
NIDays

Richard Roberts
Technical Marketing Engineer
NI

What will the **Internet of Things** look like in five years time?


STANFORD
UNIVERSITY


NOKIA


industrial internet
CONSORTIUM


cisco


IBM


DELL


Ruckus


intel

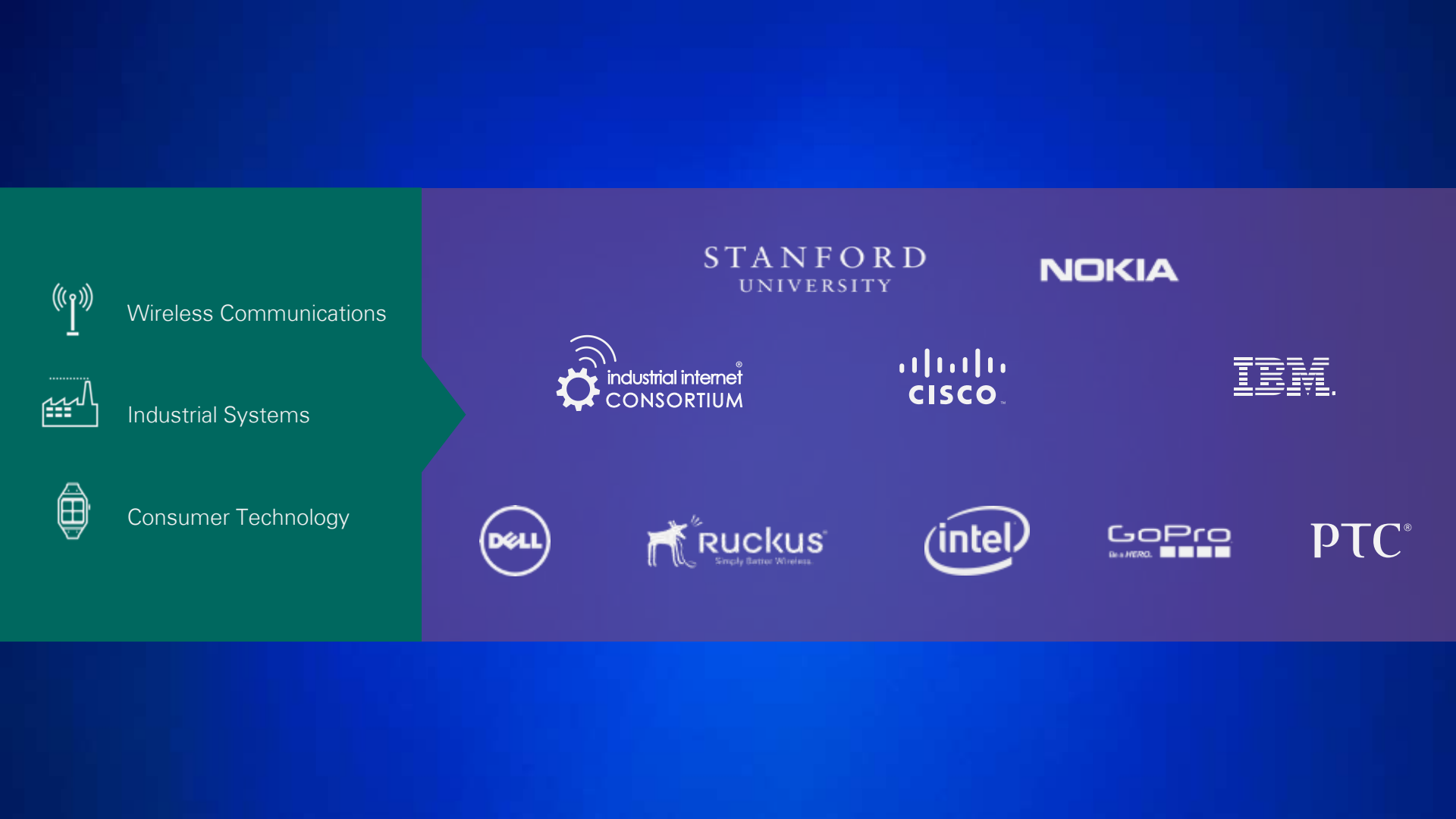

GoPro

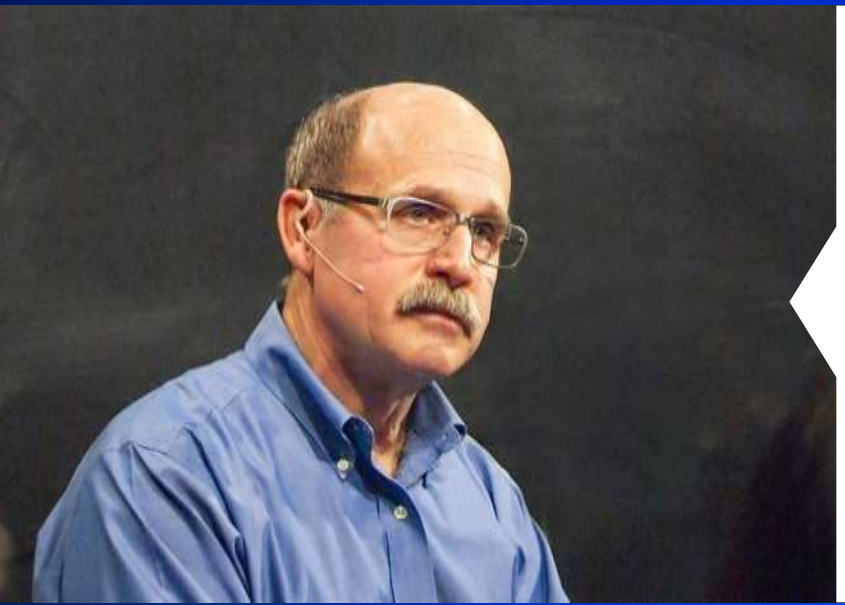

PTC

Wireless Communications

Industrial Systems

Consumer Technology

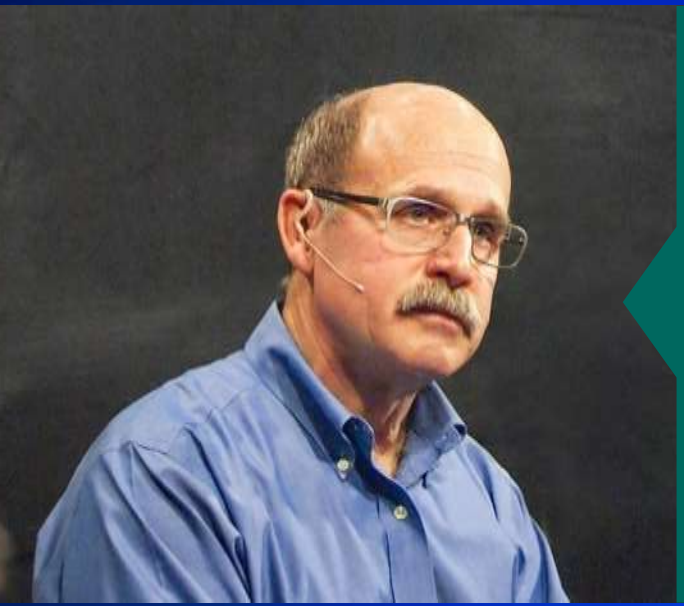




Paul Saffo

Futurist, Technology Forecaster, Consulting Professor in the School of Engineering at Stanford University

Stanford University



“The NI world is very innovative in that it uses many more sensors, is much more innovative, and is much more sophisticated than the process control. In revolutions like this, edges end up becoming centers of things.”

—Paul Saffo, Futurist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21

Smart Edge Device Architecture

SOLUTIONS AND PARTNER IP

NI PLATFORMS

COMMERCIAL TECHNOLOGIES

Kirtesh Mistry
Inside Sales Engineer
NI

ABB
Accenture
Altera Corporation
Analog Devices
Auburn University
Bosch
Dell
Deloitte LLP
Eclipse Foundation
Fujitsu Limited
Hewlett-Packard
Hitachi Ltd.
Honeywell
Huawei
Infineon Technologies
Jabil
Johns Hopkins
Kepware Technologies
LocalGrid Technologies
Micron Technology
Microsoft
MIT
Mitsubishi Electric
Moxa Inc.
NEC Corporation
Oracle
PTC Inc.
Purdue University
Putman Media
Real-Time Innovations
Red Hat
RPI
Rubicon Labs
Samsung
Siemens
Tech Mahindra
ThingWorx
Toshiba
Toyota Motor Sales
TTTech
Tyco
Vanderbilt University
Verisign, Inc

Industry Savings with 1% Efficiency Improvements

Industrial Internet Consortium Activities

Collaboration +

Business Usage Scenarios
Thought Leadership
Best Practices

Interoperability +

Frameworks
Standards
Open Engineering Technology

Testbeds

Experimentation
Real-World Scenarios
Proven Architectures

Products
Architectures
Methodologies

Condition Monitoring and Predictive Maintenance Testbed

industrial internet CONSORTIUM

NATIONAL INSTRUMENTS

IBM

“IBM will invest $3 billion over the next four years to establish a new Internet of Things (IoT) unit.”

—IBM, March 2015

Evolution of Maintenance Strategy


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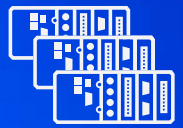
Technical Challenges

Cloud Integration

Interoperability

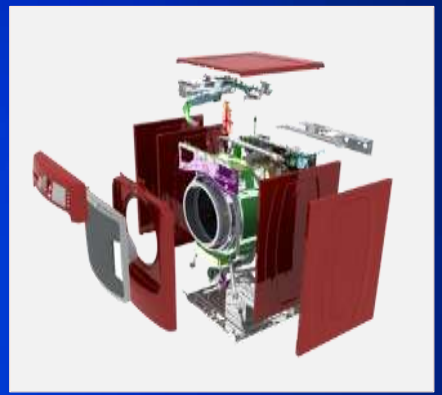
Security



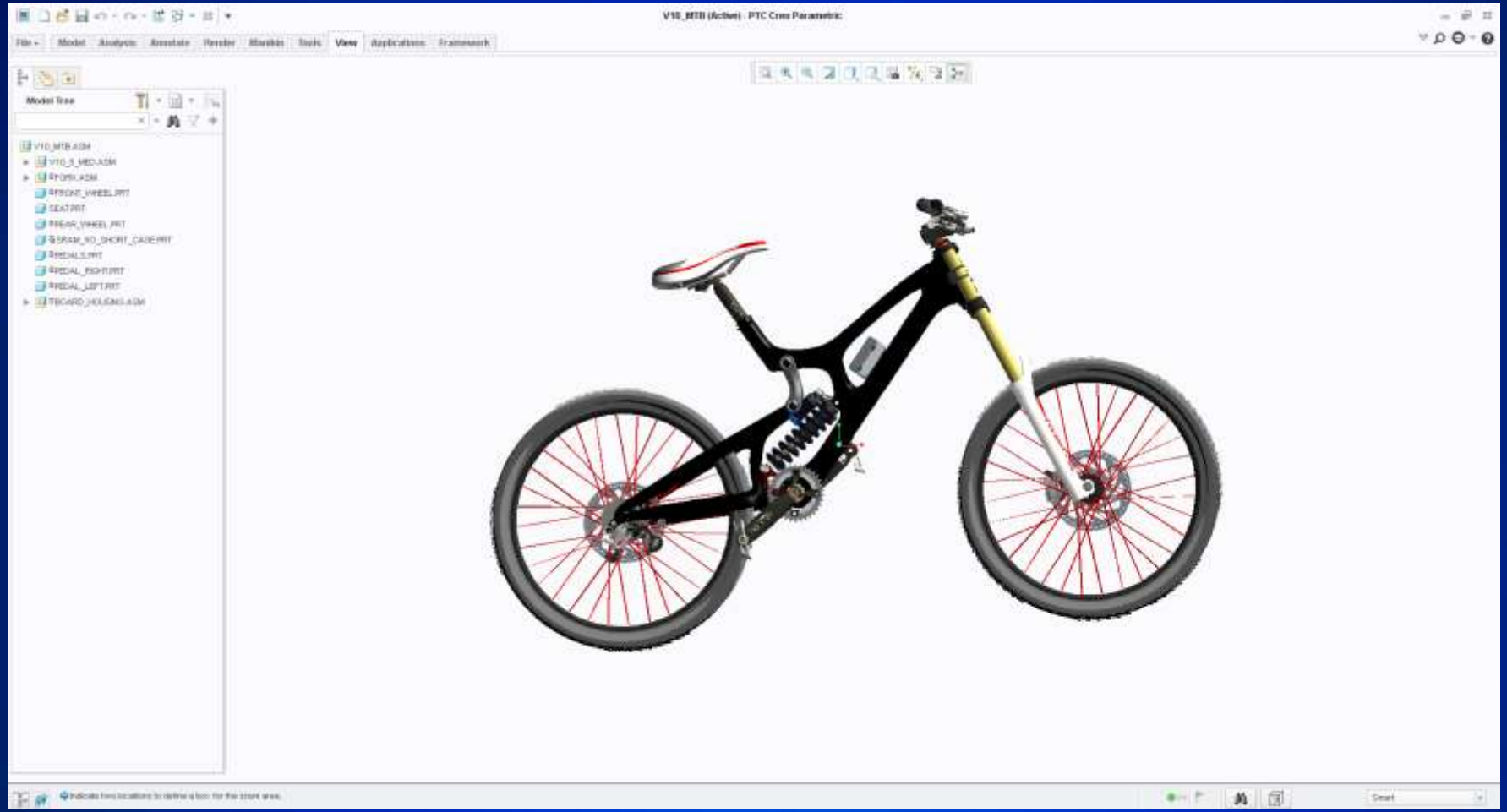
Scalability

End-to-End Analytics

Matthew Surridge
Applications Engineer Team Leader
NI



NI and PTC End-to-End IoT Solution


V10_MTB (Active) - PTC Creo Parametric
File
Model
Analysis
Annotate
Render
Manikin
Tools
View
Applications
Framework
Model Tree
V10_MTB.ASM
V10_S_MED.ASM
FORK.ASM
FRONT_WHEEL.PRT
SEAT.PRT
REAR_WHEEL.PRT
SRAM_XO_SHORT_CAGE.PRT
PEDALS.PRT
PEDAL_RIGHT.PRT
PEDAL_LEFT.PRT
TBOARD_HOUSING.ASM
Smart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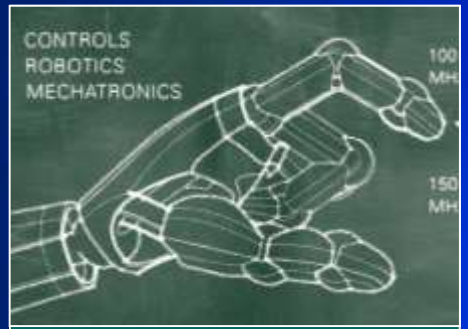
STUDENT DESIGN COMPETITION



System-Level Design

Industry Grade Tools

Raw Creativity

MedSIM

University of Leeds
A Haptic Simulator
for Medical Training

Balancing Bicycle

Tsinghua University
Auto-Balancing
Hybrid Electric Bicycle

Scalevo

ETH Zürich
Stair Climbing
Electric Wheelchair

MedSIM

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Scalevo

ETH Zürich
Stair Climbing
Electric Wheelchair


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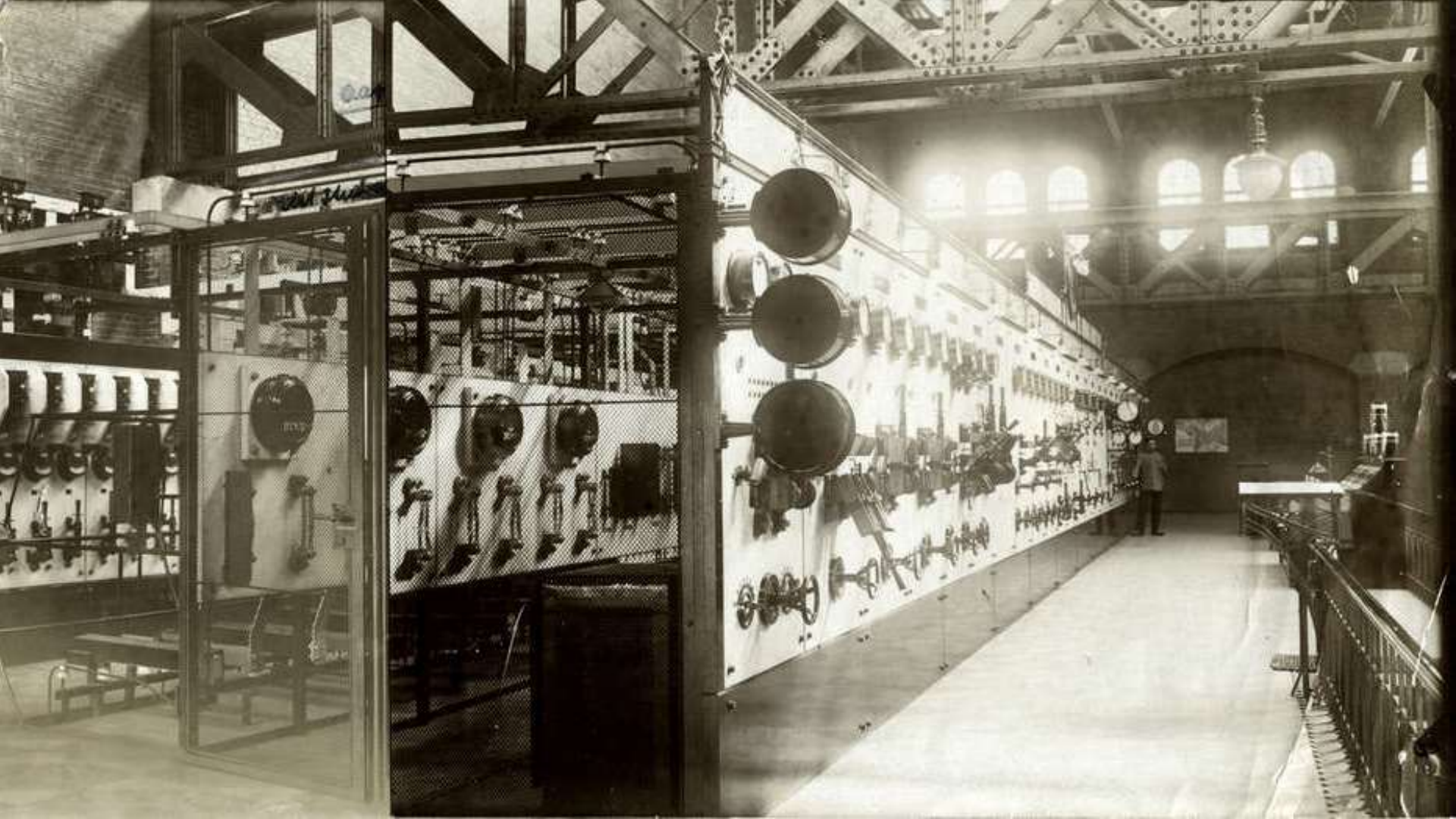

Herman Bontius

Energy Consultant
Alliander

alliander

liander

Electricity and gas
Electricity
Gas

endinet

Electricity and gas
Gas

revenue (in € million)
1,700

operating profit (in € million)
457

7,154 employees

819 kt CO2 footprint

91% Customer satisfaction consumer market

85% Customer satisfaction consumer market

24 mins annual outage electricity

38 secs annual outage gas

Beyond grid management


Smart Cities & Communities


Energy Storage

Smart Home applications


Zero emission buildings


Microgrids


E-mobility


Privacy and security


Big data


M2M

Active Distribution Networks

Transitioning to multiple actors
and dynamic load pattern

The C-DAX project addresses two major challenges:

How to exchange data *secure and reliably* between many distributed Smart Grid nodes?

How to *protect, monitor & control* future active grids ?

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How to exchange data *secure and reliably* between many distributed Smart Grid nodes?

How to *protect, monitor & control* future active grids ?

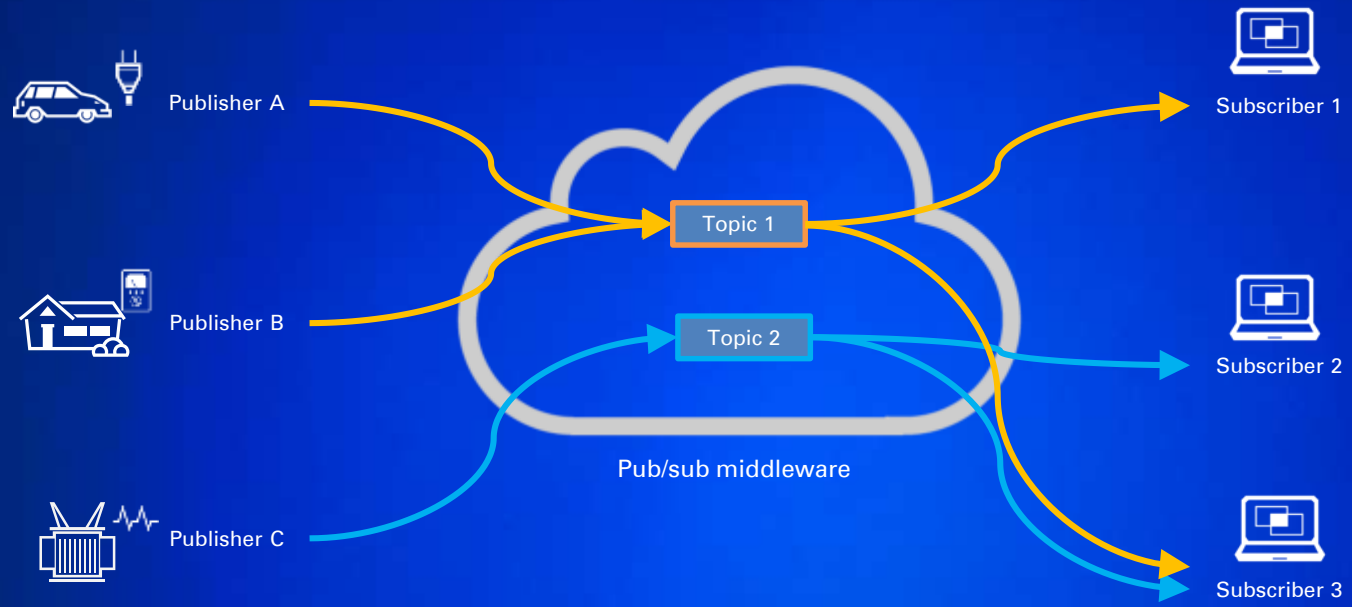
C-DAX : Information centric networking

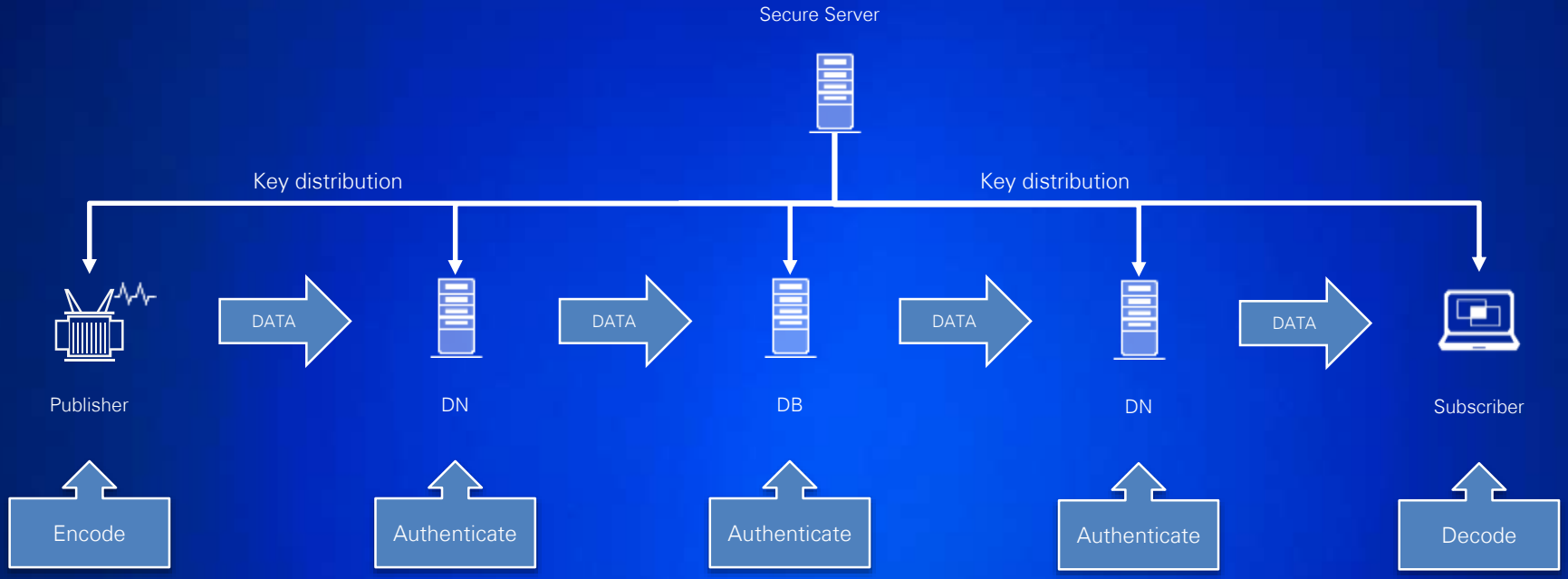
Information Centric Networking paradigm:

- Data is distributed over physically separated nodes
- Data is accessed through the Publish – Subscribe method.

Advantages:

- Inherent security
- Flexible Management
- Resilience
- Efficiency


Publisher A
Publisher B
Publisher C
Topic 1
Topic 2
Pub/sub middleware
Subscriber 1
Subscriber 2
Subscriber 3


Secure Server
Key distribution
Key distribution
DATA
DATA
DATA
DATA
Publisher
DN
DB
DN
Subscriber
Encode
Authenticate
Authenticate
Authenticate
Decode

The C-DAX project addresses two major challenges:

How to exchange data *secure and reliably* between many distributed Smart Grid nodes?

How to *protect, monitor & control* future active grids ?

Relevant Use Case

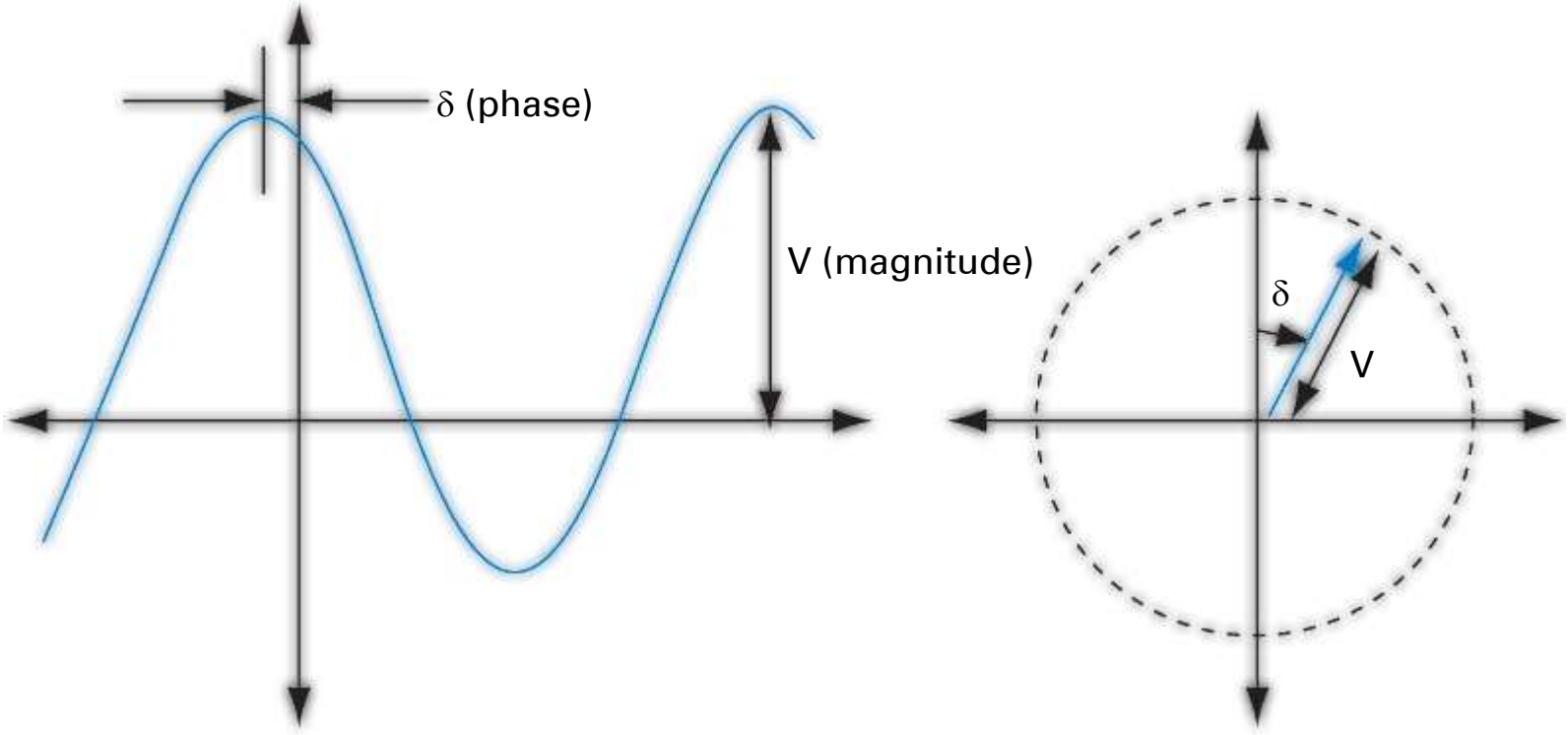
Evolution of distribution grids → *Active Distribution Networks*

Need for better observability of the grid

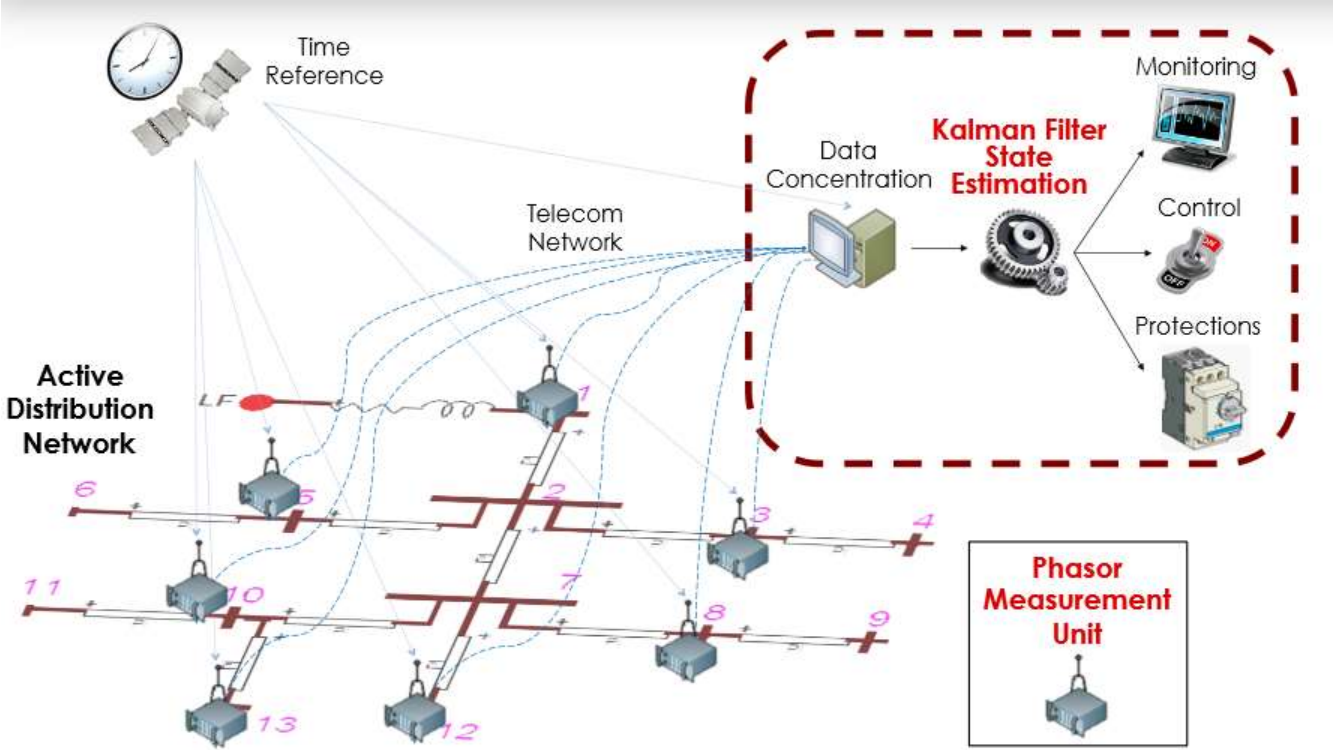
Real-Time State Estimation:

Use **Phasor Measurement Units** (PMUs) for
Regional/Local Area Measurement, Protection and Control

Phasor Measurements?



Advanced Real Time State Estimation



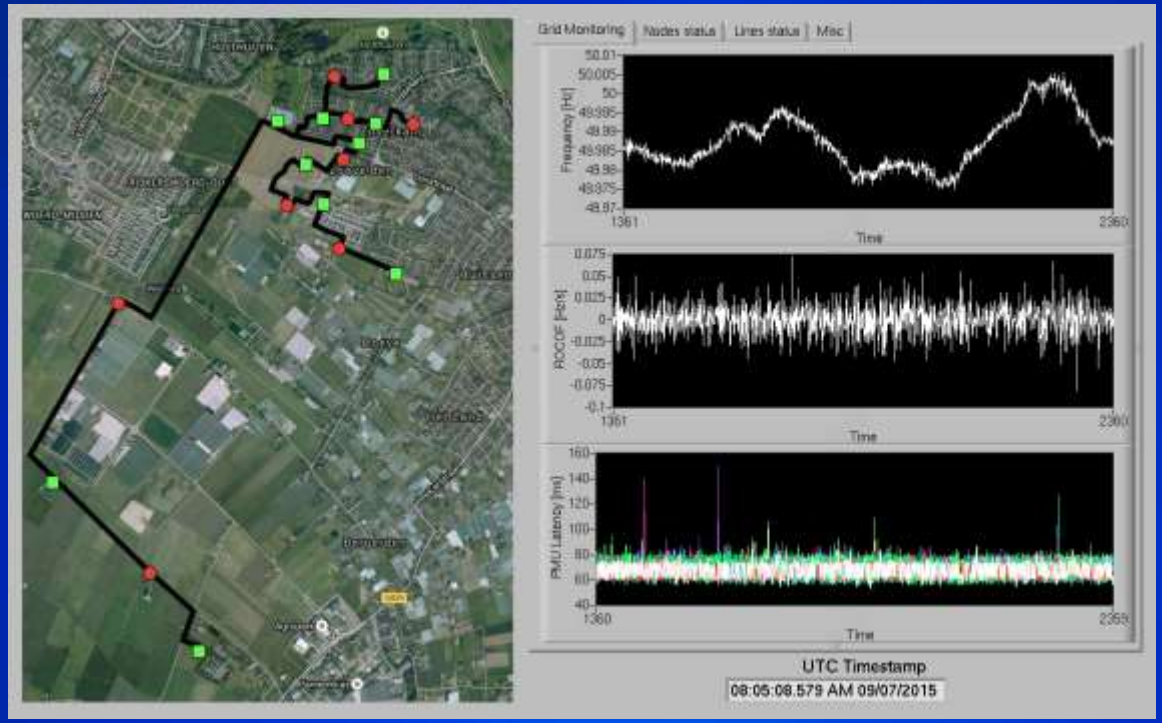
Field Trials

Environment:

- **Distribution grid** provided by Alliander
- Commercial **LTE communications** network
- **PMUs** provided by National Instruments (CompactRIO)
- **RTSE** application developed by EPFL
- **C-DAX software** developed by C-DAX/Bell Labs

Into the fields





Grid Monitoring
Nodes status
Lines status
Misc
Frequency [Hz]
50.01
50.005
50
49.995
49.99
49.985
49.98
49.975
49.97
1361
2360
Time
ROCOF [Hz/s]
0.075
0.05
0.025
0
-0.025
-0.05
-0.075
-0.1
1361
2360
Time
PMU Latency [ms]
160
140
120
100
80
60
40
1360
2360
Time
UTC Timestamp
08:05:08.579 AM 09/07/2015

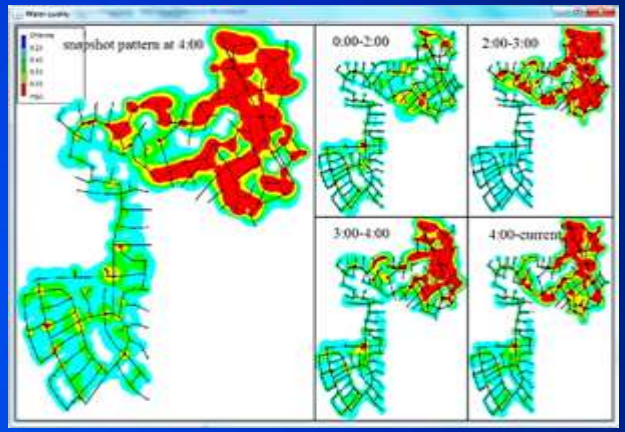
Challenge of electrification

- Electric transport of energy is a succes story ! But…
- Electrification of heating and transport and massive PV on consumer level is a thread to our aging distribution network. It impacts the oldest and most vulnerable part: the local MV/LV
- Challenge is to accommodate this electrification in the most economic way.

Local MEASUREMENTS

Strategy called "Local agility"

- 1. Know your grid load down to LV level
- 2. Determine local power accomodation factor and solutions.
- 3. Monitor and *forecast* local load profile (State estimation)
- 4. Act local with most efficient solution
- How ? Local MEASUREMENTS….

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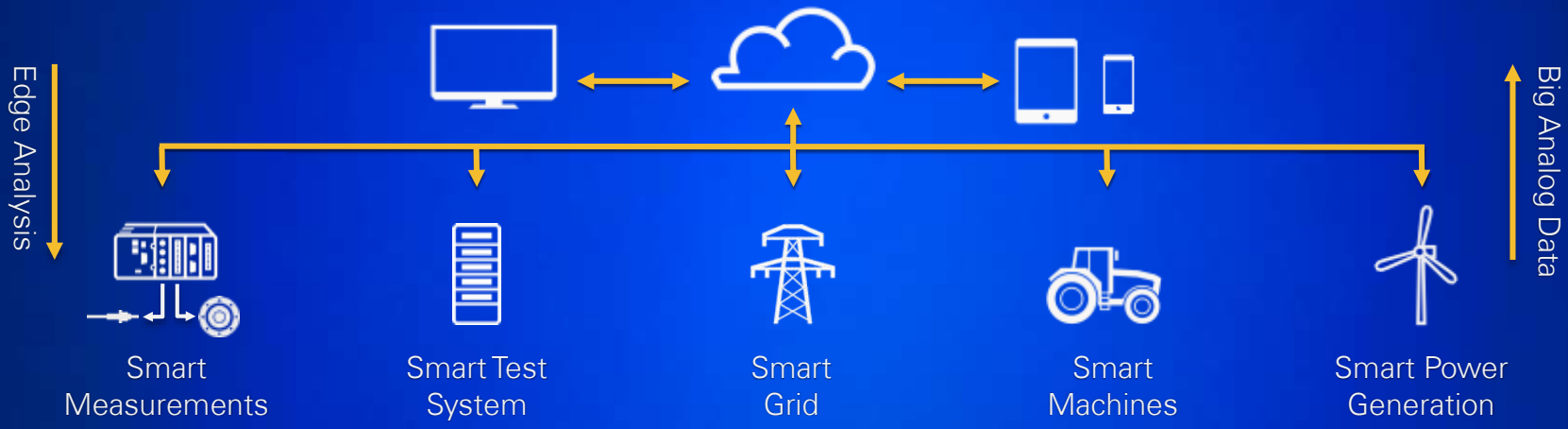
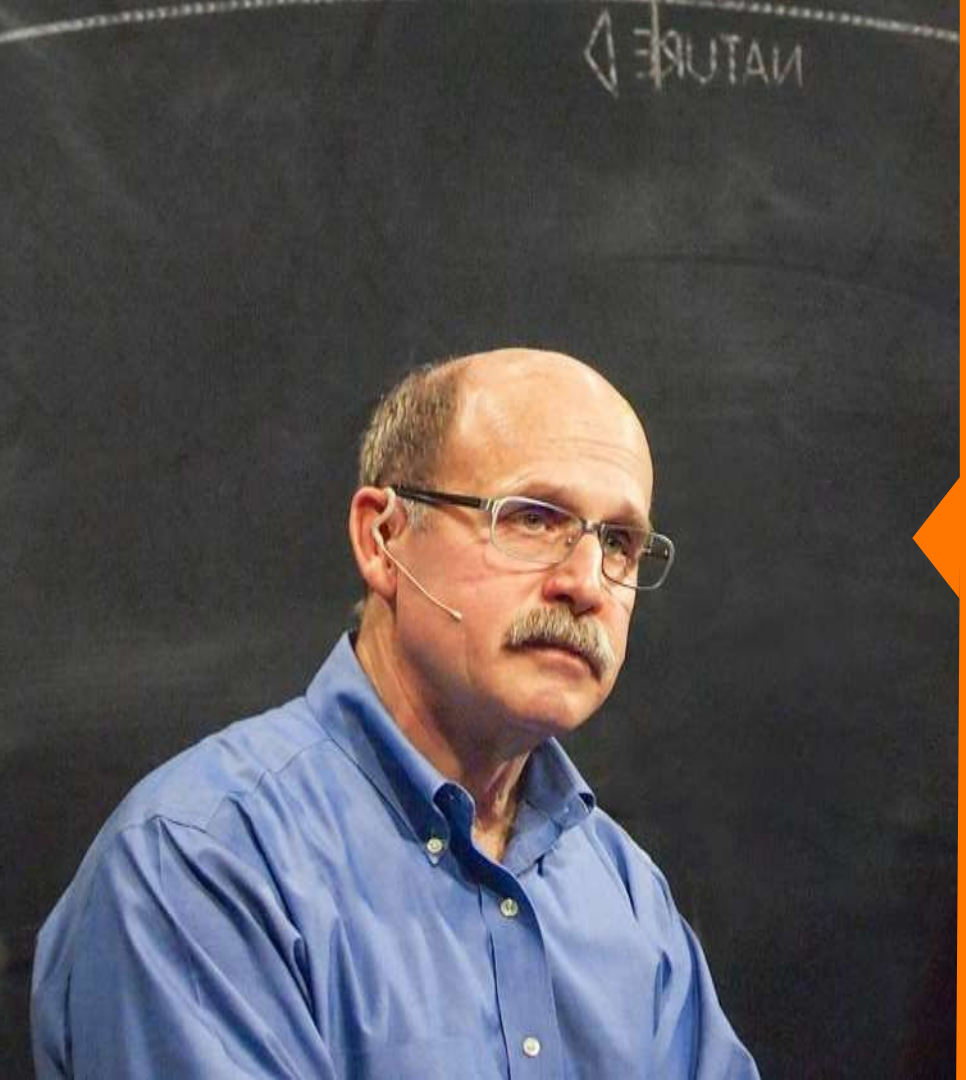
Internet of Things
The New Industrial Revolution





“Uncertainty is going to be as huge as opportunity, and it’s going to take every bit of your visionary skill, your management skill, and your technical vision to take advantage of what is about to happen.”

Paul Saffo, Futurist

> “The Industrial Internet is indeed transformative. It will change the basis of competition, redraw industry boundaries, and create a new wave of disruptive companies”
>
> World Economic Forum

You and NI will create the **Internet of Things**.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