



WiFi: NOVOTEL
Login ID: cinnamon
Password: cinnamon



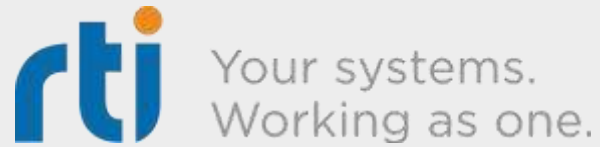
RTI Makes the World Run Better™

Singapore ConnexCon 2019

October 2 – 3 at the Novotel Singapore Clarke Quay

WiFi: NOVOTEL
Login ID: cinnamon
Password: cinnamon





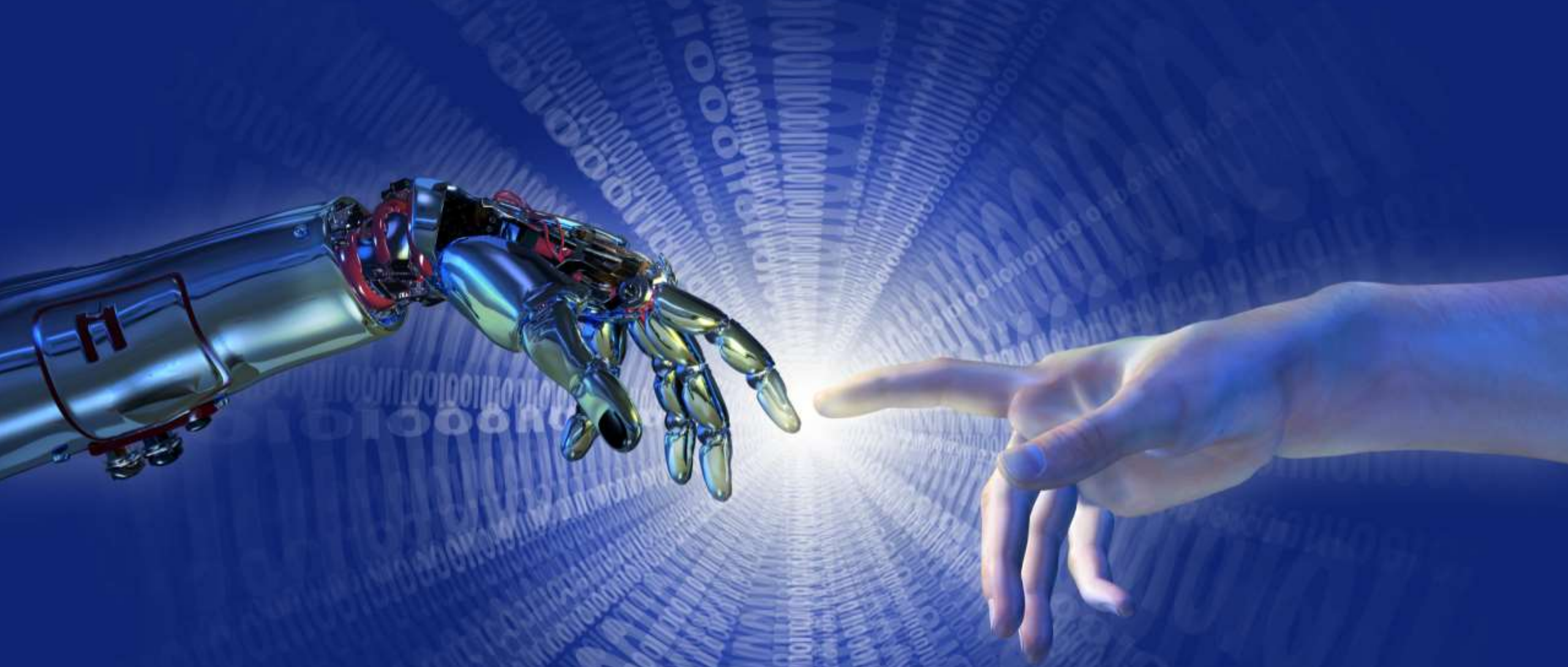
Accelerating Autonomy

Stan Schneider, PhD

CEO Real-Time Innovations, Inc. (RTI)

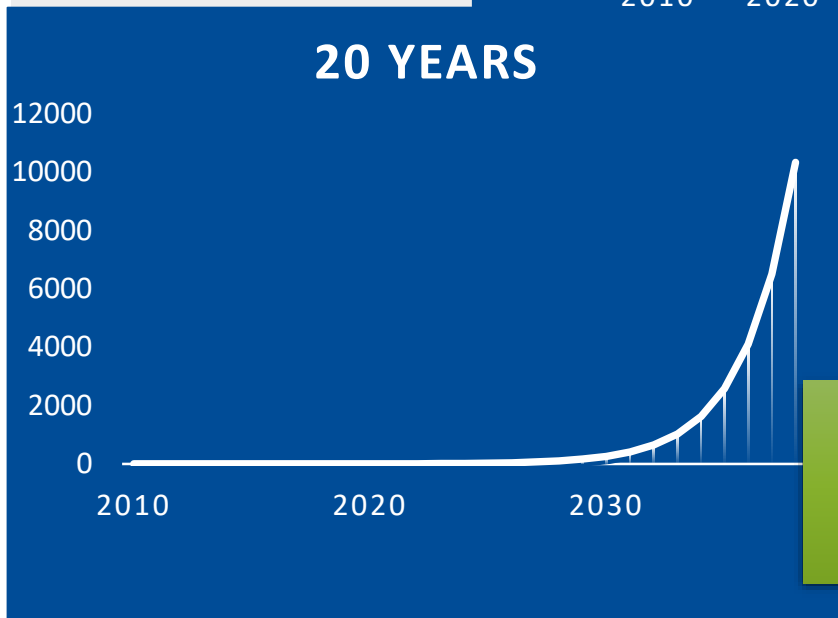
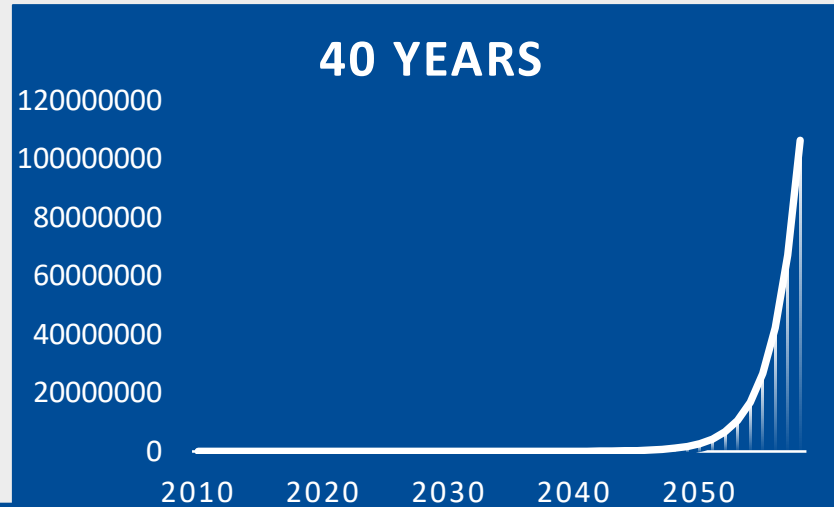
Vice Chair, Industrial Internet Consortium (IIC)



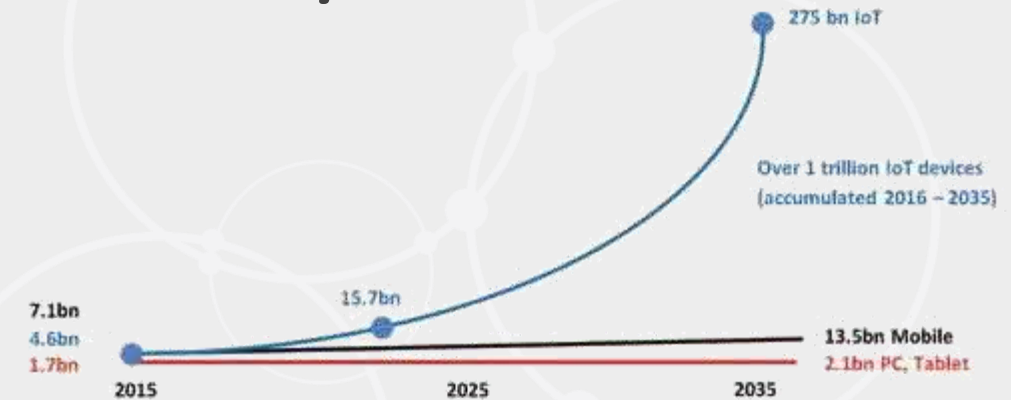


The smart machine era will be the most disruptive in history
—Gartner

The Design Factors: CPU & Connectivity

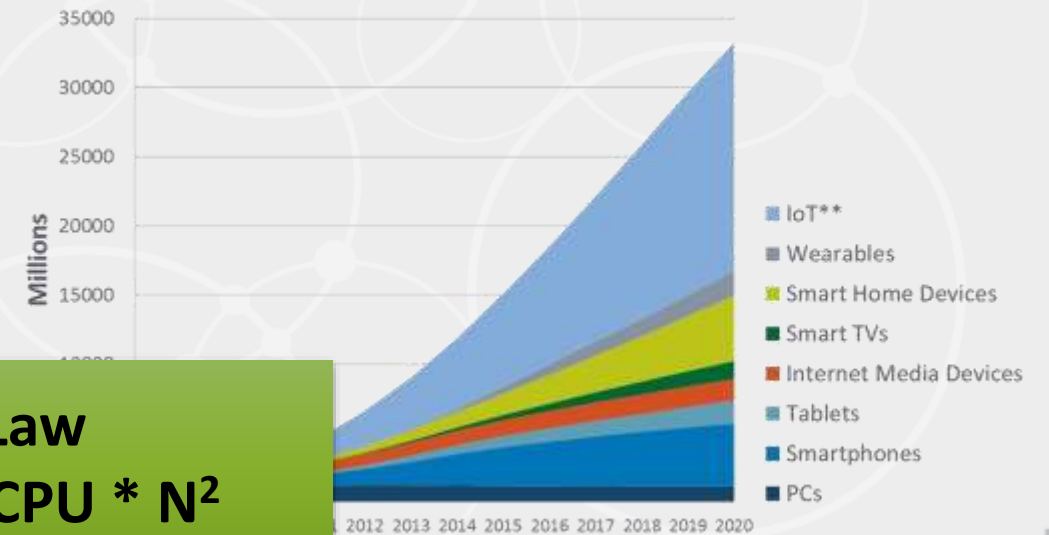


Gerardo's Law
 $\text{System value} = \text{CPU} * N^2$

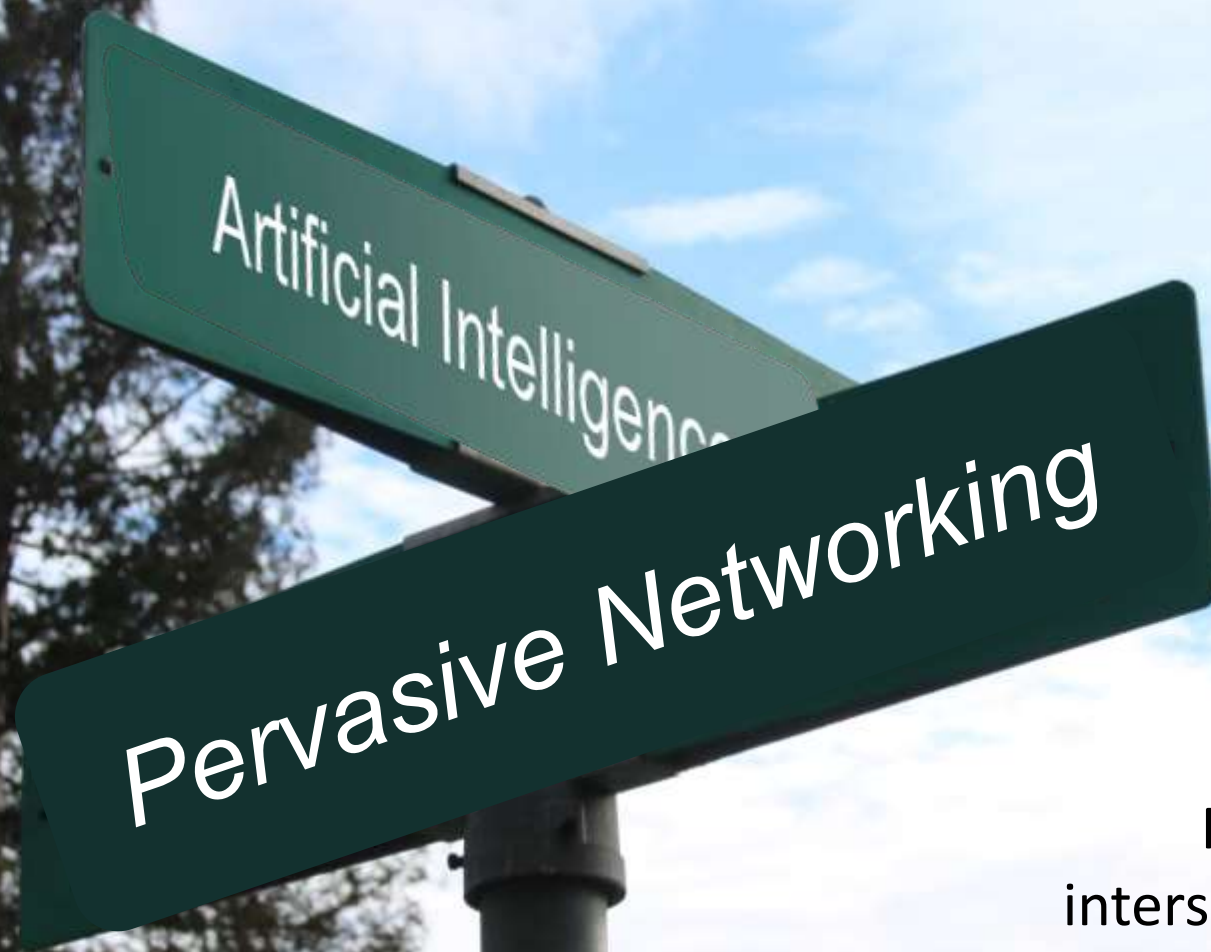


Source: Created by SoftBank Group Corp. Based on data by Ericson.

Global Internet Device Installed Base Forecast STRATEGYANALYTICS



Source: Strategy Analytics October 2014



RTI lives at the
intersection of functional
artificial intelligence and
pervasive networkingSM

RTI & The Smart Machine Era

- RTI is the largest Industrial IoT connectivity vendor
 - 1350+ designs, many real-world programs across industries
 - 500+ research efforts
- Full DDS, tools, services, support, secure & certified versions



What's The Future of Smart Machines?

Three lessons of the Internet of Things





*The universe is BIG...
...and diverse*

The Industrial IoT is

Big

and Diverse

Education		Aerospace & Defense		Energy & Utilities		Transportation		Manufacturing		Near Space & New Space	
Colleges & Universities		Air Force		Chemicals		Aeronautics		Apparel		Closed Loop Ecological Systems	
Conferences & Workshops		Army		Electric		Airport		Beverage & Tobacco Product		Closed Loop Living Systems	
Laboritories		Aviation		Mining		Cargo Handling		Chemicals		Constellation Controllers	
Publication		Home Land Security		Oil & Gas		Cruise Industry		Computer & Electronic Products		Consumer Traffic Analytics	
Schools		Military		Petro-Chemicals		Fleet Management		Electrical Equipment & Components		Ecological Planning	
Trade Schools		Navy		Power		Freight Management		Fabricated Metal Products		Environmental Monitoring	
		Space Flight		Renewable		Logistics		Factory		Hyper-Local Agriculture	
				Sewer		Mobility		Food		Hyper-Local Construction	
				Water		Pipelines		Furniture & Related Products		Hyper-Spectral Imaging	
						Postal & Delivery Services		Industrial Automation		In-Flight Satellite Servicing	
						Public Transportation		Leather & Allied Products		On-Site Materials Analytics and Inventory	
						Rail		Machinery		On-Site Materials Optimization	
						Roads		Nonmetallic Mineral Products		Parametric City Planning	
						Shipping		Paper		Parametric Construction Planning	
								Petroleum & Coal		Remote Maintenance and Diagnostics	
										Space Based Planning	
										Weather Pattern Analytics	

Smart Machines are Transforming all Industries

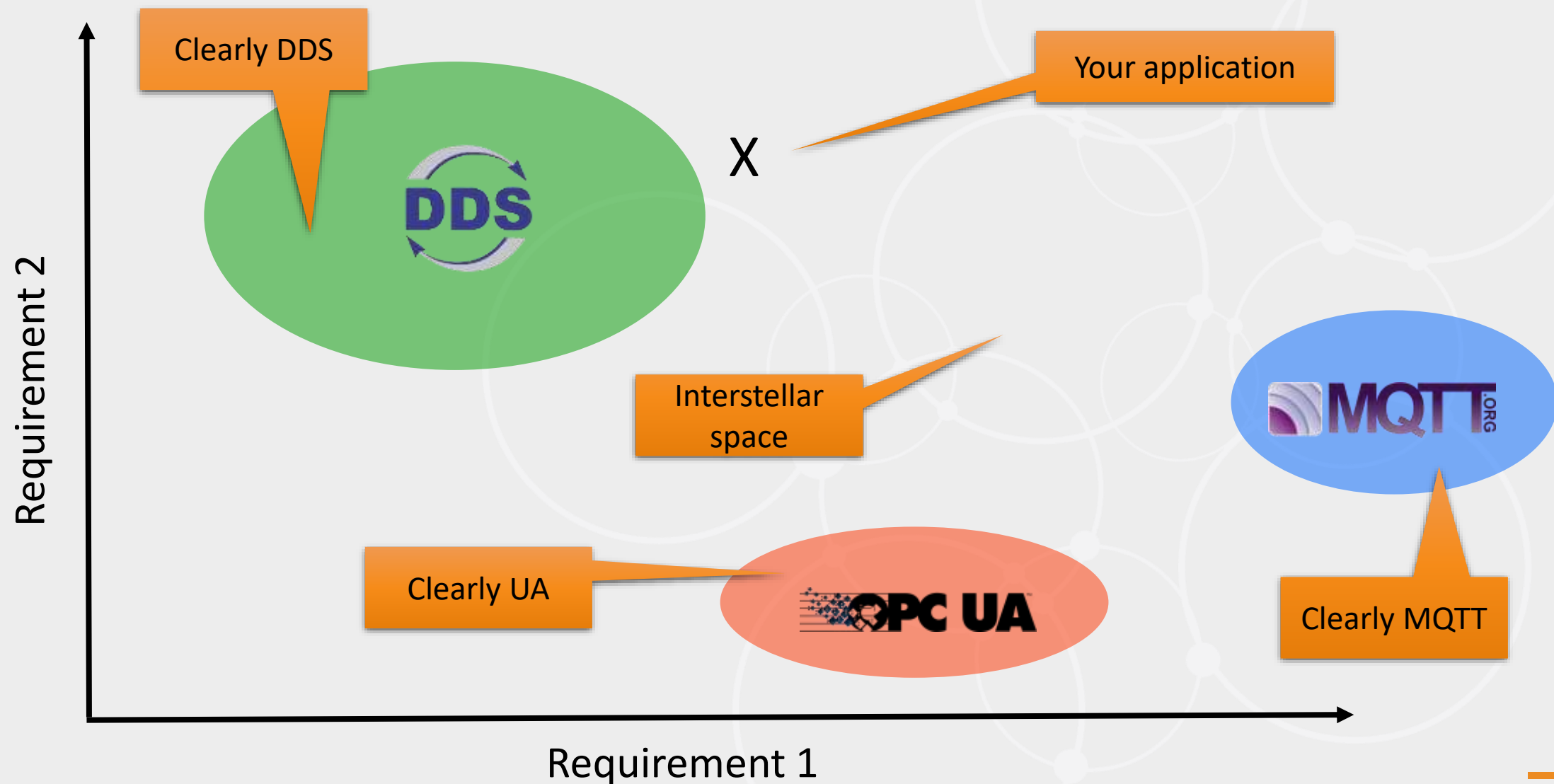


The Industrial Internet Connectivity Framework

- The industry's only detailed analysis of IIoT Connectivity Technologies
- Architecture
- Assessment
- Standards
 - DDS
 - OPC UA
 - OneM2M
 - HTTP
 - MQTT
 - CoAP
- Examples & selection guidance
- Years of work by many architects across industries, standards, & technologies



The IIoT is So Big...Standards Don't Overlap



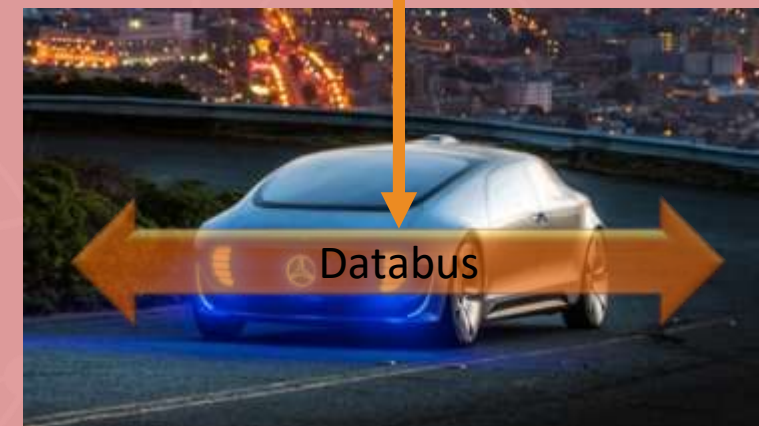
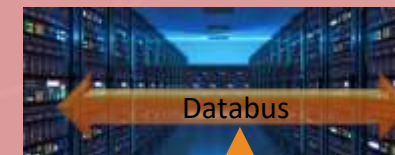
Three Types of IIoT Smart Things



Analytic
Optimization



Device
Monitoring



Edge
Autonomy



What is the Industrial IoT Really About?



technologies from



industries better



**DATA-CENTRIC
MINDSET CHANGE**

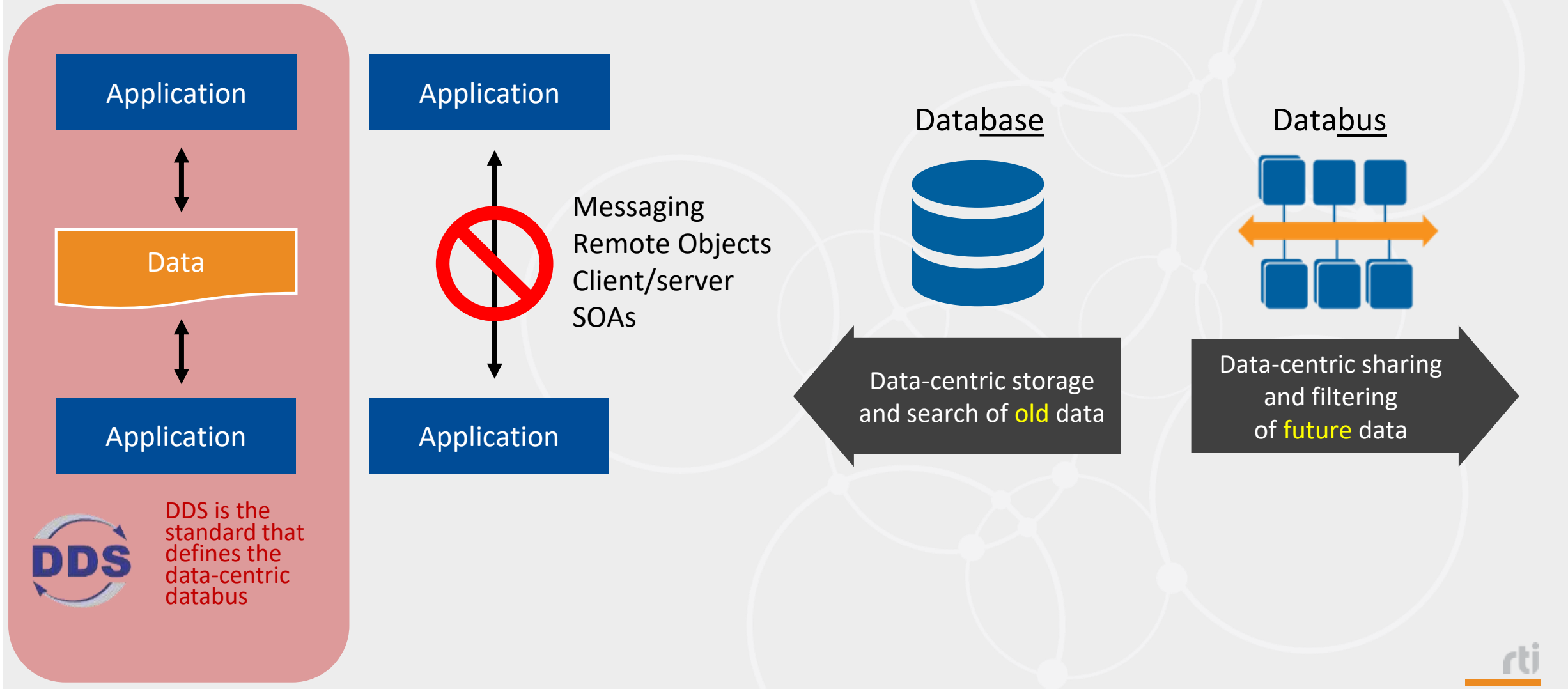
**NO EASY
WAY DOWN**



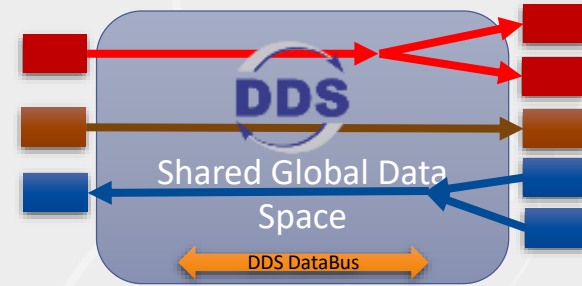
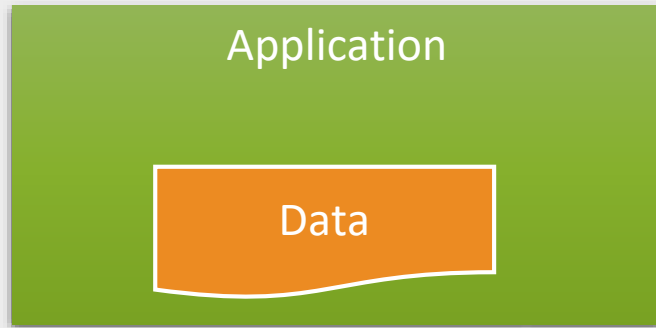
Systems are About the Data

Intelligent Systems Need an Architecture that Effectively Shares Data

Design the System Around the Data



Why Does Data Centricity Matter?



"Data Everywhere" **Sharing**

- Logically puts all data "inside" every application
- Apps read or write like local memory
- With full control over timing, reliability, filtering, security

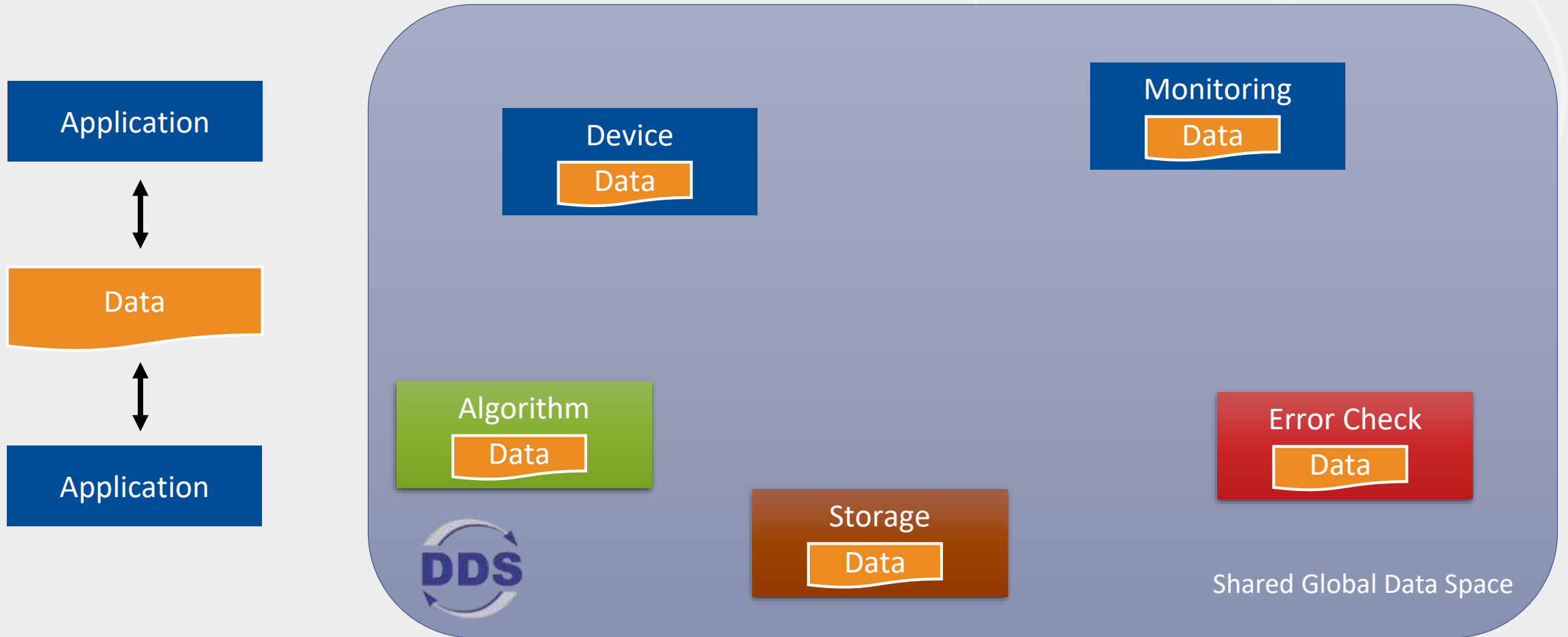


"Data Any Place/Time/Flow" **Decoupling**

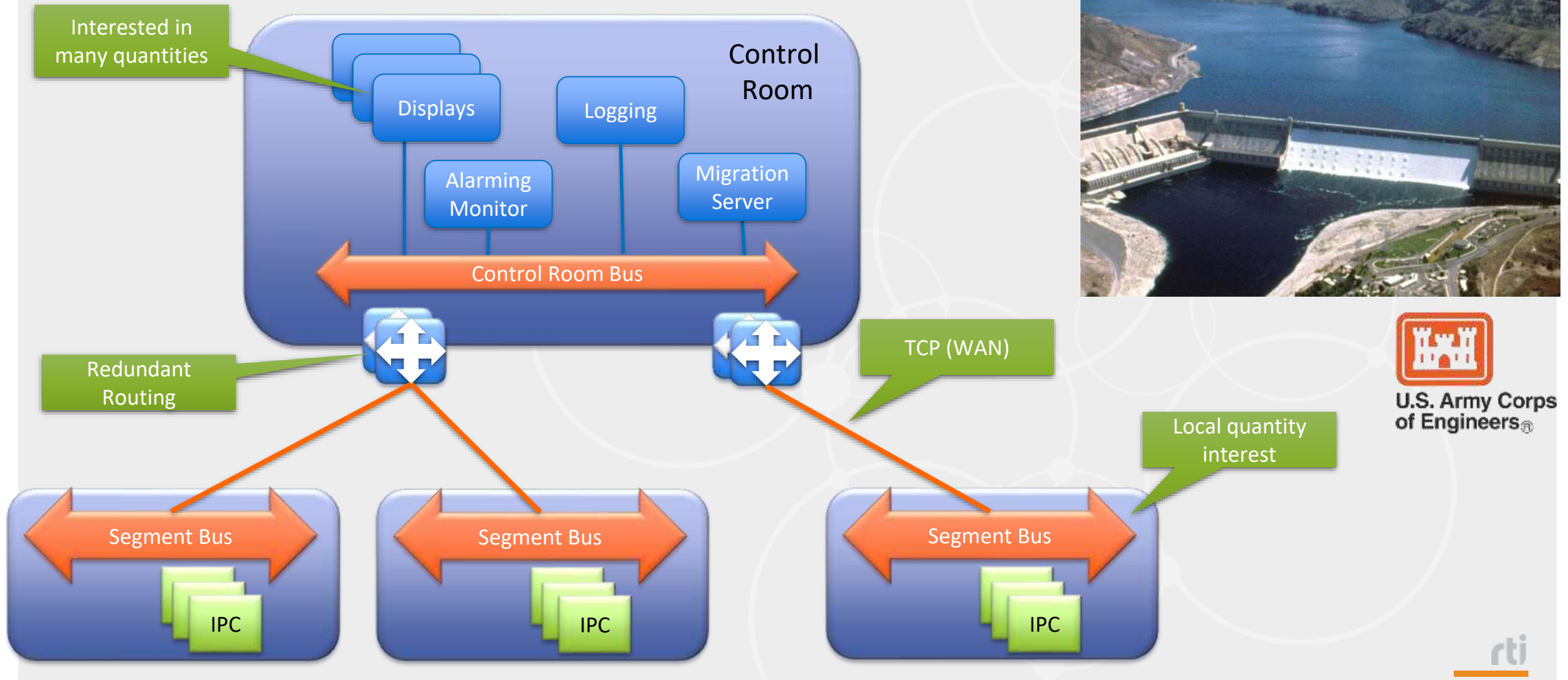


***Your Systems.
Working as One.***

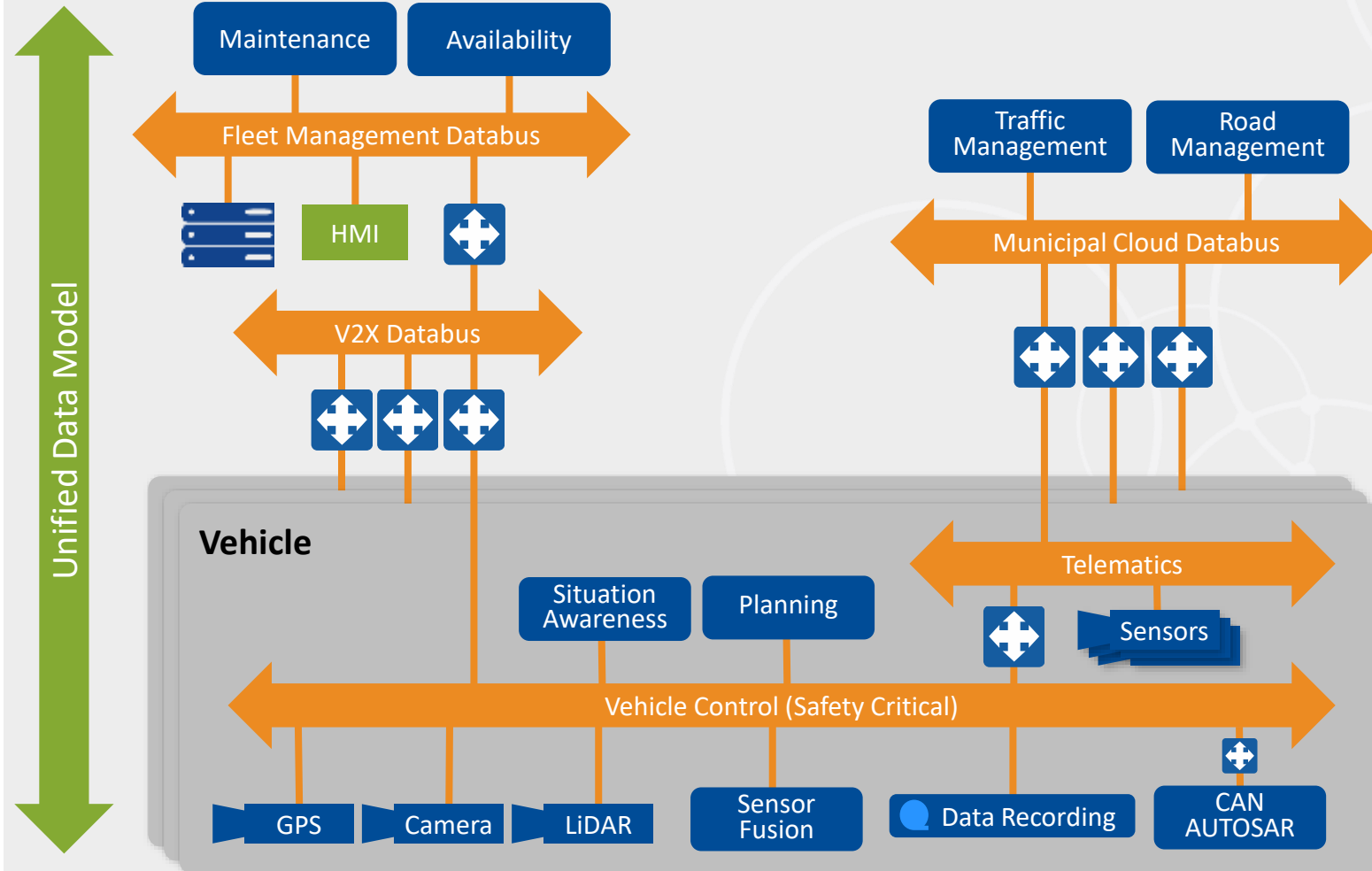
Data Centricity Makes Mobility Transparent



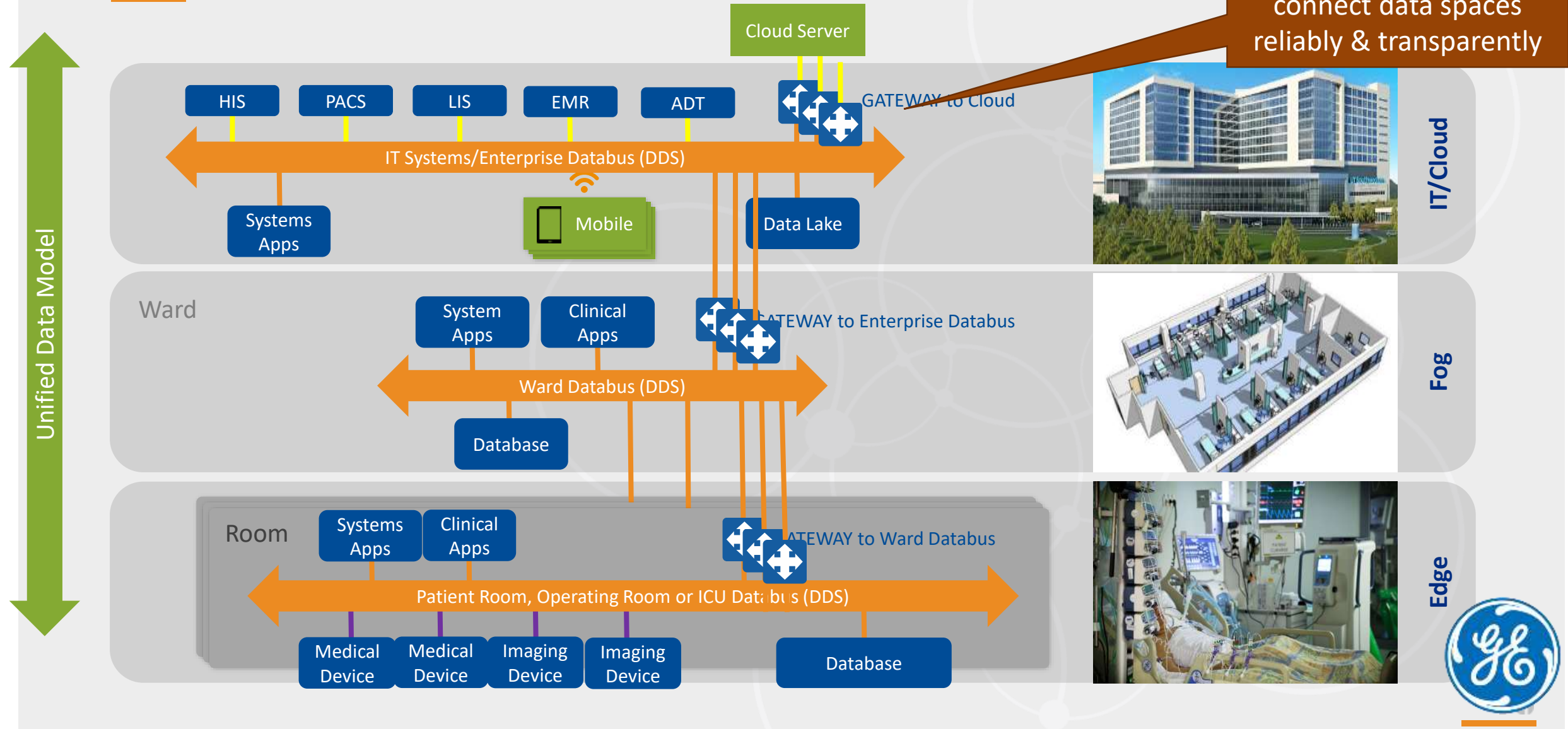
Data Centricity Enables Extreme Availability



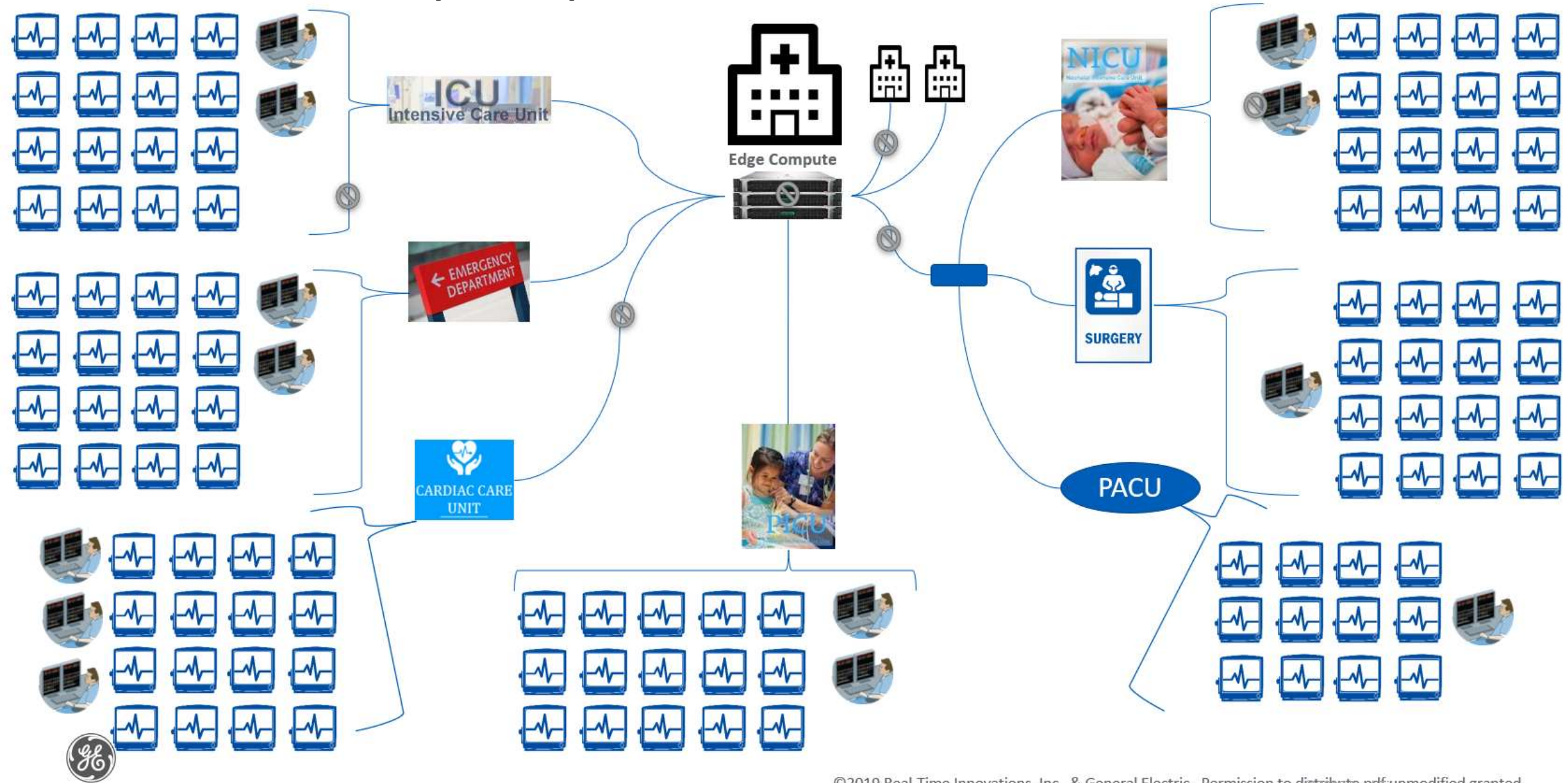
Data Centricity Shares Data End-to-End



Data Centricity Scales



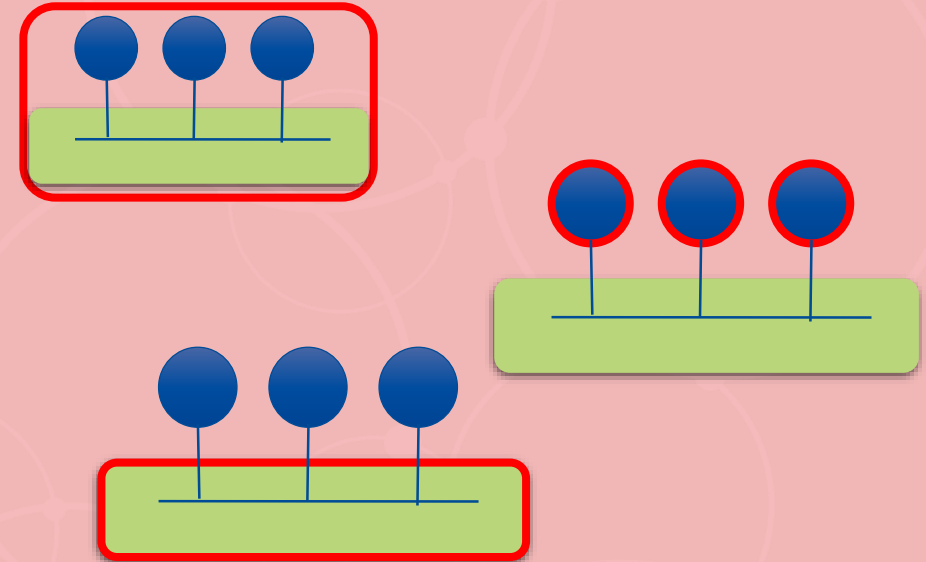
Data Centricity Simplifies Fault Tolerance



Data Centricity Allows *Data Defense*

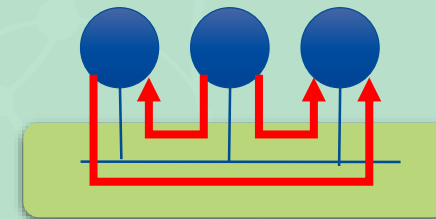
- System edge
- Host
 - Machine/OS/Applications/Files
- Network transport
 - Layer 2-3 “pipe” security
 - Layer 4-5 “session” security

Important, “bolted on”, not enough



- DDS: Dataflow Security
 - Control *application interaction*
 - Secures the data itself; no API!
 - Independent of transport, OS, chip

Perfect match to architecture: no code!



You Need RTI if You Face These Problems

- ✓ Are there severe consequences of failure for one minute?
- ✓ Have you said “millisecond” in the last 2 weeks?
- ✓ Do you have more than 10 software engineers?
- ✓ Does your data have many destinations?
- ✓ Are you building a next-generation IIoT design?

3+ Yes?



What's the Disruption?



Software is eating the world

-- Andreessen Horowitz
Silicon Valley VC

The Future is About Software

All Industries Must Become Software Driven

Industry Competitive Disruption!

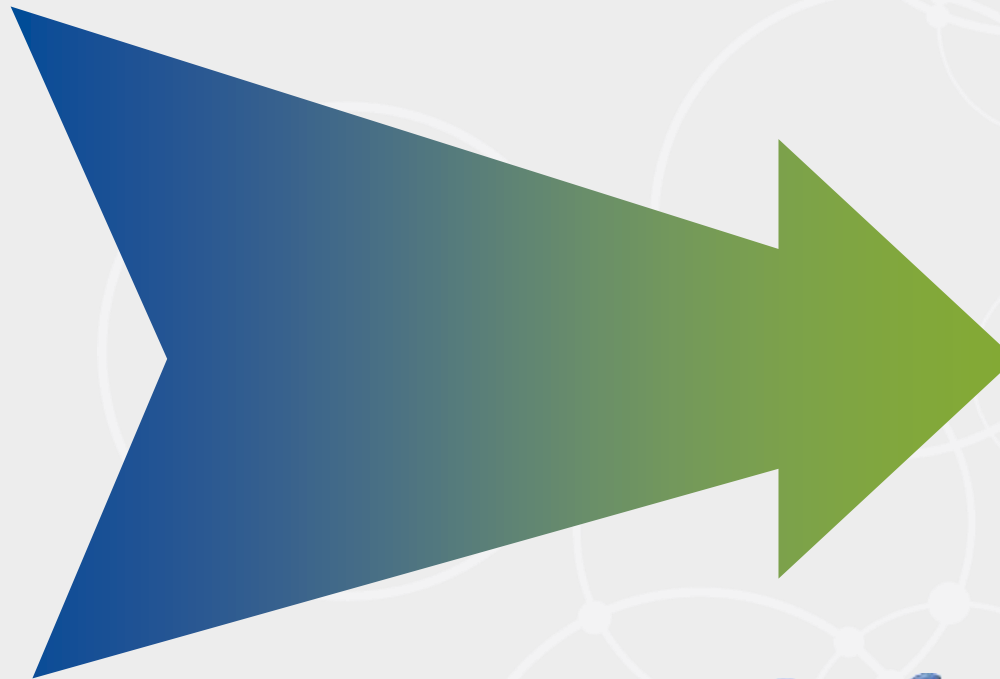
Style

User Experience

Interoperability

Performance

Safety



Software

Best Software Wins

Problem: Mistakes Kill

“... the anesthesiologist forgot to resume ventilation after separation from cardiopulmonary bypass...”

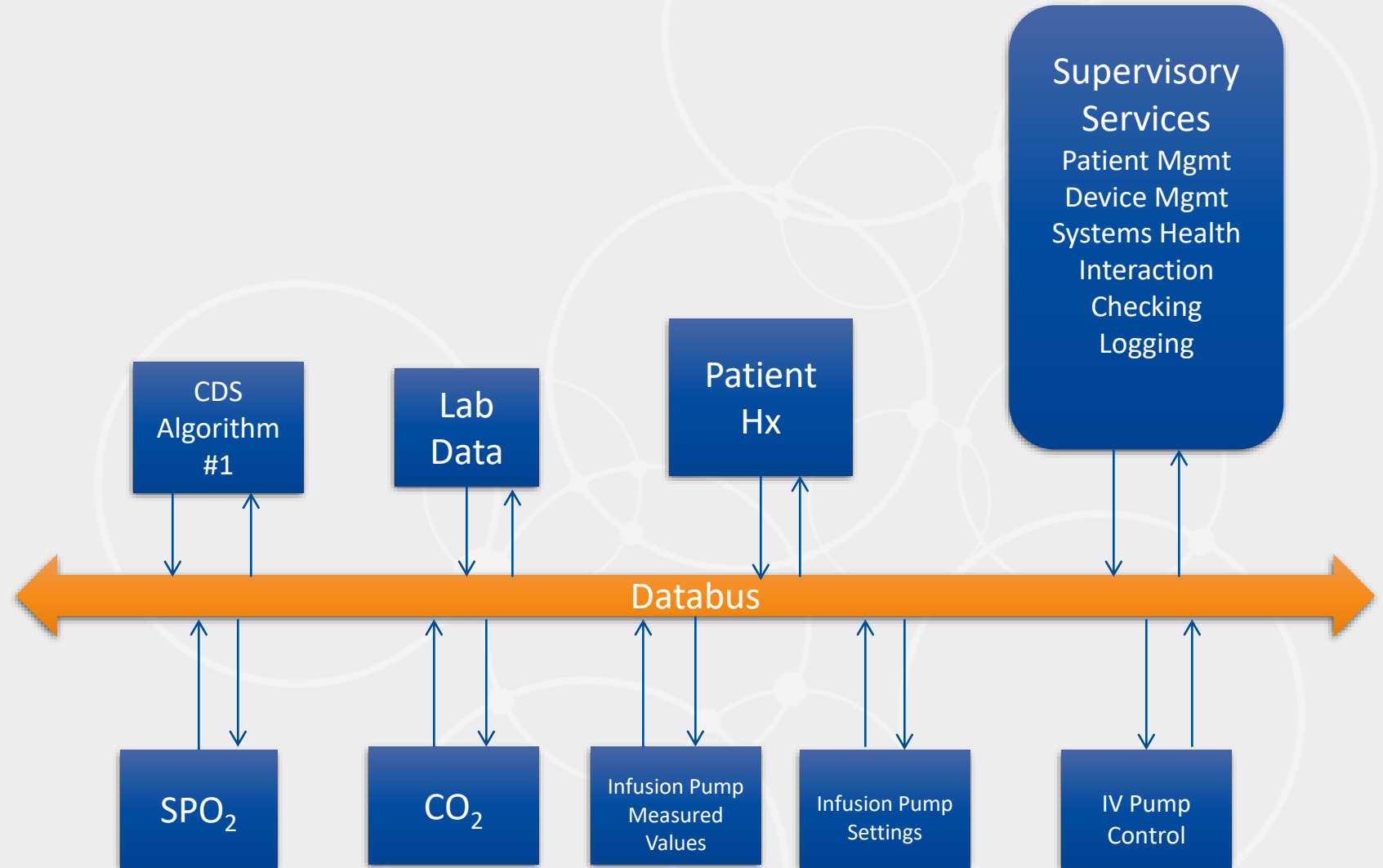
Every surgical team surveyed has experienced this error!

Hospital error is the 3rd leading cause of death in the US

Solution: Smart Connected Patient Care



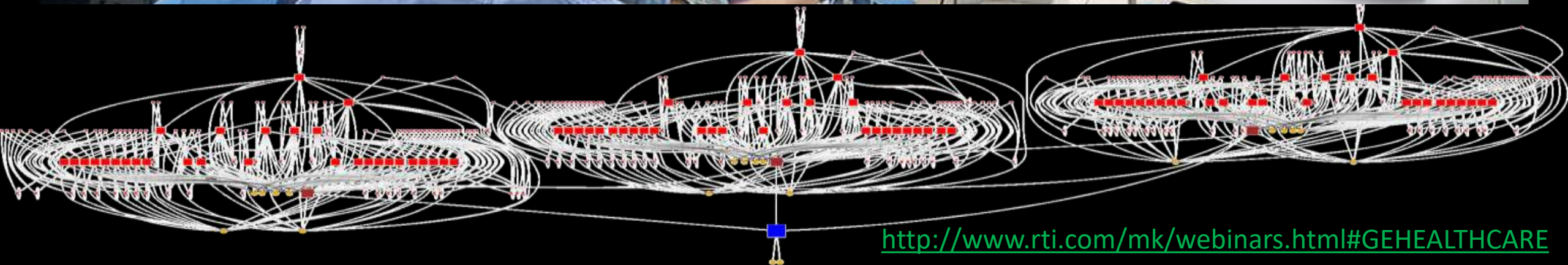
MD PnP
Getting Connected for Patient Safety™



Smart Machines Join the Care Team

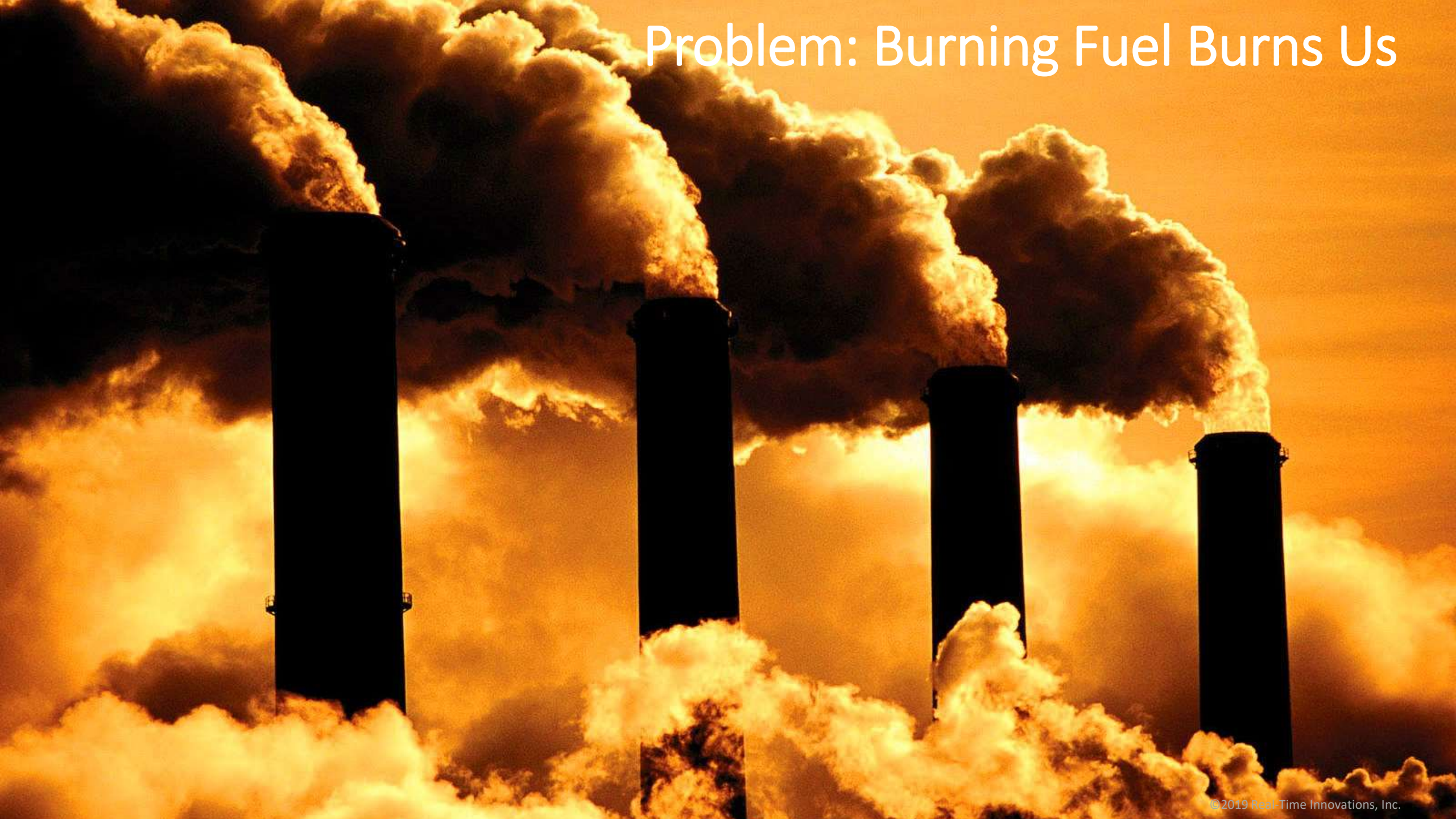
The Medical Industry Now Competes on Networking

GE Healthcare's smart distributed architecture will connect 300 types of devices with RTI software.

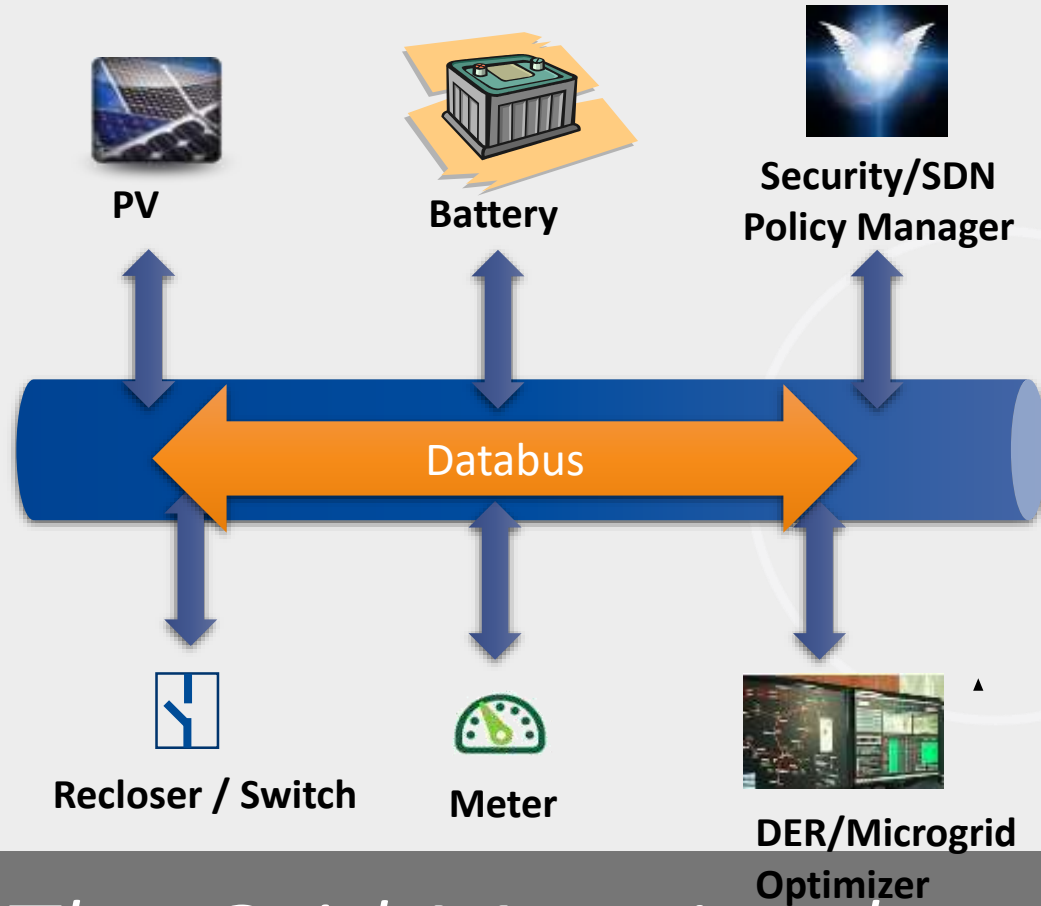


<http://www.rti.com/mk/webinars.html#GEHEALTHCARE>

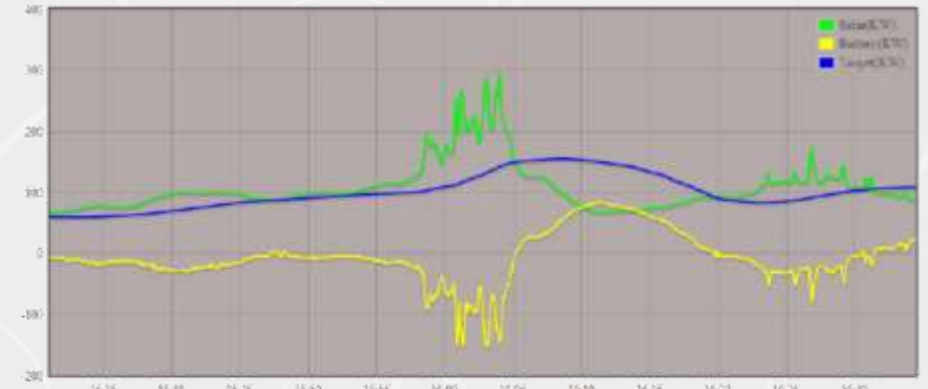
Problem: Burning Fuel Burns Us



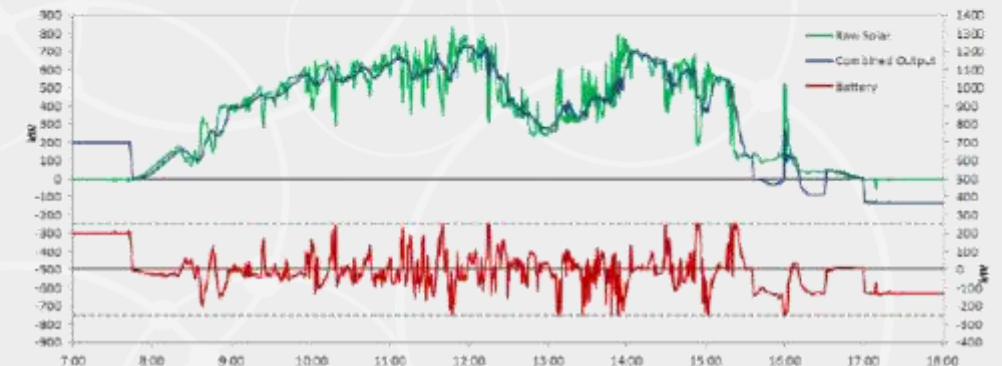
Solution: Enable Efficient DER



1 Hour Snapshot

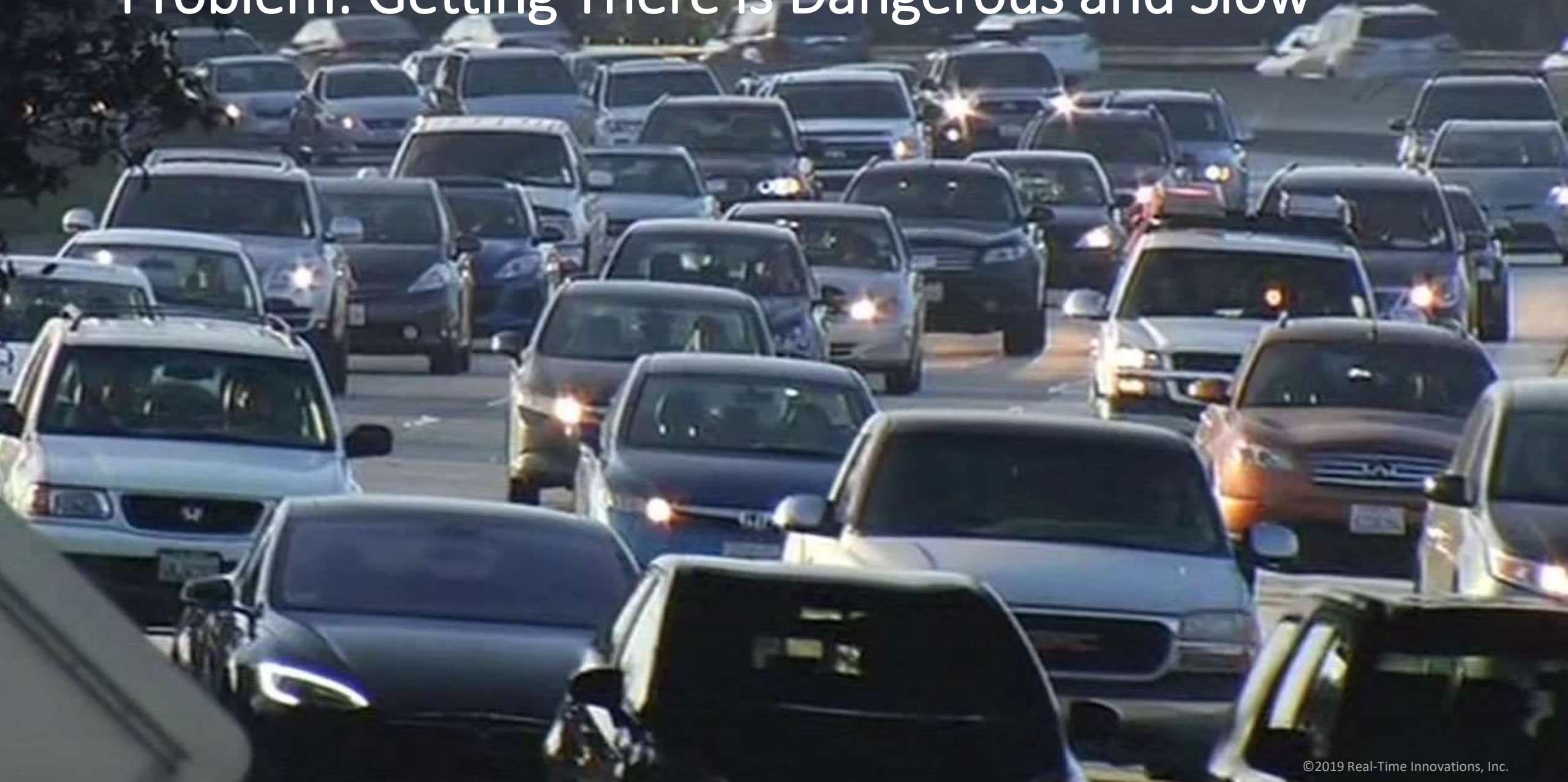


12 Hour Waveform



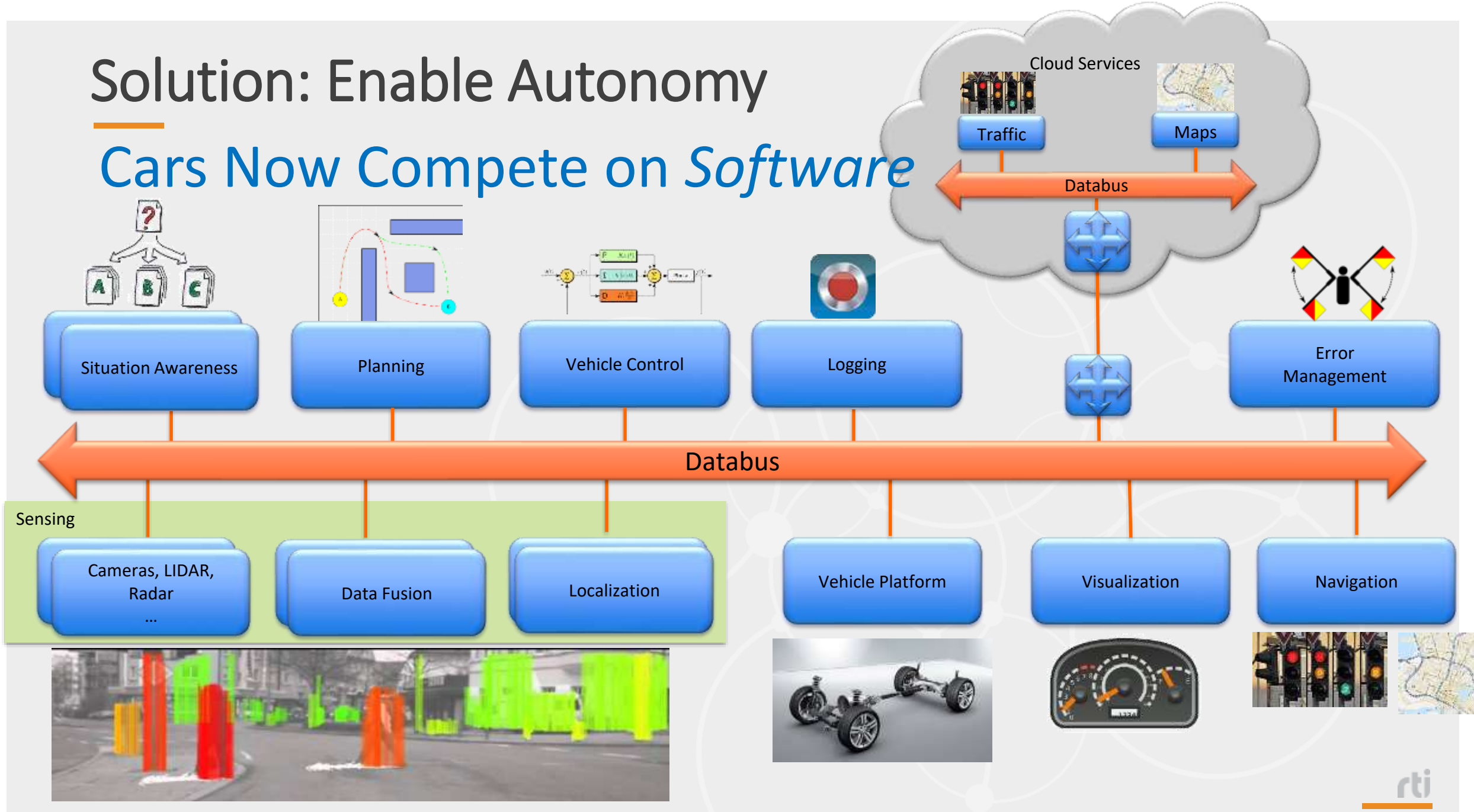
The Grid Must Implement Distributed Control

Problem: Getting There is Dangerous and Slow



Solution: Enable Autonomy

Cars Now Compete on *Software*



Historians will look back on our time
and wonder how we got by without
smart things

Disruptions Don't Happen...Until They Do

Year 1900: One Motor Vehicle



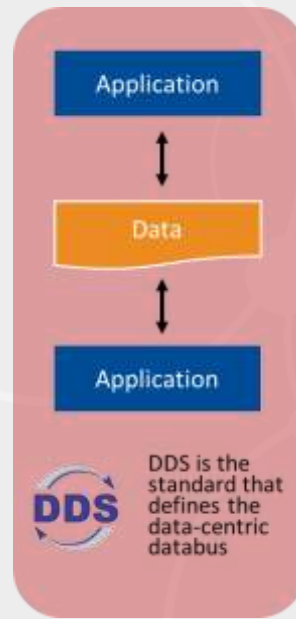
Year 1913: One Horse & Carriage



The Future of Smart Machines



The IIoT Impacts All Industries



Systems Need Data Centricity



Software is the New Competition

Who Uses RTI?

A few of our 1300+ applications...



Make Renewables Reliable



RTI runs the largest hydropower plants in North America, soon expanding to 75 dams.



RTI is a principal in the leading new grid standard for solar and battery integration.



RTI controls Siemens Wind Power's most advanced wind turbines, thousands deployed worldwide.

RTI controls >24GW of renewable power, displacing 124m metric tons of CO₂/year

Lead Connected Healthcare



Support Hundreds of A&D Programs



Control Transportation: Land, Sea, Air, & Space



200+ RTI Autonomous Vehicle Projects!

- 50+ commercial systems
 - 10+ Passenger vehicles
 - 10+ EV startups
 - 5+ Software platforms
 - 7+ Trucks, mining vehicles, forklifts
 - 2 Flying taxi services
 - 2 Hyperloop & other
 - 2+ Autonomous ships
 - 2+ Underwater robots
- 100+ defense systems (land, sea, air)
- 75+ research programs (companies, universities, etc.)



AUTOSAR

ROS

Drive Efficient Development

Audi – Functional Engineering Platform (FEP-SDK)

HiL Simulation for development and test across the Volkswagen Group



Audi



Handle Complex Traffic Control

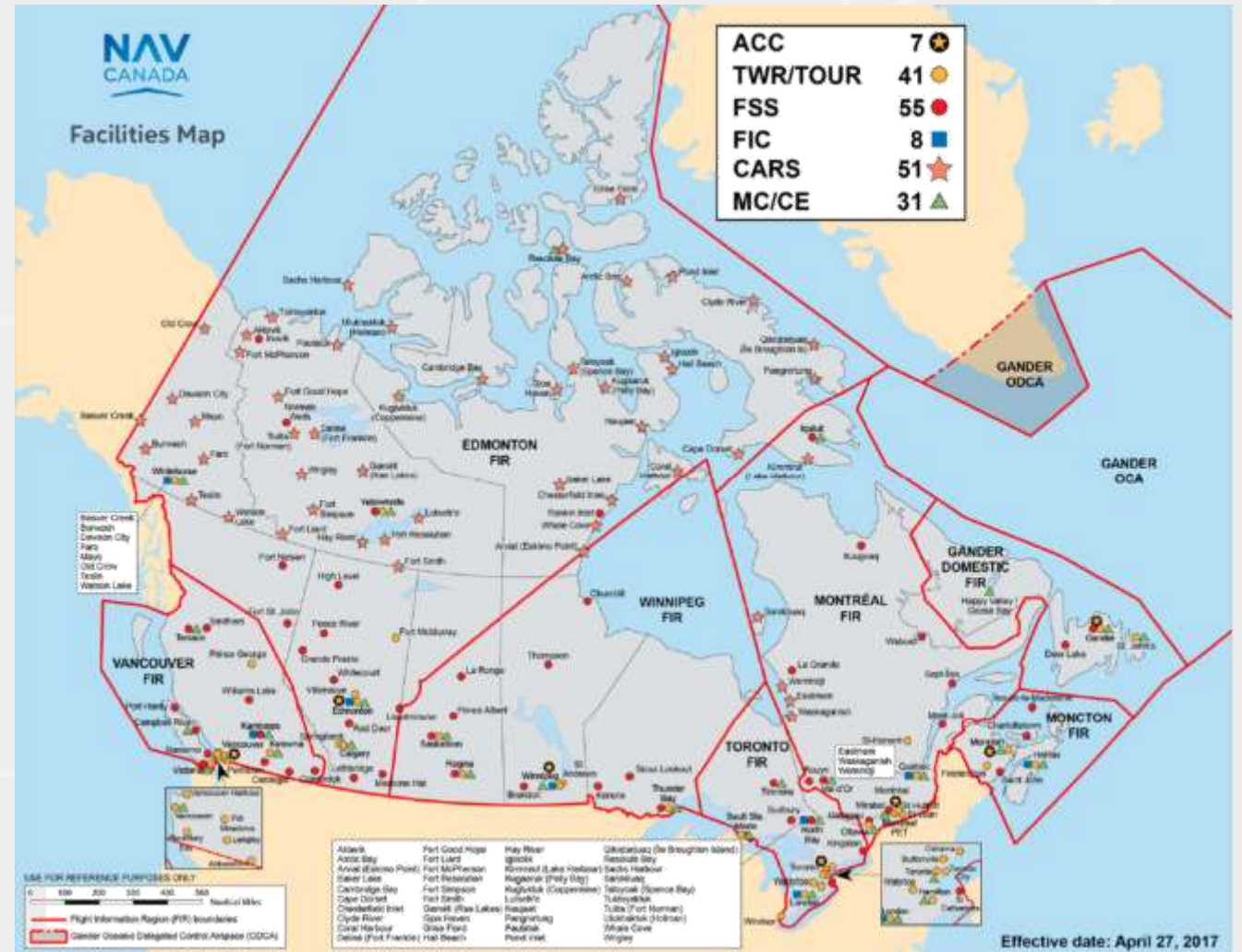


DDS is in operation at Shanghai PVG ground control since 2015
Currently operating 30+ airports in China

Run 24x7 Across Continents

We selected RTI Connex DDS for its high **security** rating; its wide support of tools and programming languages, and its reputation for **performance, scalability, and 24/7 reliability**

Sid Koslow, Chief Technology Officer



Air Traffic Control for Canada
2nd largest ANSP in the world
7 major centers



Connect Open Architectures

"By replacing our previous messaging software with RTI Connex DDS, we were able to increase efficiency by 30% while providing a secure, open architecture that will make it easy for us to monitor the system remotely into the future. Together with RTI we are building locomotives that leverage the full power of the Industrial Internet."

—Tab Mong, System Architect at GE
Transportation



Control Rail Transit



- Casco owned by China Railway Signal & Communications with investment from Alstom
- Provides all-round signaling system and technology for normal-speed, high-speed and intercity railways.



Control Future Transport





Scale Intelligent Transportation



- Cubic's NextCity™ vision integrates city management, integrated traveler payment, and system information
- Modernizing traffic control and mass transit helps travelers find the smartest way to travel and easiest way to pay
- Helps transportation authorities manage demand across the entire transportation network in real-time

Integrate Large-Scale Systems

- The NASA KSC launch control is the world's largest single-system SCADA
- It combines 300k points, at 750k updates/sec
- RTI Connex DDS powers launch control, in-flight monitoring, UAV reentry-tracking ground station, and the recovery ship



JORN – Jindalee Operational Radar Network

- \$1.2b AUD project to upgrade Australian Over-the-horizon radar (OTHR)
- Migration to modular, scalable software

BAE SYSTEMS



Enable Safe Flying Cars



- Urban air mobility will transform daily life for millions.
- Airbus Vahana is developing the first *certified, electric, self-piloted* vertical take-off and landing (VTOL) passenger aircraft.
- *RTI Connex DDS* addresses diverse systems with the same technology, greatly simplifying design integration and modularity.





RTI Runs the World's Navies

LOCKHEED MARTIN



Australian
Air Warfare
Destroyers

Norwegian
Fridtjof Nansen Class
Frigates

U.S.
Ticonderoga Class
Cruisers

U.S.
Arleigh Burke Class
Destroyers

Spanish
Álvaro de Bazán Class
Frigates

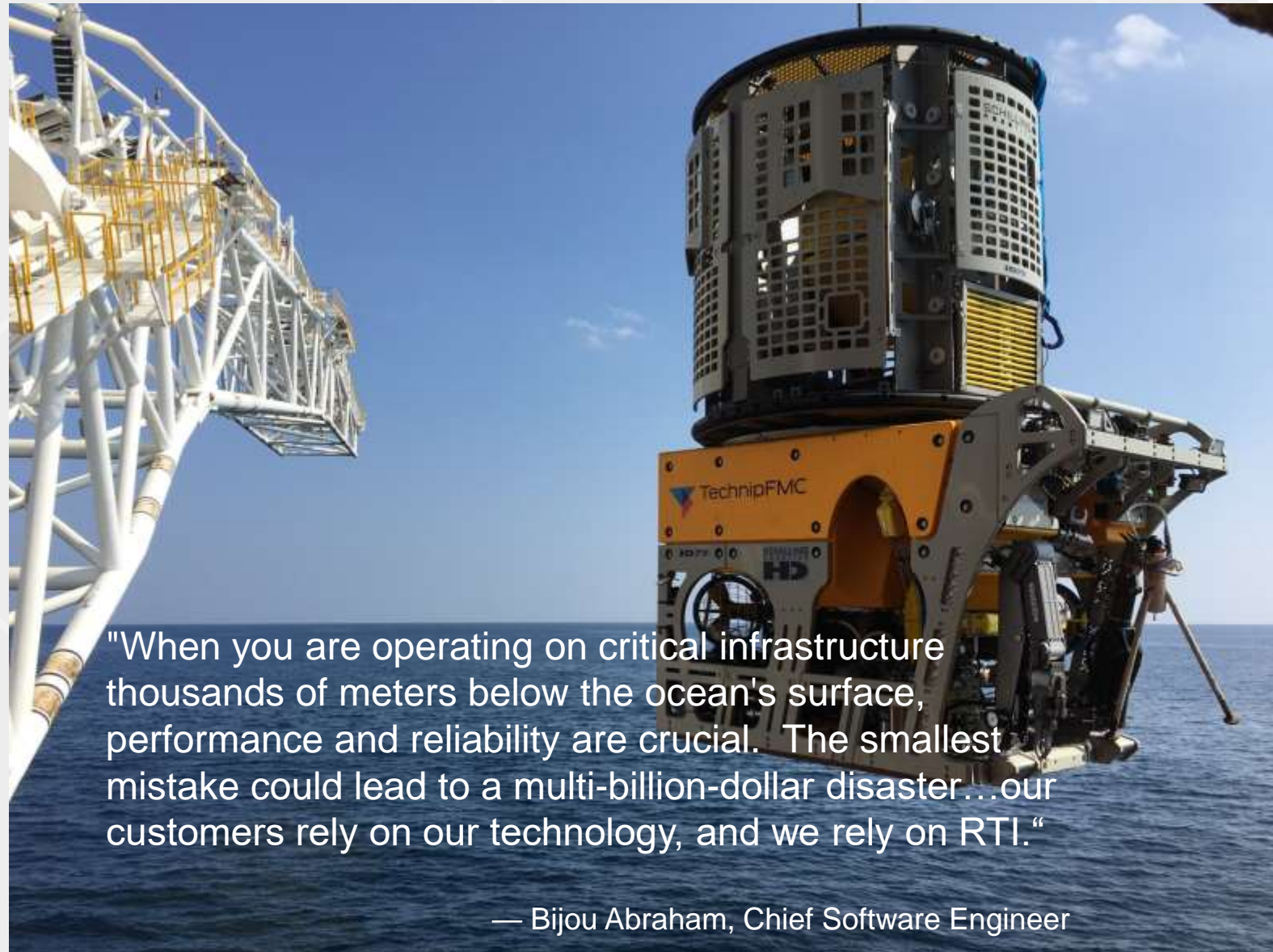
South Korean
Destroyers

Japan
Kongo & Atago
Class Destroyers

- Cross-System Interoperability
 - Lockheed Aegis
 - Raytheon DDG 1000
 - Raytheon SSDS
 - LCS (Lockheed and GDAIS)
 - Raytheon LPD-17
 - Many more, US and allies
- Highly distributed systems include radar, weapons, displays, controls

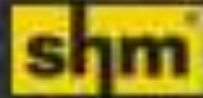
Bring Autonomy to Harsh Environments

- TechnipFMC builds robots for deep-sea operations
 - Autonomous operations can replace hours of teleoperation
 - Cost effective operation improves construction, eases maintenance, and ensures environmental protection



"When you are operating on critical infrastructure thousands of meters below the ocean's surface, performance and reliability are crucial. The smallest mistake could lead to a multi-billion-dollar disaster...our customers rely on our technology, and we rely on RTI."

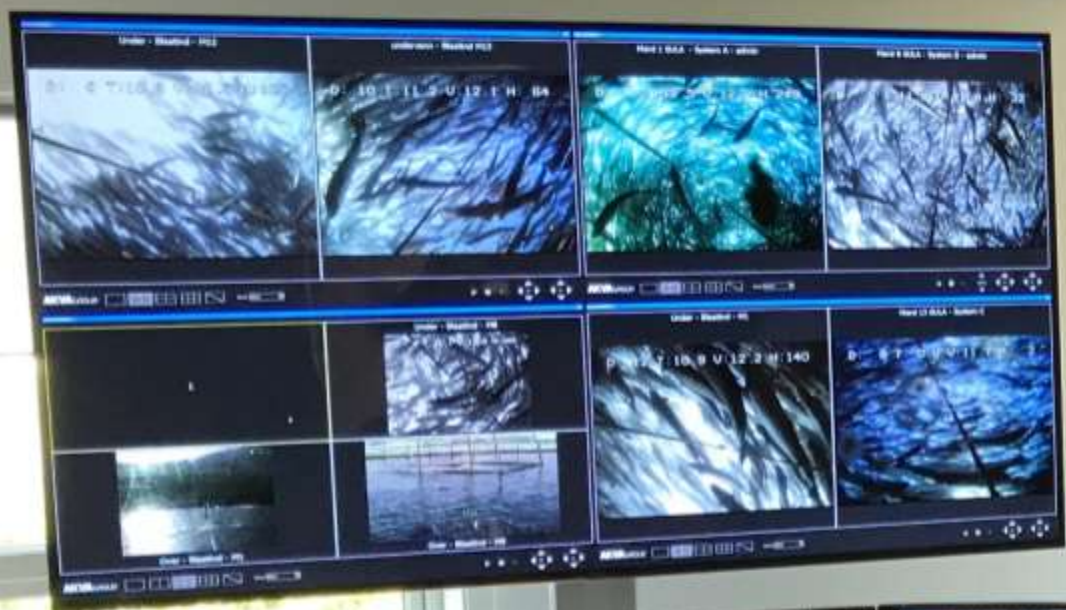
— Bijou Abraham, Chief Software Engineer



FJERNSUPPORT HUB



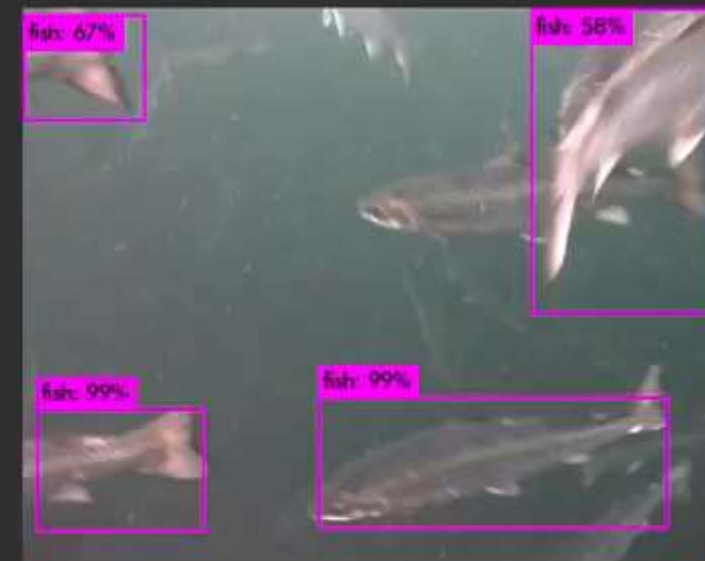
Facilitate Sustainable Salmon Farming



Density



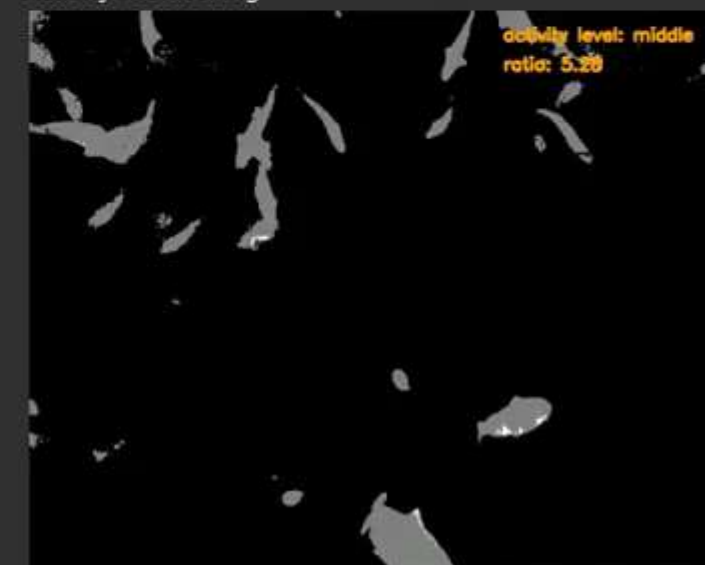
Fish detection



Particle detection



Activity monitoring



Shooting lice with laser

- Lice on salmon cost \$2Bn per year
- Virus
- Escape
- Feeding cost
- Operational cost
 - Cleaning net
 - Net last for 5 yrs
 - Handling
 - Remove lice from fish
 - Fish welfare





Democratize Undersea Exploration

OPENROV

OpenROV is bringing a robust, reliable and capable underwater drone platform to consumer, research, and industrial markets

“With RTI Connex DDS, and OSRF's ROS2 (Robot Operating System), we made it possible for customers to expand and interoperate with our system.”

— Charles Cross
Embedded Systems Engineer



RTI Connnext DDS in the MS&T market

- **Kratos:** Reconfigurable Virtual Collective Trainer (**RVCT**)
- **US Army:** CCDC AvMC UH 60V **SIL**
- **HII:** US Navy trainer for AEGIS called **BFTT** (Battle Force Tactical Trainer)
- **Textron/SRC:** Next Generation Electronic Warfare Environment Generator (**NEWEG**)
- **LMCO:** UK Scout tank SV Turret Training



Scout SV:

In addition to producing the Scout Specialist Vehicle turret, Lockheed Martin will soon provide a new turret training system. Using realistic, immersive simulators, the training system will help prepare Commanders and Gunners of the Scout SV turret to complete their missions safely.

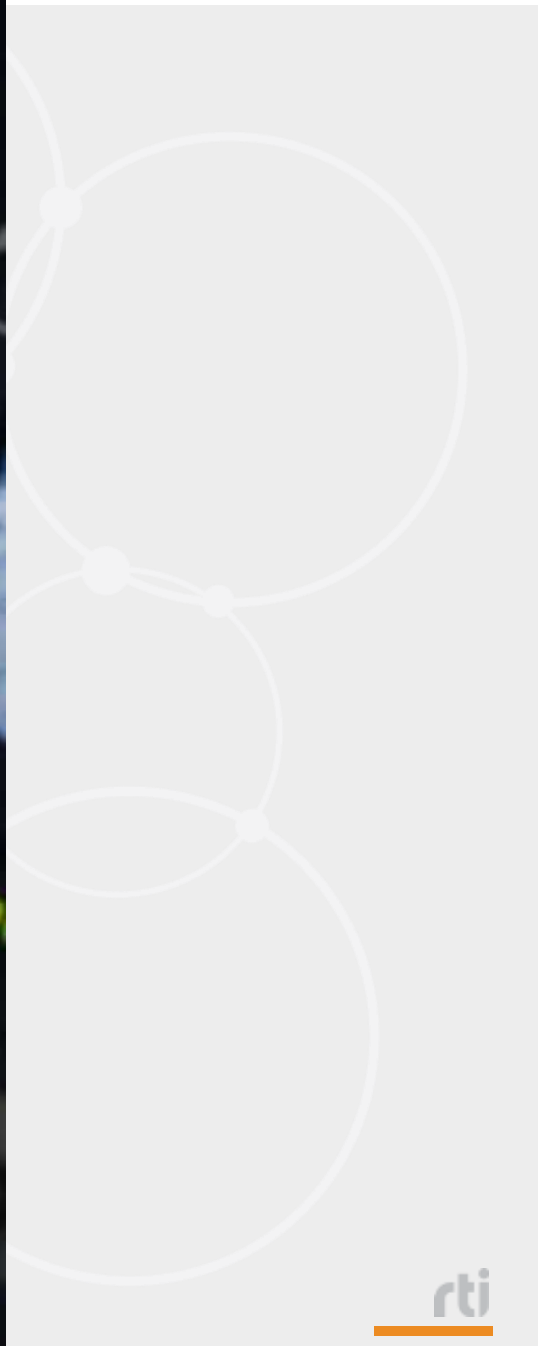


LOAD ACCESS

NO.	SCHEDULE
1	COMB 1
2	COMB 2
3	COMB 3
4	COMB 4
5	SPRIDE
6	WCH-CLUMP 2
7	SPR 1
8	SPR 2
9	OFF
10	ARM

RTI
00.00 00.00 00.00 00.00 00.00 00.00
TTTTTT
PWR PWR PWR PWR PWR PWR

NEW ACCESS POINTS WILL NOT BE VIEWED
UNLESS THE ACCESS POINTS OF THE
NETWORK ARE CURRENTLY COMMUNICATING



Mining and Construction

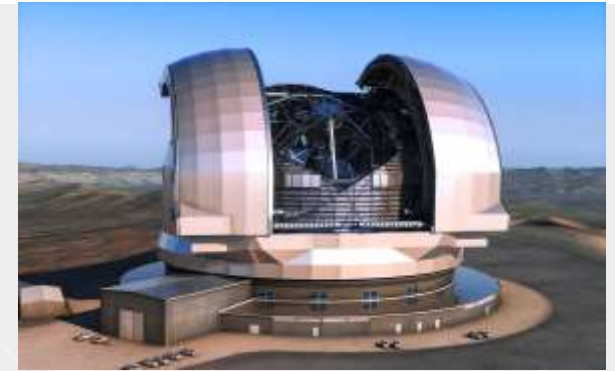
- Deep mining
 - Komatsu (Joy Mining) continuous miner
- Surface mining
 - Autonomous trucks
- Construction cranes
- Full connectivity
 - System safety
 - Data analytics
 - Mine-to-cloud



Advance Precision Science



Thor's Helmet Nebula
Credit: ESO/B. Bailleul

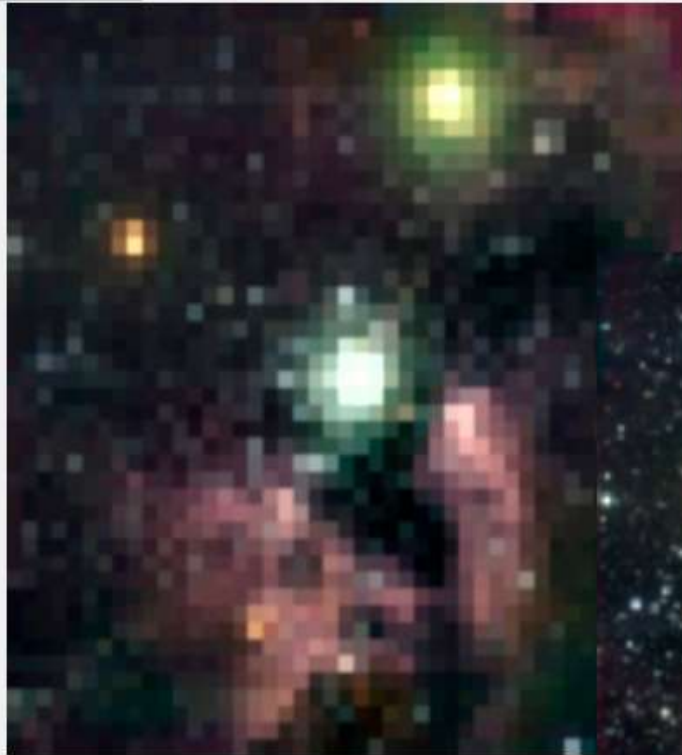


- European Southern Observatory's 8.2m Very Large Telescope can see objects four billion times fainter than the eye
- The new 39-meter Extremely Large Telescope, under construction, will be the world's largest optical telescope
- The telescopes precisely synchronize hundreds of servo mirrors and scientific instruments
- RTI middleware coordinates precise control and measurement





Spectacular Resolution



HST



VLT+AO



ELT

Support Common Platforms



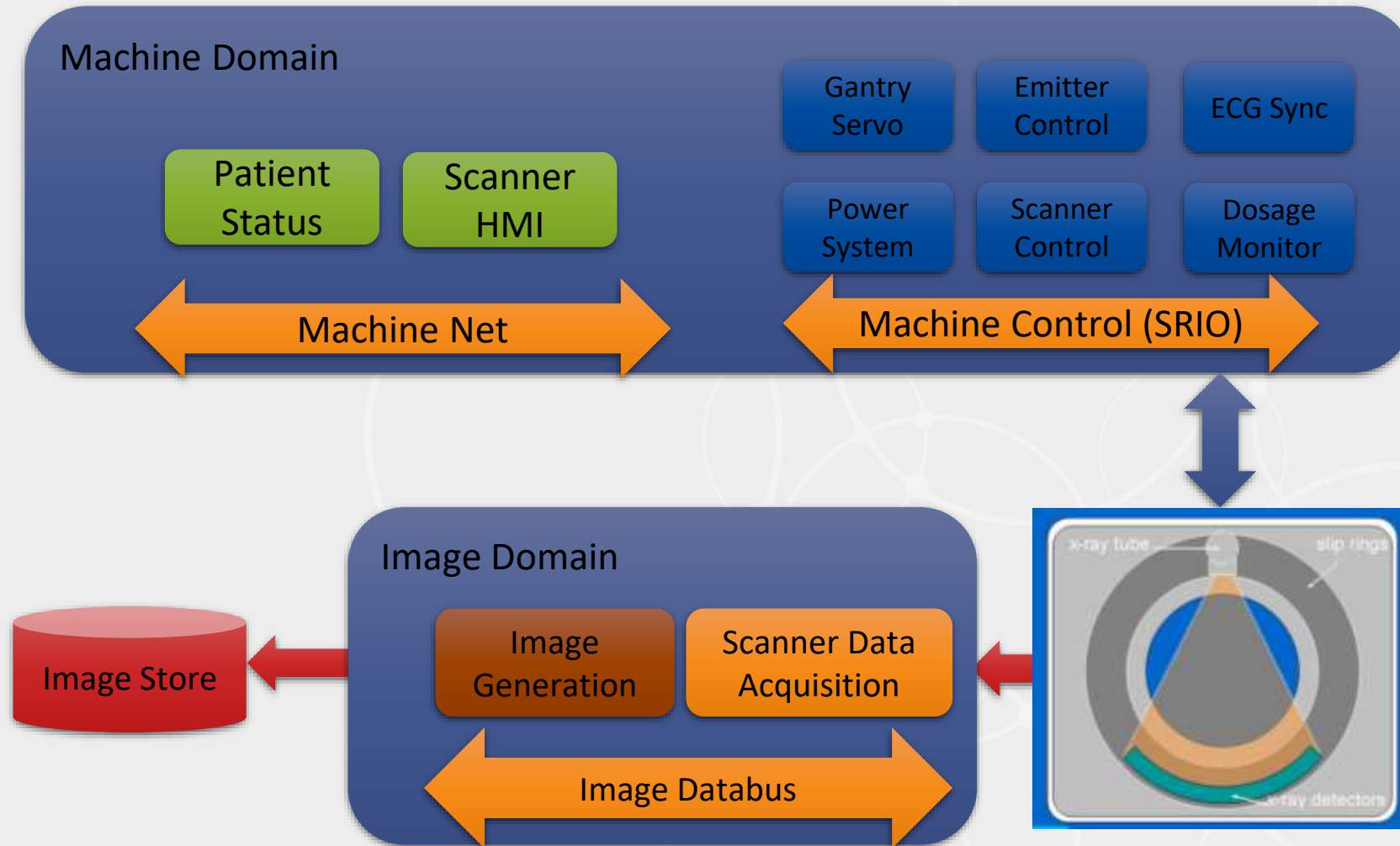
"GE Healthcare chose RTI DDS because it can handle many classes of intelligent machines. DDS satisfies the demanding requirements of our devices and supports **standardization on a single communications platform across product lines.**"

-- J Gustavo Perez, General Manager for MI&CT Engineering





CT Scanners Mix Processors, Networks, Intelligence



Deliver Fast Data On Time



- The Minimally Invasive Robotic Surgery (MIRS) system at DLR coordinates three robots to perform delicate heart surgery.
- The system closes a distributed loop between the robots and the remote surgeon's control at 3kHz.
- RTI enables new medical techniques

Ensure Reliability for Complex Systems



- Mevion's Proton-Beam Radiation Therapy system zaps tumors with accelerated protons
- The treatment must be continuous for 30-40 days; downtime endangers treatment success
- With RTI Connexx DDS, Mevion's PBRT delivers dependable treatment at low cost



First patient treated Dec 2013,
Siteman Cancer Center, St. Louis

Connect Vehicle/Cloud/Infrastructure

**PHYSIO
CONTROL**



Physio-Control supplies emergency response medical equipment to 60% of the world's emergency vehicles

"Physio-Control is utilizing RTI Connex DDS to exchange critical patient care information throughout the system of care."

—Dale Pearson, VP Data Solutions

We envision a society in which no person dies from acute, treatable medical events



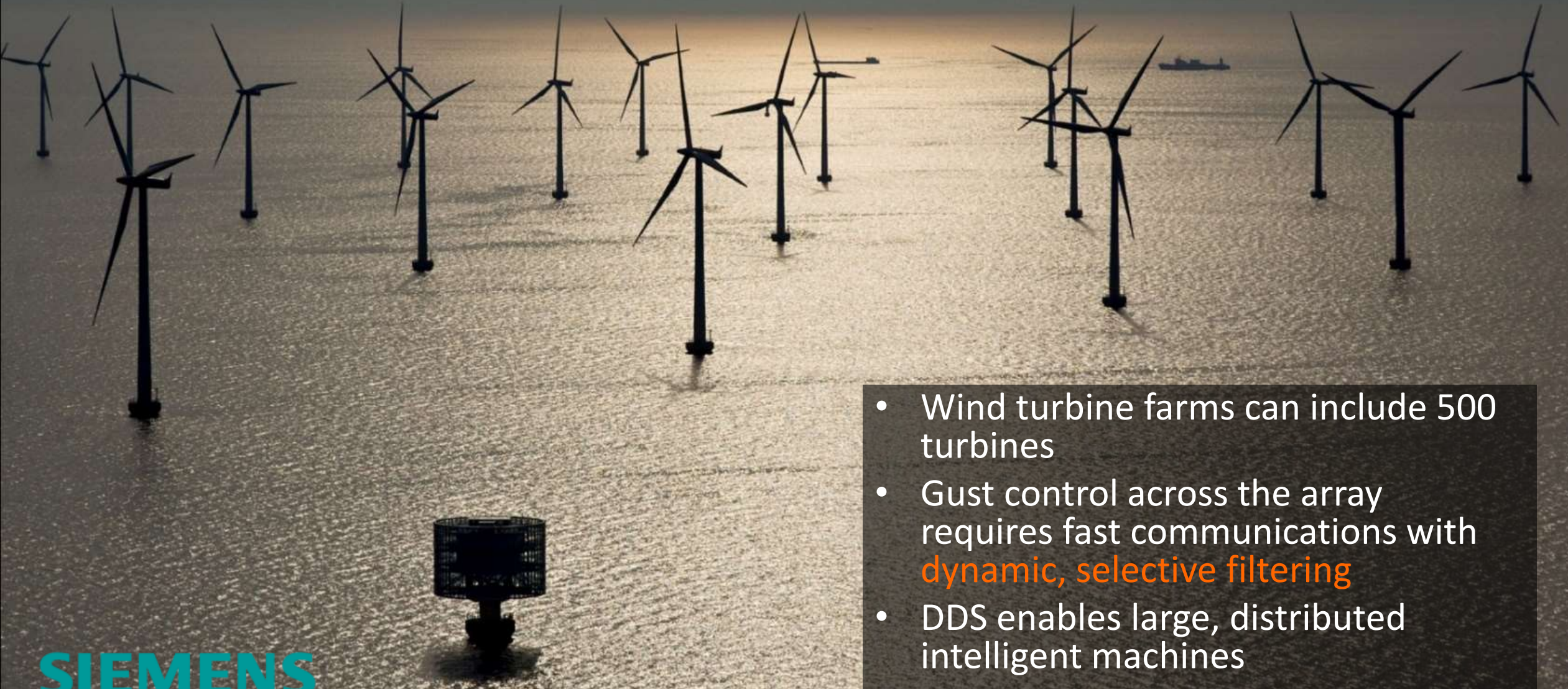
Build Hydropower Across North America



- USACE's 75 dams generate 20.5 GW, or 100 billion kilowatt-hours a year
- 20 more dams installed
 - Grand Coulee, #1 in NA
 - Chief Joseph, #2 in NA
 - The entire Willamette basin, OR
 - Savannah River, GA



Distribute Real-Time Control



- Wind turbine farms can include 500 turbines
- Gust control across the array requires fast communications with **dynamic, selective filtering**
- DDS enables large, distributed intelligent machines

SIEMENS

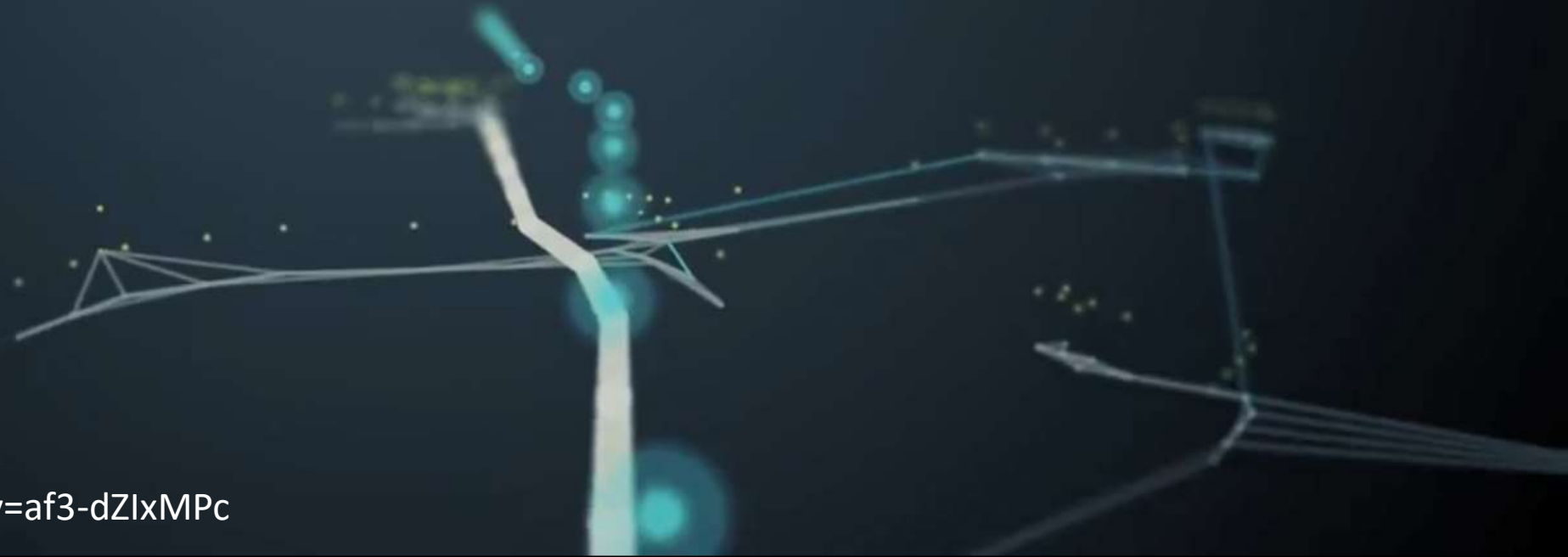


InGRID

Efficiency and increased value
in power grid management



An Example of The Challenge
of the IIoT and the Power of
Data Centricity





indra

Early Applications Adopting RTI Connex DDS

- Transportation
 - Autonomous vehicles & E/E frameworks
 - Rail & mass transit
 - Traffic control (ground & air)
 - Drones and personal aviation
- Energy
 - Renewable generation (hydro, wind, solar)
 - Renewable integration (Substation automation, DER pilots, microgrids)
 - Automated drilling & production
- Medical
 - Intelligent connected medical devices
 - Surgical robotics
 - Imaging & treatment systems
- Defense
 - Avionics & UAS
 - Naval systems
 - Radar/antimissile/air defense
 - Ground vehicles
 - Asset tracking/C2



Why RTI?



Where Are We Going?



Why: Make the World Run Better



By enabling a new generation of intelligent distributed systems, RTI boldly seeks to transform entire industries. We particularly seek applications that promote a sustainable, safe, green, and healthy planet.

How: Earn Trust and Build People

We earn trust by insisting on the highest quality product, the utmost ethics, and the best team.

We offer a truly great work experience and outstanding financial reward to our employees.

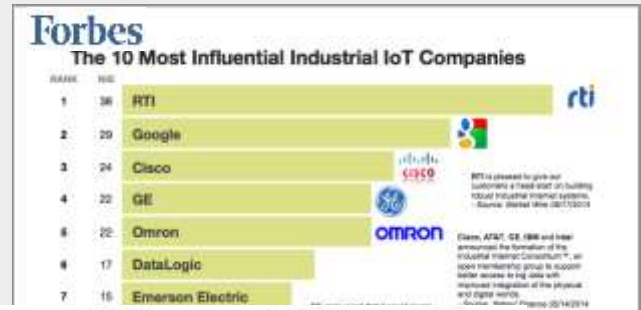
Accept the Responsibility

What: Enable Smart, Distributed Machines

RTI is the #1 connectivity software provider for edge autonomy



Lead the Market



Top 100 IoT Companies
CEO Top 25 Influencer

Must Follow Company
All from news

STOCK.it

Stock.it brings the benefits of the Blockchain - transparency, security and autonomy - to the real world.

Arkessa

Arkessa goes into the ground to connect the world of things. To achieve this, Arkessa has developed the

RTI

RTI is the world's largest provider of real-time data. It is the only company that provides real-time data to the world of things. To achieve this, RTI has developed the



RTI: 2016 IoT Emerging Company of the Year for the Enterprise Market
Compass Intelligence

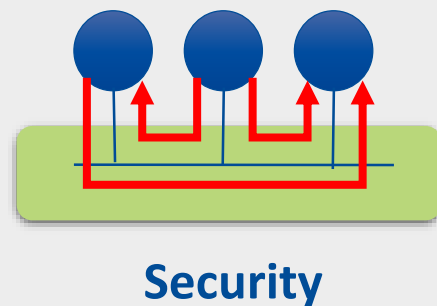
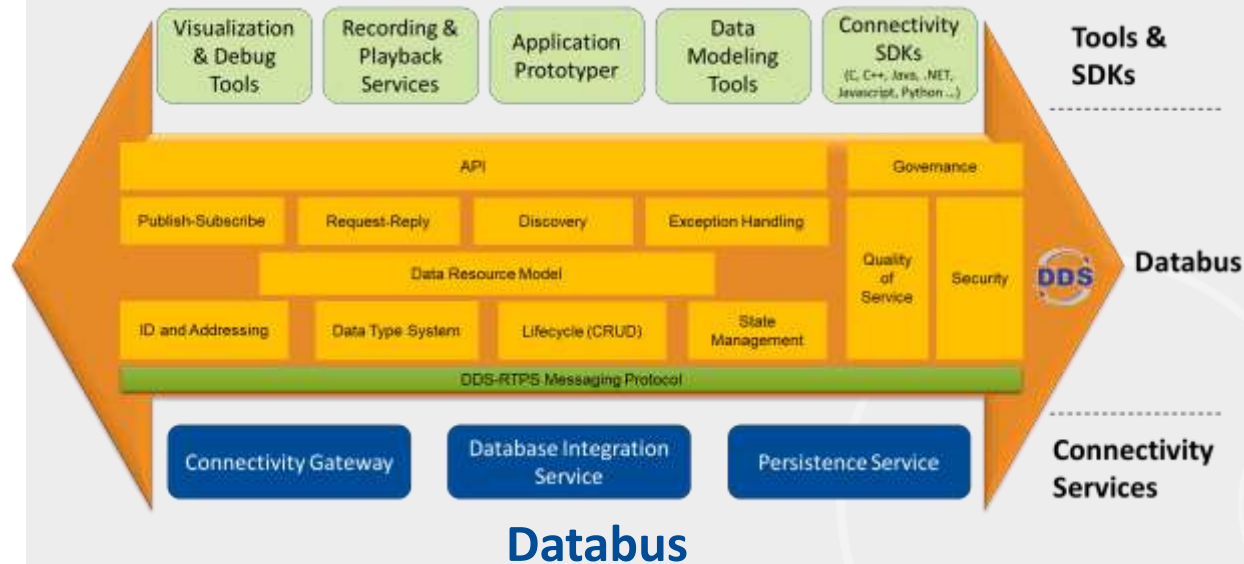
//CODiE//
2018 SIIA CODiE WINNER
Best IoT Solution

TOP WORK PLACES
2018
Silicon Valley Top 10



- Top 10 Companies Industrial IoT
- IBM
 - AT&T
 - Cisco
 - GE
 - RTI
 - Consumer IoT
 - Amazon
 - Google
 - Samsung
 - Apple
 - Microsoft

Deliver the Most Complete Product



Tools



Admin Console



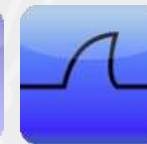
Monitor



Recording Console



Shapes Demo



Wireshark



Excel Add-in

Services



Routing Service



Recording Service



Replay Service



Persistence Service



Database Integration Service



Queuing Service



Web Integration Service

Utilities



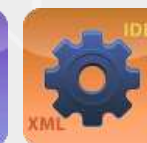
Code Generator



DDS Ping



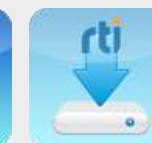
DDS Spy



Type Convert



Record Convert



RTI Package Installer

Built and Tested with Unmatched Process

- Well documented quality manual
 - Professional development tools
 - Extensive, automated testing
 - Rigorous training and reviews
 - Careful configuration and branch mgmt
 - Extensive issue tracking & mgmt
- The IIoT industry's best lab facility
 - 240-core scale test; runs 1000s of concurrent programs, 10k endpoints
 - 32 fast Xeon CPU array
 - 128-board Micro test array
 - Almost 100 types of computers
 - 2x NVIDIA Drive PX
 - Cloud, fog, edge, embedded systems
- **DO-178C level A evidence capable**
- We welcome customer process audit!

GE Healthcare is using DDS provided by RTI to develop the future of Patient Monitoring

- Proven vendor of DDS technology
- Experience in mission critical systems
- Full and robust security solution
- Outstanding set of design and troubleshooting tools
- Capable and responsive team
- They become part of our team

Providing mission critical monitoring



Real-time



Reliable

Solving for :

Scalability



Data liquidity & analytics



IT friendliness



Flexibility



Workflow



Service friendliness



Commit to Deliver What Customers Need



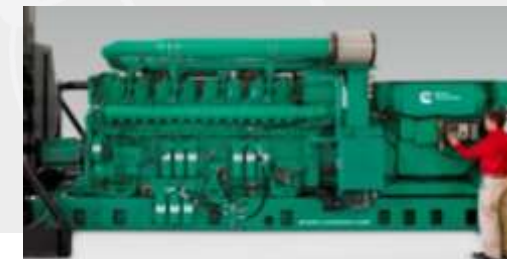
Our Values Drive Our Advantage

- Reciprocal responsibility to realize potential
- Overwhelming value for customers
- Absolute honesty
- Open communications
- Excellence
- Think we not I
- Value & reward hard work
- Enjoy the journey
- Do Well. Do Good.

If you were responsible for a \$2b system,
which company would you trust?

Be that company.

RTI's Commitment



Your systems.



Working as one.

“The secret of joy in work is contained in one word-excellence. To know how to do something well is to enjoy it.”

— Pearl S. Buck







A Better Smart Machine World



You don't compete against competitors.
You compete against market transitions.
– John Chambers



The real value is a **common** architecture that connects sensor to cloud, interoperates between vendors, and spans industries

Profound!



ConnexCon Goals

Learn
Teach
Grow
Interact

ConnexCon Case Studies!



community.rti.com

ConnexCon Case Studies this Week!



Customer Speakers

- Keith Leong, Vice President (Global Delivery), NCS



- Dounan Wei, Commercialization Manager, Baidu



- Wan Azlan, Principal Engineer (Real Time Systems - Grid of the Future) - Tenaga Nasional Berhad (TNB)



- Carlos Toro Ph.D, Technology Architect, ARTC & A*STAR



RTI Speakers

- Dr. Gerardo Pardo-Castellote, CTO



- Enrique Pallares, Sr. Applications Engineer



- Bob Leigh, Sr. Market Development Director (Autonomous Systems)



- Fernando Frespo, Software Architect



Connect!!



- Contact

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- Bio

- CEO Real-Time Innovations, Inc
- IIC Steering Committee Vice Chair
- Advisory Board, IoT SWC
- Top-10 Global IIoT Influencer
- PhD, EE/CS, Stanford





RTI Makes the World Run Better™