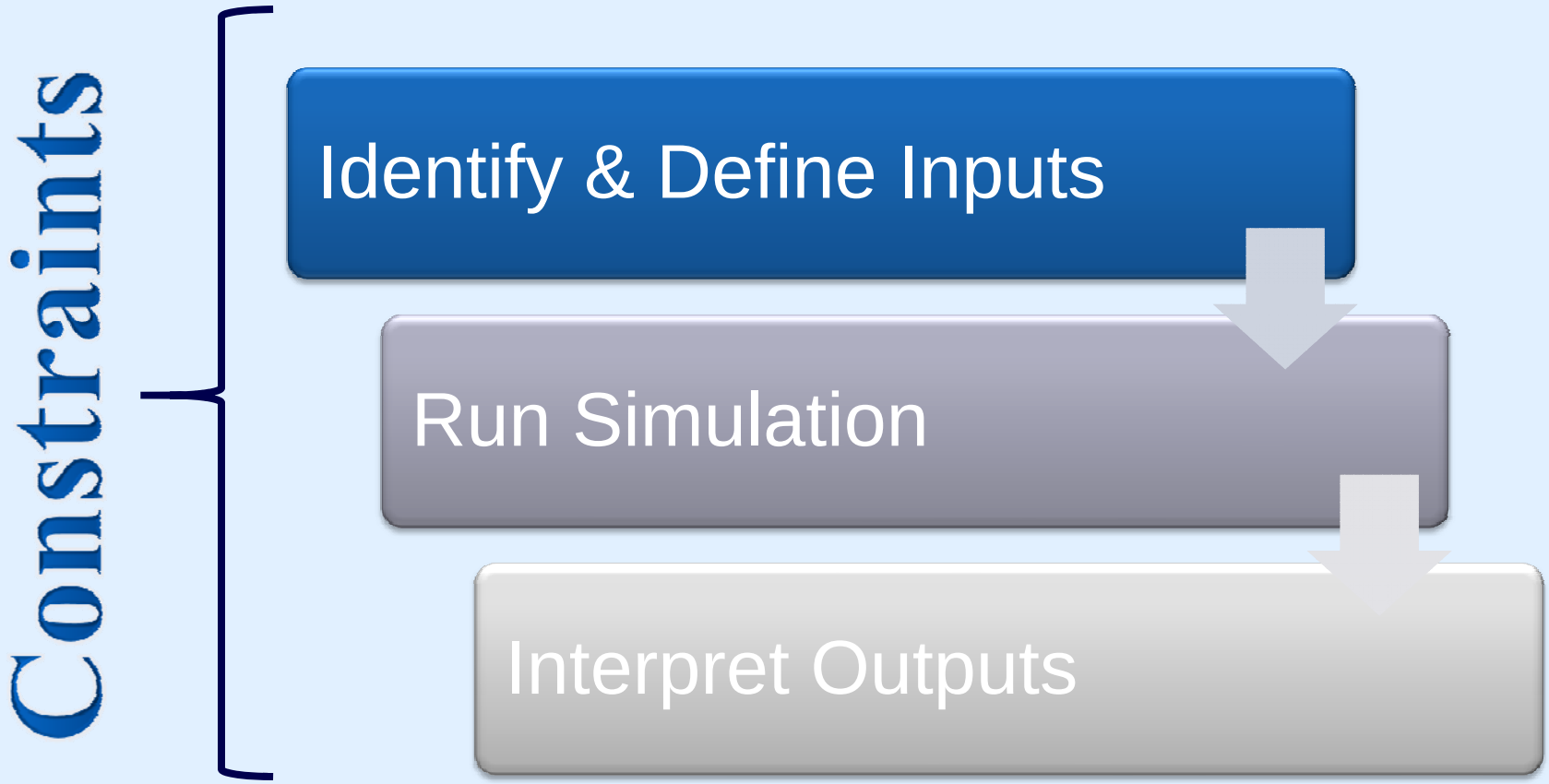
Blue Force Tracking: The Impact on the Automatic Identification System (AIS) Very High Frequency Data Link (VDL)

1/c David Couture

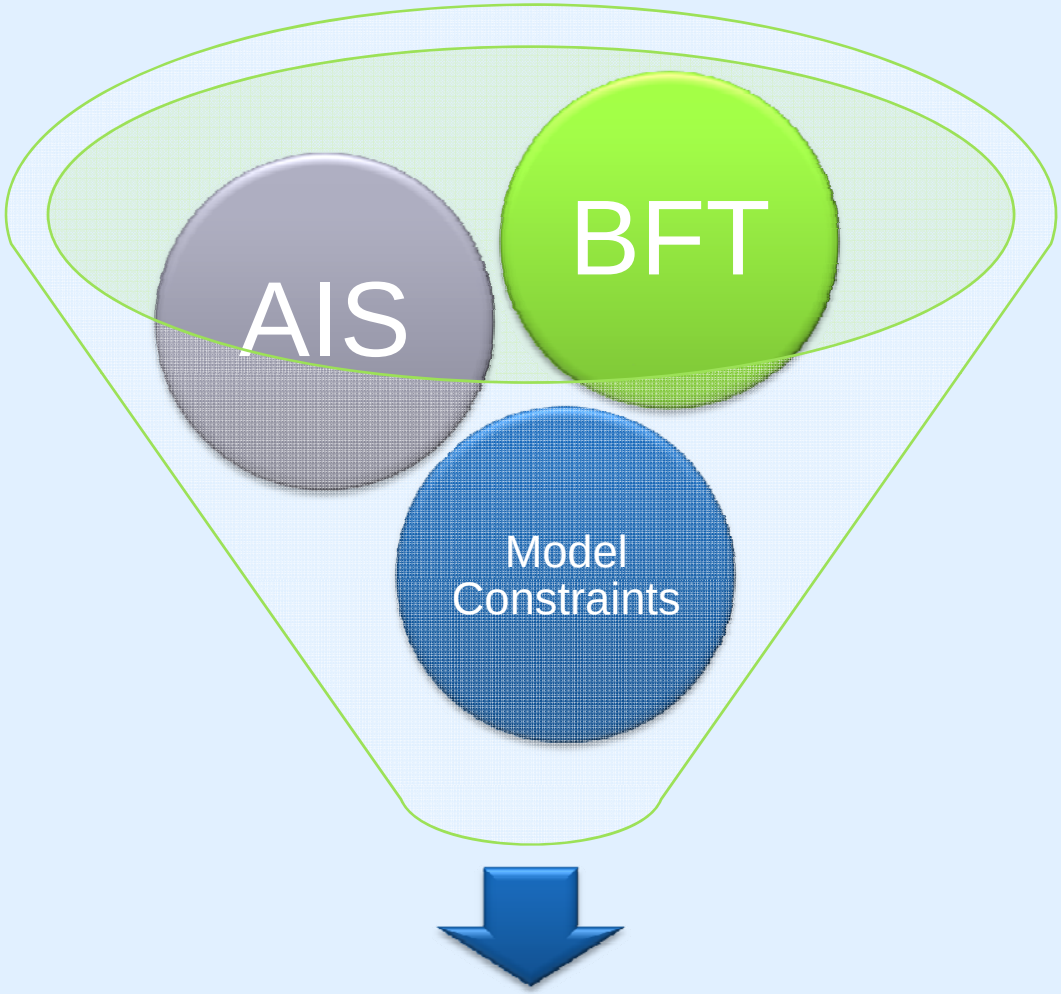
Project Advisor: LCDR Robert Oatman

Sponsor: LCDR Eric St. Pierre (CG-641)

Develop a process which can be easily repeated for subsequent analysis of other ports and/or changing operational requirements

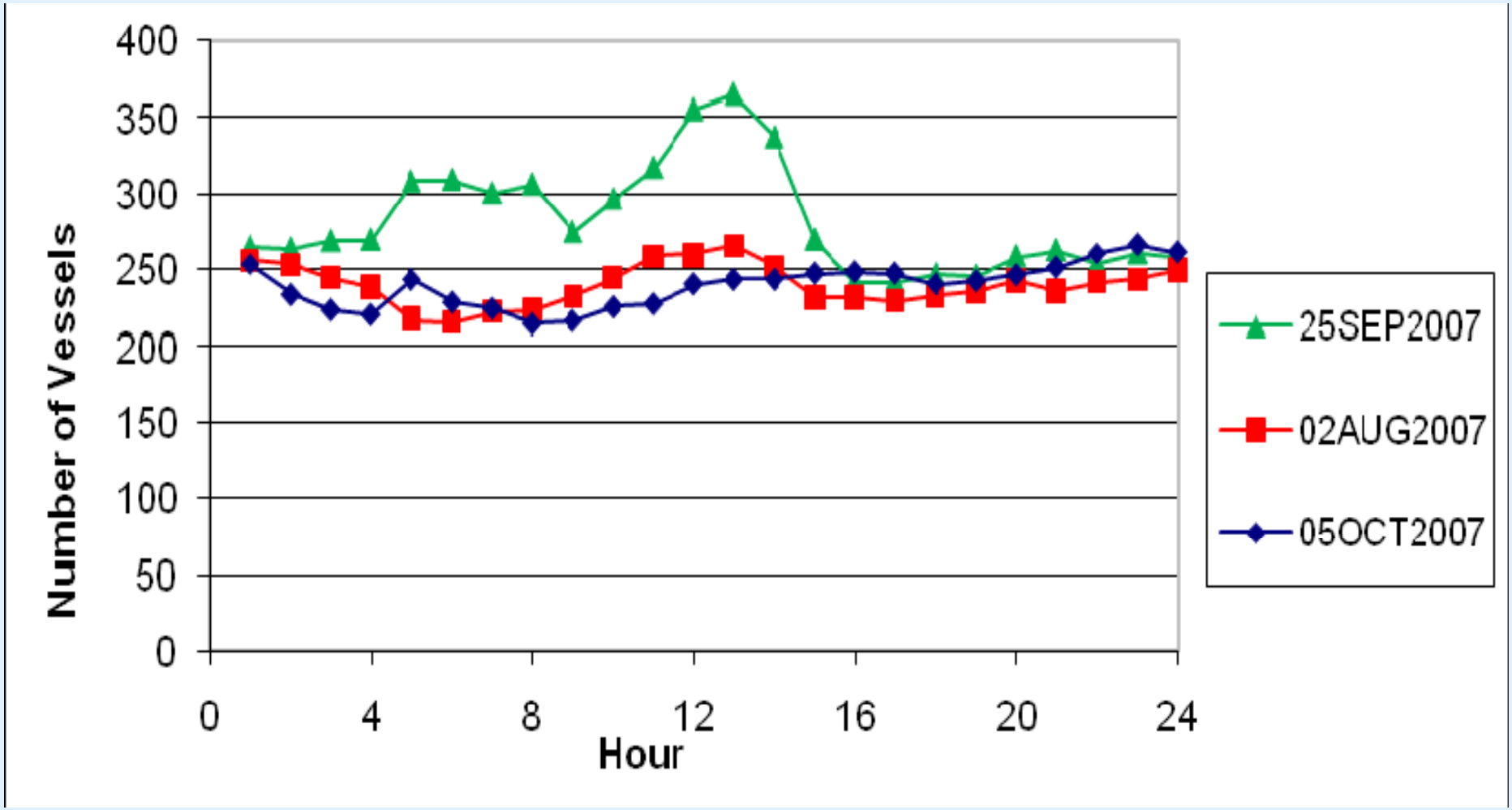


The inputs for the simulation included 'real' AIS data and predicted Blue Force activity



Inputs to Simulation

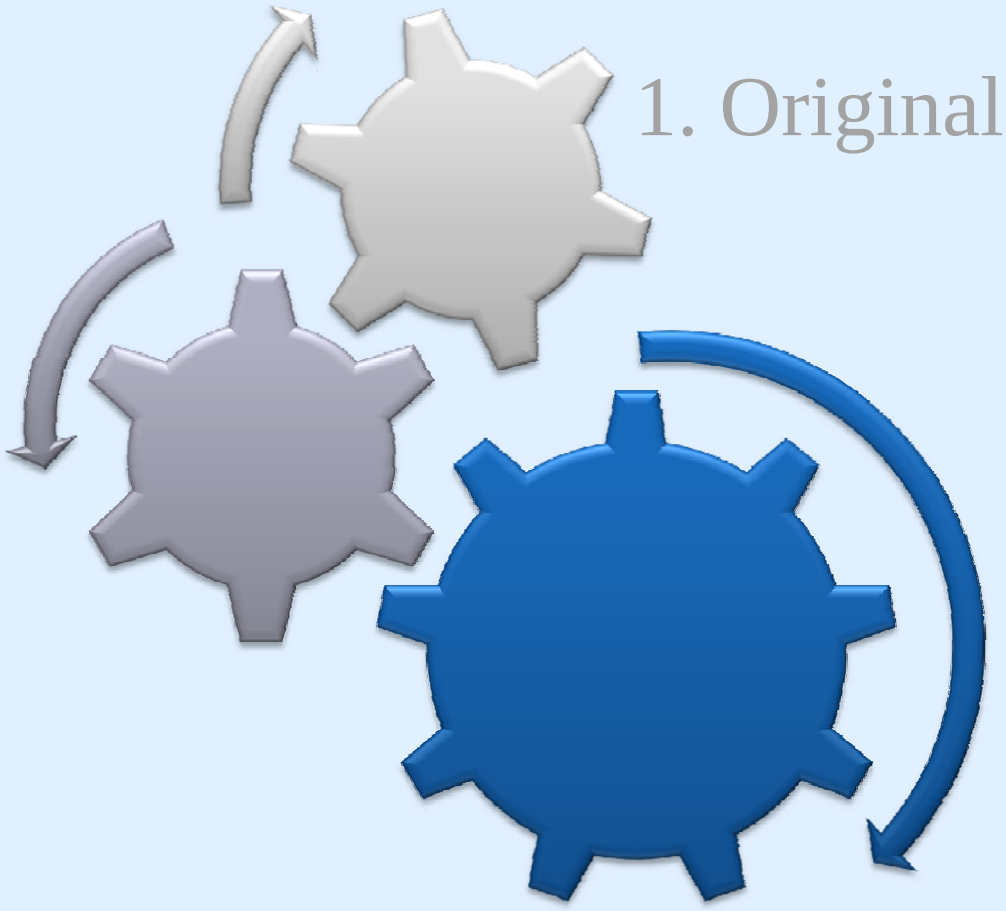
‘Real’ AIS data was selected after identifying days with the highest observed loading levels



Blue Force Activity predictions were constructed following a review of current operations for Sector New York

- 244 single-slot transmissions per minute
  - 61 vessels (4 reports per minute)
  - Position reports
  - Max loading (Sept 11 scenario)
  - CG and Port Partner vessels
- 18 multi-slot transmissions per hour
  - Overlays (search patterns/security zones)
  - Text messages

The Simulation required modifications to the USCG R&DC's AIS VDL Simulation Software



1. Original

2. Incorporate BFT position reports

3. Model multi-slot usage on the VDL

The simulation produced 2 key output files summarizing slot usage and availability on the AIS VDL

Slot Availability

- Per minute/frame availability of contiguous slots

Slot Usage

- Per minute/frame activity on AIS VDL channels

The simulation outputs allowed the number of available slots to be calculated by subtracting BFT usage from availability

- Took max loading hour (hour 13)
- Sum total slots used, divide by 60
- Subtracted value from loading summary values of the day

Future processes may want to consider AIS VDL slot ‘corruption’ and local, i.e., non-global, perspective to provide greater fidelity and understanding of BFT impacts

- Local perspectives provide a greater picture of slot usage
- Local perspectives may differ from specifc area to specific area

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Results of Modeling the Impact of Blue Force Tracking (BFT) Over the Automatic Identification System (AIS) Very High Frequency Data Link (VDL)

1/c DeCarol A. Davis

Project Advisor: LCDR Oatman

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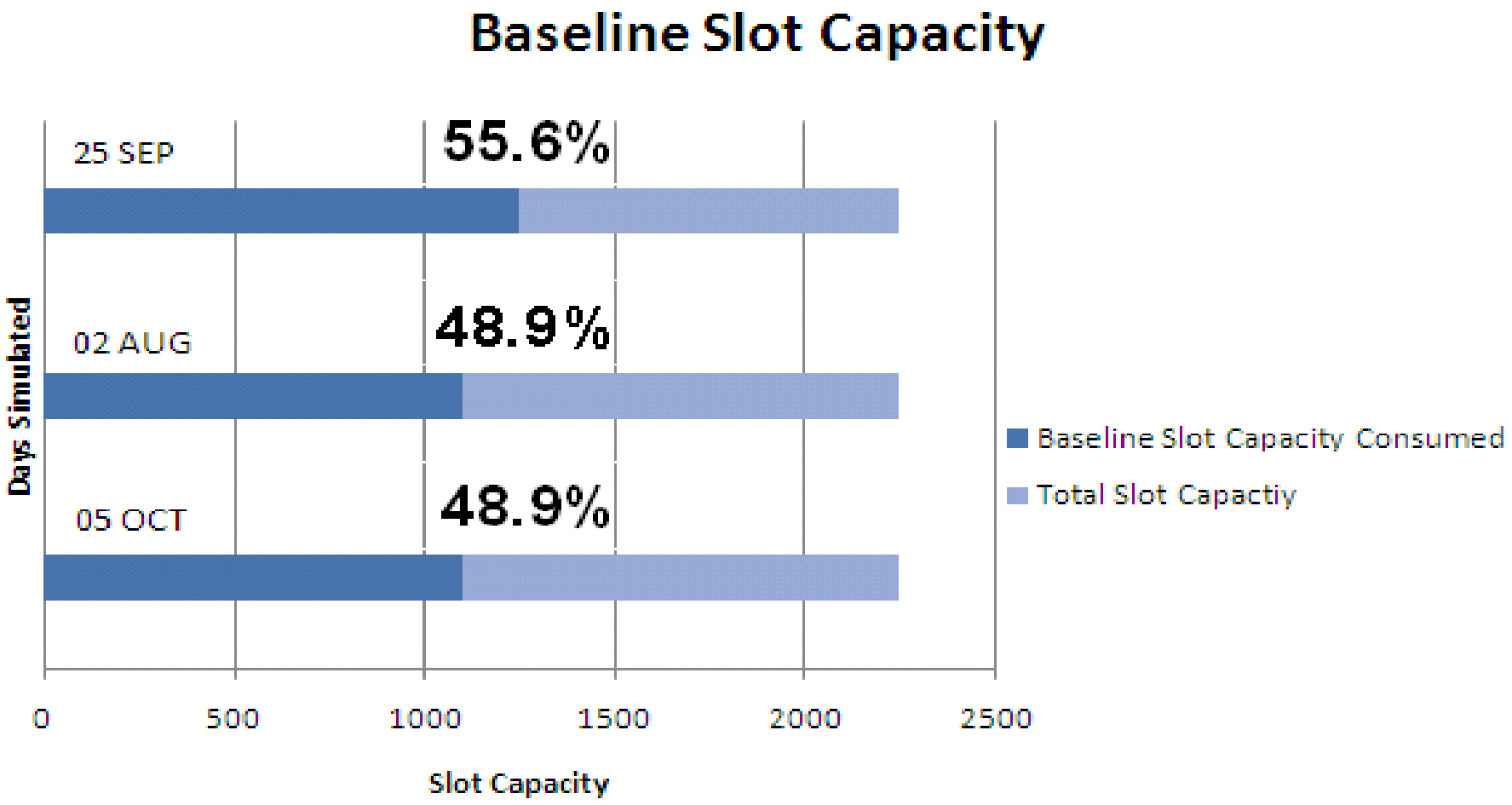
Three-Stage Process

- Stage 1: Baseline scenario modeling the operation of Class A vessels over the AIS VDL without Blue Forces

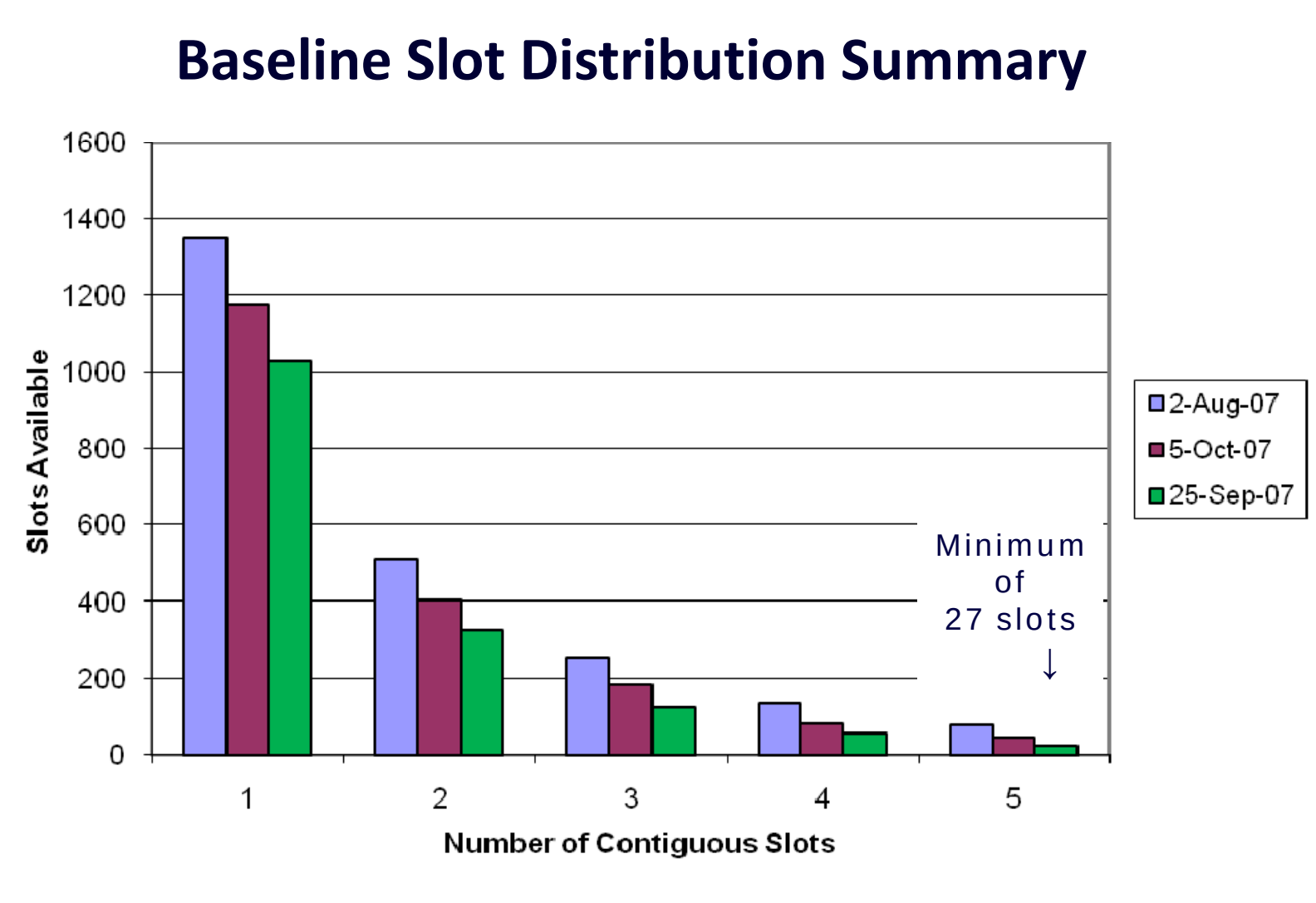
- Stage 2: Stage 1 with the addition of 61 Blue Forces transmitting 1-slot position reports every 15 seconds

- Stage 3: Stage 2 with additional loading created by having 18 of the Blue Forces transmitting one 5-slot message every hour

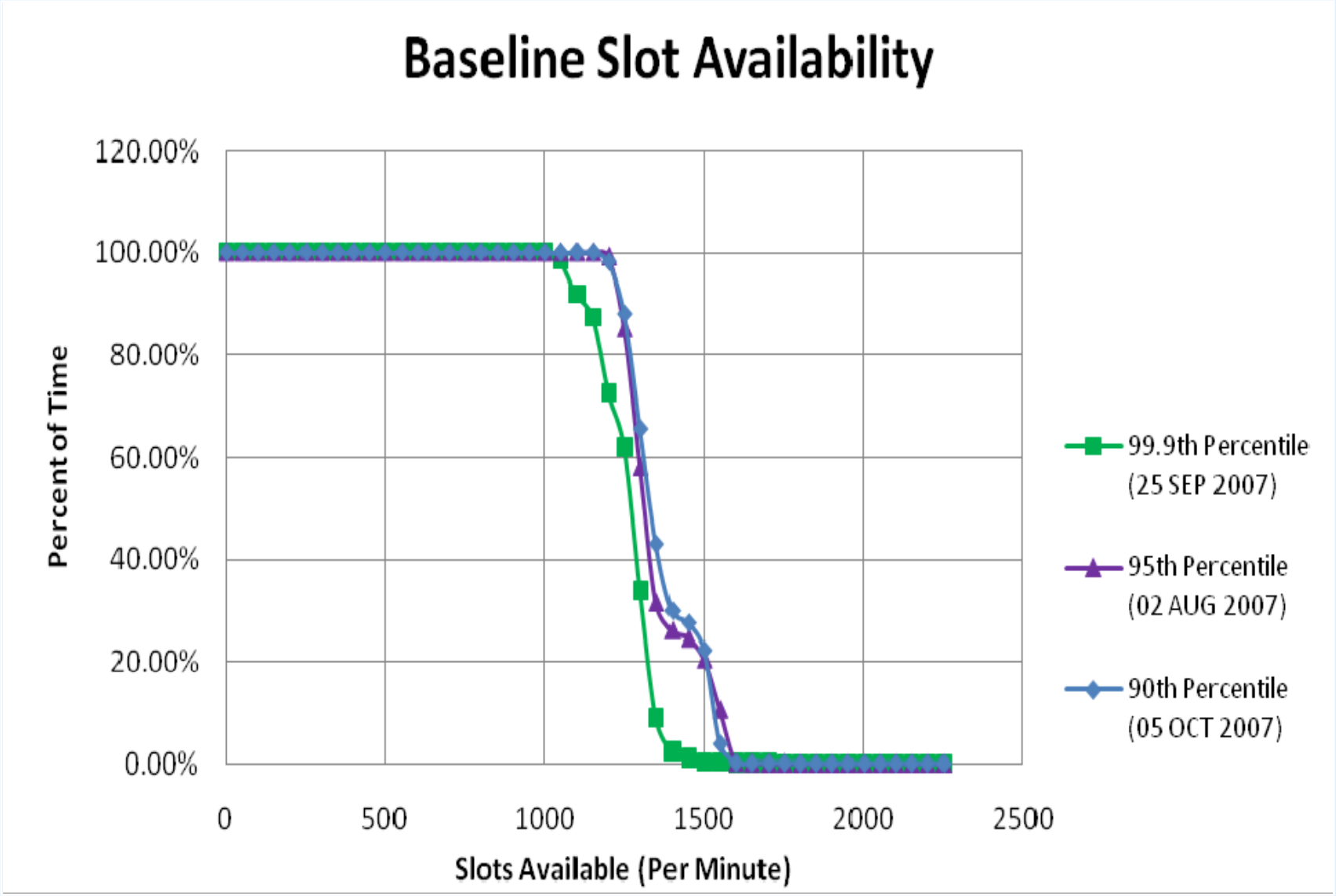
Stage 1: The AIS VDL has the capacity to support BFT data requirements



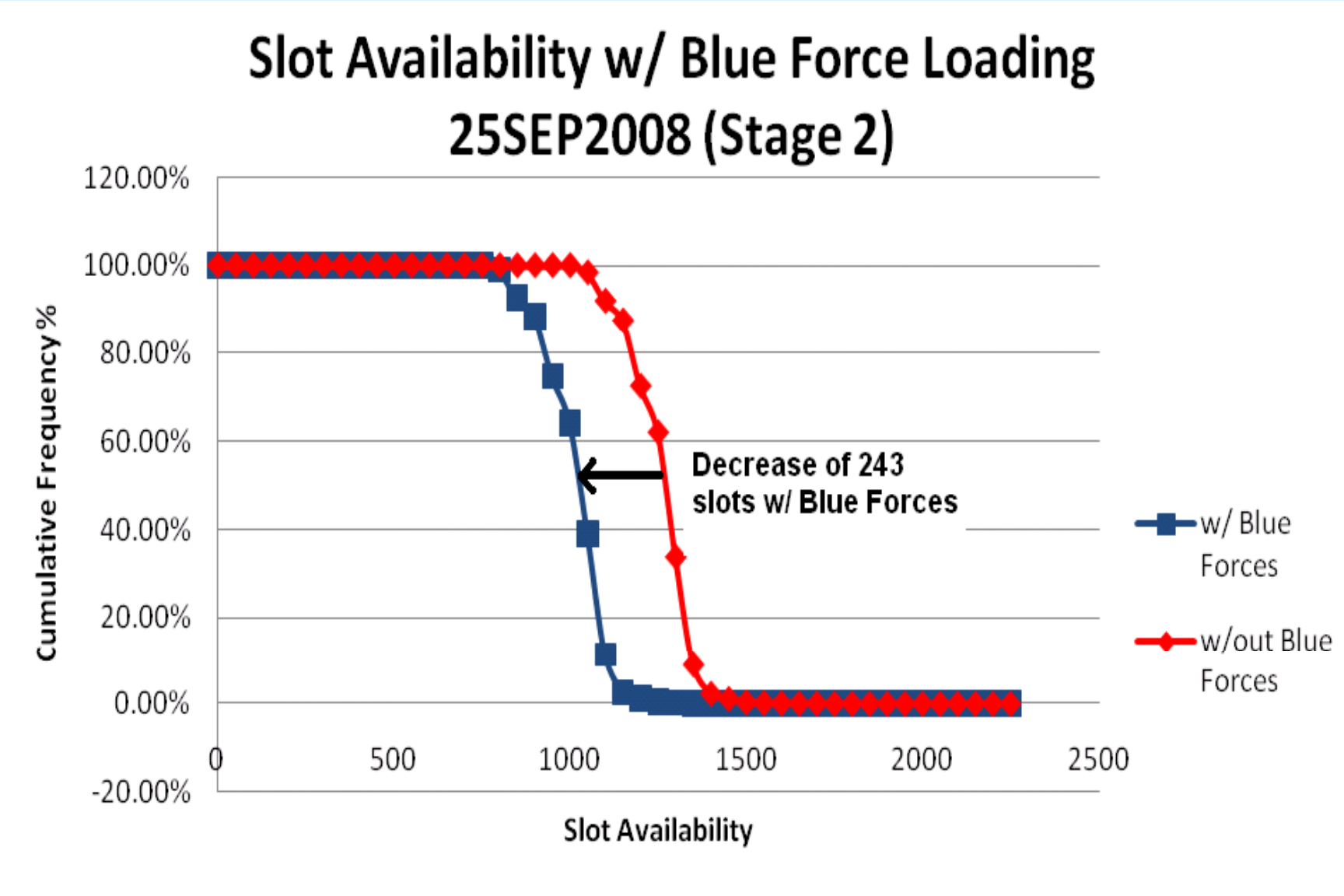
Stage 1: A sufficient number of multi-slot occurrences exist to support new BFT operational requirements



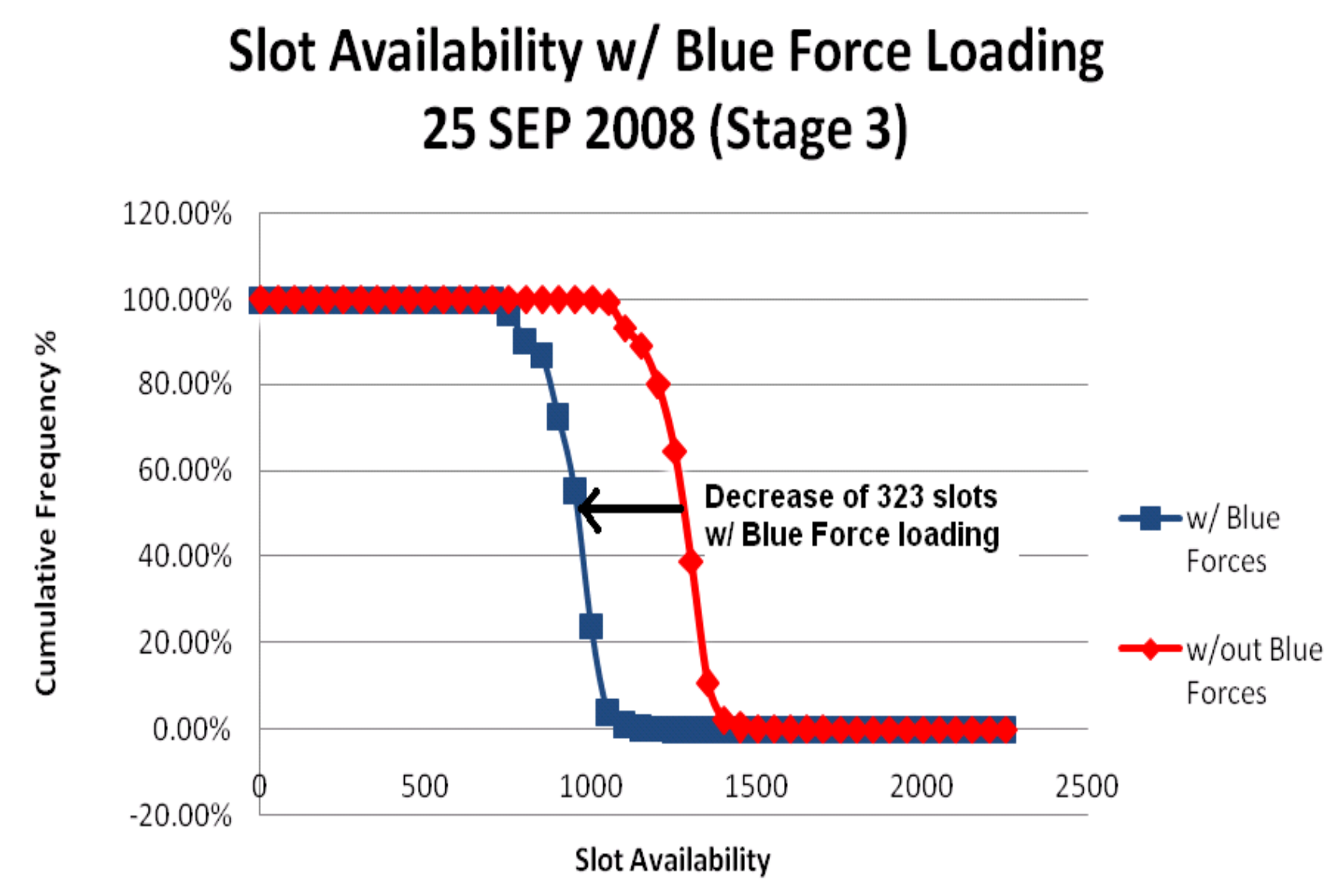
Stage 1: During the peak vessel loading day in NY, at least 1000 slots were available per minute



Stage 2: Blue Force position reporting resulted in a 24% decrease in the slots available per minute



Stage 3: Blue Force multi-slot transmissions consumed 32% of the available slots per minute



Conclusion

- These results conclude that although BFT has a noticeable impact on the AIS VDL, it does not overload the channel's capacity.
- The Coast Guard may be able to employ the AIS VDL in New York for additional data communication requirements.
- An analysis of more ports can increase the fidelity of results found in this project and better determine the AIS VDL's capability across the nation.

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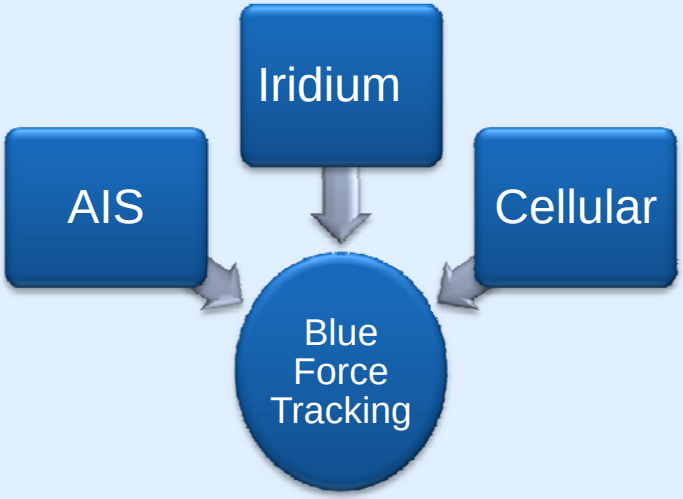
Alternative Analysis



Framework for Analysis

- Performance
- Interoperability
- Usability
- Maintenance
- Security
- Cost

Existing operational requirements and current development efforts bounded the analysis

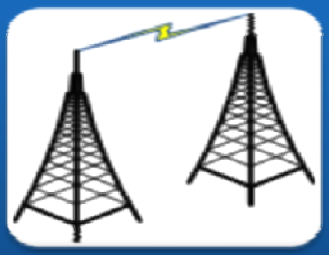
- STED's applied as a restriction as means to keep analysis within boundaries of Coast Guard operations.
- Only real-time information was used, no "future plans" taking into account during analysis.

Informative analysis and ranking methodology allowed all systems the opportunity to score equally well

- Based on how well the system could fulfill requirements set forth by each category.
- Sub-categories were used to create structure in each category as well as objectivity.

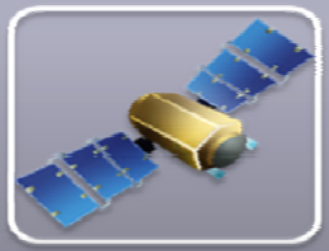
PERFORMANCE: AIS fulfilled all of the STED's operational requirements

Overall



AIS

- Aptitude
- Efficiency
- Capability



Iridium

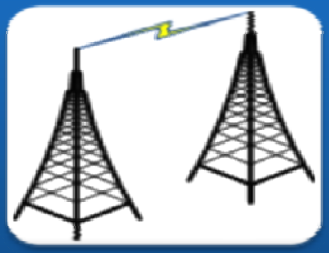
- Aptitude
- Efficiency
- Capability

Cellular

- Aptitude
- Efficiency
- Capability

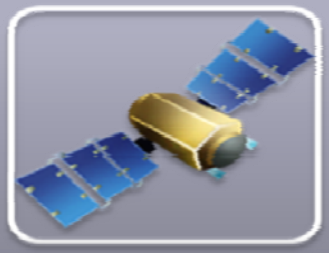
INTEROPERABILITY: All systems satisfactorily fulfilled requirements for COP data exchange

Overall



AIS

- Smooth Interaction
- Integration
- Information Exchange



Iridium

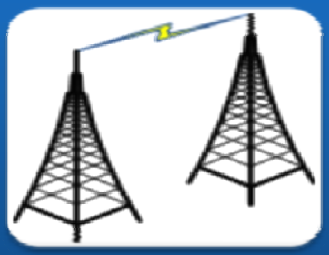
- Smooth Interaction
- Integration
- Information Exchange

Cellular

- Smooth Interaction
- Integration
- Information Exchange

USABILITY: Minor concerns with Cellular due to its interactive nature.

Overall



AIS

- Complexity of Operation
- Interpretation
- Training

Iridium

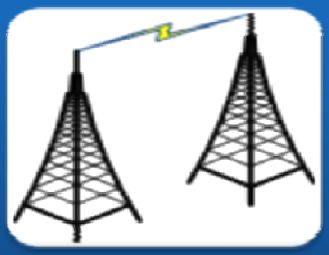
- Complexity of Operation
- Interpretation
- Training

Cellular

- Complexity of Operation
- Interpretation
- Training

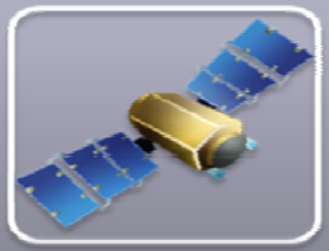
SECURITY: All systems are vulnerable to signal jamming but meet encryption standards by using AES

Overall



AIS

- Encryption
- Vulnerabilities



Iridium

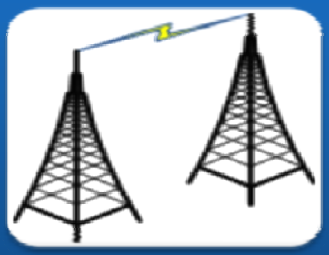
- Encryption
- Vulnerabilities

Cellular

- Encryption
- Vulnerabilities

COST: AIS is the most cost effective solution given that there are no long term service costs

Overall



AIS

- Initial Fee
- Operational Fee
- Maintenance Fee

Iridium

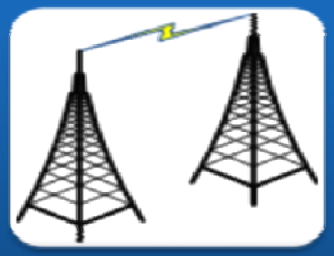
- Initial Fee
- Operational Fee
- Maintenance Fee

Cellular

- Initial Fee
- Operational Fee
- Maintenance Fee

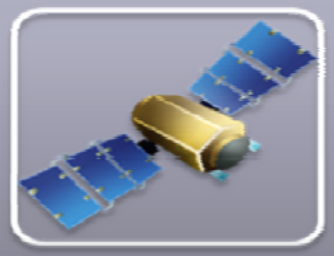
MAINTENANCE: All systems satisfactorily fulfilled requirements.

Overall



AIS

- Support
- Time of repair/replacement



Iridium

- Support
- Time of repair/replacement

Cellular

- Support
- Time of repair/replacement

Thank you

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ETCS Gerard O'Connell

ENS Jesse Houck (Sector Seattle)