Hope and Healing since 1978

DELL Technologies + Mercy Ships

IT Architecture and Implementation at Mercy Ships

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Mercy Ships

- Founded in 1978 by Don Stevens – started by several refurbished ships ending in the Africa Mercy (currently in operation) in 2007.
- Business model was finetuned to finally focus on hospital ships, as 80% of the world population are at most 150km away from a major port. A hospital ship is a clean and isolated environment, minimizing chances of infections.
- Focusing on healthcare offerings that are not sufficiently covered by local institutions + providing training to local caregivers.
- More than 100.000 surgeries until today in 40 years of existence, trainings given to 42K caregivers and supported several community initiatives.

Global Mercy

- Constructed in China with final works (including ICT and medical equipment) concluded in Antwerp, measuring 174m long and 28.6m wide, containing 12 decks.
- Largest purposely build hospital ship: 6 Fully equipped operating rooms and accommodation rooms for 199 patients. Also containing: a lab, classrooms and an auditorium.
- First mission: From 27th May 2022 in Dakar (Senegal), built for 50 years of useage.
- 642 Crew members, all volunteers.

Mercy Ships – Ship Leaving Port of Antwerp

Mercy Ships – Patient Onboarding

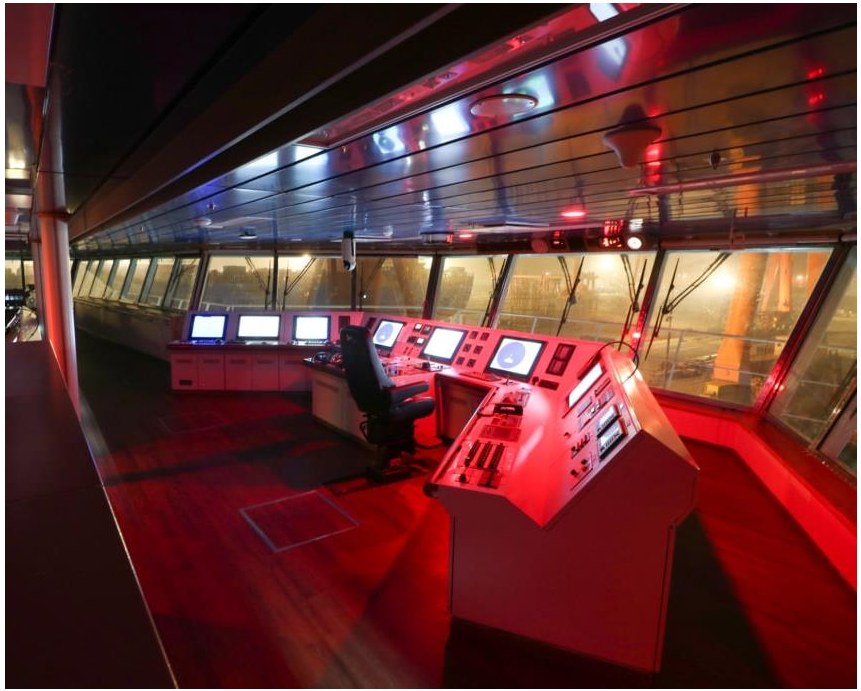
Mercy Ships – Cabins for Volunteers

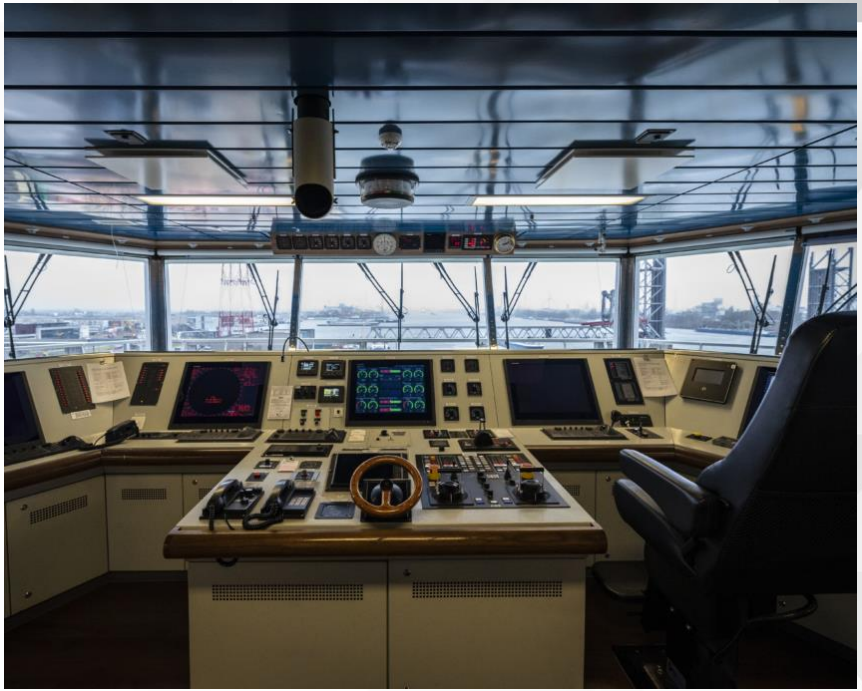
Mercy Ships – Surgery & Monitoring Patients Equipment

Mercy Ships – Medical Scanners

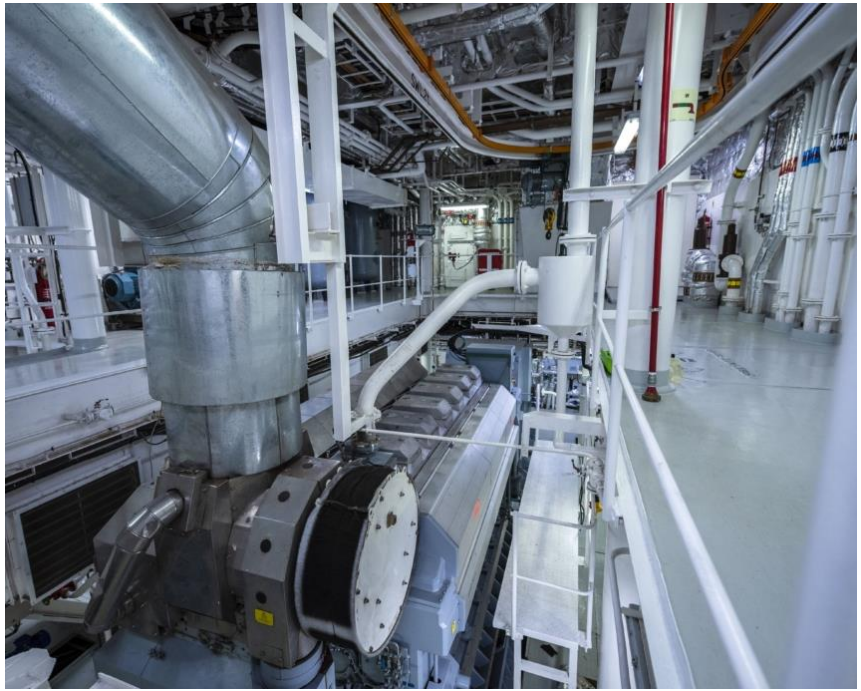
Mercy Ships – Onboard K12 School

Mercy Ships – Captain’s Control Center





Mercy Ships – Engine Room

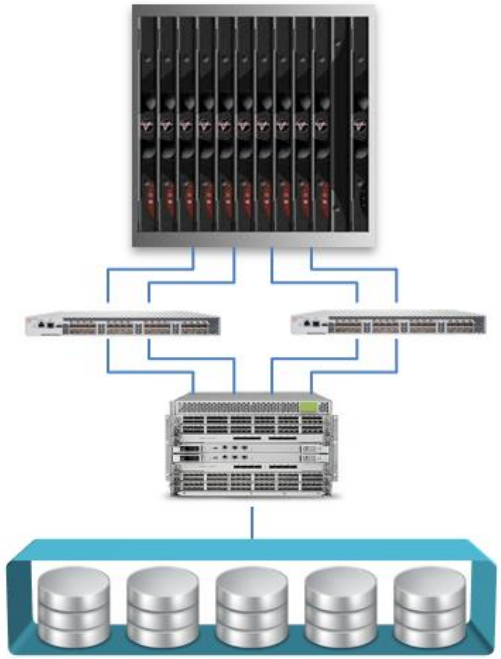


Mercy Ships – Connectivity

Data Room Requirements

- Builders needed the data room design Global Mercy four years before it's maiden voyage.
- Key requirements:
  - Reducing complexity and increase manageability. Standardize on skillsets easily found on the market.
  - Marine conditions while travelling.
  - Minimize space (free up space for medical resources and personnel).
  - Long term viability of the data room design.

Challenges of Traditional Infrastructure



- Multiple components to manage.
- Complex to scale, also with regards to space requirements.
- Forklift migrations both for data and equipment.
- Different management tools.
- Manual fine-tuning.

Virtual

Virtual Overview

Hosts		CPU & Memory		VM Storage		VM Details		Average VM		Physical Util	
Total Hosts:	155	Total Sockets:	374	Provisioned (TB):	1,296	Total VMs:	3,441	vCPU:	4	Avg CPU:	53%
Clusters:	12	Total Cores:	3,792	Consumed (TB):	719	vCPUs:	14,426	vRAM (GB):	14	Avg RAM:	64%
Avg Cluster Size:	12.9	Total RAM (TB):	50			vRAM (TB):	46	Used Storage (GB):	214	*Point in time snapshot	
						VM/Physical:	22:1				

Current Environment

Vendor	Model	Count
Cisco	B200	25
Cisco	B200	56
Cisco	B200	45
Cisco	B200	14
HP	B200	60
Dell	B200	23
IBM	SE5	4
IBM	BGE	3
Lenovo	Knjm	1

VM Profiling

Powered On VMs	2,802	OS Versions	21 derived OS types
Powered Off VMs	639	VM HW Versions	1
Guest iSCSI Present	20		

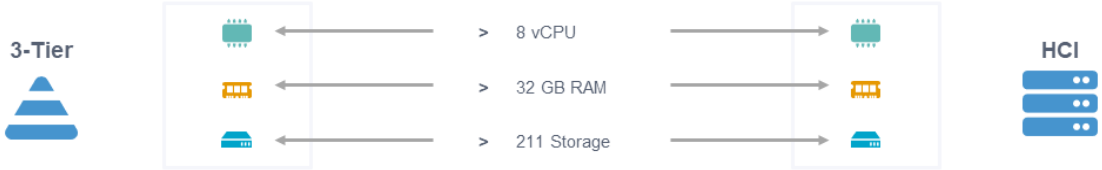
T-Shirt Sizes	130 different vCPU/vRAM VMs combinations
Unique VMs	50 unique vCPU/vRAM VMs

WINDOWS		LINUX		OTHER	
Windows 2000	1	CentOS	1	Linux Other	1
Windows 7	20	Debian	20	Other	20
Windows 10	3	Fedora	3		
Server 2000	2	Ubuntu	2		
Server 2003	61	Red Hat 4	61		
Server 2008	105	Red Hat 5	105		
Server 2008 R2	681	Red Hat 6	681		
Server 2012	716	Red Hat 7	716		
Server 2016	344	SUSE	344		

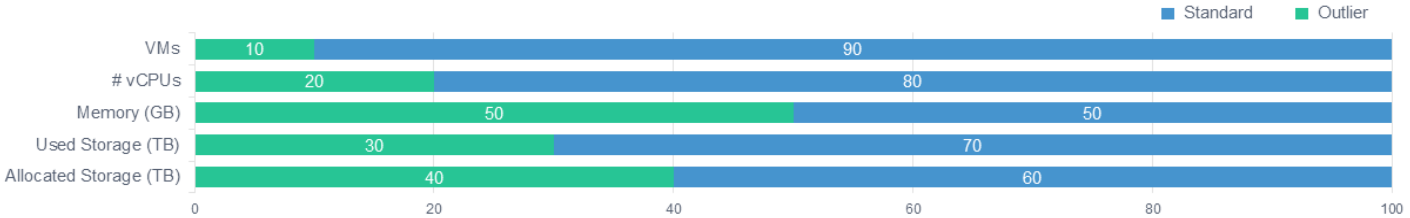
This is sample data, not coming from Mercy Ships!

VM Resource Distribution

VM Profile	VM Count	Total vCPU	Total RAM (GB)	Storage (TB)	Average vCPU	Average RAM (GB)	Average Storage Provisioned (GB)
STANDARD	368	811	2,531	72	2	7	200
OUTLIER	40	190	1,144	58	5	29	1,498



Thresholds are based on 95% calculations



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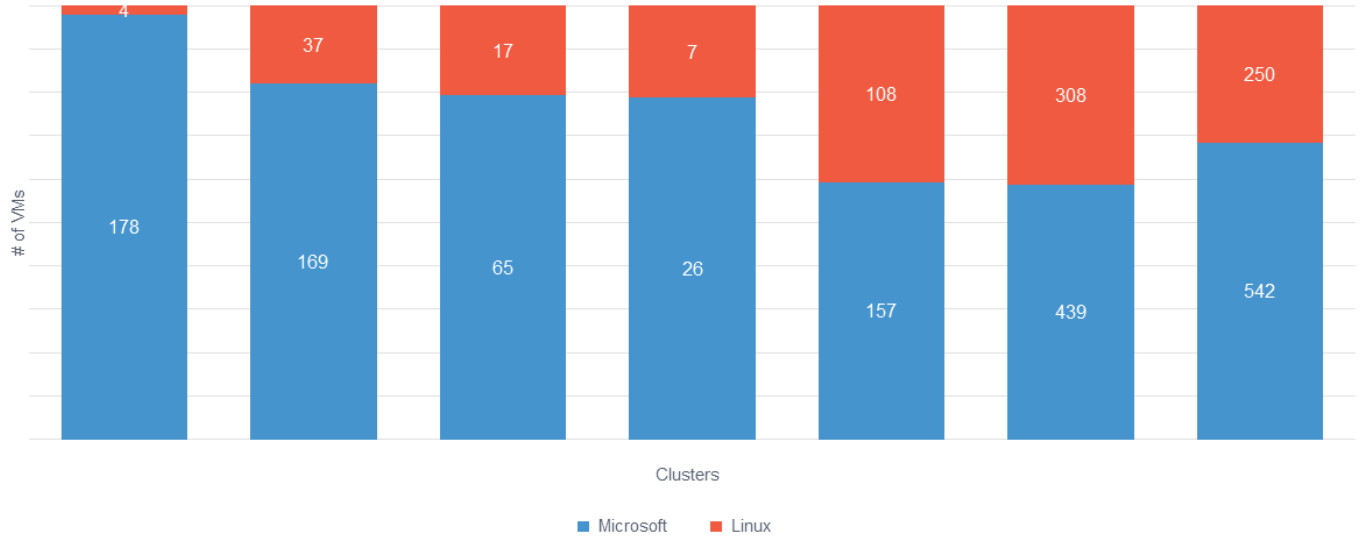
OS Licensing by Cluster



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VM sizing Intelligence

OS versions

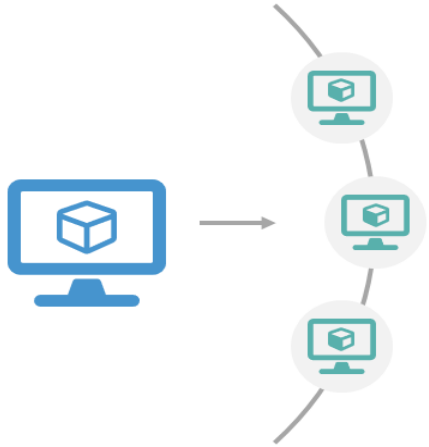
- **17** derived OS types

T Shirt Sizes

- **44** Different vCPU/vRAM combinations

Unique VMs

- **16** unique vCPU/vRAM combinations



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Benefits Hyper-Converged Infrastructure

- Simplicity.
- Scalability.
- Non-disruptive migrations.
- Managed as one.
- Fully integrated.

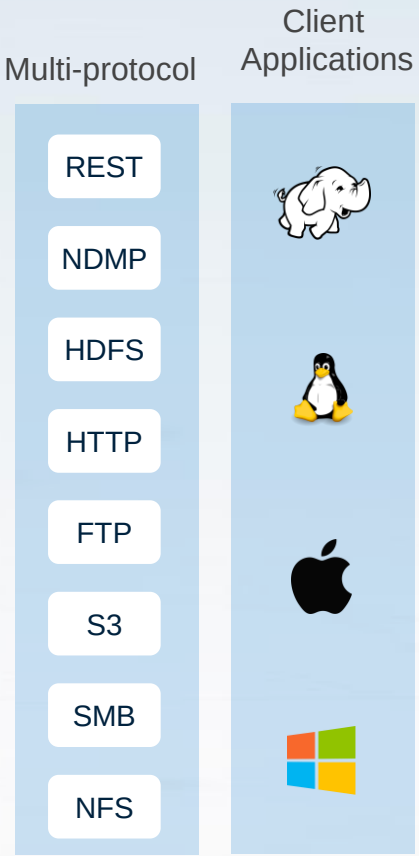
Mercy Ships Requirements

- Key requirements:
  - Manageability: Onboard IT would need to be supported by a similar size IT team, although the ship is 50% larger than the Africa Mercy.
  - Providing a certified platform for industrial and medical applications. Support for diverse requirements:
    - Hospital systems, including medical records
    - K12 onboard school
    - Business functions for safety (patient crash alarms) and people and resource scheduling.
  - High availability possible for key applications.
  - Proven technology, reducing number of vendors.
  - IT transformation to boost staff efficiency and services.

Scale Out Network Attached Storage for Medical Data

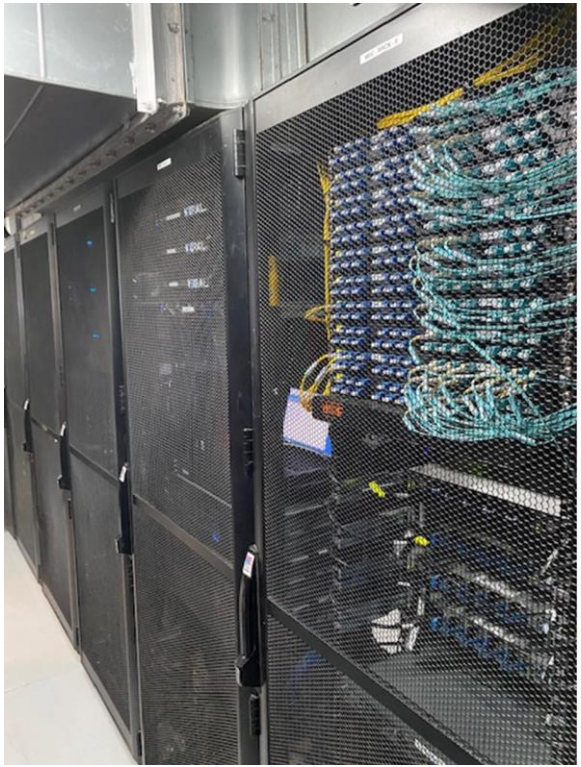
- Balance data - No hot spots with auto balance, auto connect and auto provision.
- Elasticity – From TB to PBs in one filesystem.
- Efficiency – Inline data reduction.

Scale Out NAS for Medical Data



- Availability – Sustain failures of up to 4 nodes or 4 drives in a single node pool.
- Unified – File, object and big data protocol access to the same data set.
- Non-disruptively scale and refresh across product generations.

Mercy Ships – Onboard Data Center



Data Protection and Replication Requirements

- Setup must be consistent across core datacenter (Texas) and edge locations (ships) – allowing remote management.
- Integrated backup possibility.

HEALING ACROSS THE OCEANS

Mercy Ships relies on Dell Technologies hyperconverged infrastructure to empower caregivers to heal people.

TRANSFORMATIONS

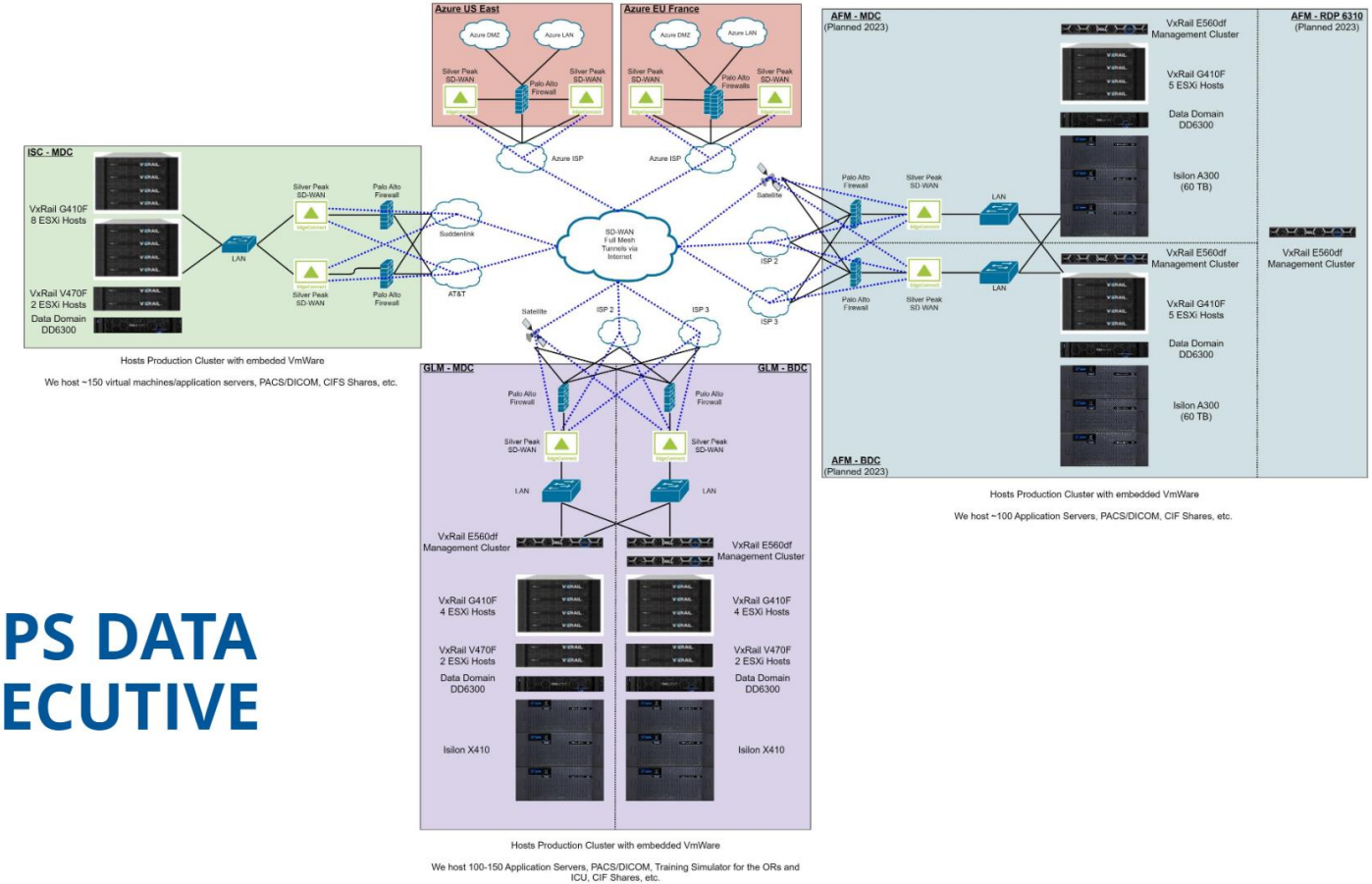
- Empowers local caregivers, even after Mercy Ships vessels move on.
- Streamlines IT management across onboard and onshore data centers.

OUTCOMES

- Drives continuous care improvements through innovative medical technology.
- Allows real-time data sharing in consultations with experts anywhere.
- Speeds up decisions and critical steps in patient care.

DELL Technologies + MercyShips

MERCY SHIPS DATA CENTER EXECUTIVE SUMMARY



Hosts Production Cluster with embeded VmWare

We host ~150 virtual machines/application servers, PACS/DICOM, CIFS Shares, etc.

Hosts Production Cluster with embedded VmWare

We host ~100 Application Servers, PACS/DICOM, CIF Shares, etc.

Hosts Production Cluster with embedded VmWare

We host 100-150 Application Servers, PACS/DICOM, Training Simulator for the ORs and ICU, CIF Shares, etc.

Overview to Impact

VXRAILS

- 150 Applications at each location
- Supporting Operations:
  - Hospital
  - Medical Capacity Building
  - Maritime
  - Logistics
  - Academy

ISILONS

- Bulk Data Storage:
  - PACS/DICOM –Hospital imaging, radiology, CT, etc.
  - Training Simulation Suite (Global Mercy)

CORE TO EDGE

- Data Synchronization from ships to International Support Center

DATA DOMAINS

- On-site disaster recovery
- Replication between data centers

SUPPORT MODEL

- Cold Spares
- Support Center Staff / Dell Technologies working relationship

Mercy Ships and Dell Technologies

A floating **hospital & training center** bringing hope & healing

A global community **inspiring** transformational change

Partners nurturing **sustainable** healthcare systems

De Drijvende Dokters

Thank You!