



National Transportation Safety Board

Voyage Data Recorders

Benefits, Limitations & The Future of Ship Data

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Presentation Outline

- History of VDRs
- Case Study – *SS El Faro*
 - Original Known Data
 - Investigative Timeline
 - What did the Data Tell Us?
- VDR Survivability Issues
 - Regulations v. Reality
 - New Regulations
 - Float Free Capsules
 - Survivability Issues
- Future of Ship Data
- Value of Wreckage Classification



What Should You Takeaway?

- Challenges and limitations of VDR recovery
- How does the VDR “complete” the investigation?
- How can we make it easier to get the VDR?
- What can we learn from aviation?
- What is the future of ship data?
- What is the value of a wreckage survey?

VDR Timeline

- 1980 – *MV Derbyshire* sinking



- 1988 – First Data Recorder (Voluntary)

- 1994 – *Estonia* sinking



- 1997 – IMO adopts standards for VDR
- 2002 – First compliance date for VDR
- 2004 – IMO adopts standards for SVDR
- 2010 – Last **S**-VDR Compliance date
- 2014 – Current regs. implemented

VDR Requirements – *Newest Rules*

- New ships built after July 1, 2014

30 DAYS



Cabinet Data Storage

- 30 Days of Recording
- Not Protected

48 HOURS



Protective Capsule

- 48 Hours of Recording
- Protected
- Sinks with Ship

48 HOURS



Float Free Capsule

- 48 Hours of Recording
- Protected
- Floats

VDR Case Study

El Faro & Her Final Voyage

- US Flagged – Jones Act Trade
- 791 foot *converted and stretched* Ro-Con ship based in Jax, FL
- 28 US Crew and 5 Polish Supernumeraries
- JAX to PR Trade (Jones Act)
- All 33 crew were lost – no survivors



In memory of the crew of *El Faro*



SS El Faro – Data Sources

- AIS Data (GPS)
- Refrigerated Container Tracking (GPS Pings)
- Inmarsat (Emails, Wx, Voice, GPS Pings)
- GMDSS (Inmarsat-C, SSAS, EPIRB)
- 1 Phone Call from Captain of El Faro
- S-VDR (Missing)
 - Bridge Audio
 - Parametric (Ship) Data
 - Environmental Data

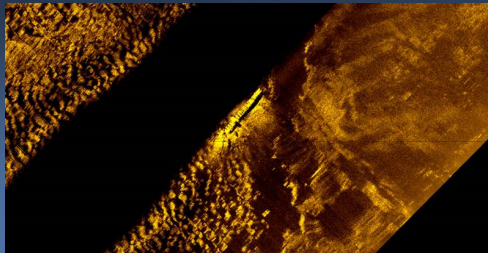


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Investigative Timeline

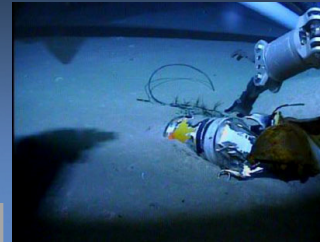


Oct 1, 2015



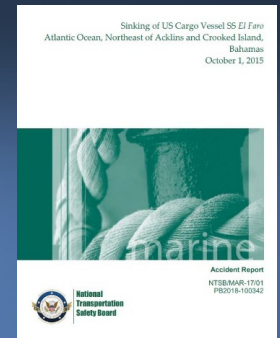
Oct 31, 2015 *Hull located*

*Mission 3 – 10 days
VDR recovered*



August 2016

Report Released



March 2017

2016

2017

Oct 15, 2015



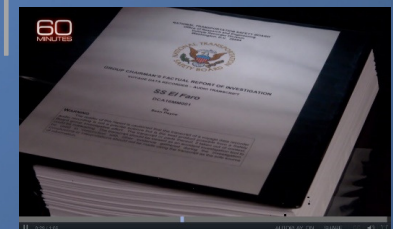
Mission 1 – 30 days

April 2016



*Mission 2 – 21 days
VDR located*

December 2016



Transcript Released



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VDR – Annual Performance Test



Sperry Marine PSR Number # 936036

Annual Performance Test for Voyage Master II S-VDR

Name of ship	Flag	Class	Gross Tonnage	IMO Number
EL FARNO		ABS	17527	7395351

S-VDR Serial Number: A06032-000937

Complete all relevant sections; give information, dates or measurements, as appropriate. Mark boxes "x" to indicate satisfactory inspection. Dates should be given in the format mm/yyyy.

A satisfactory operational status means that all major requirements and operating facilities of the equipment or unit have been tested and found to function in accordance with the associated IMO performance standards and relevant SOLAS regulations.

The following test instruments used:	Yes	No	N/A
* Voltmeter.	X	<input type="checkbox"/>	<input type="checkbox"/>
* Laptop.	X	<input type="checkbox"/>	<input type="checkbox"/>
* Mouse.	X	<input type="checkbox"/>	<input type="checkbox"/>
* Firewire Repeater.	X	<input type="checkbox"/>	<input type="checkbox"/>
* Monitor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
* Ultrasonic Tester.	X	<input type="checkbox"/>	<input type="checkbox"/>



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VDR – Annual Performance Test

Locate Acoustic Beacon.		Yes	No	N/A
Verify battery expiration date has not been reached.		X	<input type="checkbox"/>	<input type="checkbox"/>
Make.	TELEDYNE BENTHOS			
Model.	ELP-362D			
Date of expiration.	MAY 2015			
Serial Number.	47368			
If battery has expired replace or will expire within 1-year replace				
List replacement date on new battery _____				

- Date of APT – Dec. 3, 2013
- Date Pinger Expiration – May 2015
- El Faro Sinking – Oct. 2015

*Note – Battery shelf life is up to 6 years

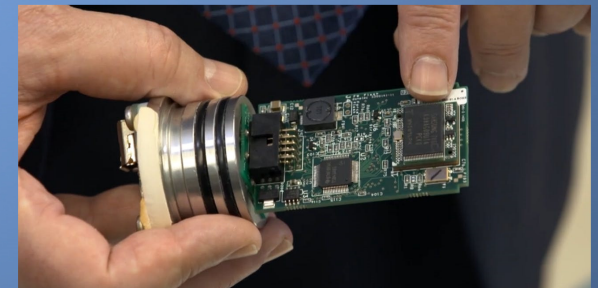
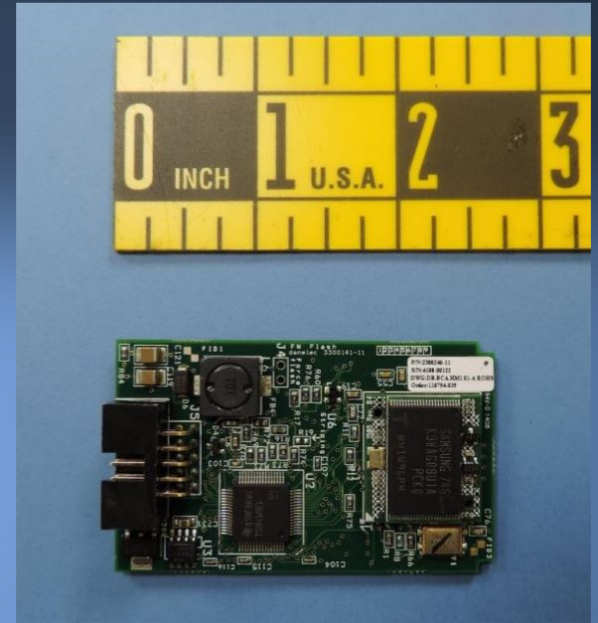


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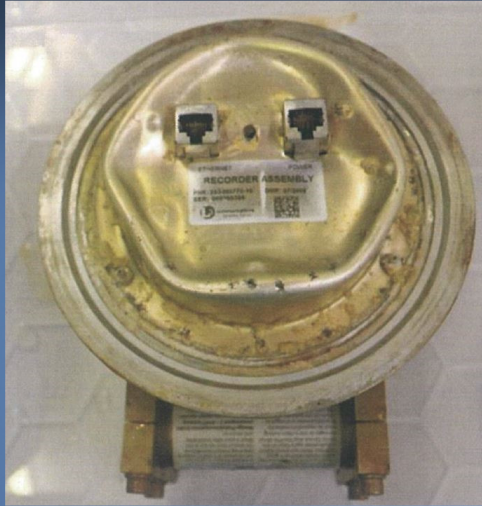
VDR Worked as Designed

- 15,000 feet (4,570m)
- 6,700 psi (46 MPa)
- Outer capsule designed to flood
- Inner capsule resists pressure to 20,000 feet (6,100m)
- Inner capsule houses double stacked NAND Flash chips

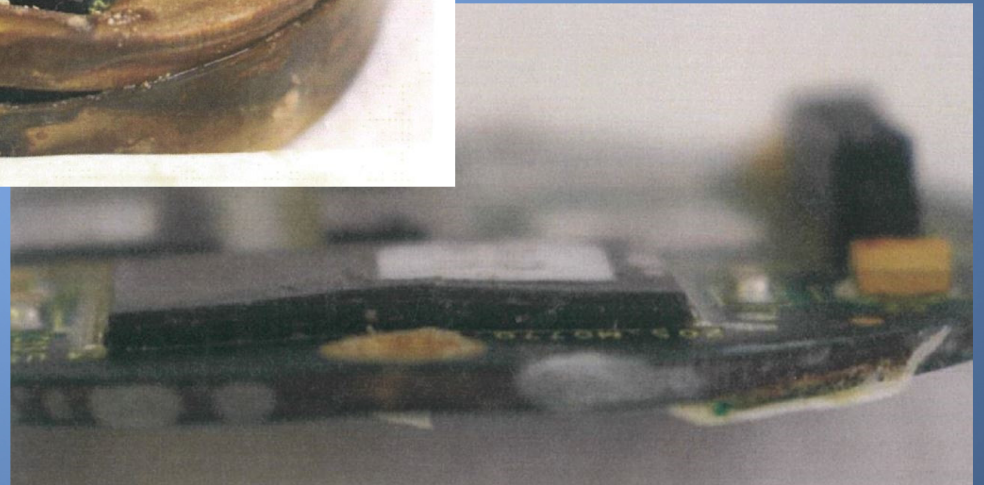


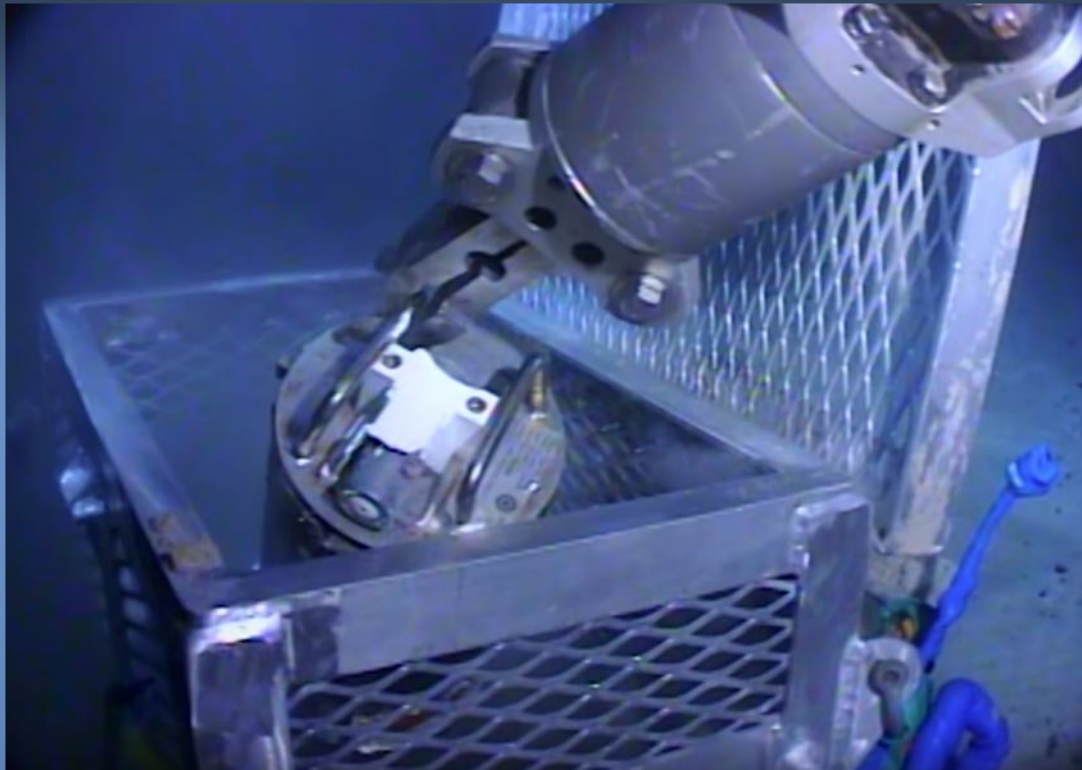


Stellar Daisy VDR



- 12,500 Feet
- Microchips Damaged
- VDR Readout Incomplete



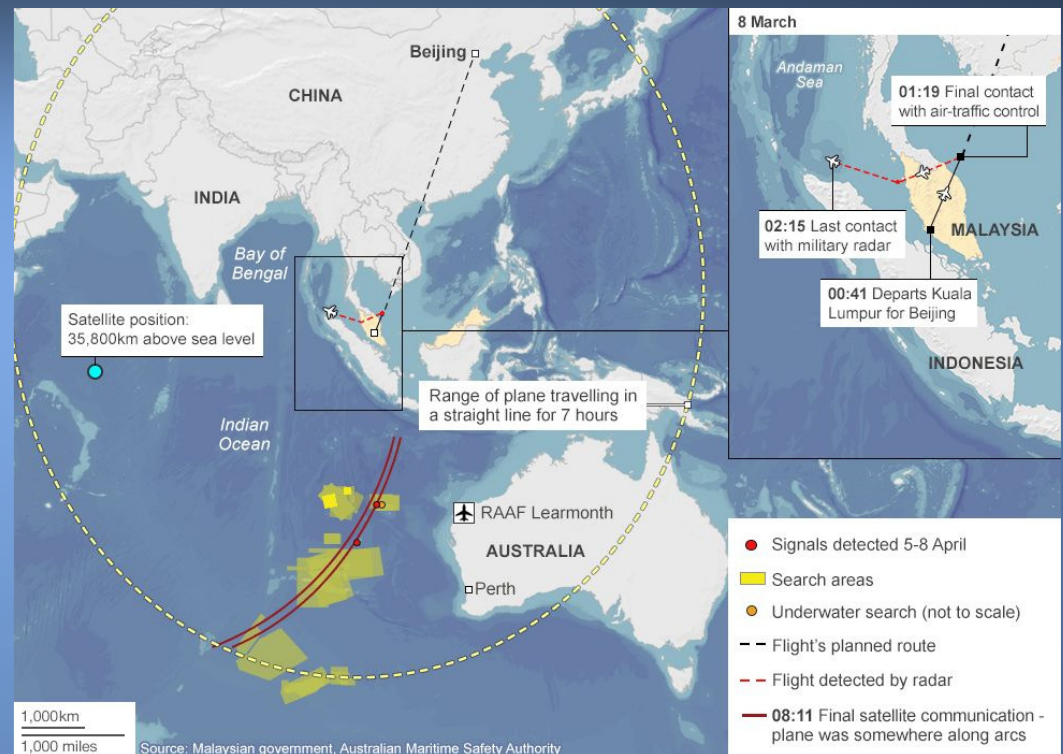


Mandatory Float Free VDRs

- 406 MHz Satellite
- 121.5 MHz Homing Radio
- Combination EPIRB
- Last 48 hours of record time

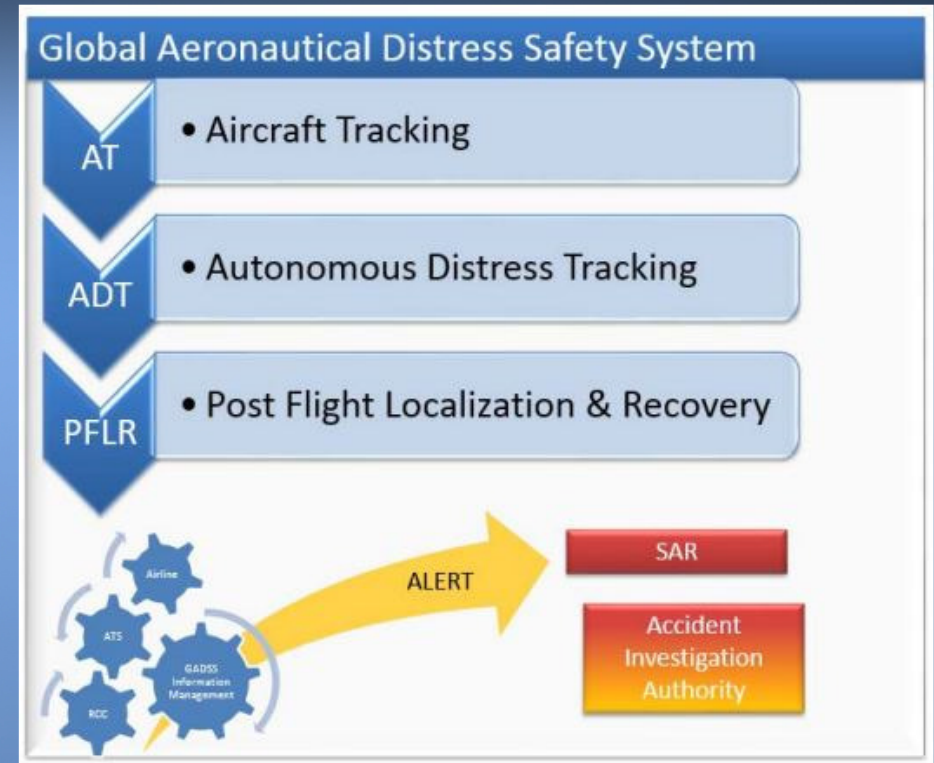


Expectations of Investigations Today

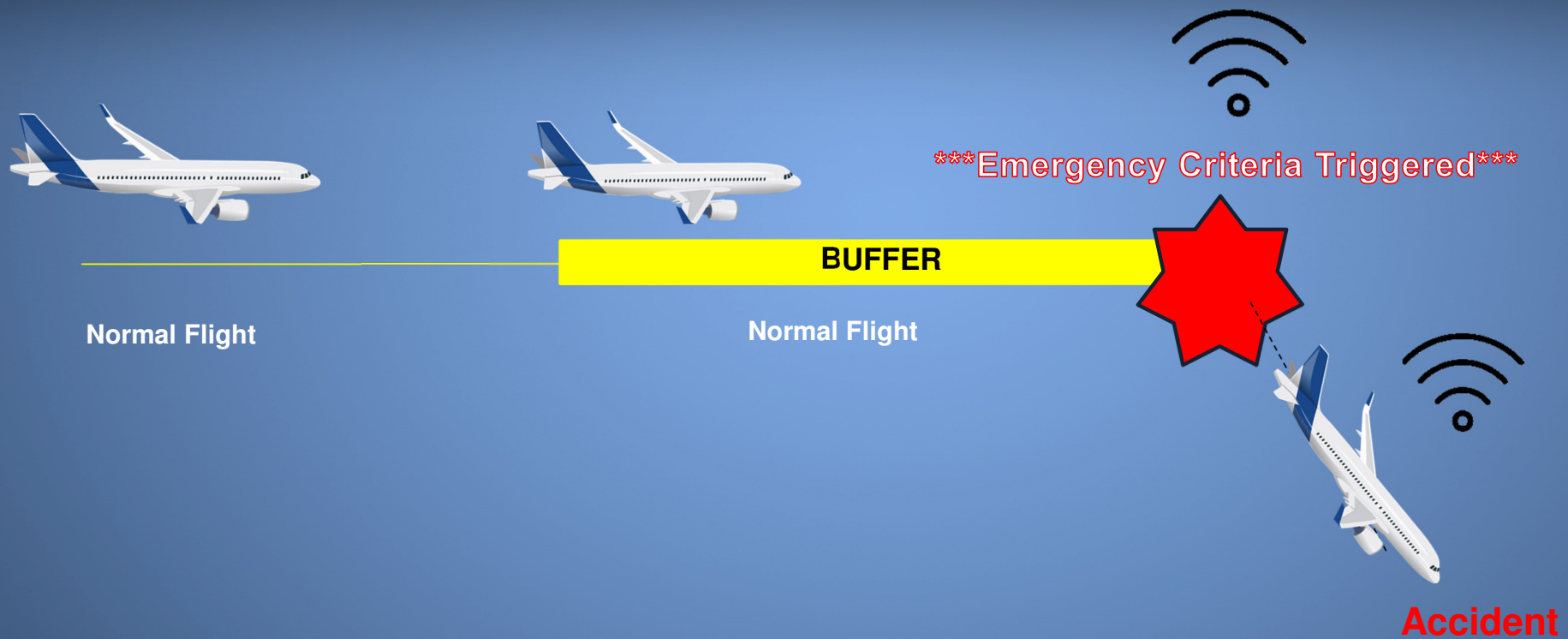


Global Aeronautical Distress & Safety System *GADSS*

- 1st – *Always Know Aircraft Location*
- 2nd – *Satellite Stream What Happened*
- 3rd – *Activate Search & Rescue*
- 4th – *Find Survivors & Wreckage*
- 5th – *Corroborate data with Wreckage Survey*



Streaming Flight Data

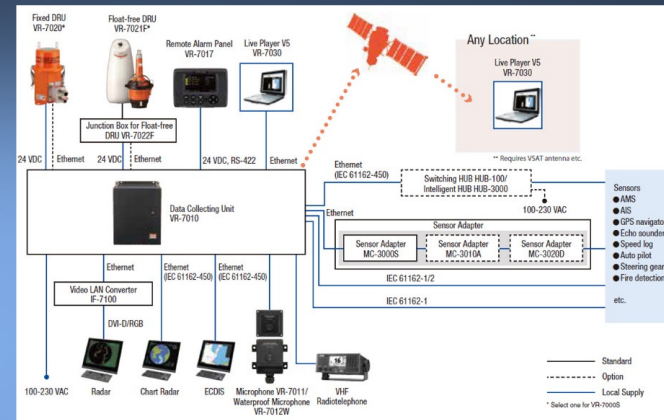
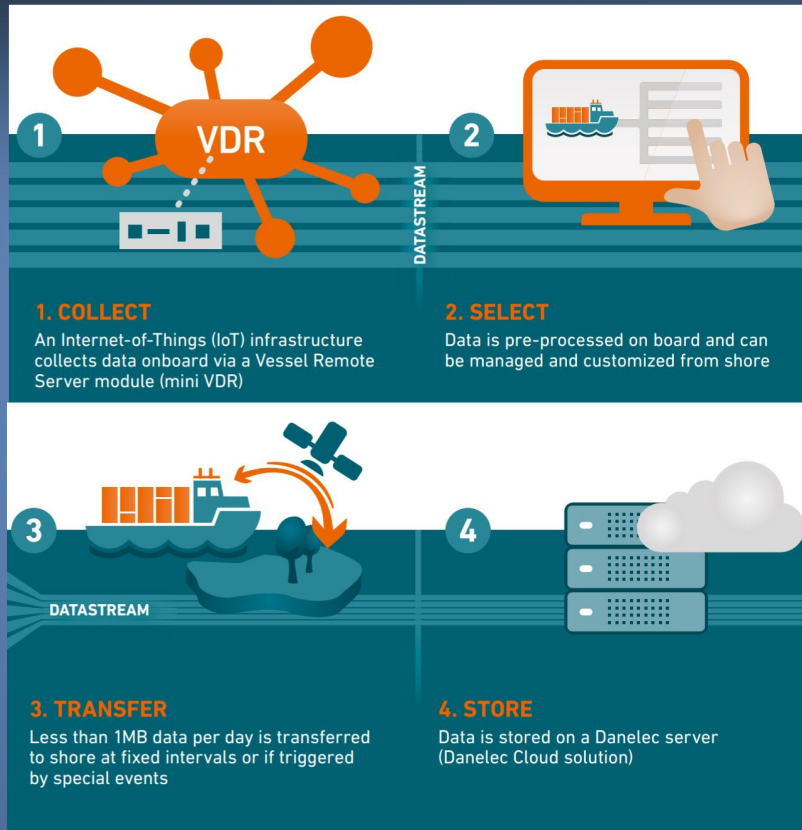


* * TRFD Final Rules Expected 2020 – ICAO Doc 10054

Future of Data Recovery



Streaming Ship Data Solutions



Benefits of Real Time Data - Aviation

- One airline saved \$100M by identifying engine over-temps during takeoff
- Identify bad flight crew procedures
- Aggregate aircraft performance deficiencies



Benefits of Real Time Data – Shipping Industry



- *“Data is the new oil”*
- Study showed benefit of using “VOQA” data to reduce idling in seaport **
- Crew performance monitoring
- Weather routing performance
- *You are already required to collect the data so MAXIMIZE it!*

** Avenca Vessel Operations Quality Assurance Study

Value of an Underwater Survey

- Validate, Verify & Corroborate
 - VDR Audio – Noises
 - VDR Data – Propulsion Issues
 - VDR Data – Flooding (Hatch Condition)
- Rule things out
- Find evidence not recorded

Takeaways

- It is HARD to find a VDR
- VDR is a critical component of a Marine Casualty
- Options for easier data retrieval
- Aviation technology can move us ahead
- We can leverage streaming ship data!
- There is no replacing a good wreckage survey



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