Linklaser

Leveraging Distributed Processing in the Smart Grid

Affordable Control and Data Acquisition

Presentation Contents

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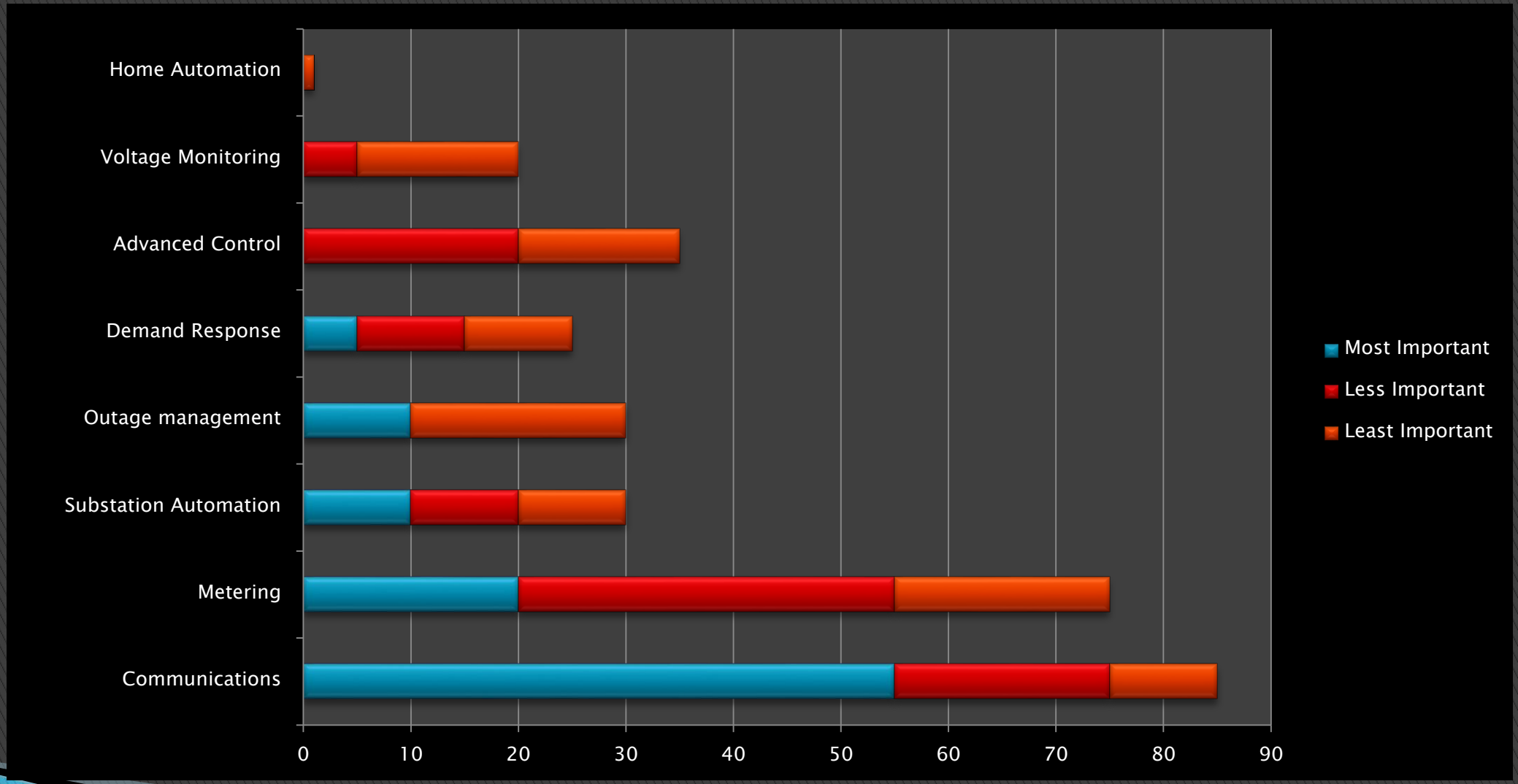
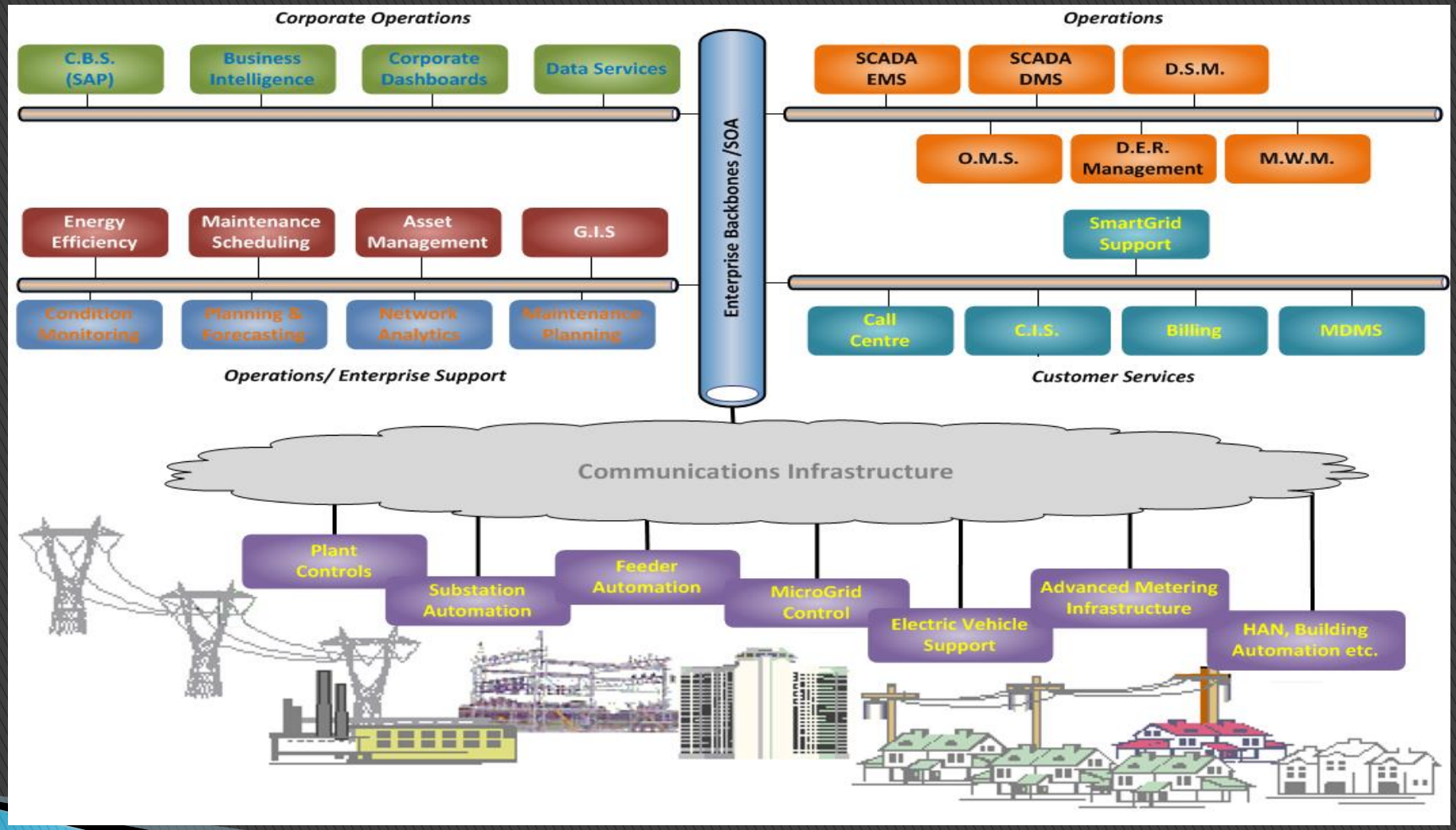
- Conclusions

Utility View of the Smart Grid

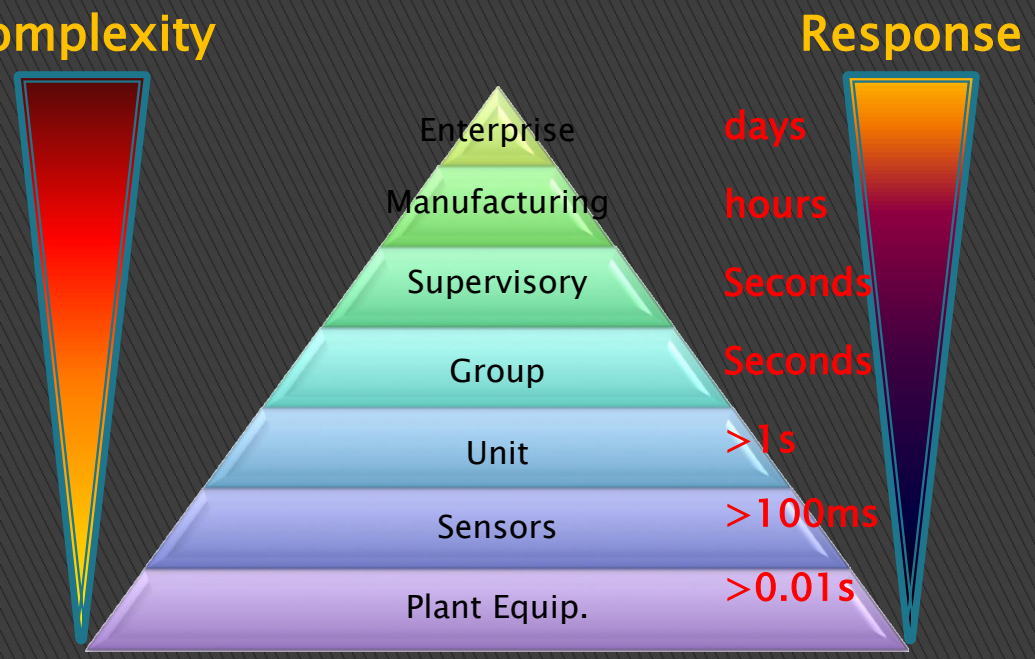


The Utility Landscape

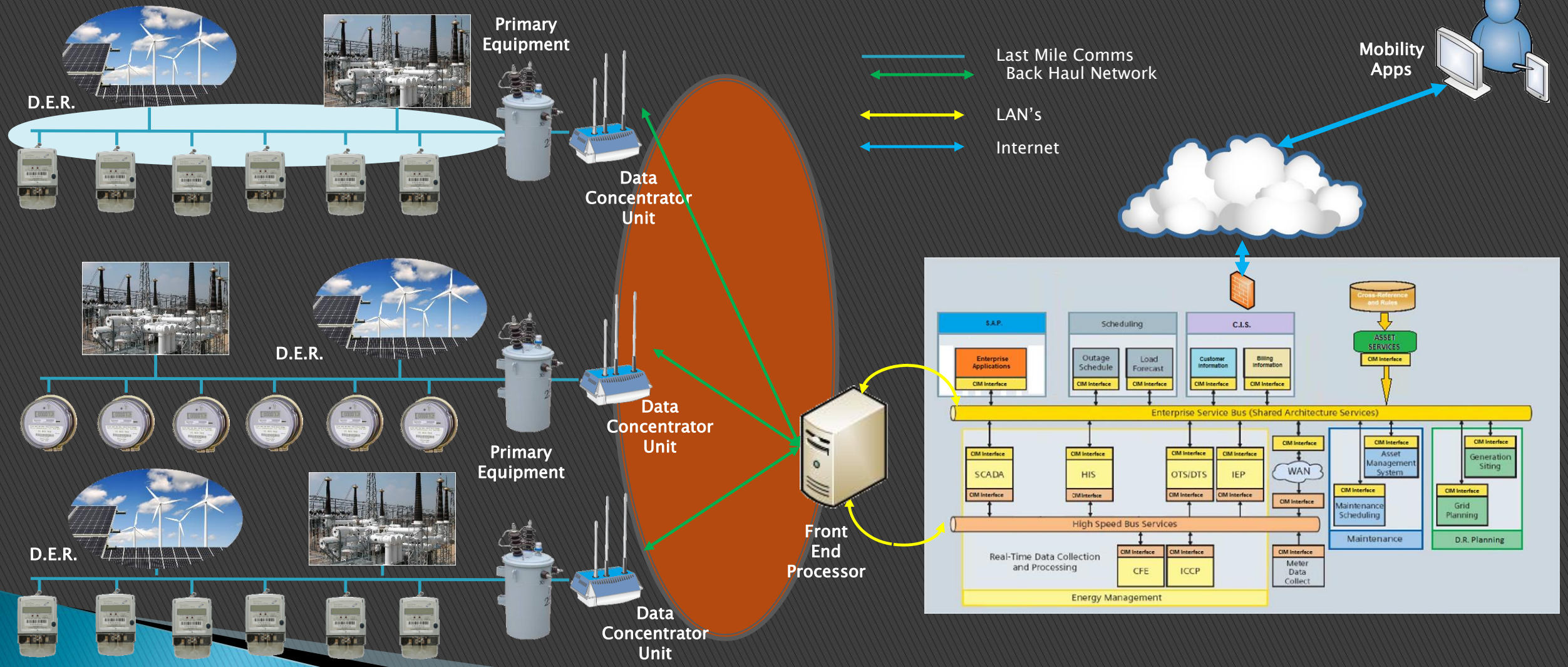


Using the Data – Enterprise

- Enterprise Levels
  - When ascending the control hierarchy, data are reduced:
    - higher level data are created (e.g. summary information)
    - Processing and decisions becomes more complicated (requires models).
    - Timing requirements are slackened – relational database
- SCADA (Master Station) Level
  - Presentation of complex data to the human operator,
  - Real-time data base.
  - Real-time functions – trending, control, alarm and events etc.
- Field Levels
  - Most demanding in response time.
  - Quantity of raw data is very large.
  - Processing is trivial (can be realized in hardware).
  - These levels are today under computer control,

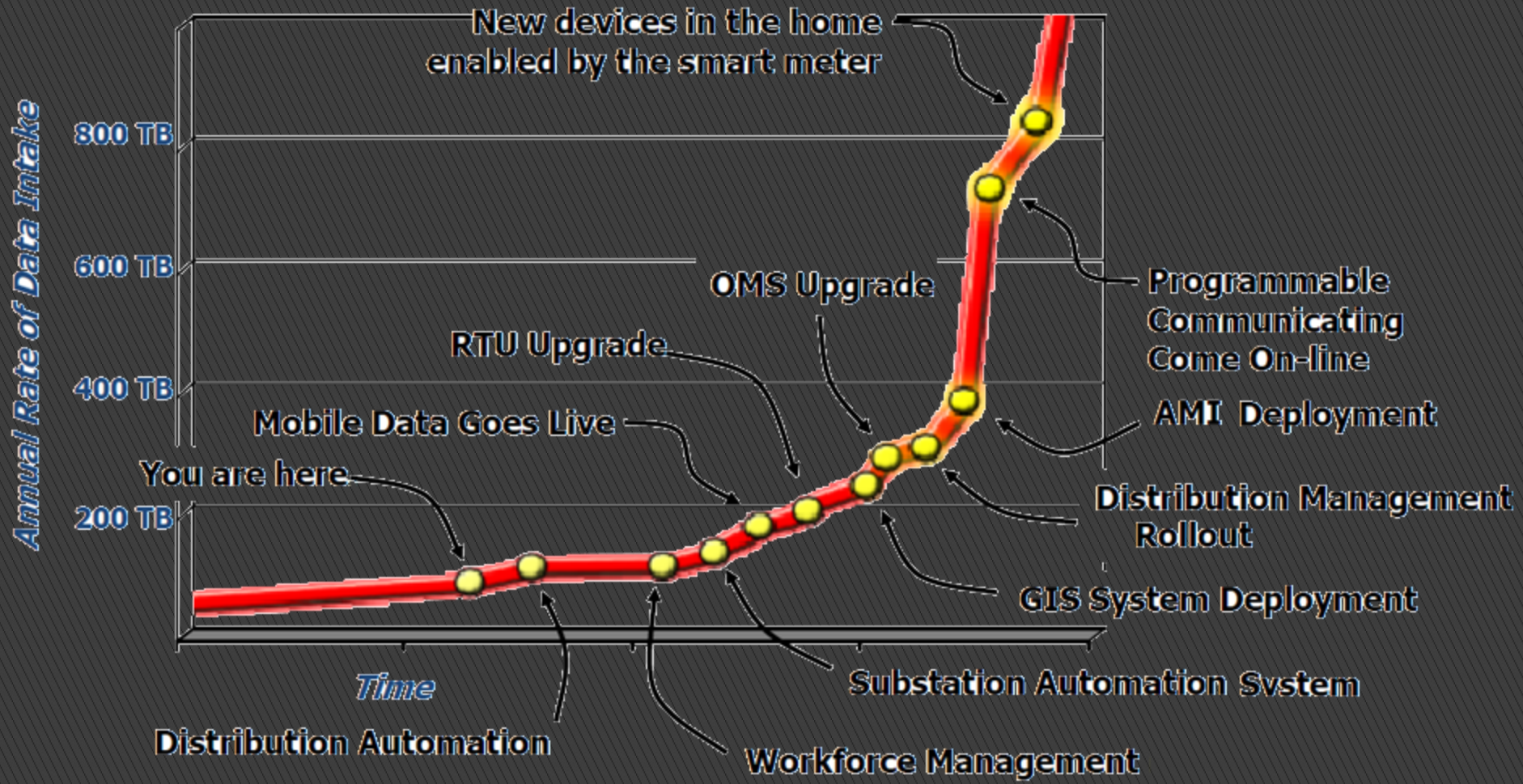


Movement of Data



Many sources of data needs one corporate strategy

Data Volumes

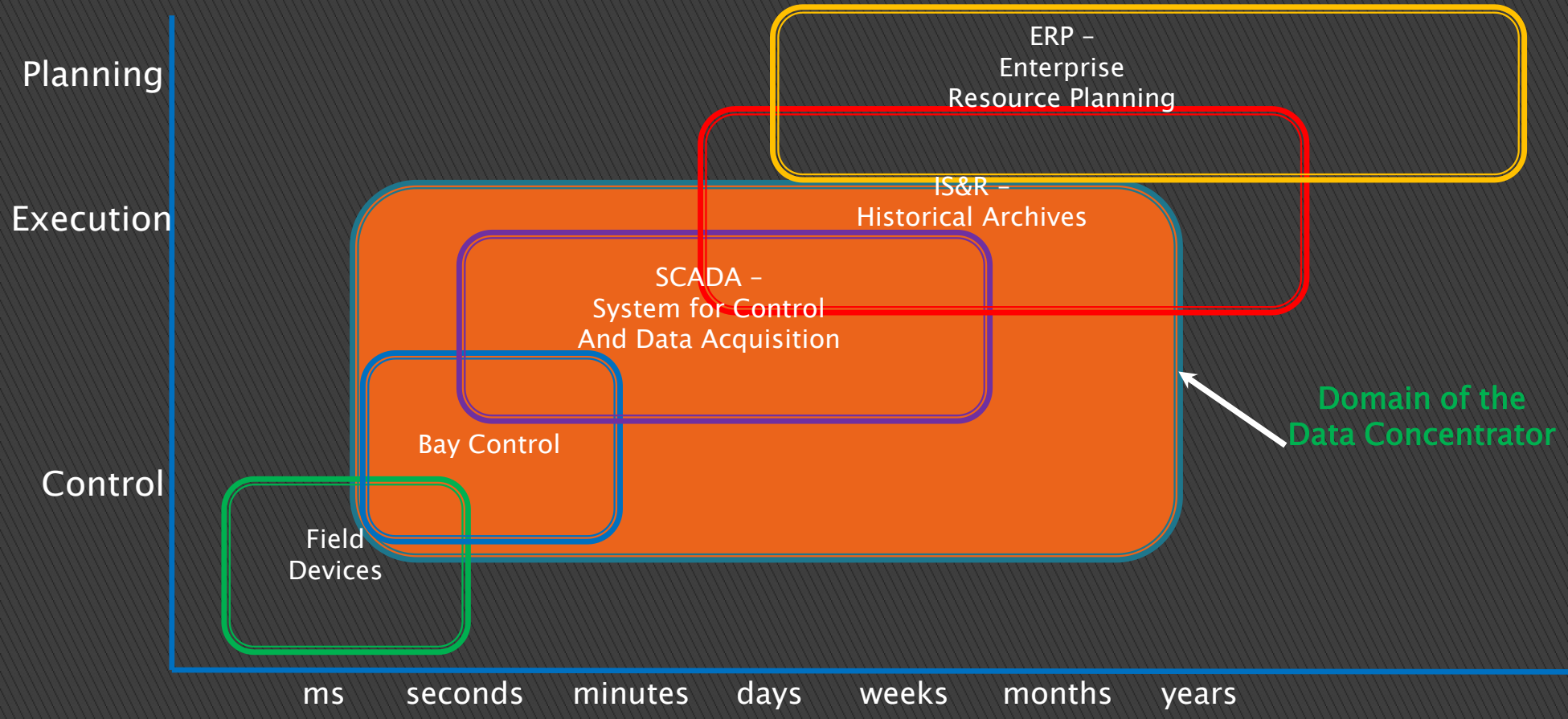


Data Concentration

- Volumes Of Data Increase Dramatically
  - Example Metering; Traditionally 12 Meter Reads Per Year Now With AMI > 35,000 Reads For Consumption Alone
- Central Systems Cannot Possibly Acquire Data From Every Individual Device
  - Store The Data Locally
  - Data Must Be Filtered, Compressed And Only Transmitted When Necessary
- Data Concentrator Can Also Act As Protocol Convertors (Zigbee -> Wimax) Firewalls Etc.
- Acquire Data From Multiple Sources Simultaneously (Metering, Public Lighting, Vehicle Charging, Primary Field Devices) And On Different Protocols
- Acquire Data For Different Commodities (Electricity, Gas, Water, Weather)

Make Use Of The Power Of Distributed Processing

Data Retention



Communication options

Last Mile

- Power Line Communication
- Radio Mesh
- 2G/ EDGE
- ZigBee
- Broadband Over Powerline
- Spread Spectrum Radio
- Hybrid Fibre Coax (HFC)

DCU to Backhaul

- Direct Connection To Backhaul
- Public Networks
  - 3G /4G LTE
  - WiMax
  - ADSL / SDSL
- Private Comms
  - GEPON
  - Private Wireless
  - Fixed Serial (Modbus)
  - MAS

No one stop shop – one size does not fit everywhere

Introduction / Product History

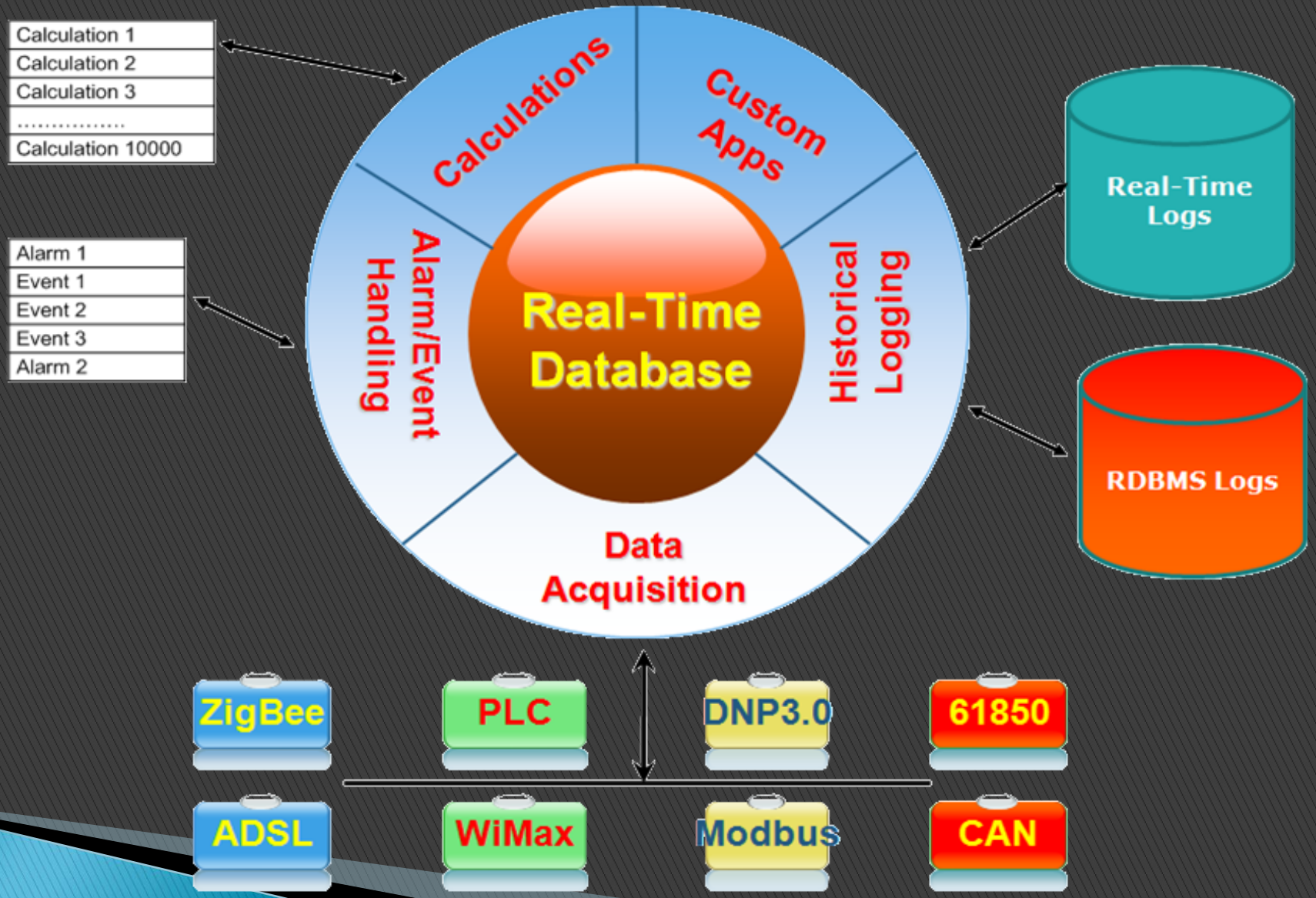
- Ran A Company With Two Friends Some Time Ago
- Produced Software For Data Acquisition And Control (SCADA / DCS)
  - 40 Man Years of software effort
  - World Class Product
  - Sold To “Blue Chip” Companies (Hoffmann la Roche, British Steel, Florida Power and Light, Manchester Ship Canal, Loveland Light and Power, Powergen, etc. etc.)
  - Competed Against Foxborough, Honeywell, ABB, Fischer Porter, Siemens, Etc.
- Originally Ran On Motorola Mc680x0 CPU’s
  - OS-9, 85% Written In ‘C’, Rest In ASM68K
- Later Product “Re-written” Under ‘NIX
  - DEC Alpha And Sun Sparc Workstations
  - 100% Written In ‘C’, Fully POSIX Compliant
- What Should it run on now?
  - Already on RPi 2, Banana Pi/ Pro, Intel x86 (including embedded processors), C.H.I.P. ??
  - Should run on OS-X, QNX, iPad, Apple TV???

What it Will Run On Today

	Original MC680x0	Raspberry Pi 3	Indicative Difference
CPU	MC 68030 25MHz, 32 bit, separate FPU, 18 MIPS	1200 MHz Quad Core, 64 bit, Integrated FPU 2460 MIPS	136 x
Memory	4 Mbytes RWM	1GByte RWM *	250 x
HDD	250MByte SCSI, 20MB/s	16 Gbyte Micro SD, 95 MB/s	64x Capacity, 4x speed
GPU	None	Integrated@ 400 MHz	
Conns	Serial, Parallel, Ethernet	Serial, Ethernet, Wi-Fi, SPI, I2C, TWI, USB, Bluetooth, etc., etc.	
Price	$1,200 ($2,000 @ today)	$50 (Board + TF)	40 x Cheaper
System	$15,000 ($28,000 @ today)	$400	70 x Cheaper

*some shared with GPU

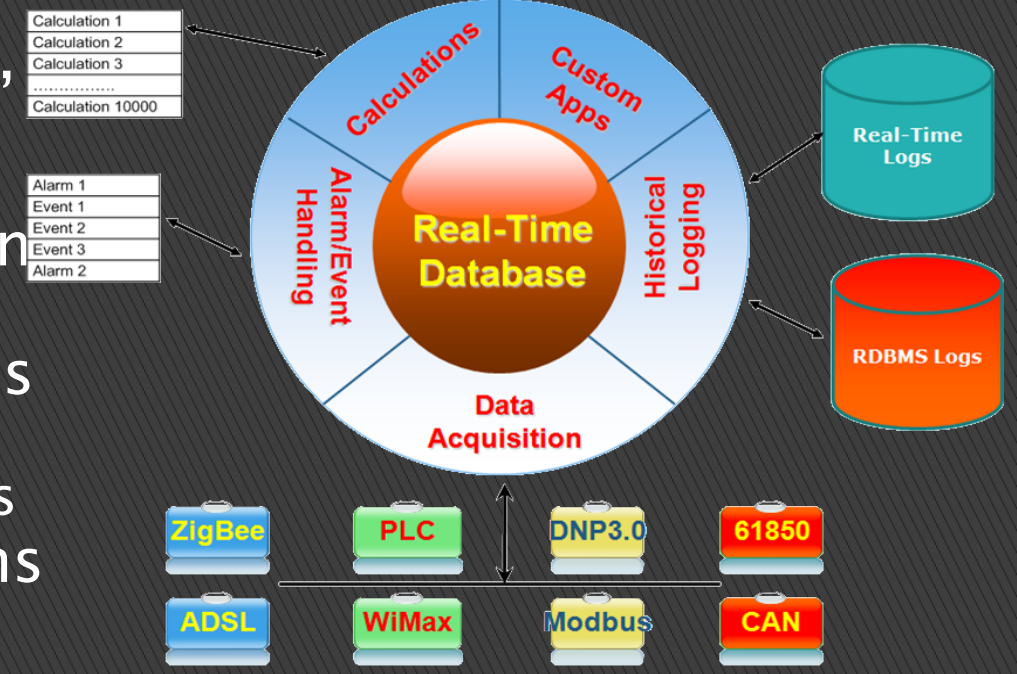
Software Architecture



Data Concentrators (cont. . . . .)

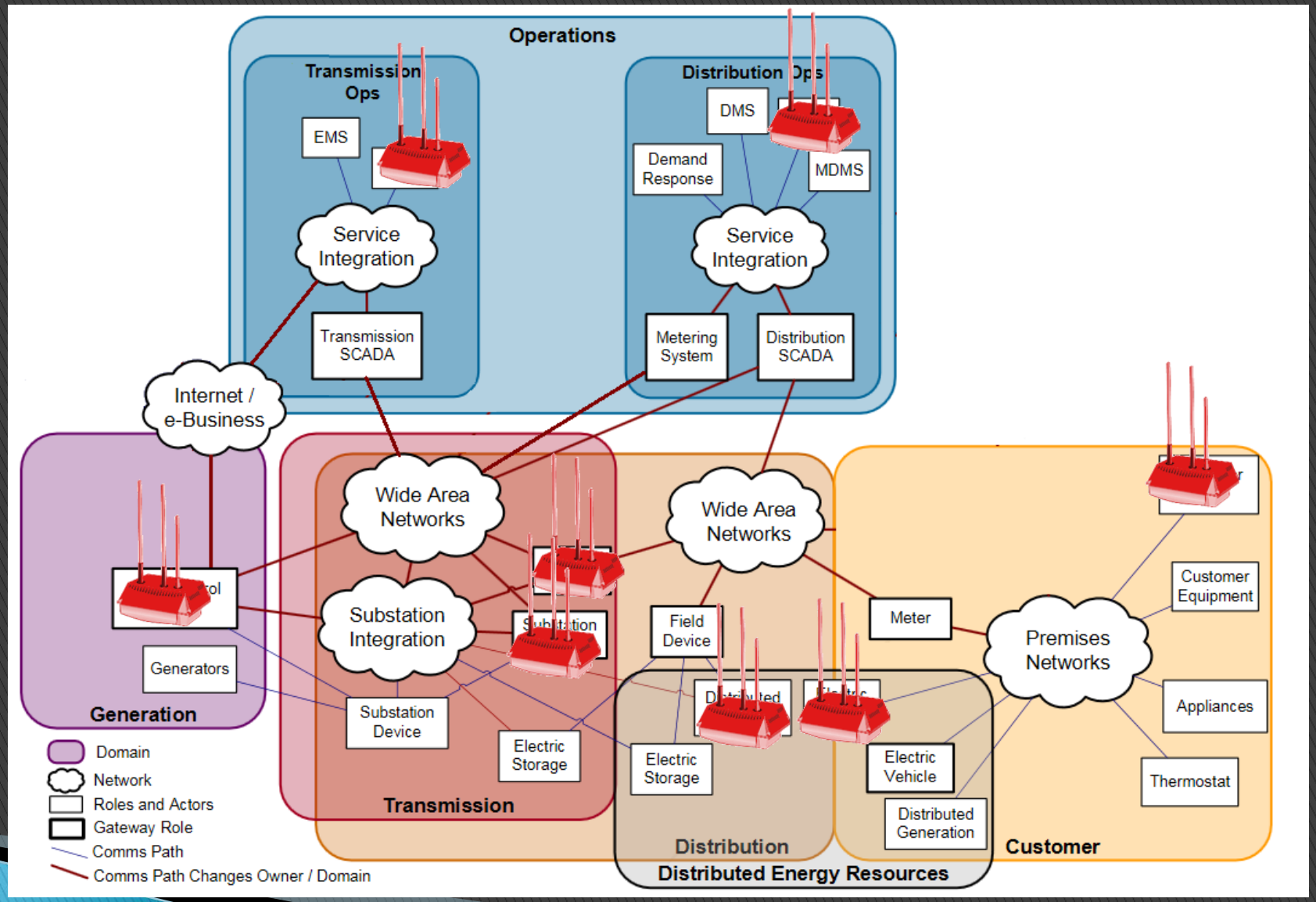
On The Basis We Are Going To Adopt A Distributed Processing Regime

- Perform Local Calculations, Alarm Handling, "Historical Storage", Filtering, Control
- Supply Data To Different Systems At Under Different Scenario's, By Polling, By Exception On Demand
- Acquire And Forward Data At Different Rates
  - E.G. AMI Read Meter Values Every 15 Minutes
  - E.G. SCADA Read Meter Values Every 30 Seconds
- Be Fully Customizable As Smart Grid Designs Shake Out
- Must Be Fully Integrated, Cheap, Low Power, Support Open Standards And Protocols.



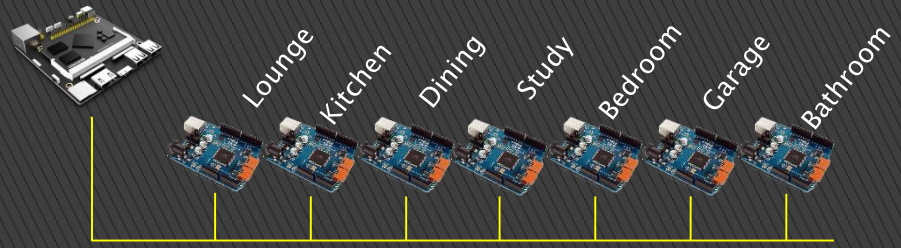
Only Move The Data You Need To When It Is Needed

Distributed Processing Candidates

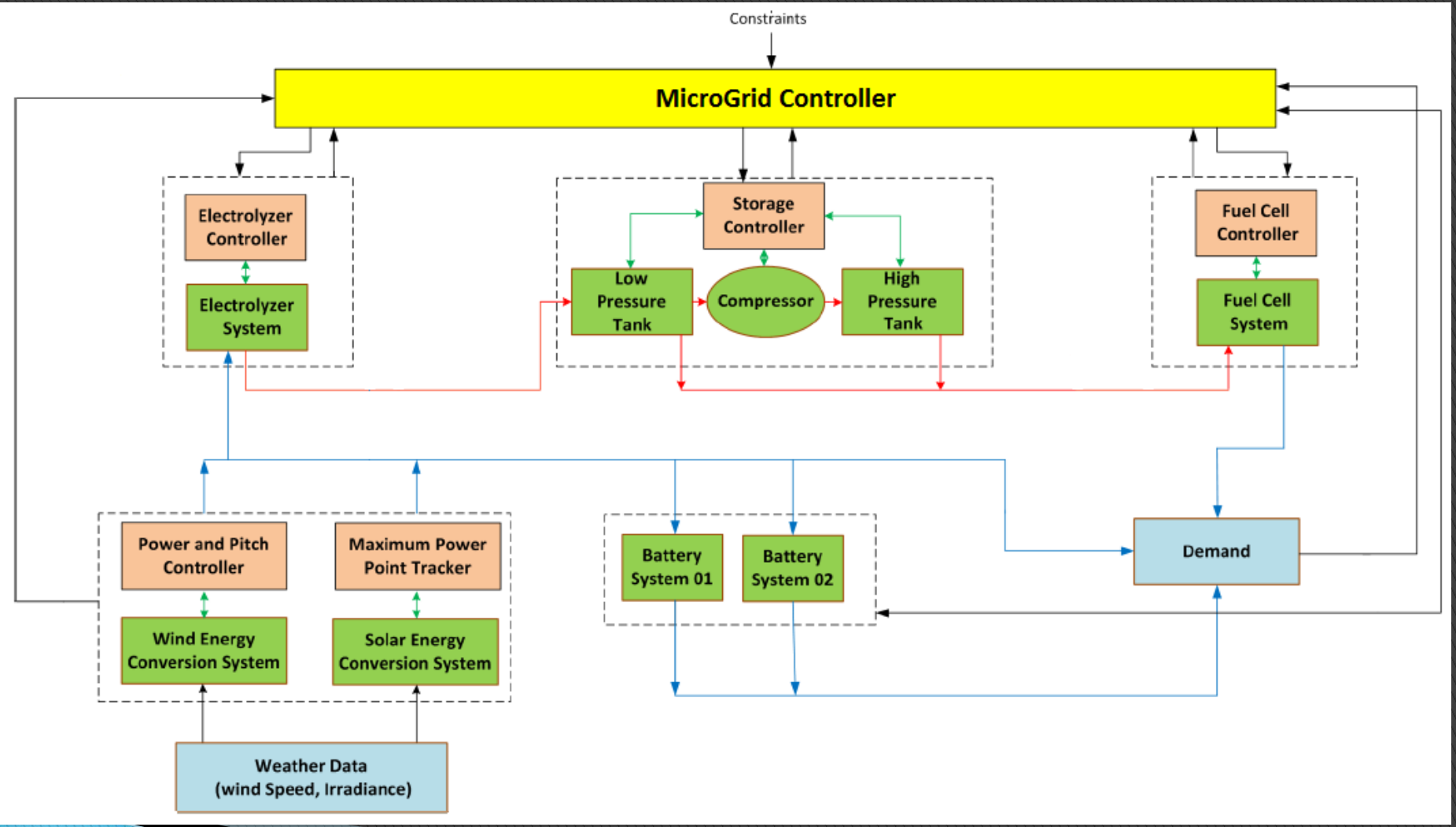


Applications

- Where Does it fit Today?
  - Smart Grid
    - Data Concentrators (AMI etc.),
    - MicroGrid Controllers,
    - Public Lighting,
    - Electric Vehicle Charging (And Billing)
    - Off-grid Generation,
    - Distribution Automation,
    - Demand Side Management
  - Building Automation
    - Home Automation dozen or so I/O – NO
    - Home Automation couple of dozen I/O per room – YES
  - Any General Process Control Application
  - Traditional SCADA Applications (Water, Telecoms, Gas, Electricity, etc.)



Example Application

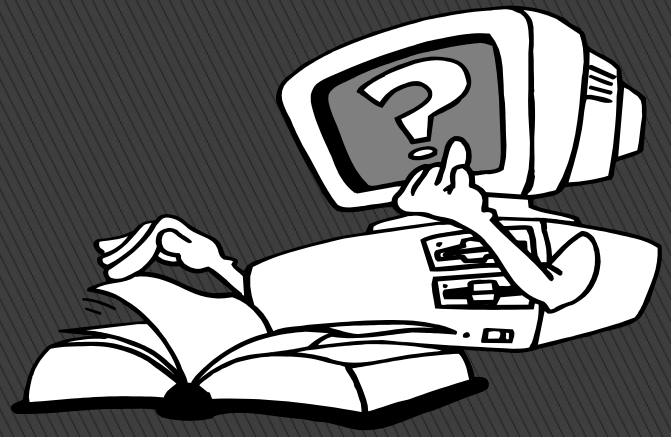


Data Delivery to Users

- Users Expect Data Delivered To Their Mobile Devices
- Other Industries Have Used This Technique For Years (Banks, Telecoms Etc.)
- Some Utilities Are Just Beginning To Realize The Value Of Sharing More Data With Consumers
- Better Provision Of Data Empowers Users

Things We Need To Take Seriously

- Cost
- Ease Of Use
- Ability to Customize
- Interoperability
- Cyber Security
- Data Presentation
- Reliability
- Platform Migration Capability
  - Allows us to embrace new technology
  - Avoids Vendor Lock-in

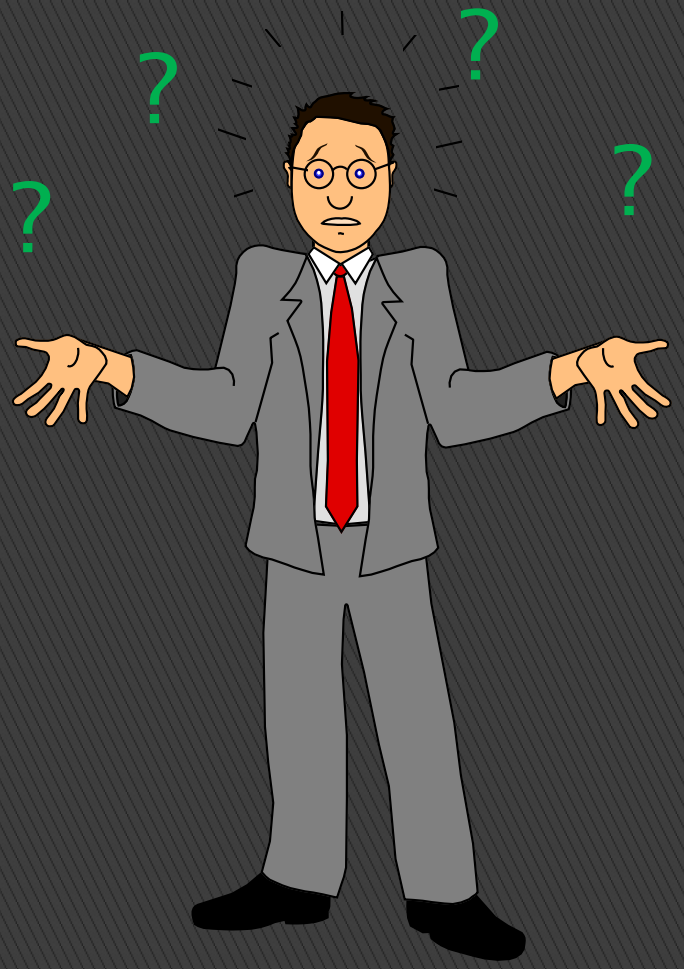


Conclusions

- Utilities Need To Plan For An Avalanche Of Data
- Getting The Pertinent *Information* Where It's Needed Takes A Lot Of Effort – But It Will Pay Dividends
- Only Move The Data You Need To When It's Required
- Leverage The Power Of Distributed Processing
- Critical Factors
  - Avoid Vendor Lock-in
  - Adopt Standards
  - Take Security Seriously
  - Take Privacy Seriously
  - Be Flexible In Systems Design And Implementation
  - Work With Experts And Industry Peers

Data Turned Into Pertinent Information is Valuable.
Empowering The Consumer Benefits The Utility

Thanks for Viewing

Any Questions / Comments Can Be Addressed To

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