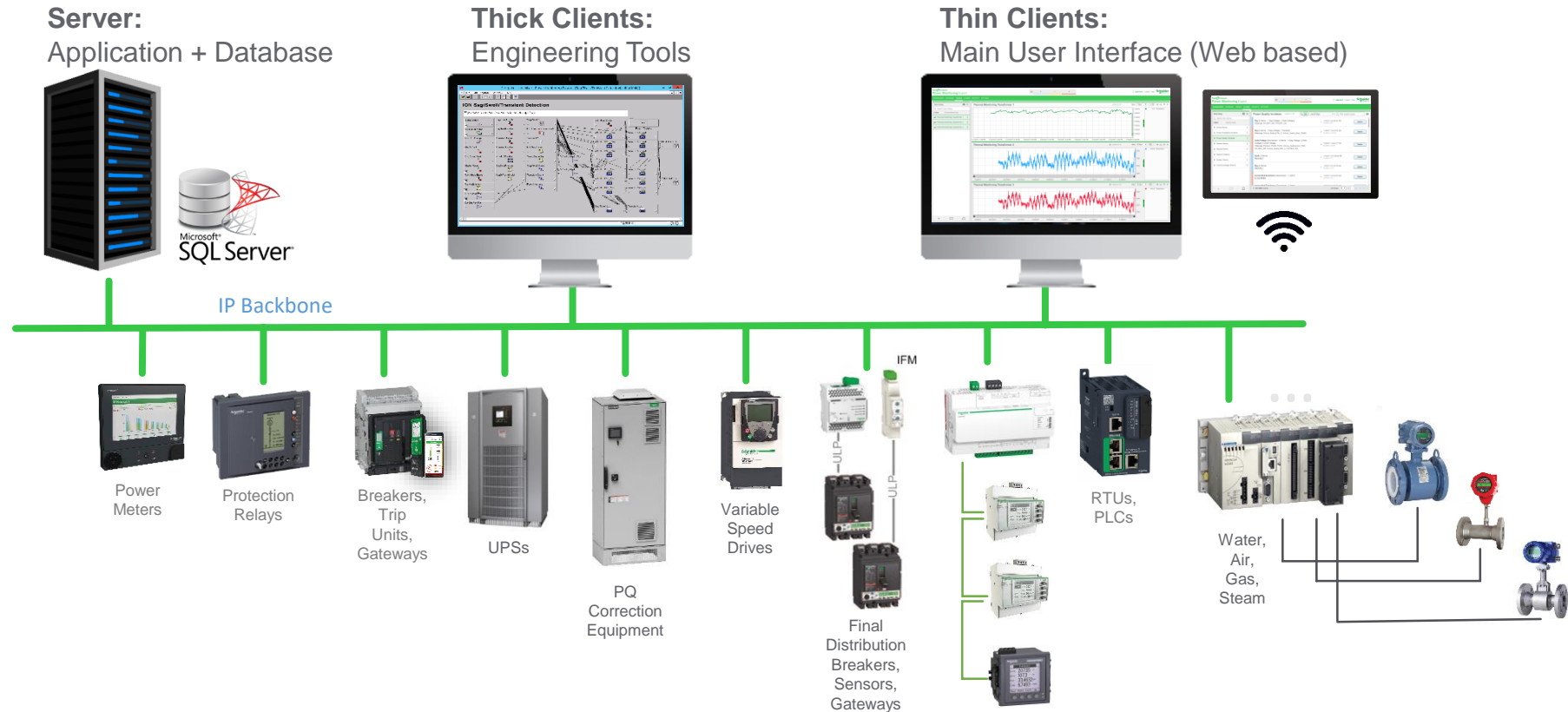


Power Monitoring Systems



➤ About US

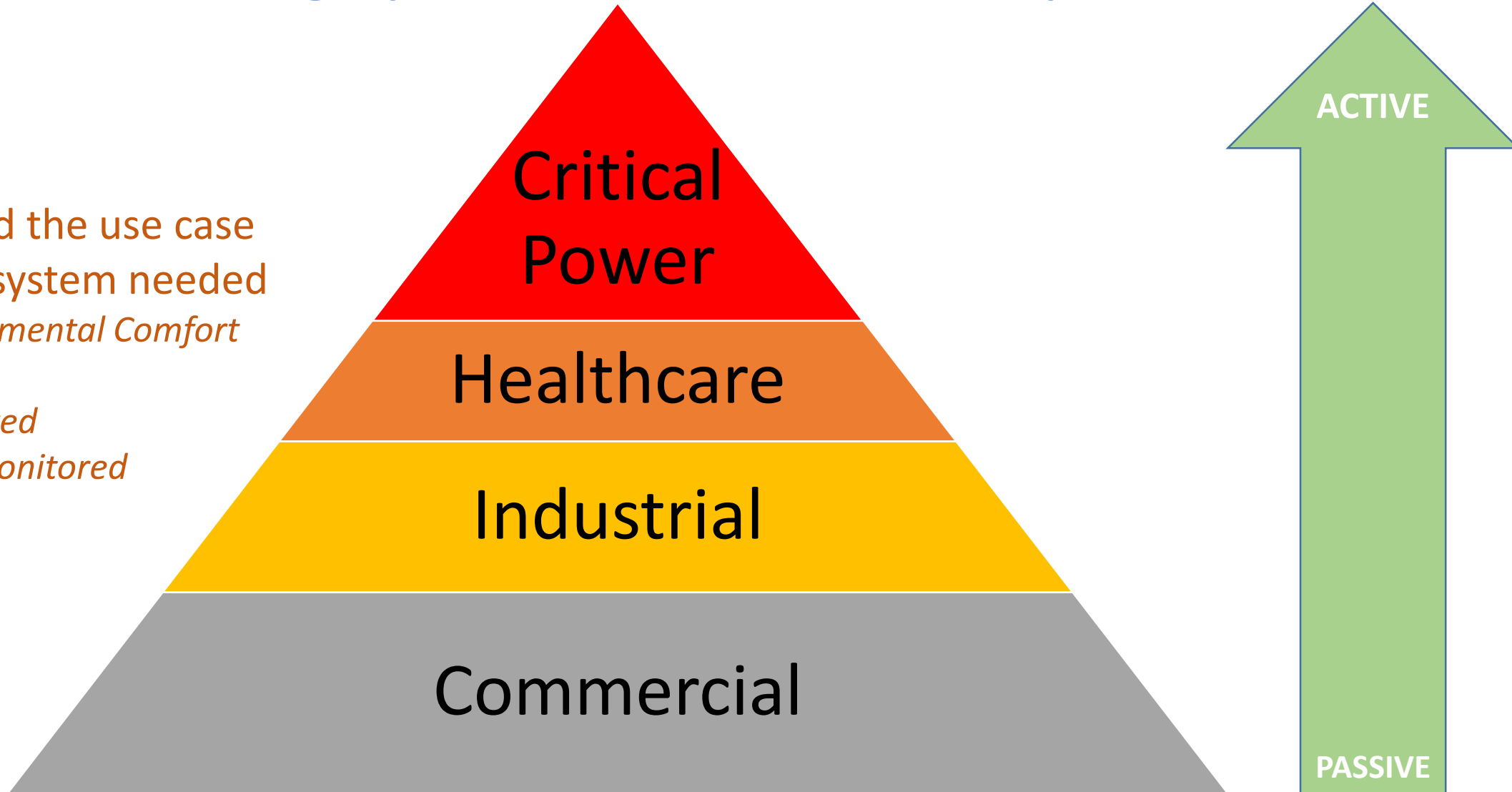
- Headquartered in Norcross, GA
- Founded in 2011 by Nabil Taha and Nasser Hamdan
- **Focused on providing PQ solutions and harmonic mitigation**
- Emphasis on the Data Center / Critical Power Industry
 - Successful implementation of dozens of DC's overall over a gigawatt total
- *2018- Currently have over 35 employees, and global offices in Netherlands, Singapore and Taiwan*

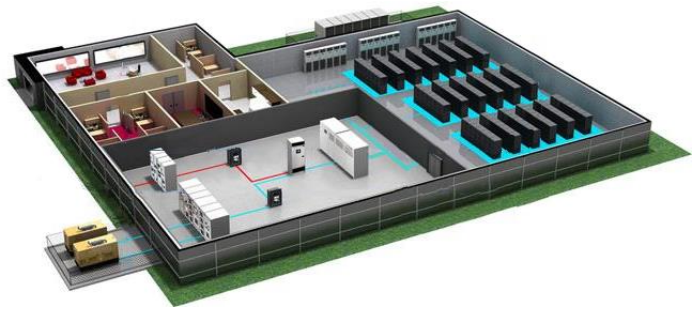


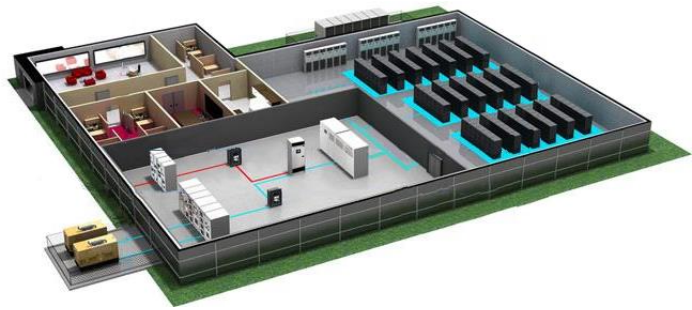
Not all monitoring systems are created equal...

The User and the use case defines the system needed

- *Environmental Comfort*
- *Safety*
- *Regulated*
- *24x7 Monitored*





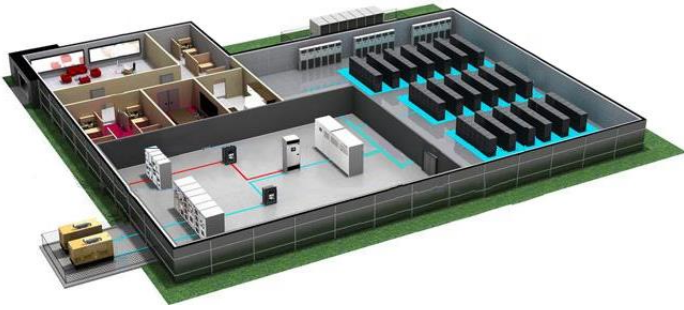


BMS

EPMS

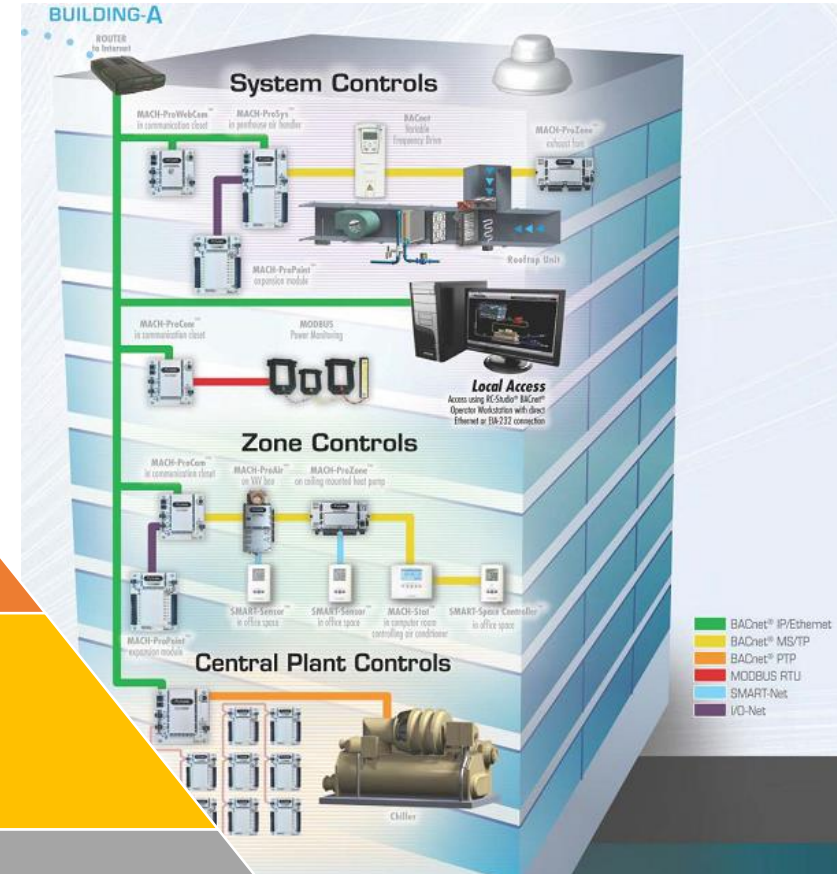
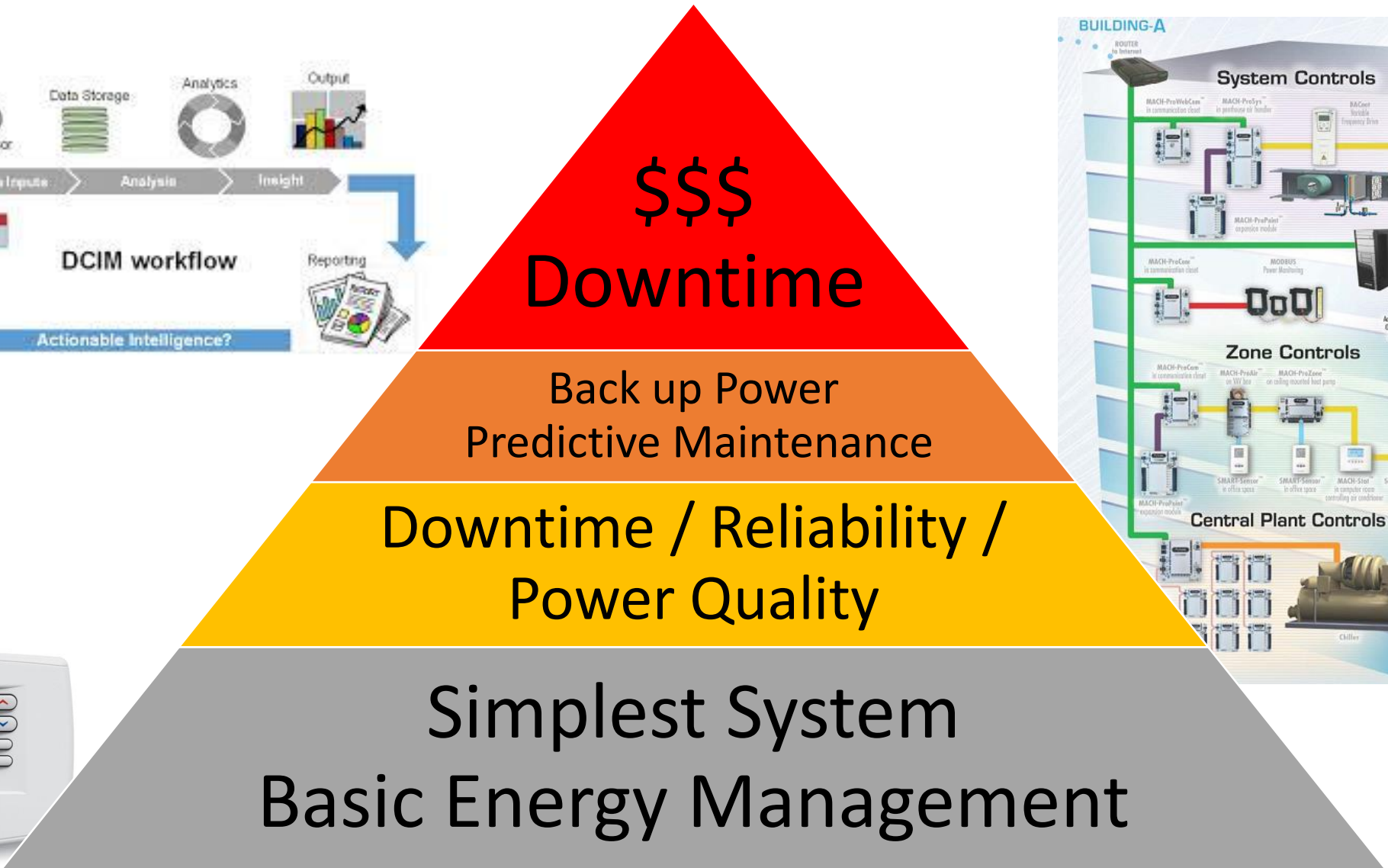
SCADA

DCIM



	BMS	EPMS	SCADA	DCIM
User Group	Operations, Engineering	Operations, Engineering	Operations, Engineering	IT Manager
Control	HVAC & Lighting Electrical Devices	Electrical Devices HVAC & Lighting	Process Automation Electrical Devices HVAC & Lighting	ePDU outlet control
Monitor/Alarm	HVAC, Lighting Electrical System Fire Alarm, Security	Electrical System All distribution Backup Power IT Power	Process Electrical System Environment	Server Floor Cooling/power /space
Alarm/Time Resolution	1 second	1 millisecond	1 millisecond	1 second

The Right Tool for the Job



Commercial

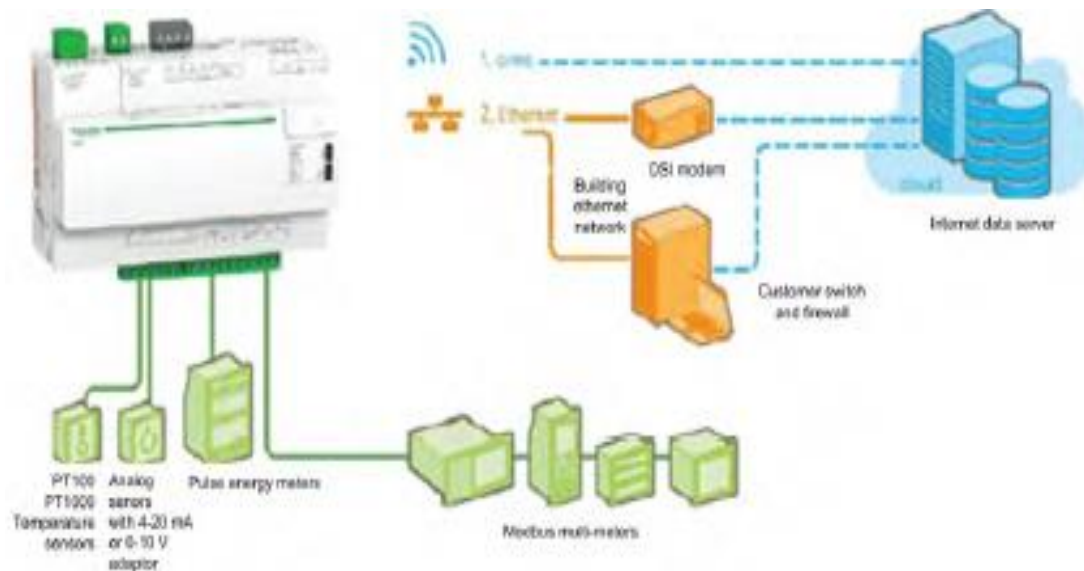
Commercial Buildings

- High rise, mixed use
- University or Campus
- Government Facilities

Typical use case

- Provide Comfort for the occupants
- Energy conservation and management – basic metering, tenant metering, cost allocation
- Power quality and sequence of events not a priority

Solution / Needs – kwhr – Led by BMS – lesser need for stand-alone EPMS – except in cases where cost allocation of energy usage is required (University Campus / Higher Education)



Industrial

Typical use cases

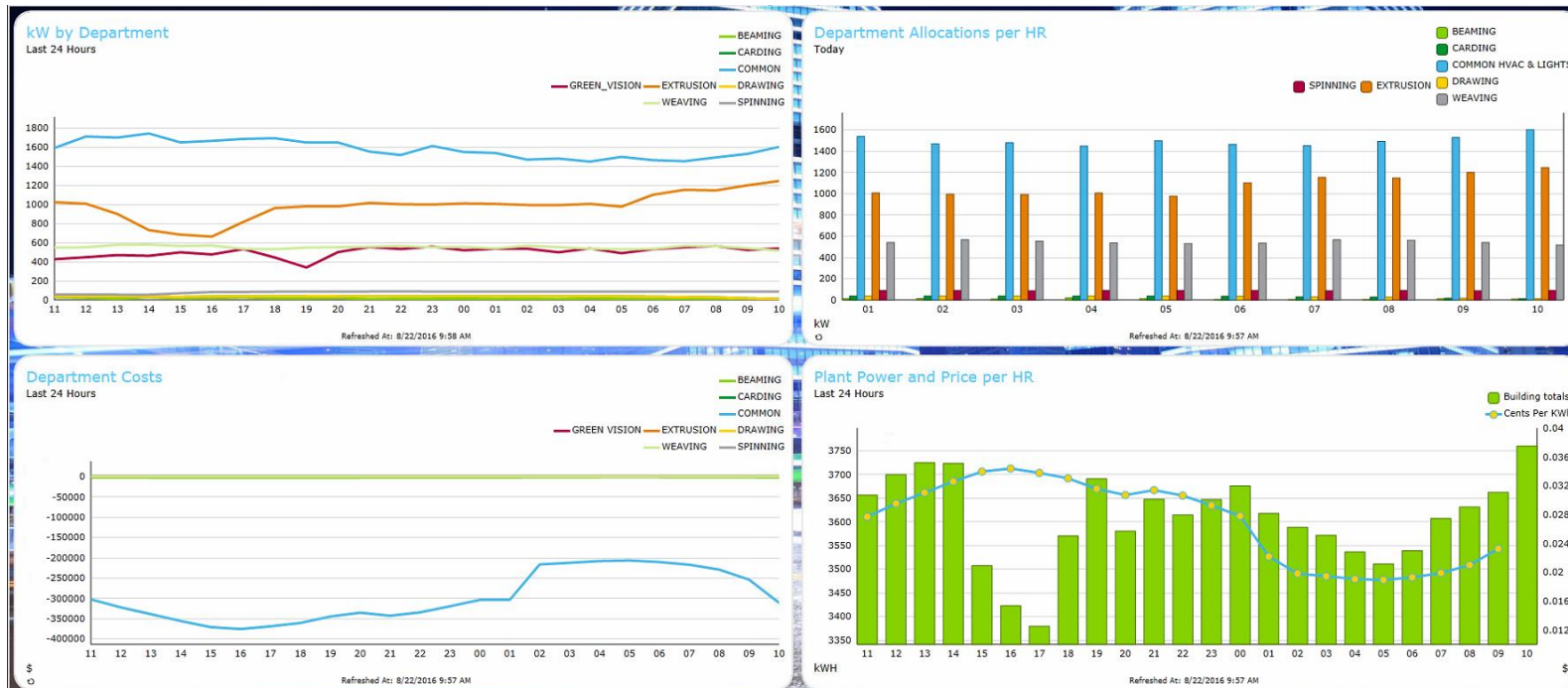
- **Downtime avoidance**
- Power Quality mitigation via active front end drives or stand alone harmonic filters
- **Electrical Distribution System reliability**
- Maintenance of system
- **Sequence of events in cases of unexpected outages**
- Power management – basic and advanced metering, cost allocation, PQ Analysis



Industrial

Typical use cases

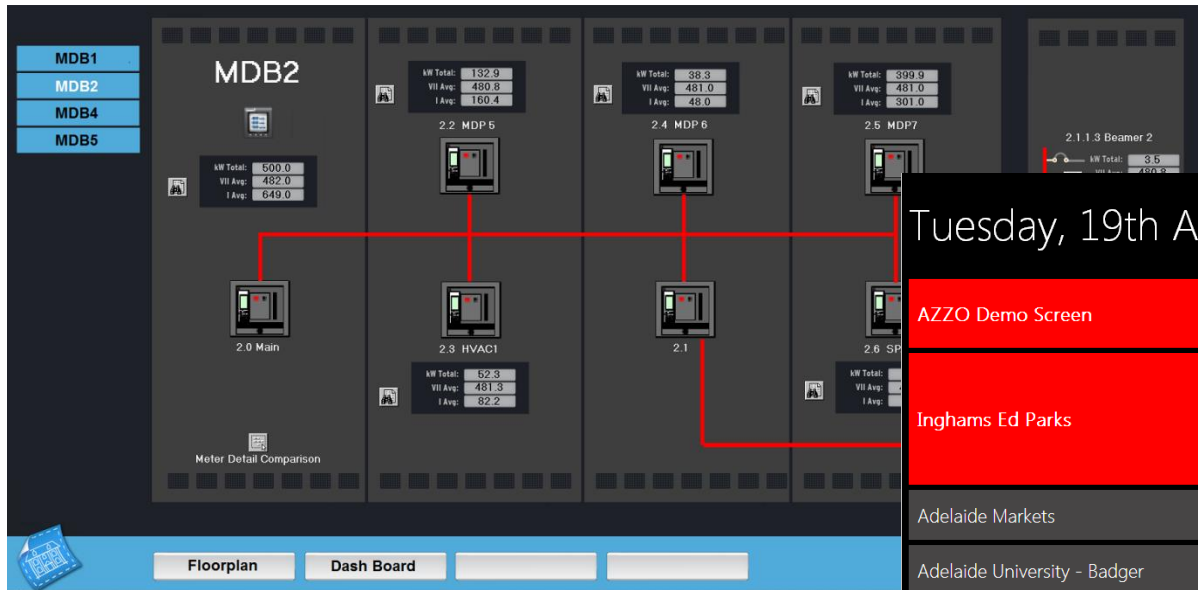
- Shadow Billing of Utility
- **Building Management systems not the primary system**
- Process Control Systems and data historians become more important
- **Internal Cost allocation**
- Integration via software – OPC or via multiple connections to the same device



Industrial

Typical use cases

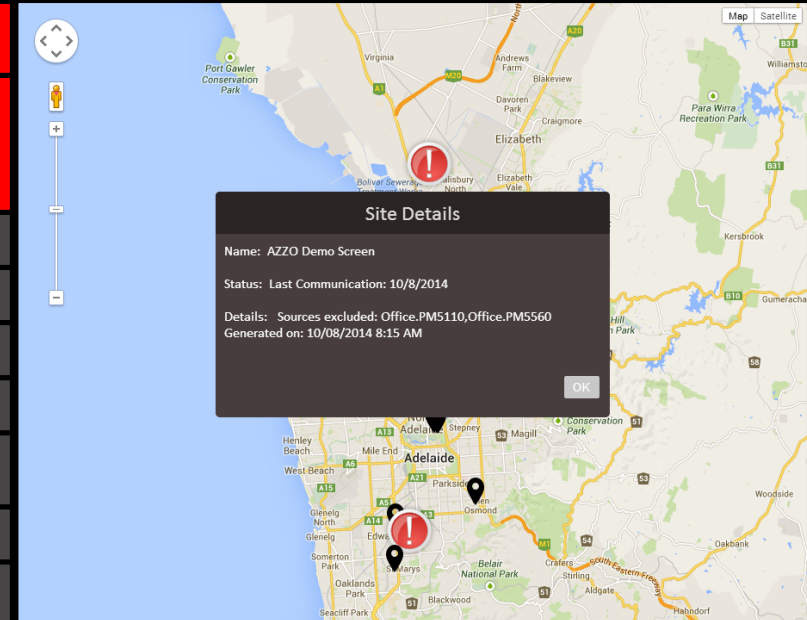
- Remote electrical system analysis
- Remote software system diagnostics



Tuesday, 19th August

☁️ 13°C, Adelaide, Mostly Cloudy, SSW 12.87 km/h

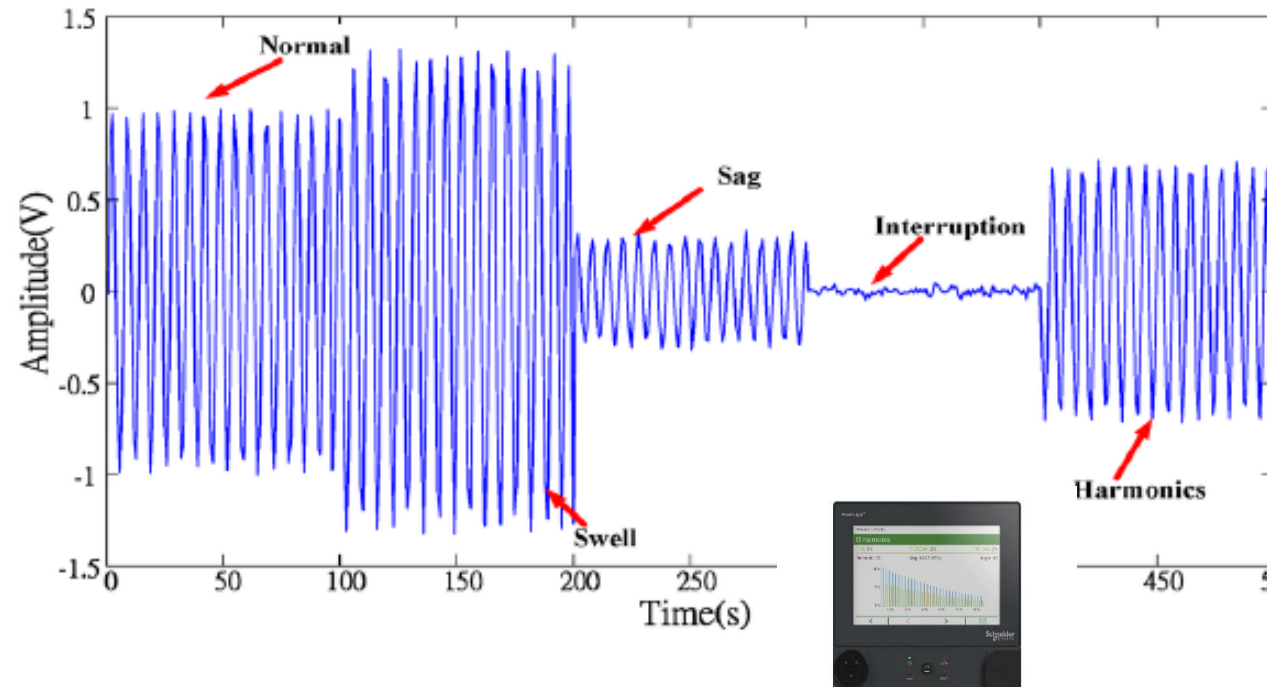
AZZO Demo Screen	Last Communication: 10/8/2014	Sources excluded: Office.PM5110,Office.PM5560 Generated on: 10/08/2014 8:15 AM
Inghams Ed Parks	System Diagnostic Failed	Source Portable ION7330 last log recorded at: 18/08/2014 12:15:00 AM (915 minutes ago). Source enabled: YES Site Portable ION7330 status is: Disconnected Sources excluded: No Exclusions Generated on: 19/08/2014 1:00 AM
Adelaide Markets	System Diagnostic Successful	Sources excluded: No Exclusions Generated on: 18/08/2014 4:30 PM
Adelaide University - Badger	System Diagnostic Successful	Sources excluded: No Exclusions Generated on: 18/08/2014 4:30 PM
Adelaide University - Barr Smith	System Diagnostic Successful	Sources excluded: No Exclusions Generated on: 18/08/2014 4:30 PM
Adelaide University - Hartley	System Diagnostic Successful	Sources excluded: No Exclusions Generated on: 18/08/2014 4:30 PM
Adelaide University - Horace Lamb	System Diagnostic Successful	Sources excluded: No Exclusions Generated on: 18/08/2014 4:30 PM
Adelaide University - Hub Central	System Diagnostic Successful	Sources excluded: No Exclusions Generated on: 18/08/2014 4:30 PM
Adelaide University - Ingharni Wardli	System Diagnostic Successful	Sources excluded: No Exclusions Generated on: 18/08/2014 4:30 PM



Healthcare

Typical use cases

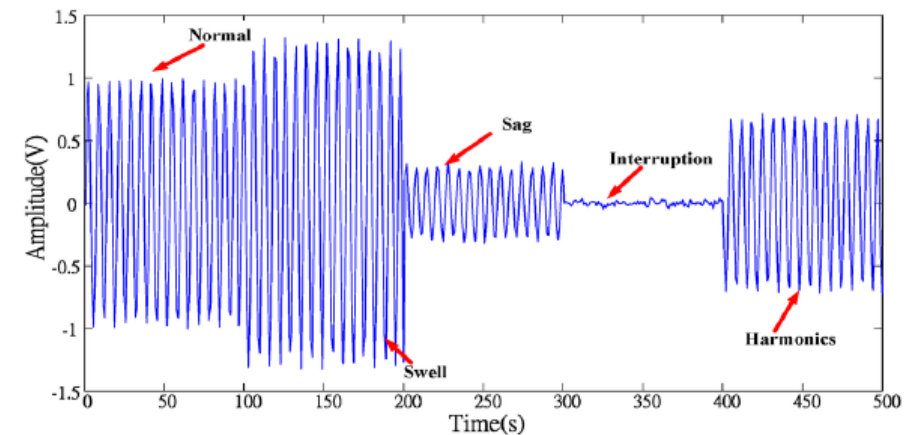
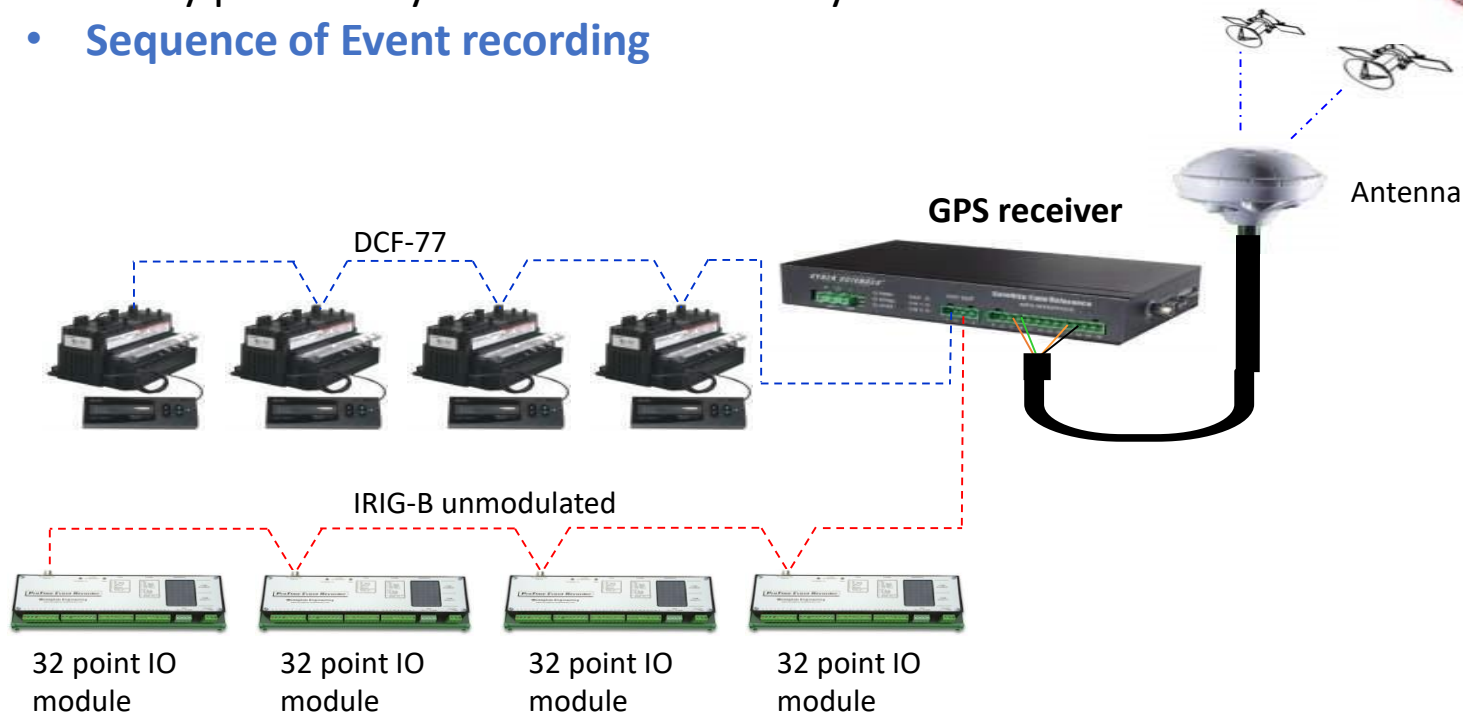
- Downtime avoidance
- **Power Quality mitigation for sensitive electronic equipment**
- Electrical Distribution System reliability
- **Generator Testing – Joint Commission Reporting**
- Power management – basic and advanced metering, cost allocation, PQ Analysis



Healthcare

Typical use cases

- Internal Cost allocation
- Building Management Systems more important
- **Integration of BMS and EPMS can be compelling**
- More complex mechanical systems, including chiller plants may warrant stand-alone systems or integration of key points only from the electrical system to the BMS
- **Sequence of Event recording**



Critical Power

Data Centers

Typical use cases

- **Complex electrical distribution systems**
- Complex mechanical systems, chiller plants, air handling units
- **Generator / Back up system testing**
- Power Quality mitigation for sensitive electronic equipment
- **Critical to commission accurately and comprehensively**
- Electrical Distribution System reliability
- Power management – basic and advanced metering, cost allocation, PQ Analysis
- IEC 61850 for protection and control



Critical Power

Typical use cases

- Multiple systems fire, building management, critical building management
- Less likely to integrate systems into 1 system
- **PQ Analysis**
- More likely to have an external data collection system for analysis and AI
- **Sequence of Event recording, 1ms time stamping**

Power Monitoring Expert

48 16 17 6,914

DASHBOARDS DIAGRAMS TABLES TRENDS ALARMS REPORTS PQ ADVISOR

supervisor | Logout | Settings | Help

Power Quality Advisor

Equipment

Power Quality Advisor - Voltage Sag

DETAILS

Number of Events	Time Period			
	Last 24 Hours	Last 7 Days	Last 30 Days	Last 12 Months
No Impact	0	4	13	173
Potential Impact	0	3	7	56
Internal	0	6	9	40
External	0	0	8	67
Undetermined	0	1	3	122
Detail Report				

DESCRIPTION

Summary
Decrease in voltage magnitude

Magnitude
90% to 10% of nominal voltage (typical)

Source
Utility or large motors starting

Duration
½ cycle to 1 minute

Consequence
Malfunction or downtime

Mitigation Devices
- Uninterruptible Power Supply (UPS)
- Dynamic Voltage Restorer

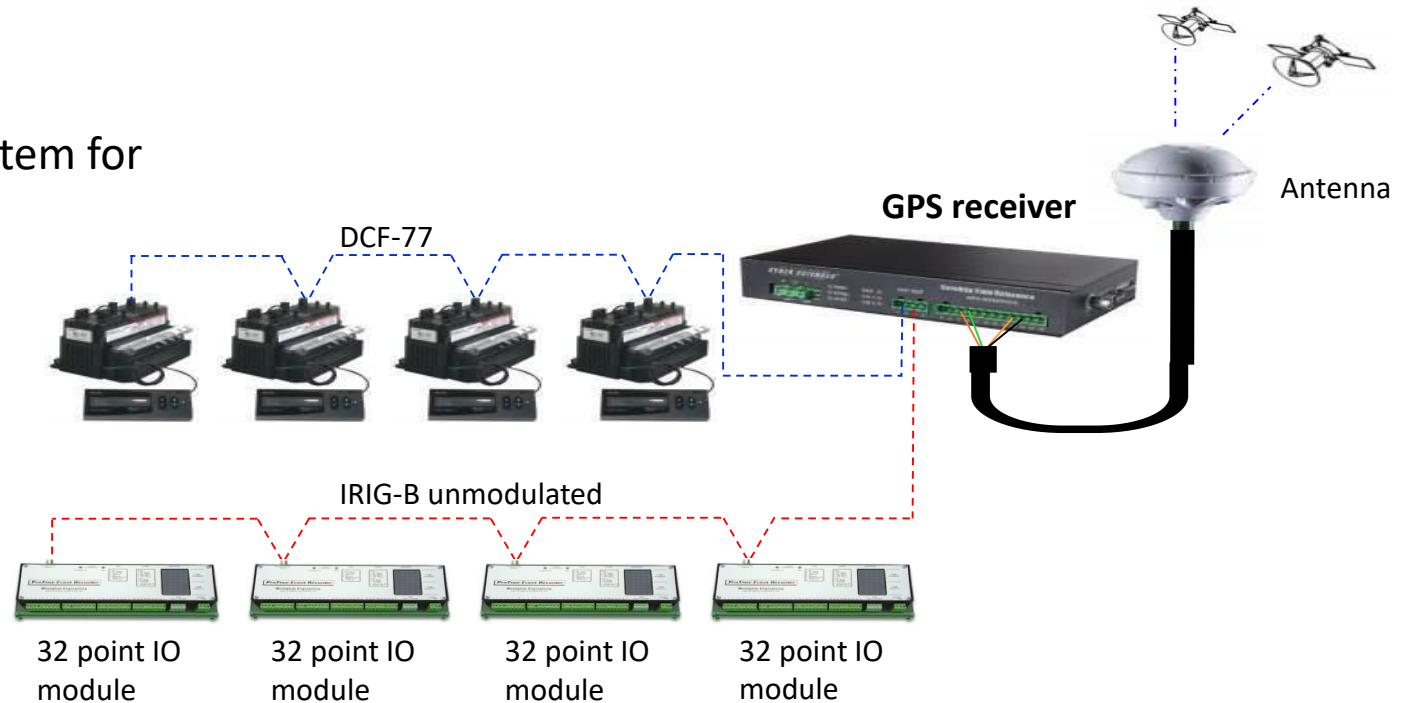
Occurrence
Average 50 to 90 events/year

POTENTIAL IMPACTS

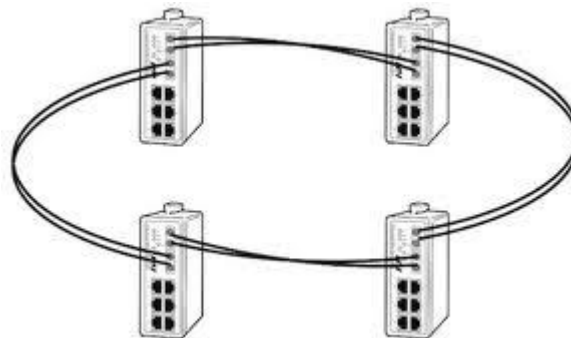
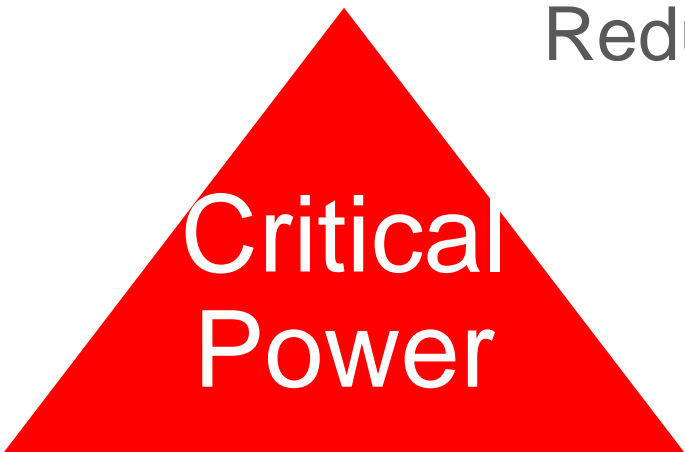
- Equipment damage
- Data corruption
- Errors in industrial process

RESOURCES

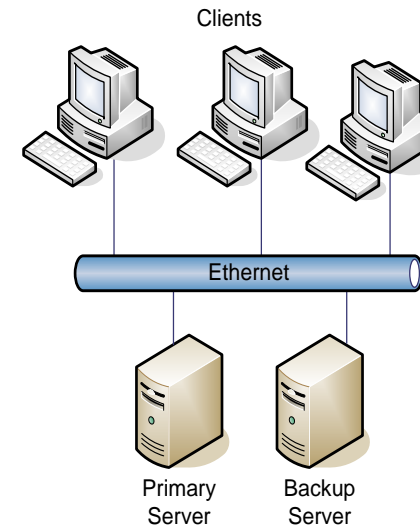
[> Learn More](#)
Solutions, Documentation and Contact Information



Redundancy



Ethernet Ring



Hot Standby Servers

>Servers / Software

- Primary and backup servers in a 'hot standby' configuration

>Network

- Redundant Ethernet ring topology

>PLC

- Hot standby PLCs for automatic transfer applications



Hot Standby PLC

Data Centers

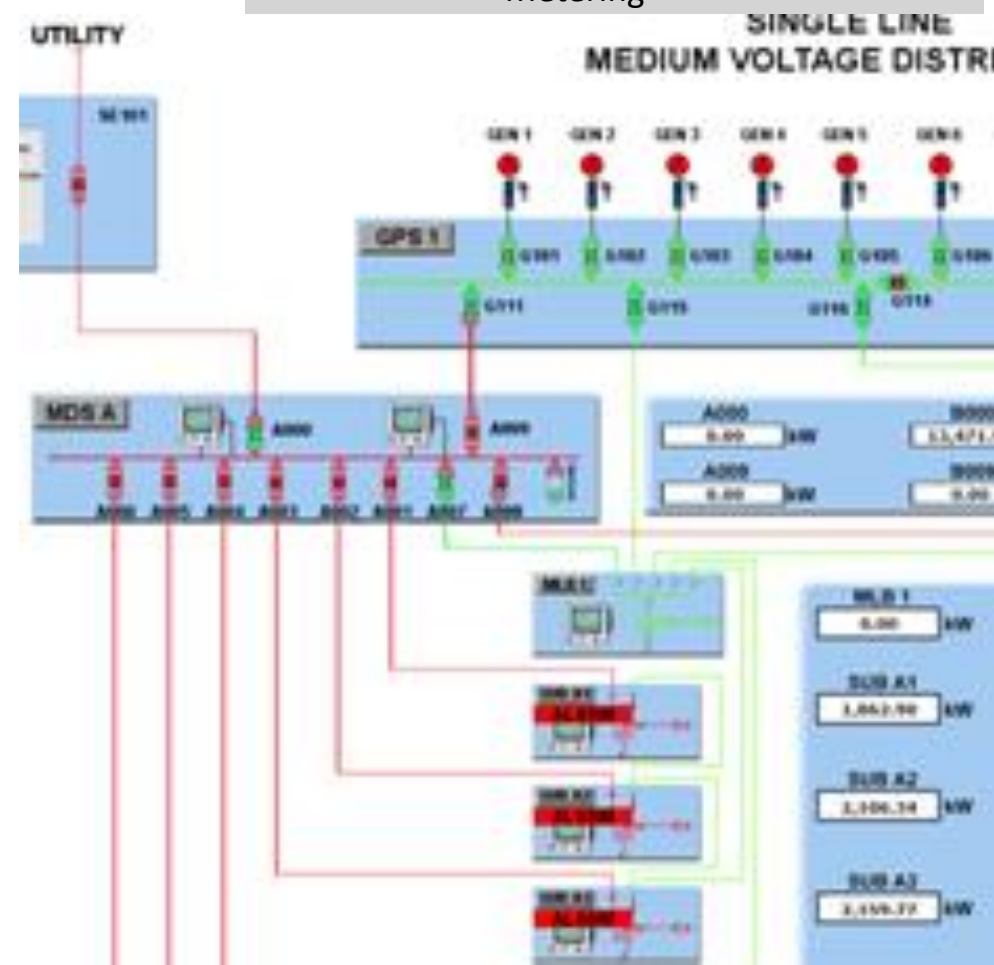
Critical Power

Typical use cases

- **Commissioning** – integral part of the project
- Validate the complex back-up distribution systems
- Utilize the EPMS to make sure everything operates correctly
- Able to view the whole system

System Verification

- Real Time Status
- Before and after
- Breaker status
- Generator status
- Voltage status
- Load status
- Metering



EPMS Commissioning - Cx

Shifting Priorities – changing trends

- Testing at equipment builders – integrators and electrical manufacturers
- Testing with load
- Validation
- More important to have EPMS integration early in the process

Enhanced Documentation and Reporting: Sequence of Events Logs

Document:

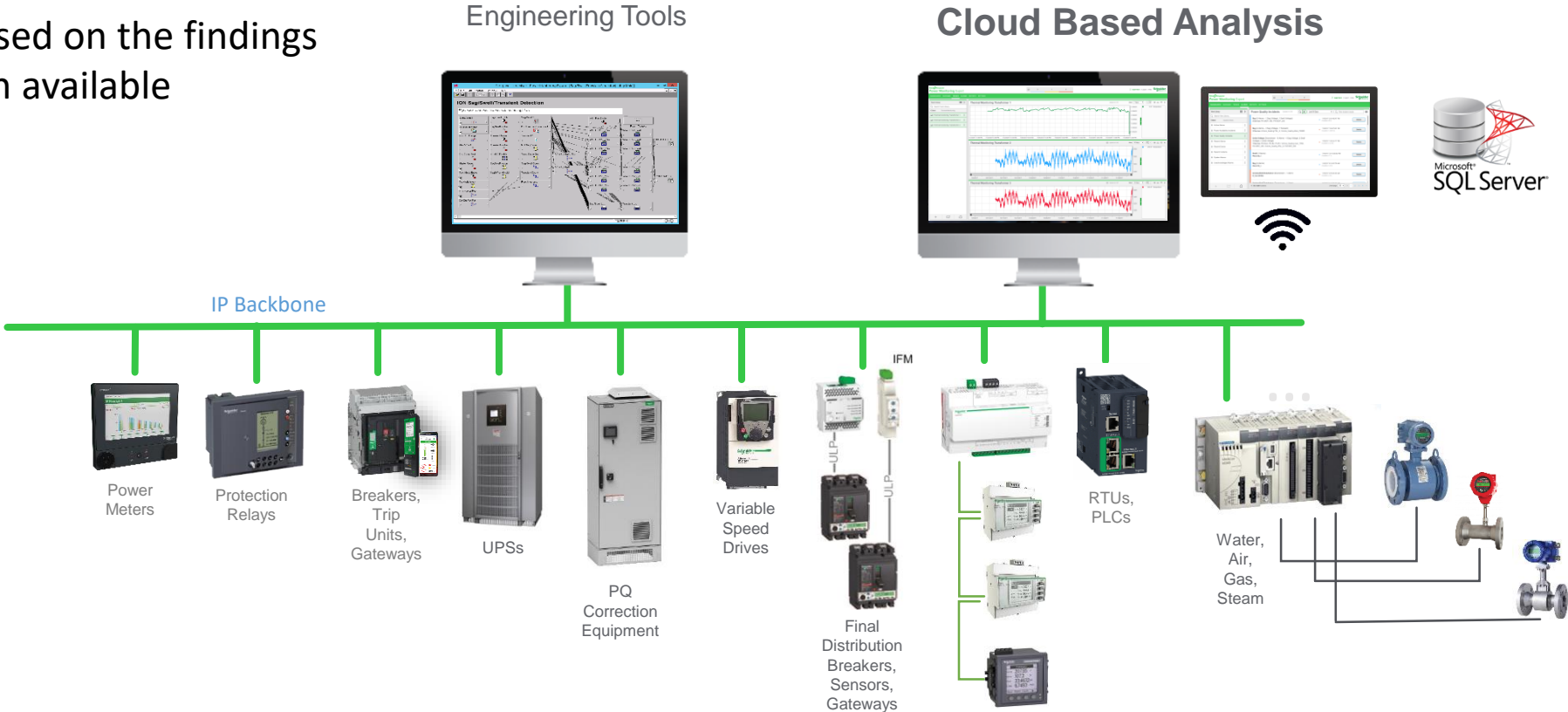
- Response to utility outages
- Generator transfers
- UPS system transfers
- ATS operations
- Switching procedures
- Maintenance procedures

timestamp	node	priority	cause_idn	cause_value	effect_idn	effect_value
09/03/2008 16:37:19.300	FMDCA_2_J	131	BD_A-24-4 OC	CLOSED	BD_A-24-4 OC	NORMAL
09/03/2008 16:37:19.300	FMDCA_2_J	131	BD_A-24-3 OC	CLOSED	BD_A-24-3 OC	NORMAL
09/03/2008 16:37:19.300	FMDCA_2_J	131	BD_A-24-1 OC	CLOSED	BD_A-24-1 OC	NORMAL
09/03/2008 16:37:19.300	FMDCA_2_J	131	BD_A-24-2 OC	CLOSED	BD_A-24-2 OC	NORMAL
09/03/2008 16:37:19.305	FMDCA_2_J	202	GEN_ROY_TO_LOAD	External	GEN_ROY_TO_LOAD	I/O Expander Attached
09/03/2008 16:37:07.967	FMDCA_2_J	180	GEN_CMD_ALARM	NOT Ready	GEN_CMD_ALARM	RESET
09/03/2008 16:37:07.967	FMDCA_2_J	180	GEN_CMD_SHOWN	OK	GEN_CMD_ALARM	RESET
09/03/2008 16:37:07.967	FMDCA_2_J	202	UTIL_BKR_Trip	NORMAL	UTIL_BKR_Trip	RESET
09/03/2008 16:37:07.967	FMDCA_2_J	131	GEN_BRKR_OC	OPEN	GEN_BRKR_OC	NORMAL
09/03/2008 16:37:07.967	FMDCA_2_J	202	GEN_BRKR_Trip	NORMAL	GEN_BRKR_Trip	RESET
09/03/2008 16:37:07.959	FMDCA_2_J	131	BD_A-24-4 OC	OPEN	BD_A-24-4 OC	ABNORMAL
09/03/2008 16:37:07.959	FMDCA_2_J	131	BD_A-24-3 OC	OPEN	BD_A-24-3 OC	ABNORMAL
09/03/2008 16:37:07.959	FMDCA_2_J	131	BD_A-24-1 OC	OPEN	BD_A-24-1 OC	ABNORMAL
09/03/2008 16:37:07.959	FMDCA_2_J	180	GEN_ROY_TO_LOAD	ROY To Load	GEN_ROY_TO_LOAD	ALARM
09/03/2008 16:37:07.959	FMDCA_2_J	180	GEN_CMD_ALARM	ALARM	GEN_CMD_ALARM	ALARM
09/03/2008 16:37:07.959	FMDCA_2_J	180	GEN_CMD_SHOWN	Shutdown	GEN_CMD_SHOWN	ALARM
09/03/2008 16:37:07.959	FMDCA_2_J	202	UTIL_BKR_Trip	TRIPPED	UTIL_BKR_Trip	ALARM
09/03/2008 16:37:07.959	FMDCA_2_J	131	GEN_BRKR_OC	CLOSED	GEN_BRKR_OC	ABNORMAL
09/03/2008 16:37:07.959	FMDCA_2_J	202	GEN_BRKR_Trip	TRIPPED	GEN_BRKR_Trip	ALARM
09/03/2008 16:37:07.959	FMDCA_2_J	131	BD_A-24-4 OC	OPEN	BD_A-24-4 OC	ABNORMAL
09/03/2008 16:37:02.595	FMDCA_2_J	255	Diagnosics 1	Recovered Error	ION 9610	452
09/03/2008 16:36:55.488	FMDCA_2_J	255	Diagnosics 1	Recovered Error	ION 9610	54608
09/03/2008 15:44:31.711	FMDCA_2_J	200	V3	Transient Detected	TRI TranV3Max	158
09/03/2008 15:44:31.711	FMDCA_2_J	200	V2	Transient Detected	TRI TranV2Max	158
09/03/2008 15:26:17.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL
09/03/2008 04:36:12.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
09/03/2008 03:52:24.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL
09/03/2008 03:51:45.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
09/03/2008 03:51:04.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL
09/03/2008 03:53:17.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
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09/03/2008 03:18:20.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL
09/03/2008 03:17:22.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
09/03/2008 03:16:42.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL
09/03/2008 03:16:00.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
09/03/2008 03:13:27.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL
09/03/2008 00:19:37.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
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09/03/2008 00:10:42.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
09/02/2008 23:55:07.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL
09/02/2008 23:34:52.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	OFF	A-2-e-2-39	ABNORMAL
09/02/2008 23:32:32.000	VIP.PMSPRIMARY	151	Input 55@TVSS_IO_Panel_1	ON	A-2-e-2-39	NORMAL

Remote Analysis and Commissioning Support

Typical use cases

- **Upload historical data to the cloud for analysis**
- Determine wiring issues
- Metering issues
- Communication issues
- Generate a report based on the findings
- Offline data collection available
- E-mail



Dashboard Only



Wonderware
Historian

EcoStruxure
Innovation At Every Level **Building**



ETL



EcoStruxure
Power Monitoring Expert
v9.0



3rd party



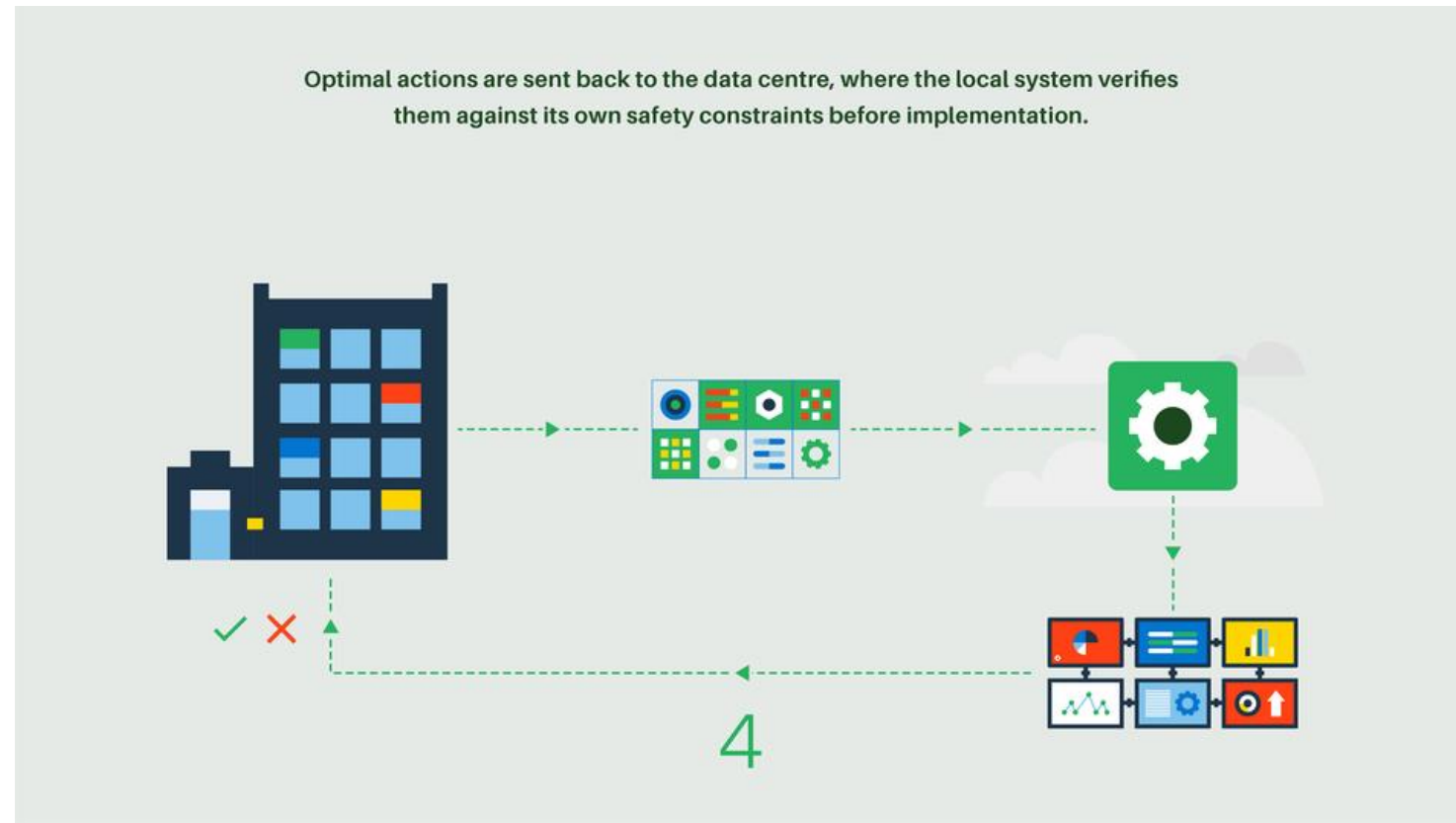
M/C Learning - Remote Analysis

Google is Switching to a Self-Driving Data Center Management System

Google spokesperson said the fully automated version saves 30 percent of energy annually, with more savings expected in the future.



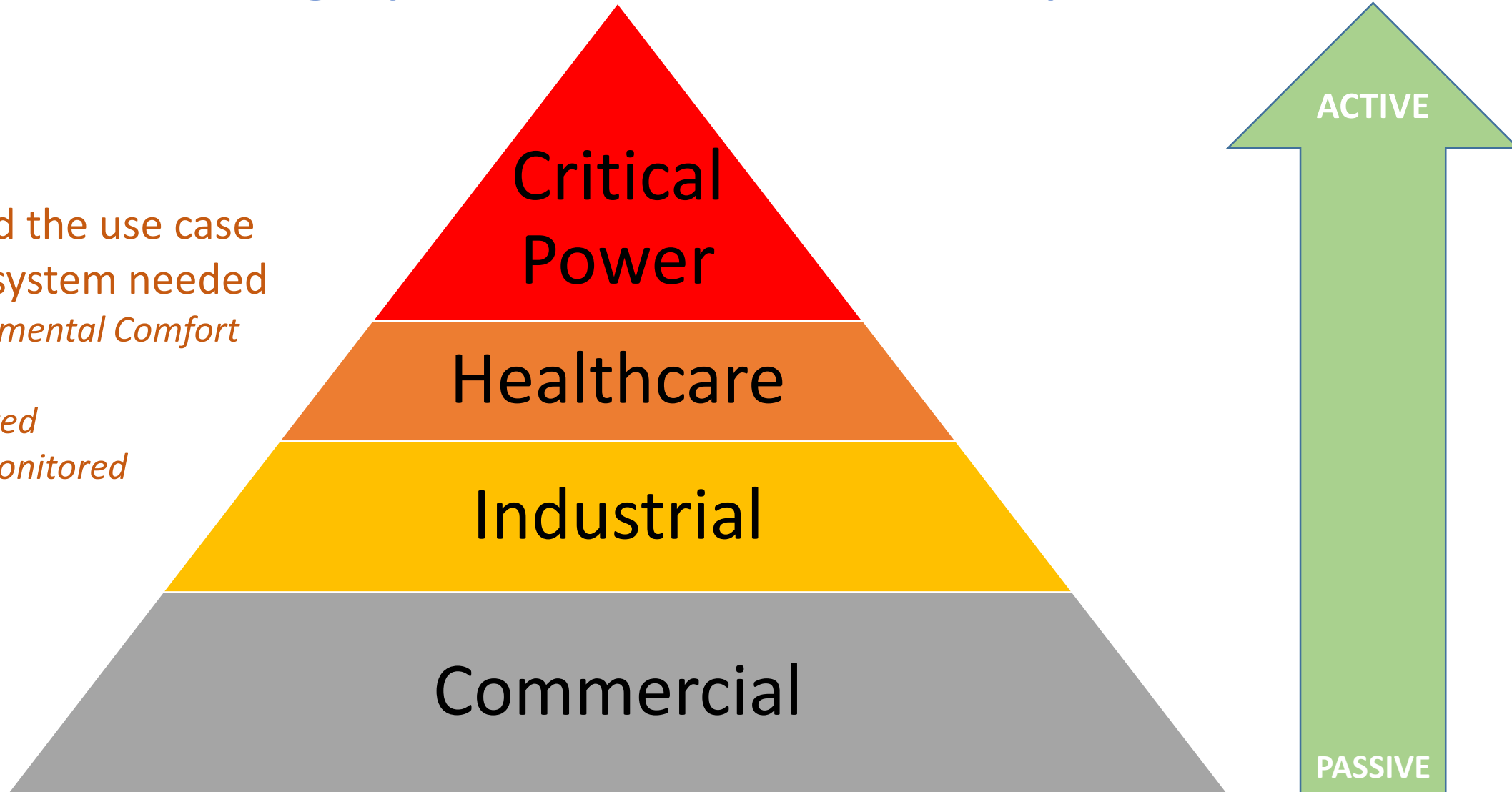
“Now we’re taking this system to the next level: instead of human-implemented recommendations, our **AI system is directly controlling data centre cooling**, while remaining under the expert supervision of our data centre operators. This first-of-its-kind cloud-based control system is now safely delivering energy savings in multiple Google data centres.” from Deep mind website



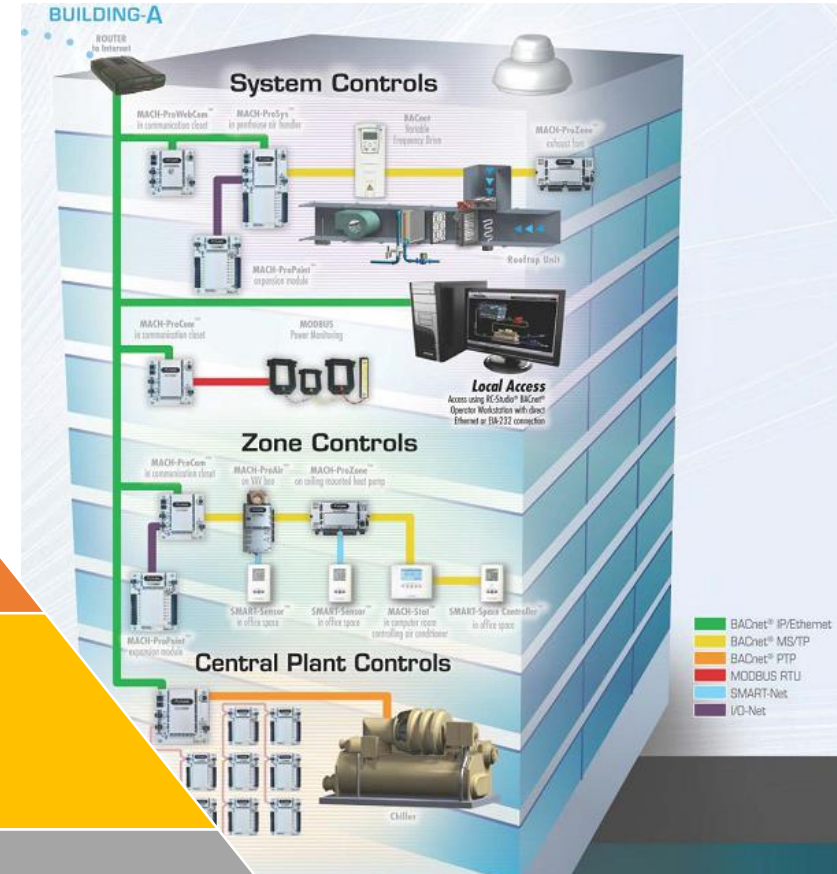
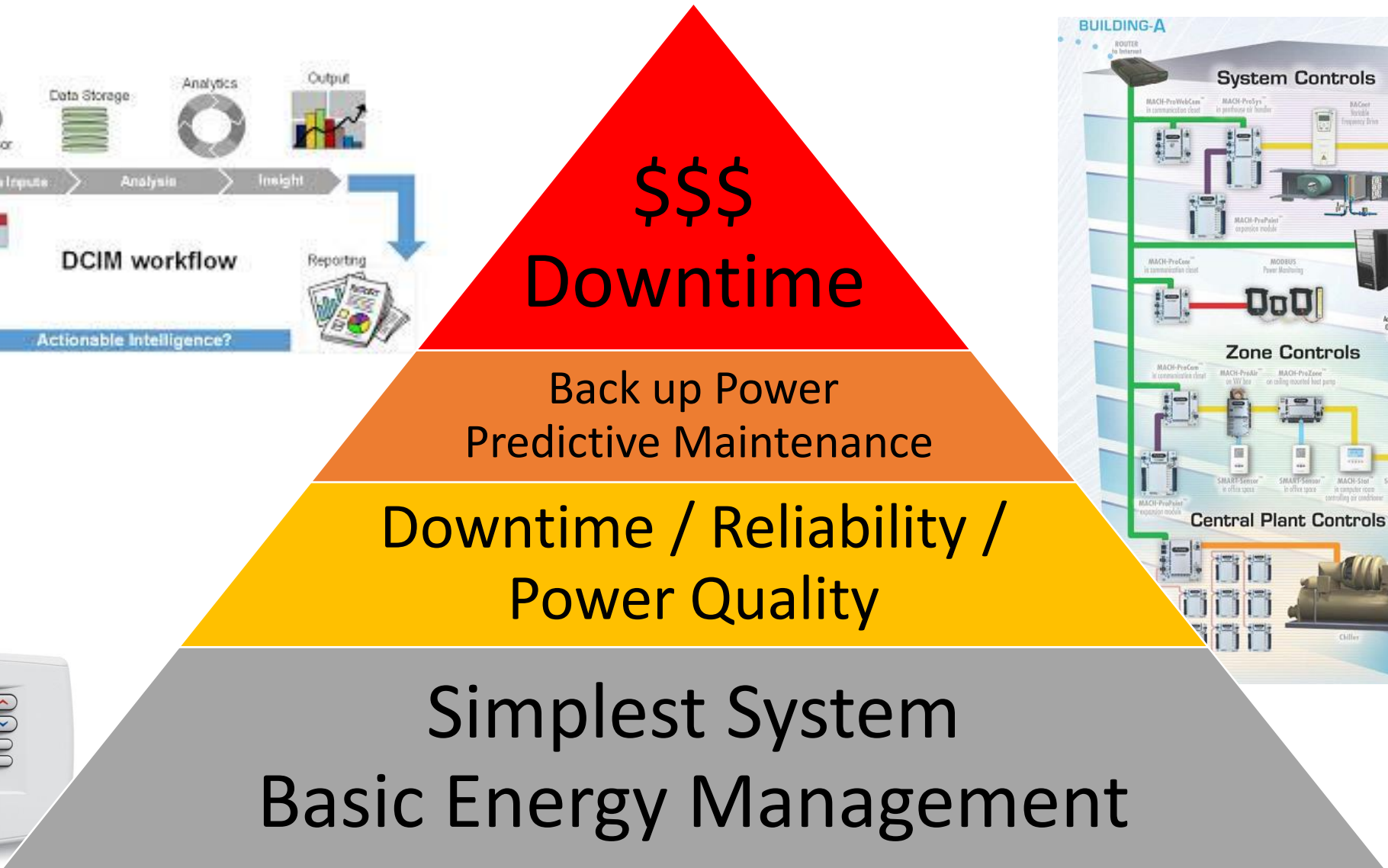
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- *Safety*
- *Regulated*
- *24x7 Monitored*



The Right Tool for the Job



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