Building Automation System, Chiller Plant Management and Data Analytics

ASHRAE INDIA CHAPTER

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SSS CONSULTANTS

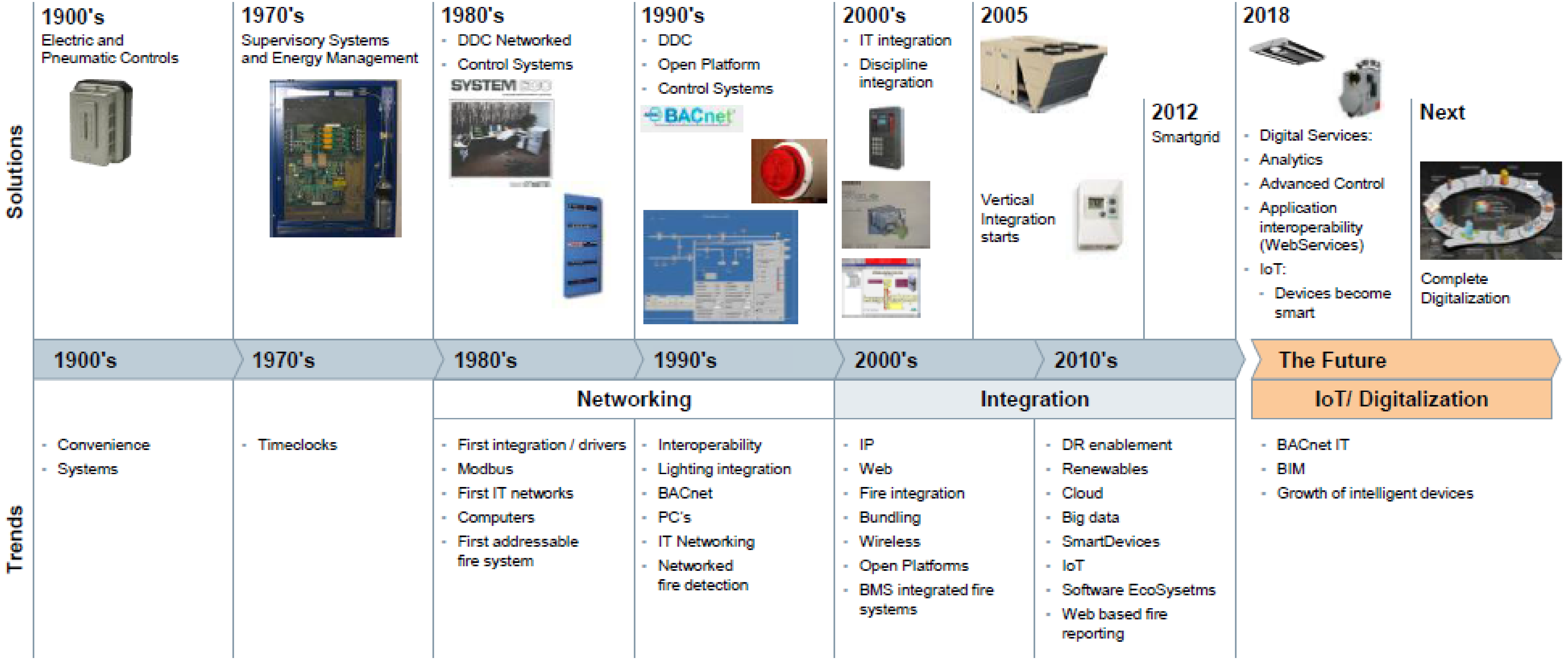
HVAC – IBMS – GREEN Buildings

Sustainability – Strategies - Solutions

Agenda

- What is a BMS and What does it do ?
- BMS Architecture for Integrating Building Services
- BMS Functionality
- MEP services integration
- Air Handling Unit, VAV Integration, Chiller Plant Management
- Data Analytics for performance improvements
- Summary

Journey towards Smarter Buildings through Digitalization



What is BMS

- Energy management systems
  - HVAC System
    - **Chiller Plant Control**
    - **AHU & VAV System Control**
  - Electrical Systems
  - PHE Systems
  - Lighting Control Systems
  - BTU Metering, Energy Metering, Tenant Billing
  - Electrical Power Monitoring System (EPMS)
- Fire, life safety systems
  - Fire detection systems
  - Access control systems
  - CCTV systems

BMS

HVAC

- Chillers/Heat Pumps
- Air Handling Units
- VAV Systems
- VRF Systems
- Precision ACs
- Ventilation & Exhaust
- Kitchen Exhaust
- BTU Metering
- Tenant Billing

Electrical

- Energy Metering
- Elevators
- HT/LT Panels
- Transformers
- EPMS
- Lighting Management
- UPS & Battery

PHE

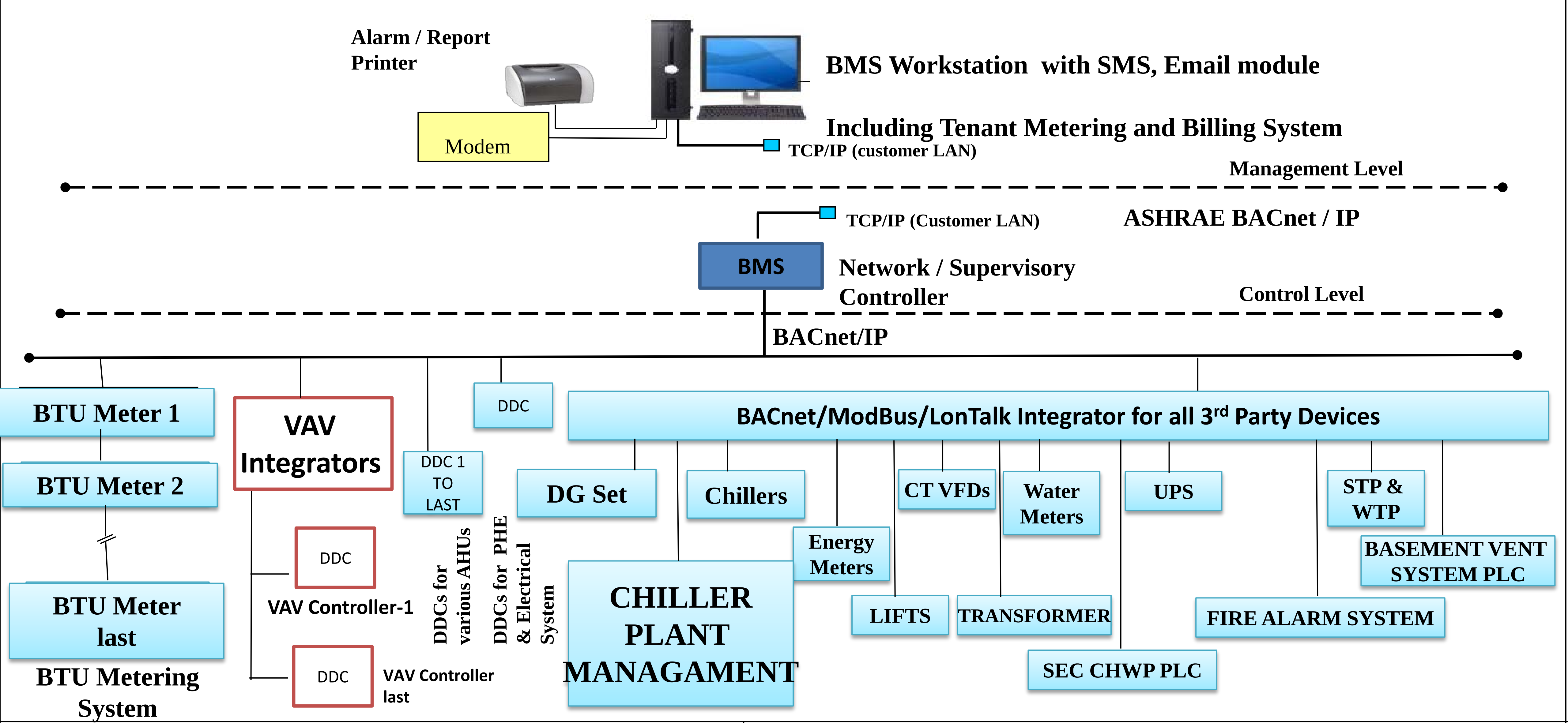
- Fire Fighting
- STP/WTP
- PHE Pumps
- Chemical Dosing
- Water Tanks
- Water Meters
- RO Systems

3rd Party Systems

- Fire Alarm Systems
- Security Systems
- VESDA System
- Basement Vent System
- BTU Meters
- Water Leak Detection
- Rodent Repellent Systems

Through Hardwiring and Soft Integration

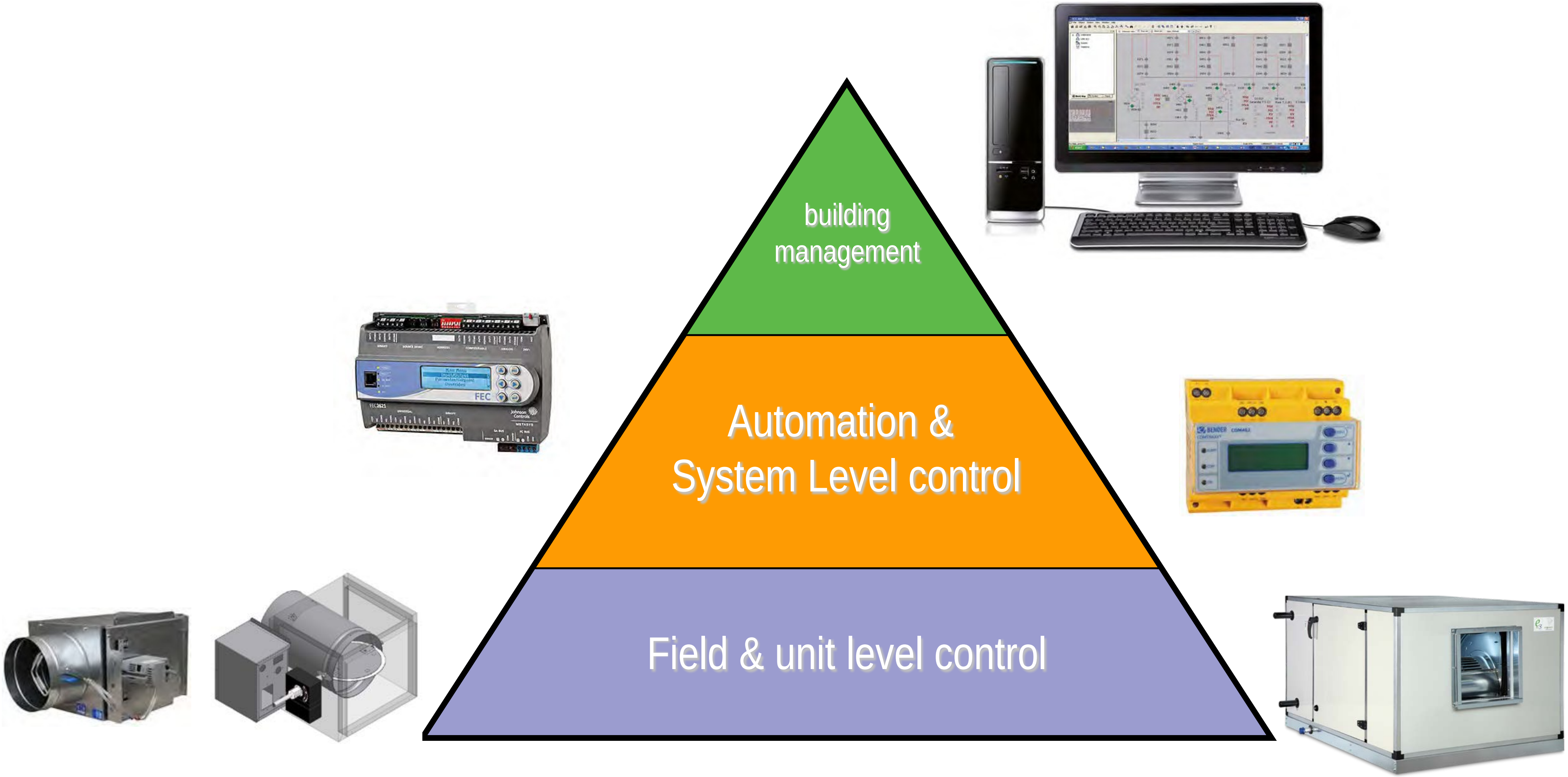
ARCHITECTURE FOR BUILDING MANAGEMENT SYSTEM



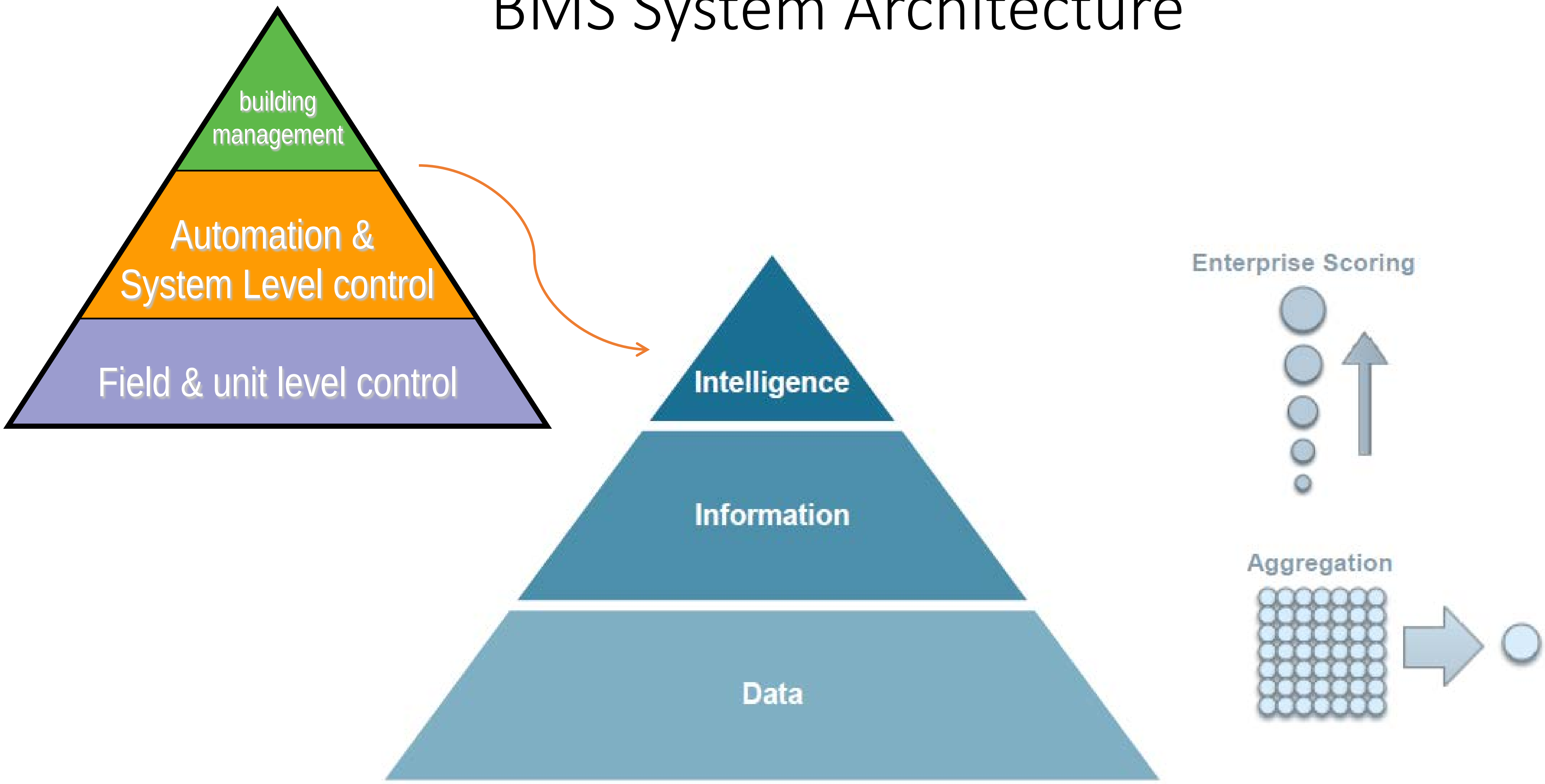
DRAWING: BMS Architecture

DATE: **REV : 0**

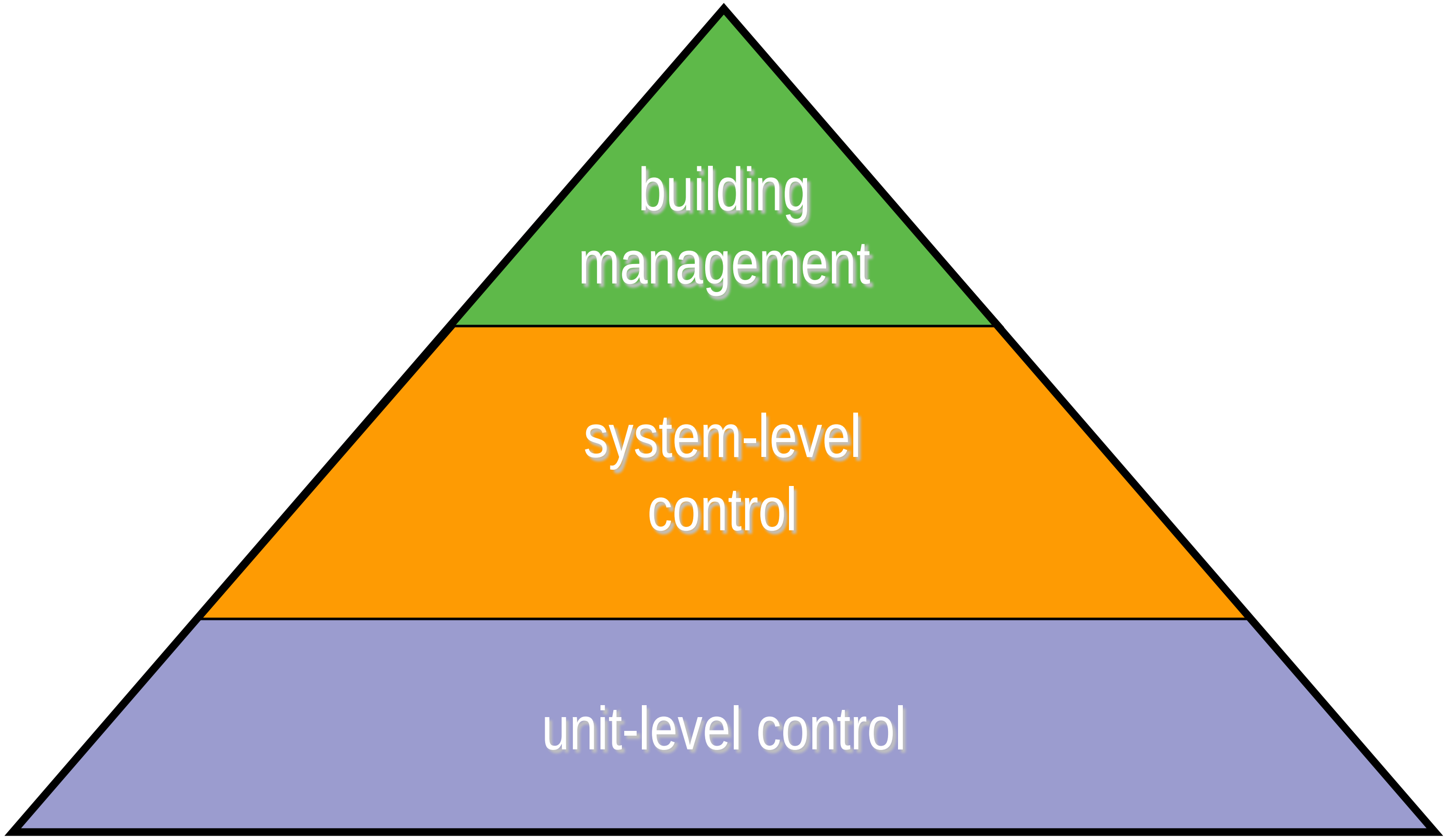
BMS System Architecture



BMS System Architecture



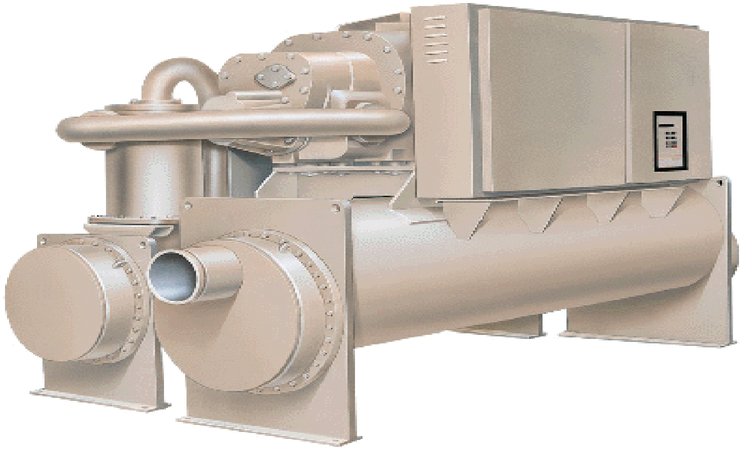
System Architecture

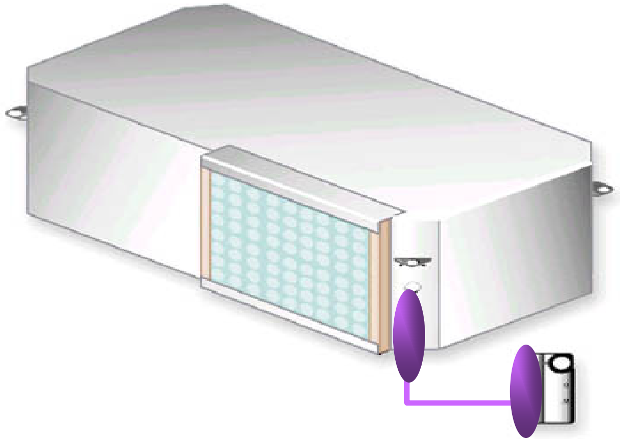


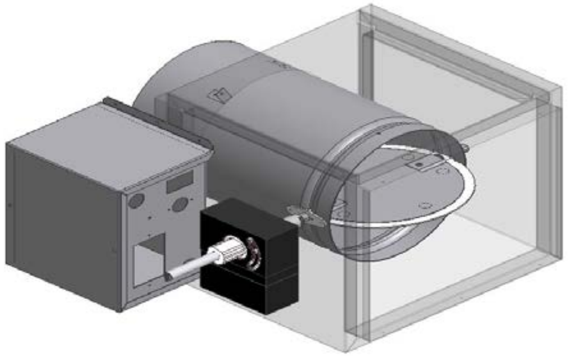
Benefits of Unit-Level Control

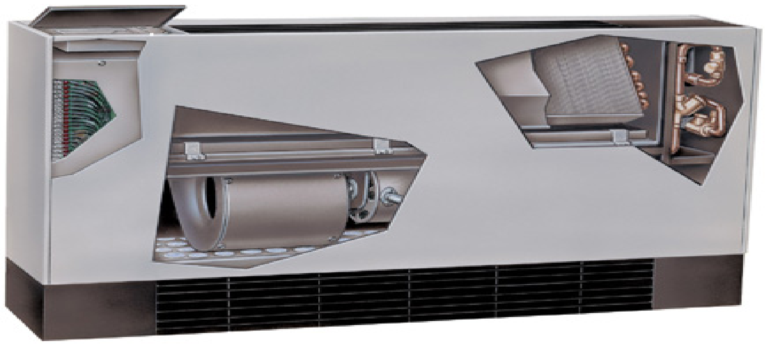
- Stand-alone control
- Safeties, alarms, and diagnostics
- Installed, tested, and commissioned in factory& field

Unit-Level Control



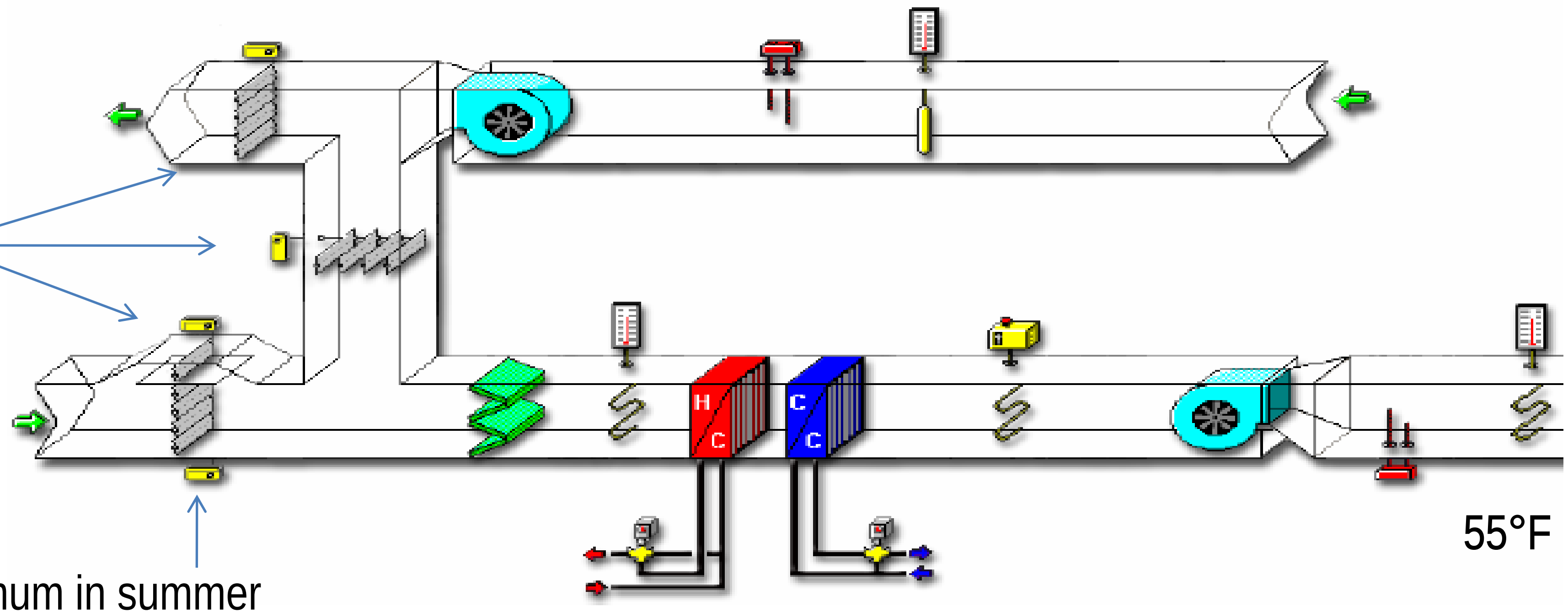






AHU - Economizer

Linked

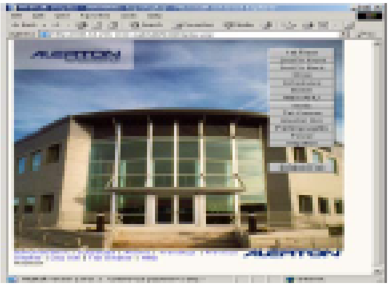


Minimum in summer
More outside air in winter

Economizer mode: Using outside air for cooling rather than mechanical cooling.

- Centralized WorkStation Computer

- With powerful user-friendly software.
- Used for everyday building operation.



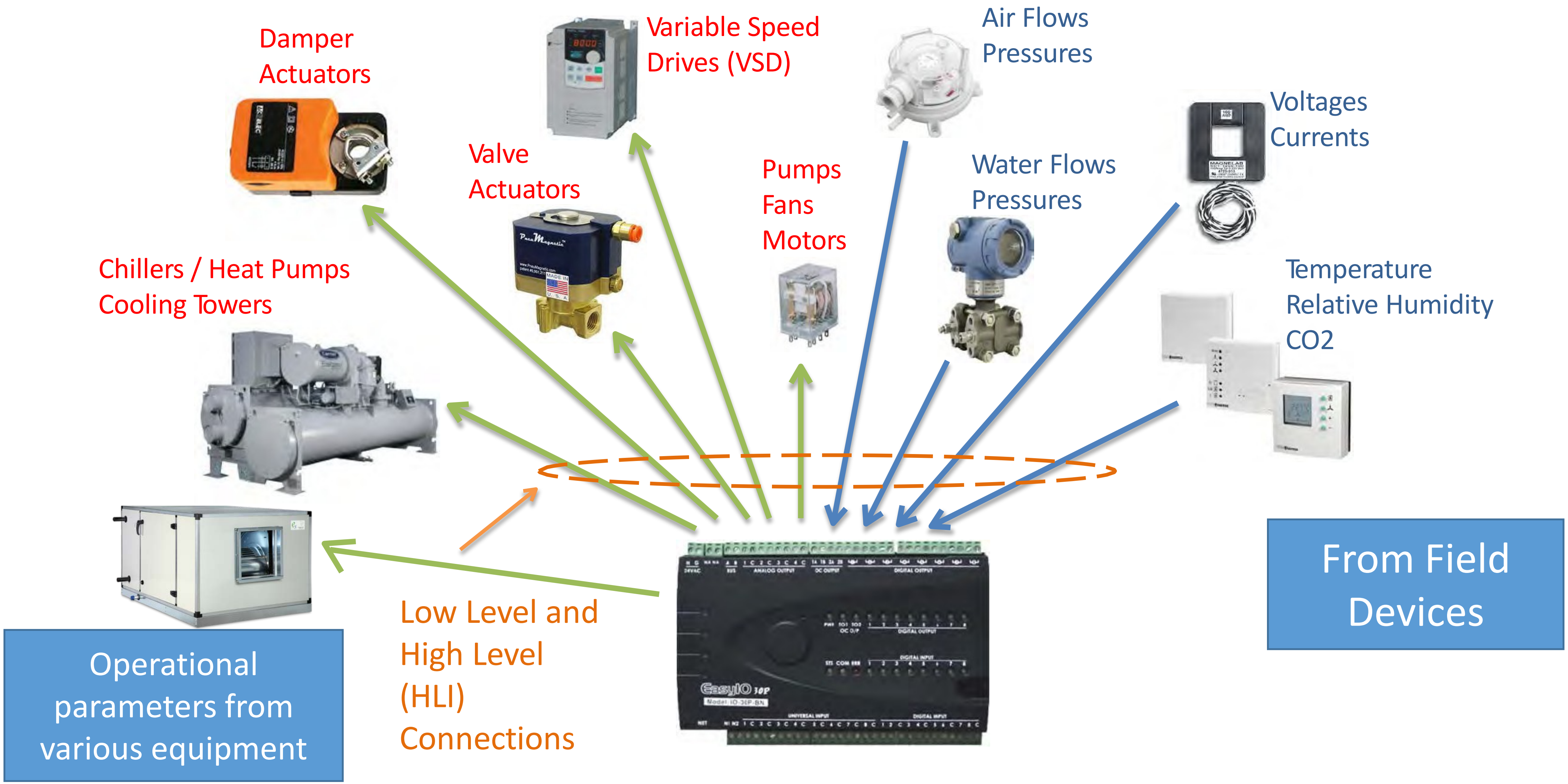
- DDC Controllers

- Micro-processor based
- Pre-configured / Freely programmable
- Controls the HVAC equipment of the building and other electromechanical equipment

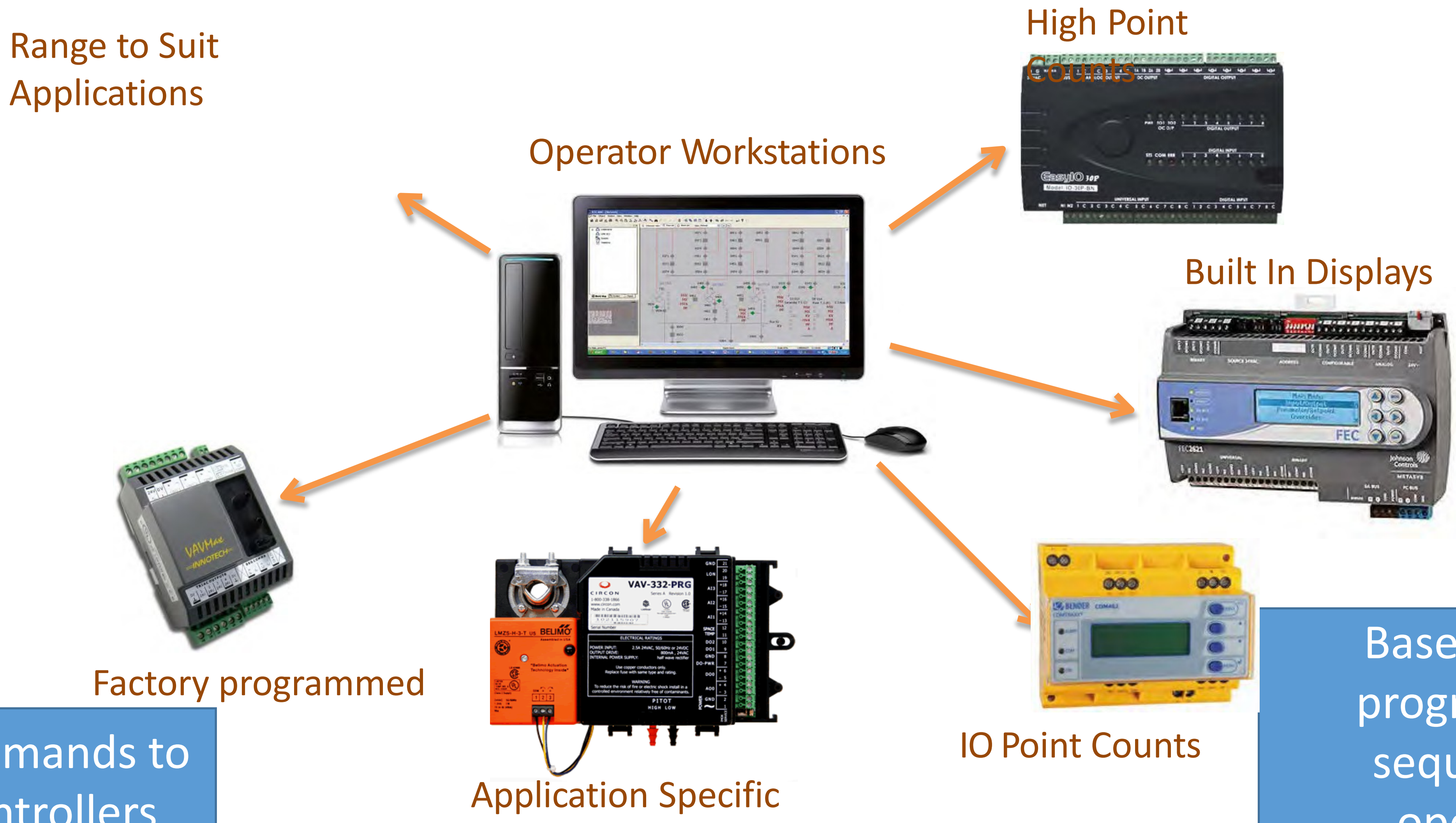
- Field devices

- Temperature, Humidity, Pressure sensors
- Valves, Actuators

Typical System Components – Field Devices & DDCs
What Does Intelligent Microprocessor Control Mean?



Typical System Components – BMS Hardware



Commands to controllers

Based on the programs and sequence of operation

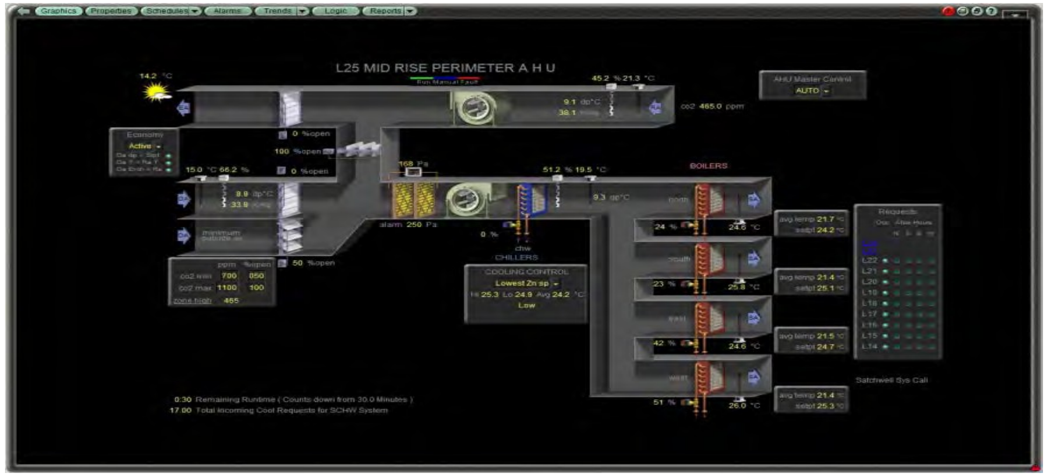
What Does a BMS Do ?

- The role of the BMS in day to day building operation
- Building Control Applications
- Measuring and Monitoring building performance
- Interaction with other building systems

The Day to Day Role of the BMS…

- The most common primary function of the BMS is the control of a buildings Heating, Ventilation and Air Conditioning Systems (HVAC), MEP including:

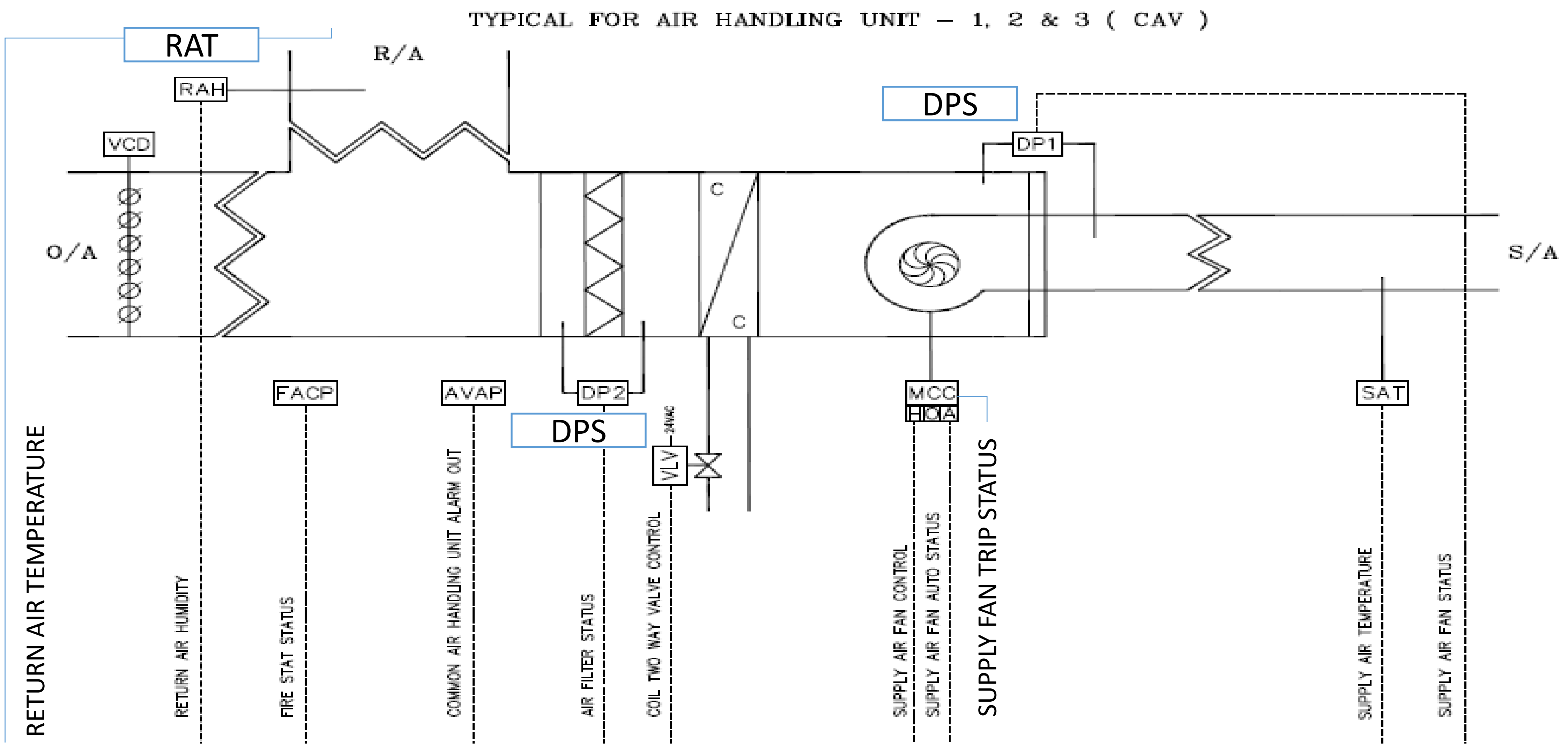
  – Air Handling Units
  – VAV Boxes
  – Chilled Water Plant
  – Cooling Towers
  – Tenant Chilled Water Billing – BTU & EM
  – Exhaust Systems
  – Zone Controls
  – PACs, Computer Room AC
  – Other MEP Systems
  – PHE Tanks, Pumps
  – Breakers, DGs etc



Building Control Applications

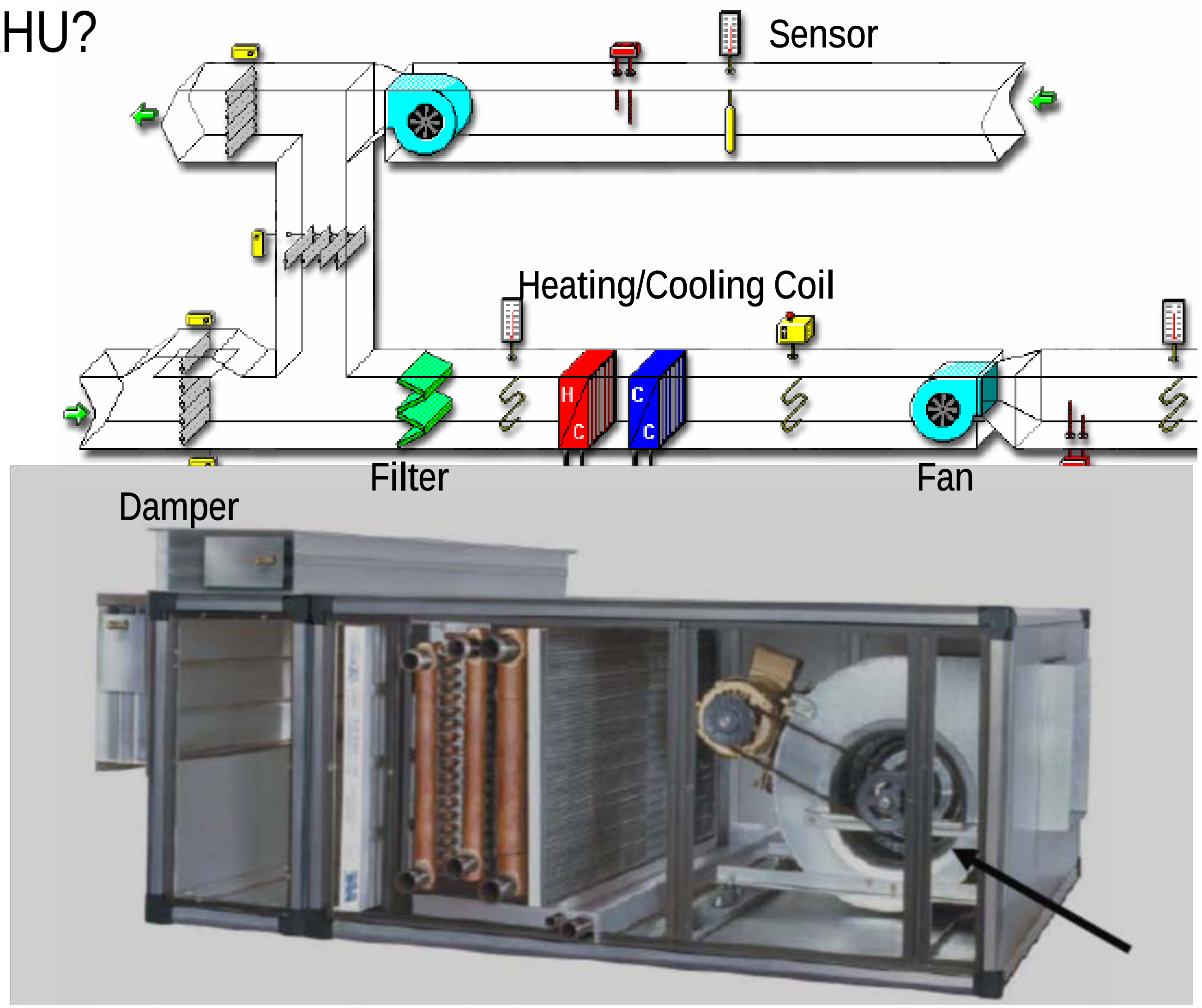
- Building control applications include for following:
  - Zone temperature monitoring and control
  - Zone Variable Air Volume (VAV) control to zones
  - Zone CO_2 monitoring and control (Air Quality)
  - Air handling unit supply air temperature control
  - Air handling unit supply air flow / pressure control
  - Main Chiller Plant Control sequencing – Chillers, CHWPs, CTs
  - Toilet, car park, kitchen and general exhaust fan control
  - After Hours Building Control

ONE EXAMPLE - CHILLED WATER AIR HANDLING UNIT



DDC Controller for AHUs – Variable Air Volume

What's in an AHU?



Building the DDC Controllers with Input / Output Points

AI (analog input)	• Inputs to the DDC; For Monitoring purpose • Inputs from Temperature/Pressure Sensor/ Analog Devices • Signal:- 0-10 V or 4-20mA
DI (digital input)	• Inputs to the DDC; For Monitoring Purpose • Inputs from Switches/ Digital devices/ Starter Panels
AO (analog output)	• For Control purpose • Outputs to Actuating devices like Valves, VFDs etc., • Signal:- 0-10 Vdc or 4-20mA
DO (digital input)	• For Control Purpose • Outputs to MCC Panels/ Isolation Valves, Fans, pumps etc to start/stop or open/close

Field Devices – Sensors & Switches

Temperature Sensor	• Immersion/Duct/ Room Type
Pressure Sensor	• Static Pressure/ Differential pressure Type
Humidity Sensor	• Duct/ Wall Type
CO_2 Sensor	• Duct/ Wall Type
BTU Meters	• Ultrasonic/ Magnetic Type
Level Sensor	• Ultrasonic / Capacitance Type
Air Flow Measurement Station	• Duct/ Pitot Type
Diff Press Switch/Tranducer	• Air / Water Type
Level Switch	• Single Level/ Bi Level Type

Cabling and Communication

Signal Cable

- For Monitoring and Controlling
- 0-10 Vdc or 4-20mA
- Usually 2C x 1 Sqmm Shielded Cable

Power Cable

- To provide power to Sensors
- Usually 3C x 1.5 Sqmm Cable

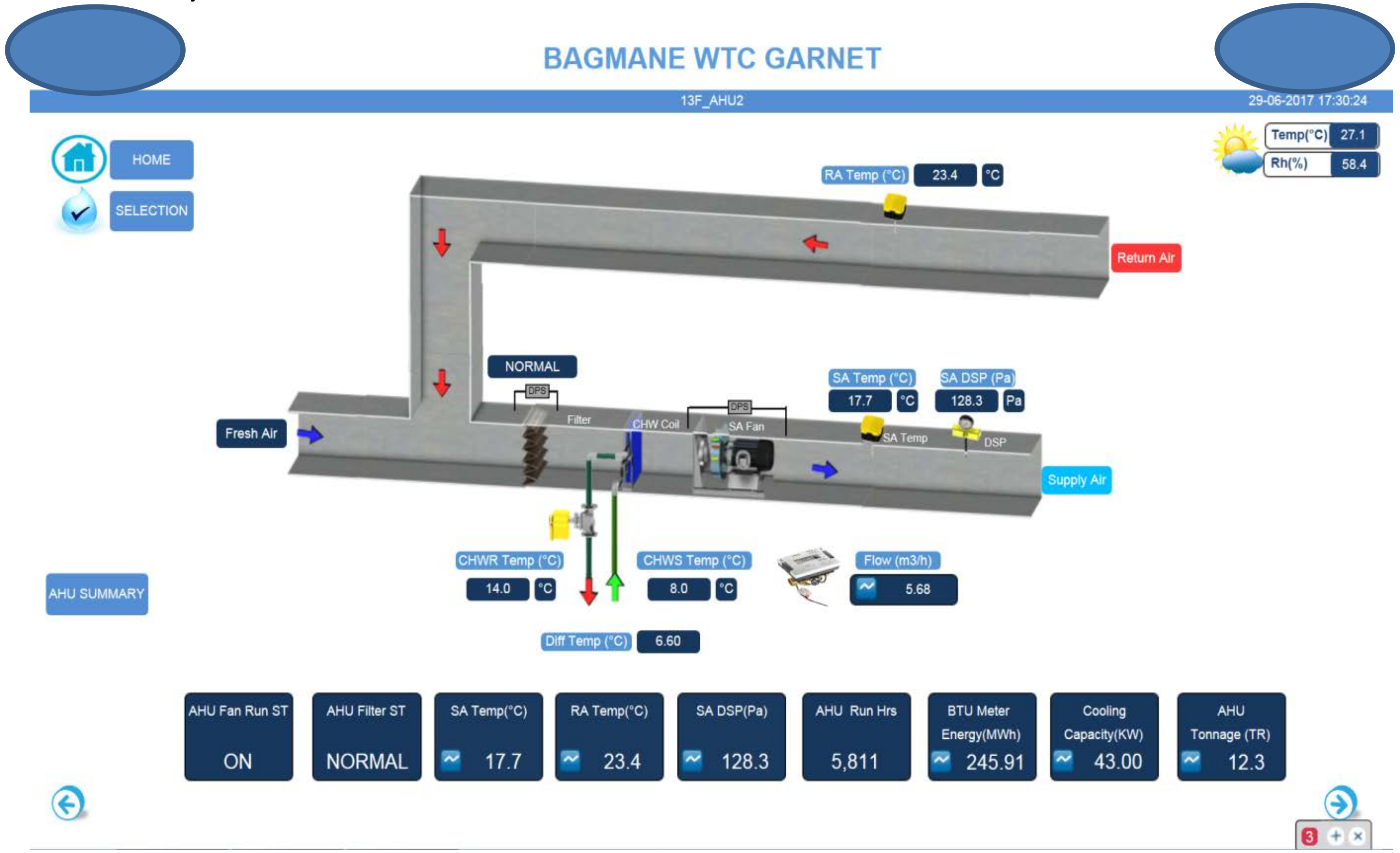
Communication Cable

- Communication between DDC and Supervisory Controllers
- Depends on System to System

BMS Wiring

Air Handling Unit

- AHU Remote ON/OFF Command & Status
- AHU scheduling
- Auto/Manual status monitoring
- Temperature monitoring / control (Supply & Return Air)
- 2-way valve control and VFD speed (control)
- Filter status monitoring
- Duct static pressure monitoring
- AHU performance monitoring
  - Run Hours
  - Tonnage
  - Consumption in Kilo Watt
  - Load pattern



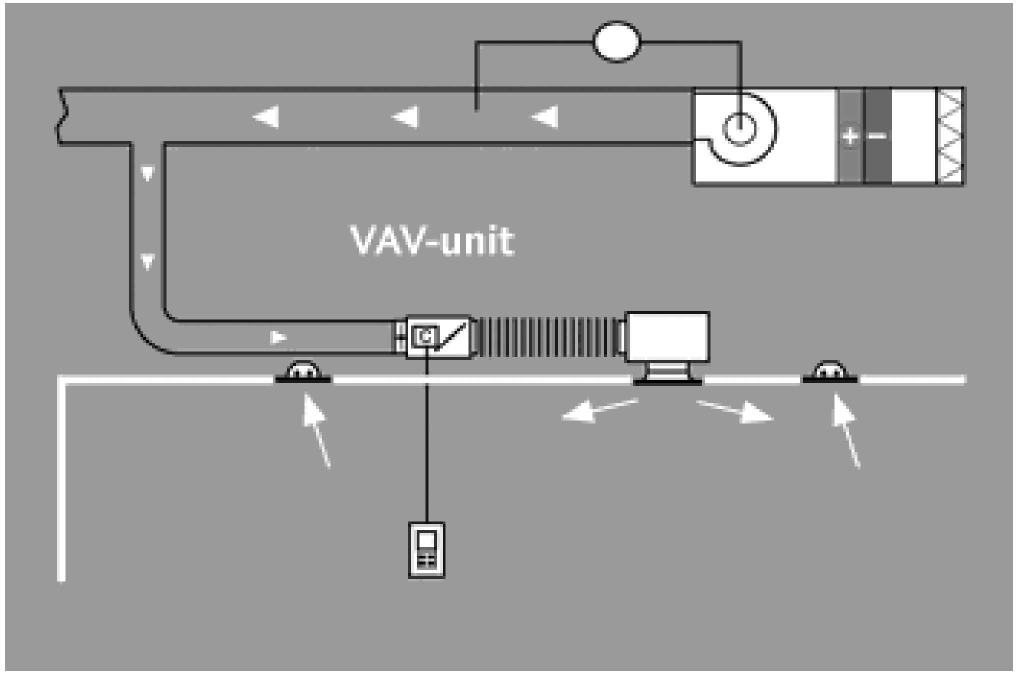
Air Handling Unit

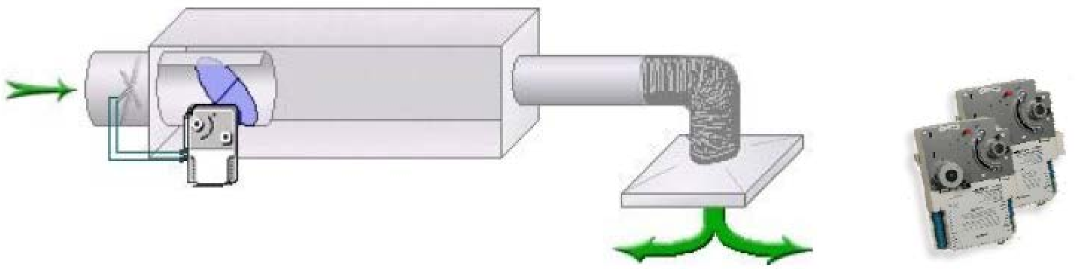
A	AIR HANDLING UNIT		AI	AO	DI	DO	(Analog Input / Output
i	DESCRIPTION OF IO POINT						Digital Input/Output)
1	VFD ON / OFF Command					1	230 V , 6A Relay. Termination to the MCC panel upto NO Contact.
2	VFD Auto/ Manual Status				1		Potential free contact from VFD MCC panel
3	VFD Trip Status				1		Potential free contact from VFD MCC panel
4	AHU Fan RUN Status				1		Differential Pressure Switch
5	AHU Filter Status				1		Differential Pressure Switch
6	Supply Air & Return Air Temperature		2				Supply Air & Return air temperature sensor - Duct Type
7	AHU Chilled Water Valve control & Feedback		1	1			2-Way Control Valve
8	SA Duct Static Pressure		1				Duct Static Pressure Transducer
9	VFD Speed Control			1			Speed signal from DDC to VFD
10	VFD Bypass Status				1		VFC from Starter Panel
11	MCC Power On Status				1		VFC from MCC Starter Panel
	Spare		1	1	1	1	AI SPARE SHOULD BE UNIVERSAL INPUT POINT
	IO POINTS FOR 1 AHU DDC PANEL		5	3	7	2	

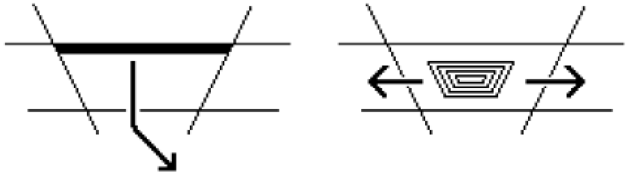
Variable Air Volume [VAV]

A VAV terminal accurately measures and controls the volume of air based on the heat load within the space & based on the temp setpoint and actual temp.

Two variables – Temperature & Air Volume



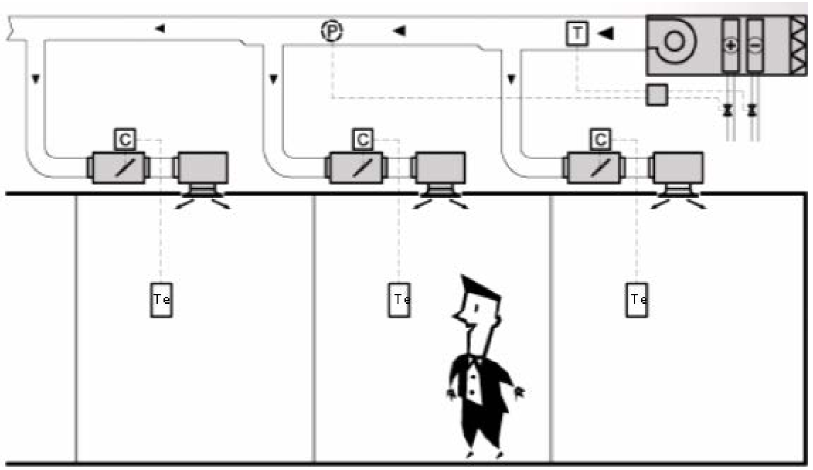


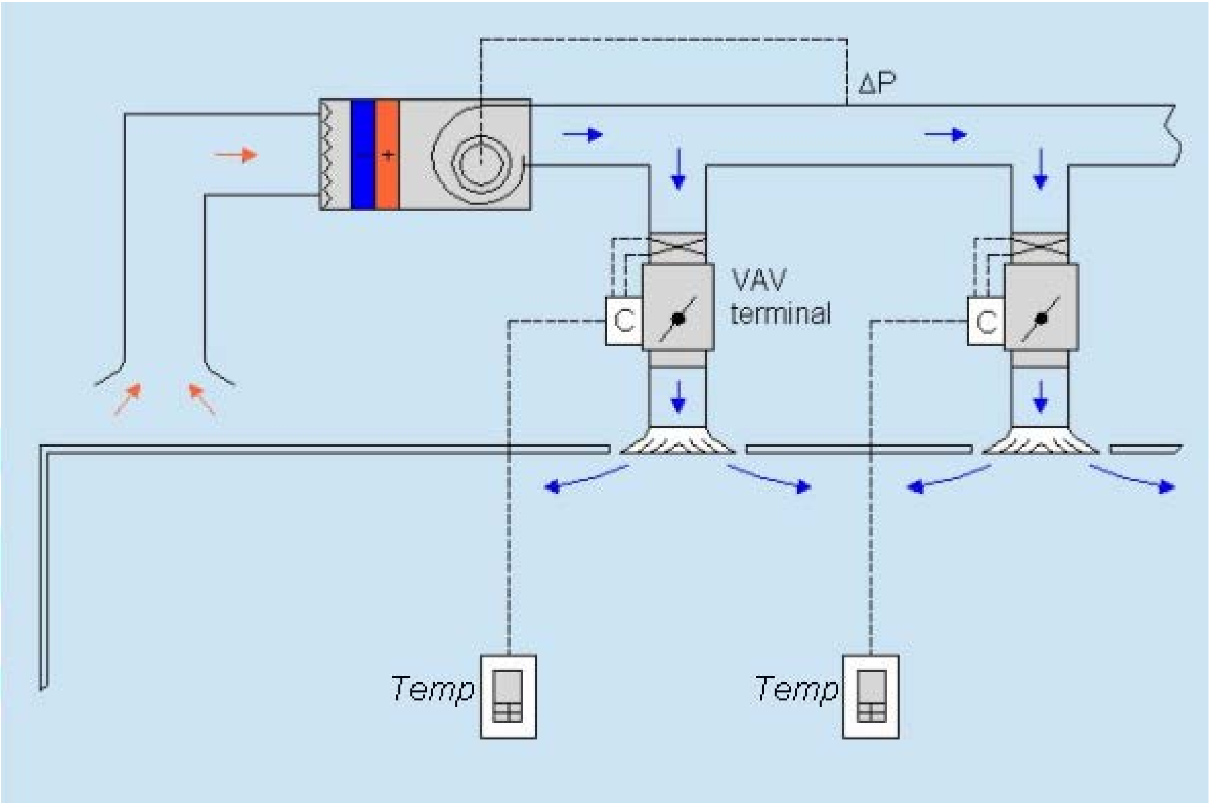


Air Diffusers

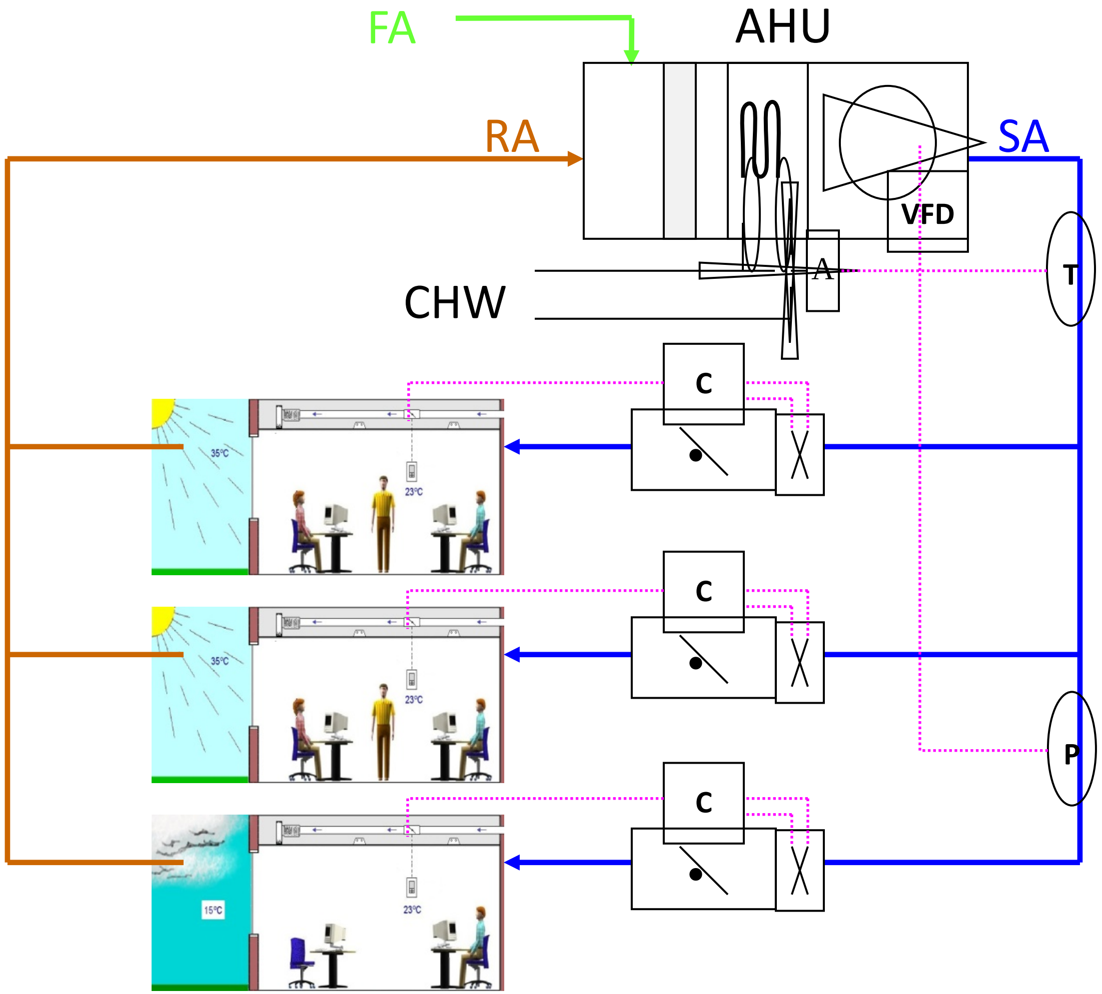
Benefits of VAV System & Pressure Independent

- Individually controllable
- High comfort level
- Low sound level
- Modulating controls
- Accurate pressure and air volume control



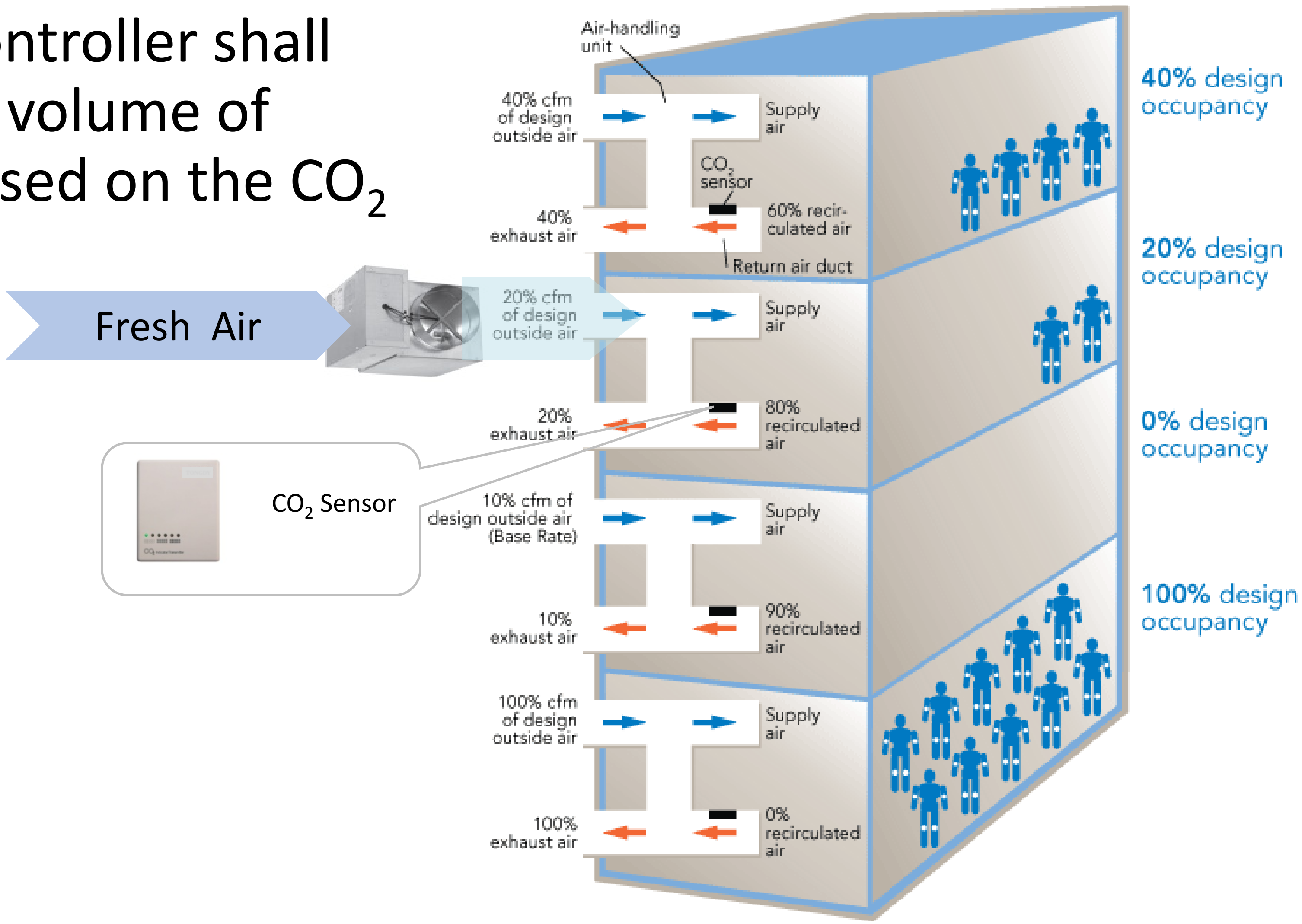


VAV control in a Centralized System



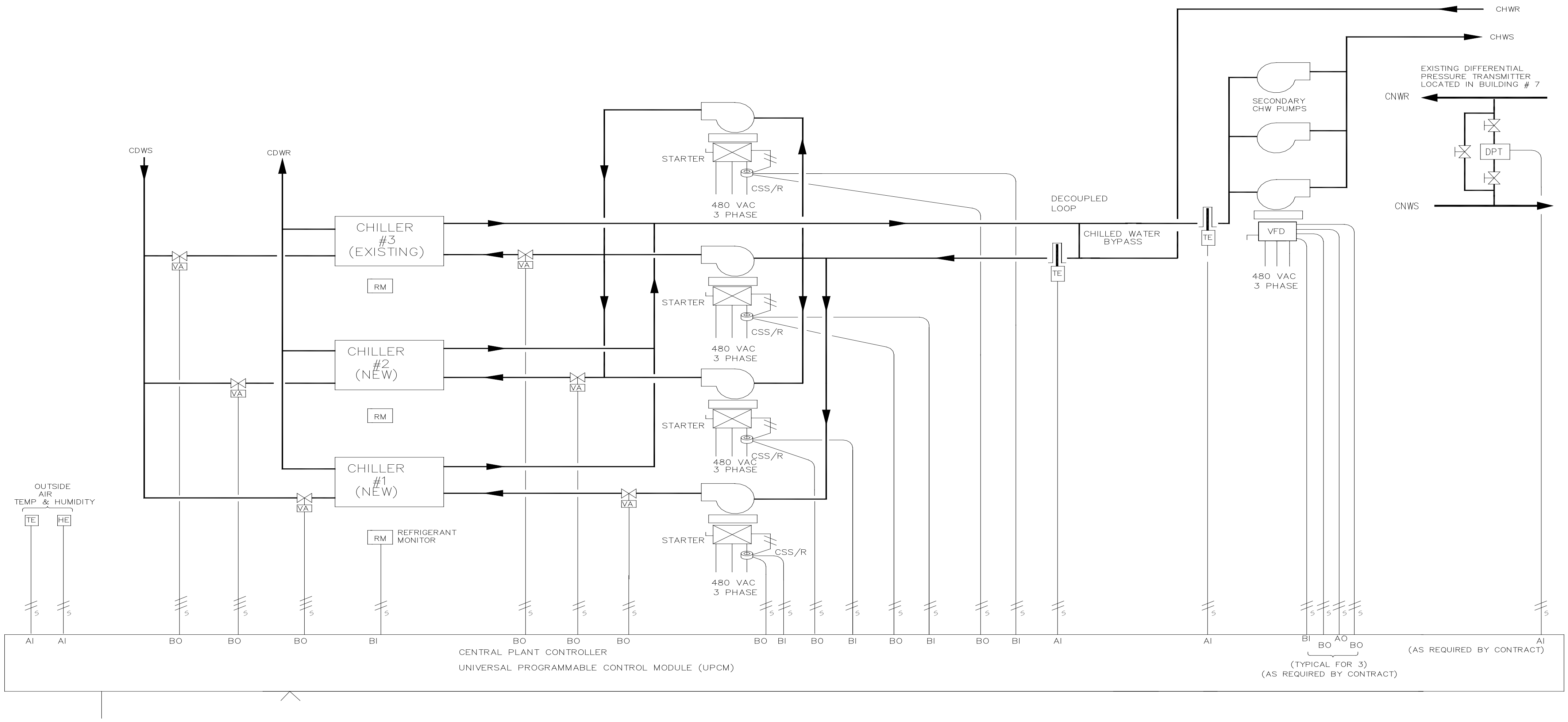
Demand Control Ventilation

The VAV Controller shall control the volume of fresh air based on the CO_2

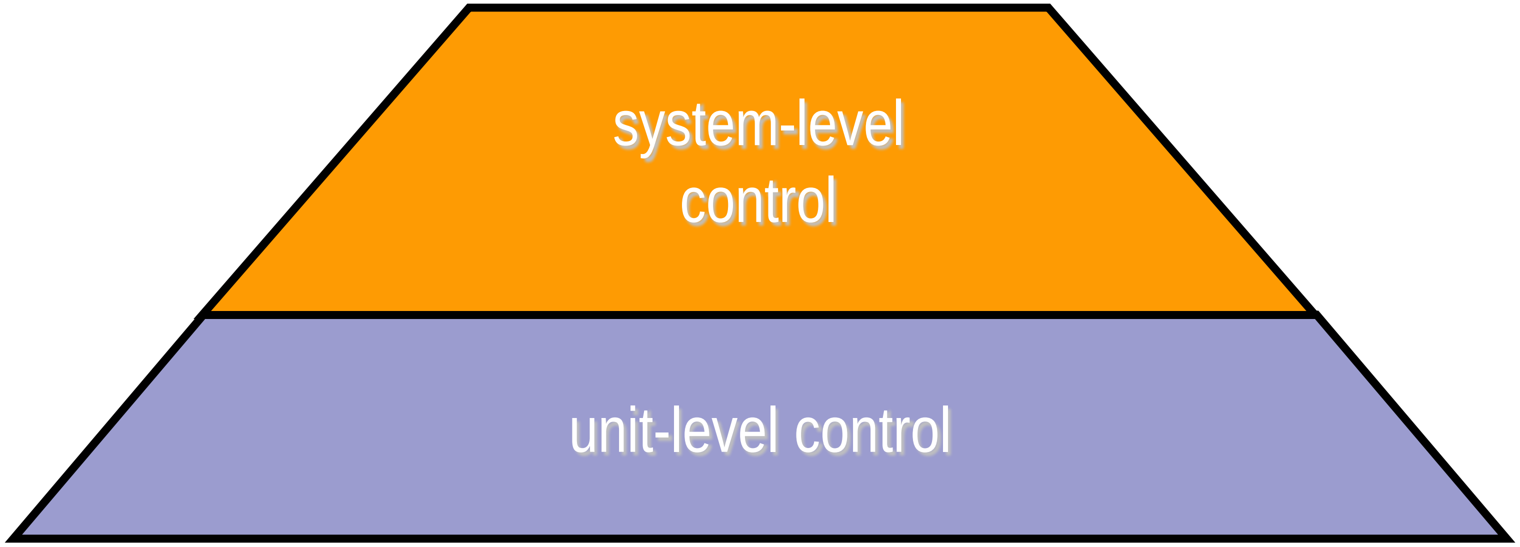


Water Side Controls

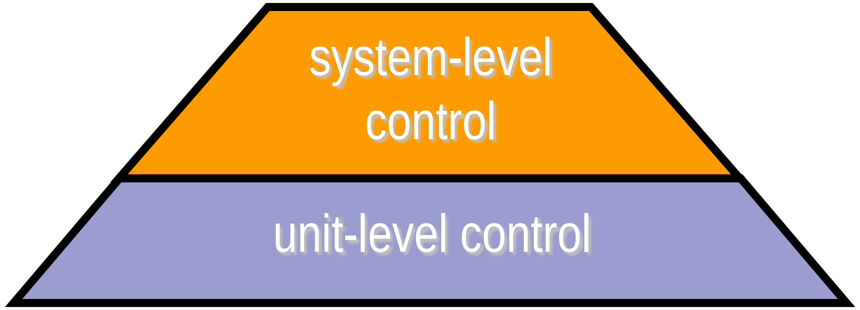
Primary Secondary Schematic

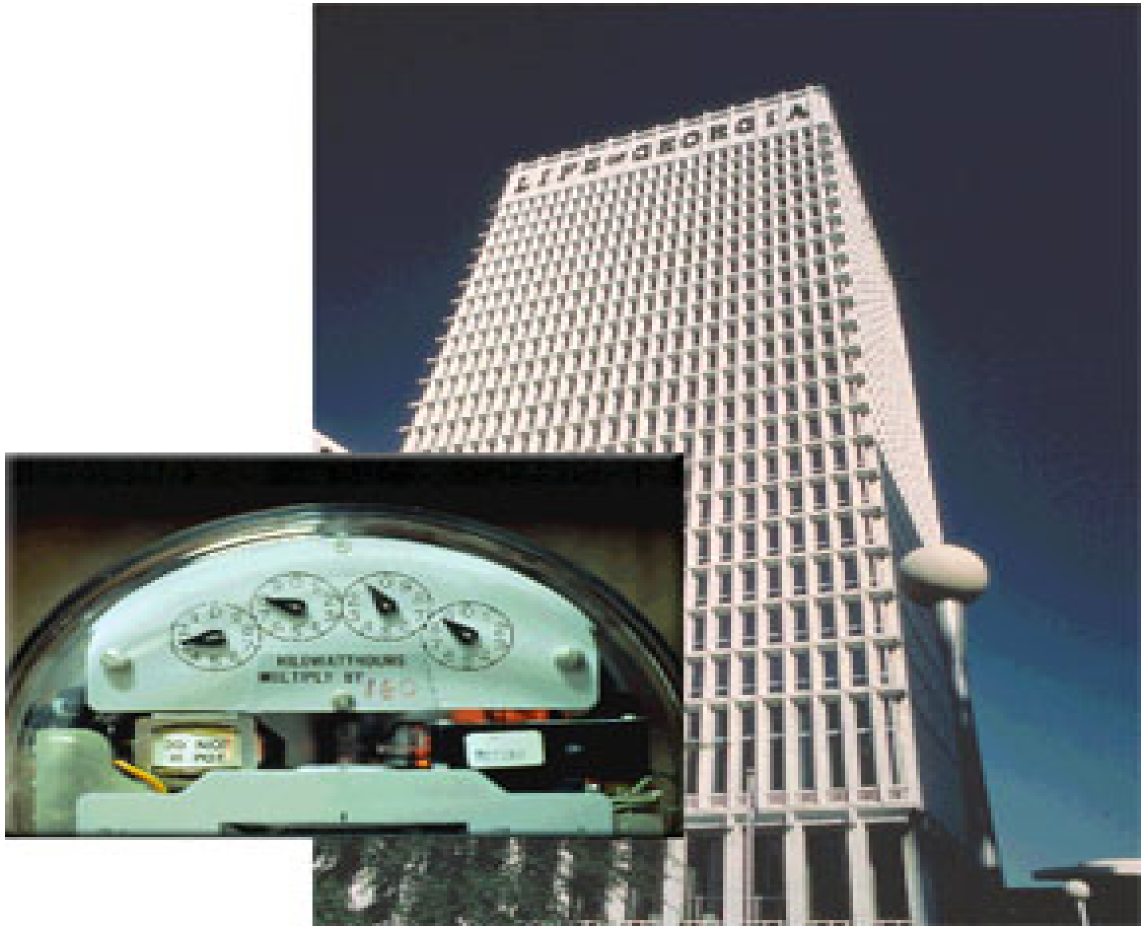


System-Level Control

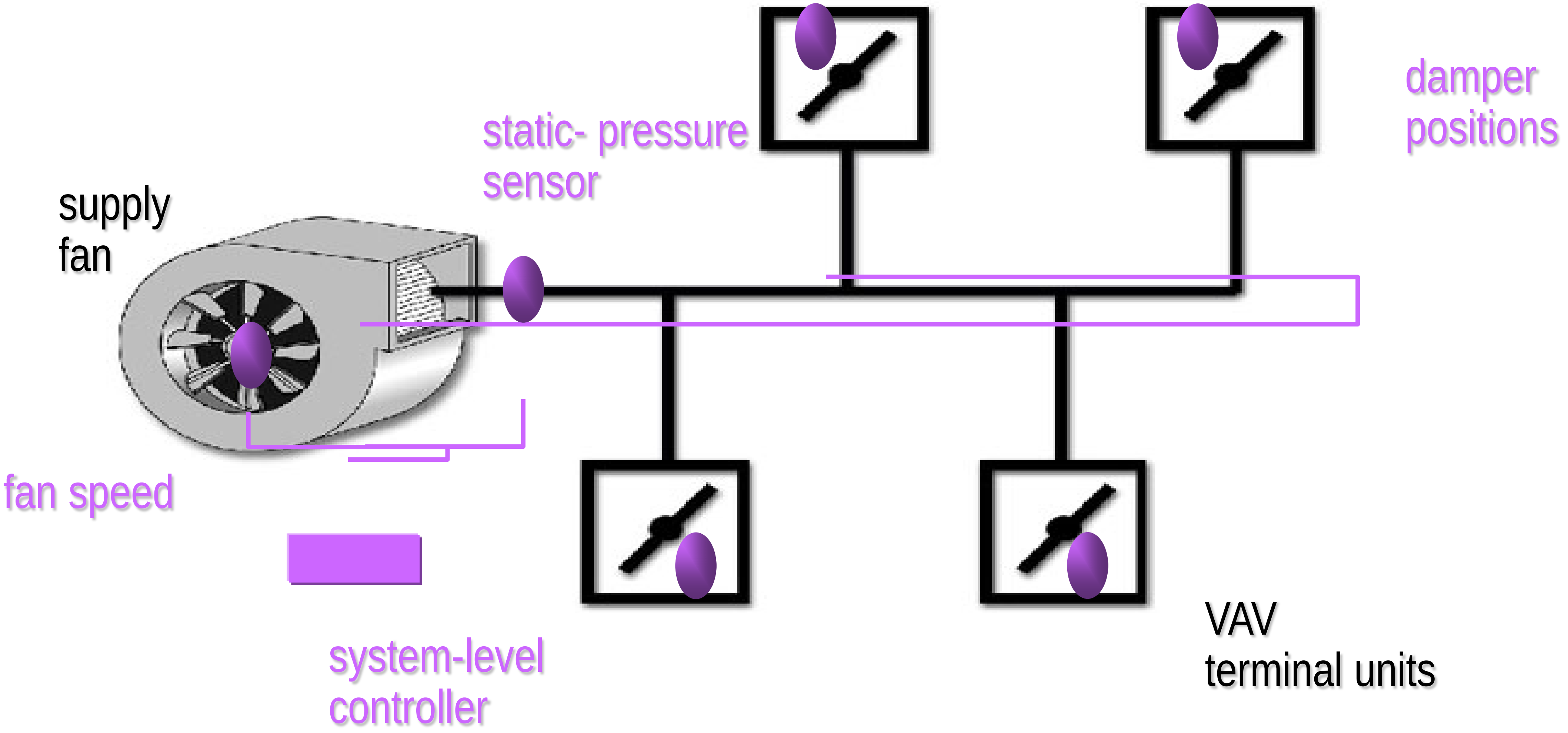


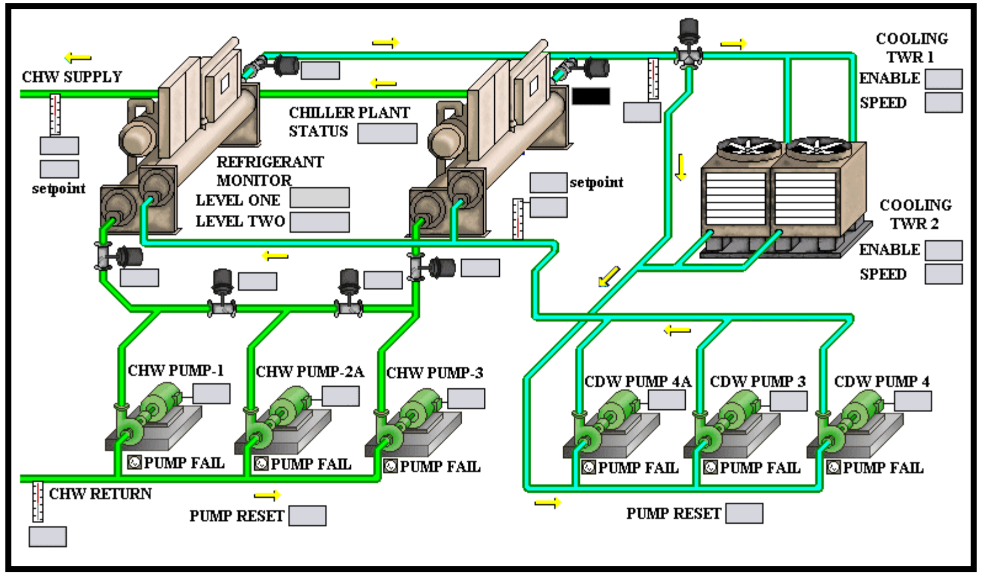
System Optimization





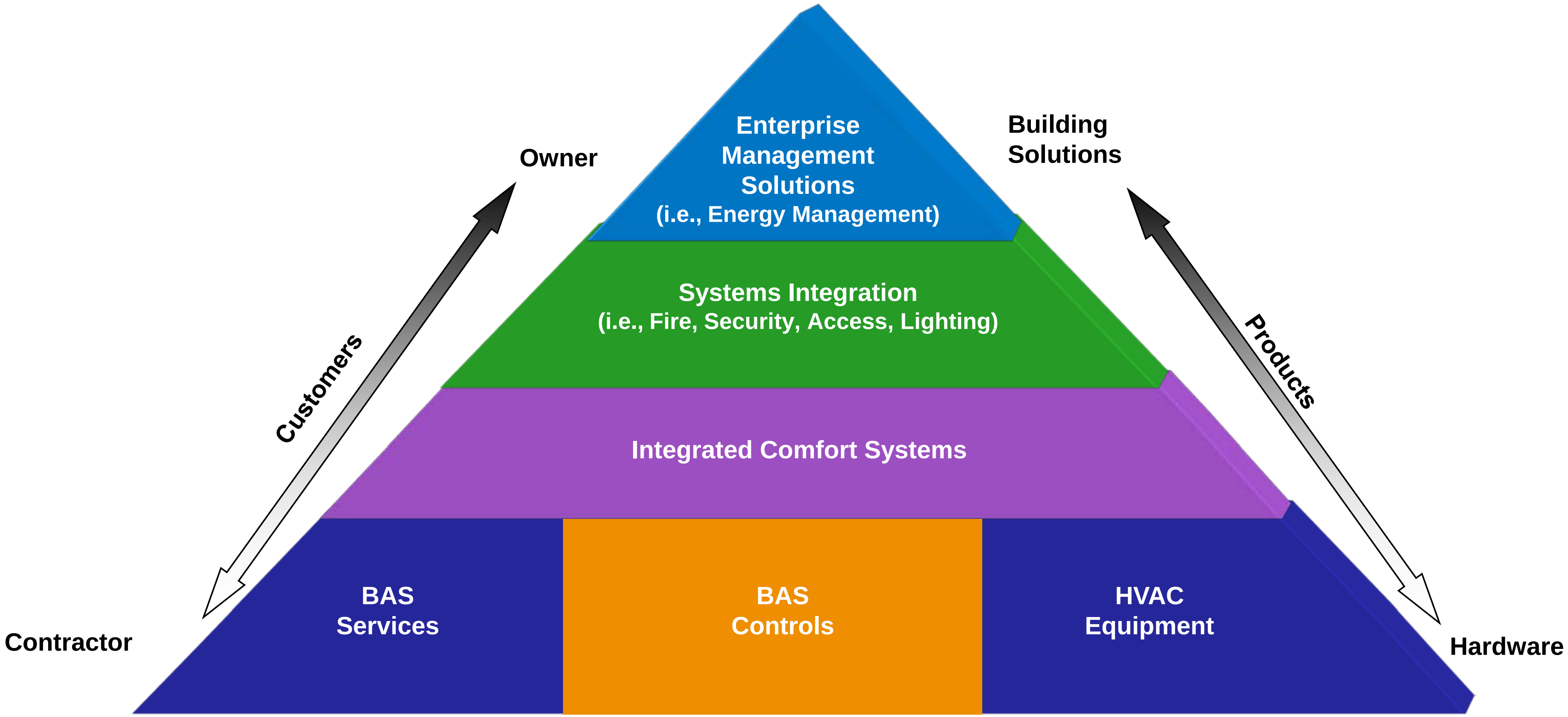
VAV system
Fan-Pressure Optimization



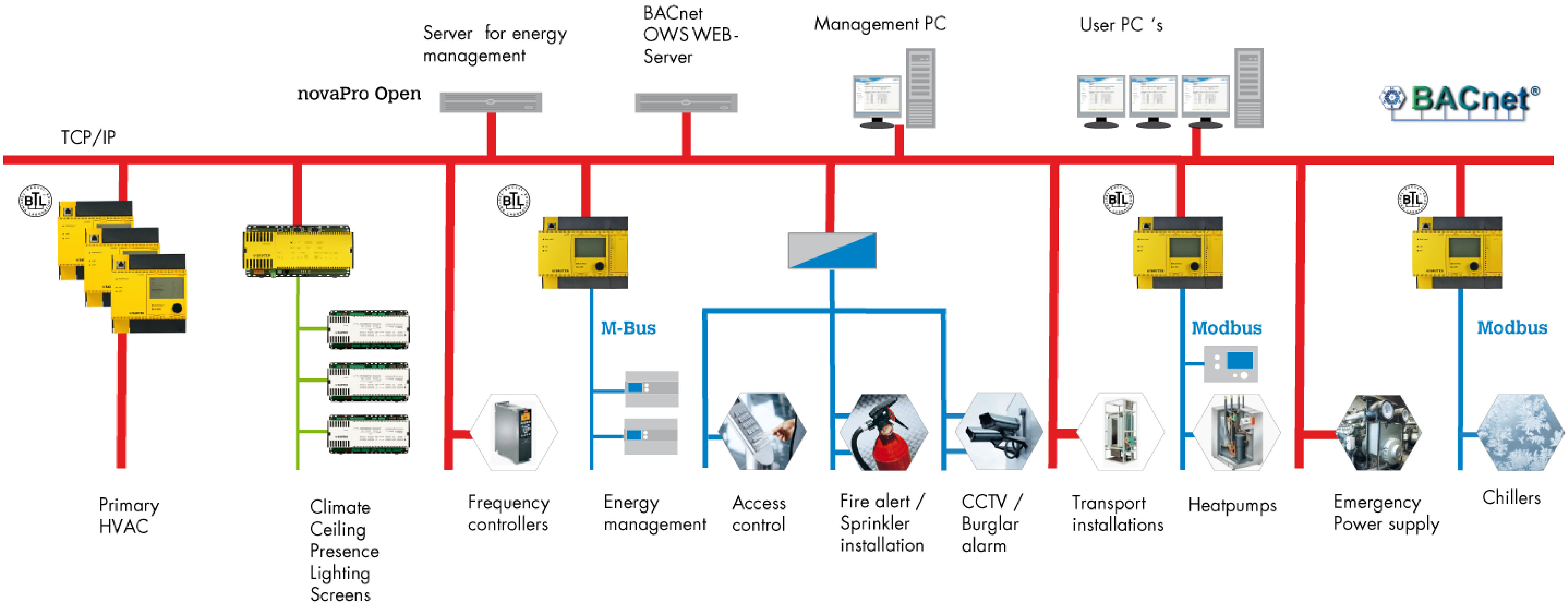


Chiller Plant Management

Intelligent Buildings



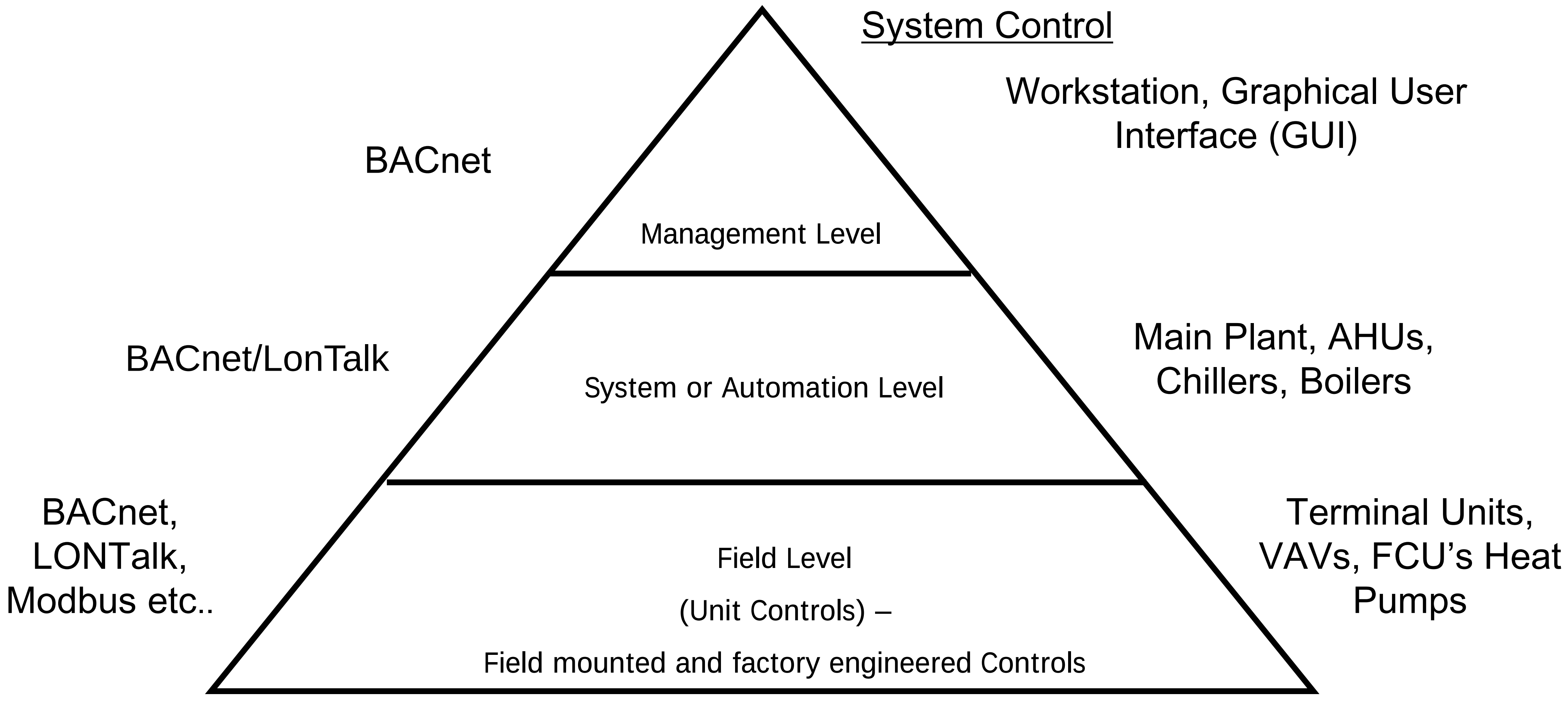
BMS Integration - Typical



Open Protocols

BACnet, LON, ModBus

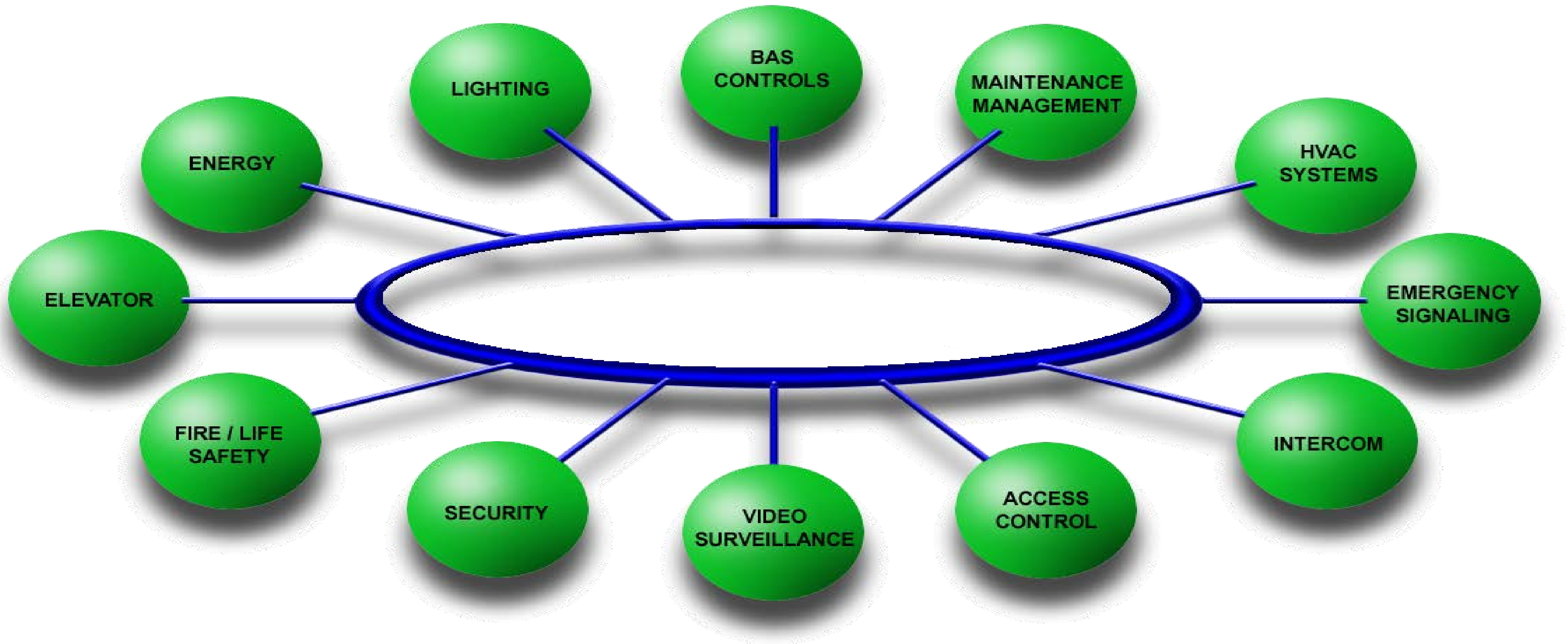
System Architecture for a generic BMS



Building Intelligence

interoperability

The ability for building systems to exchange and make use of shared information



Building Intelligence

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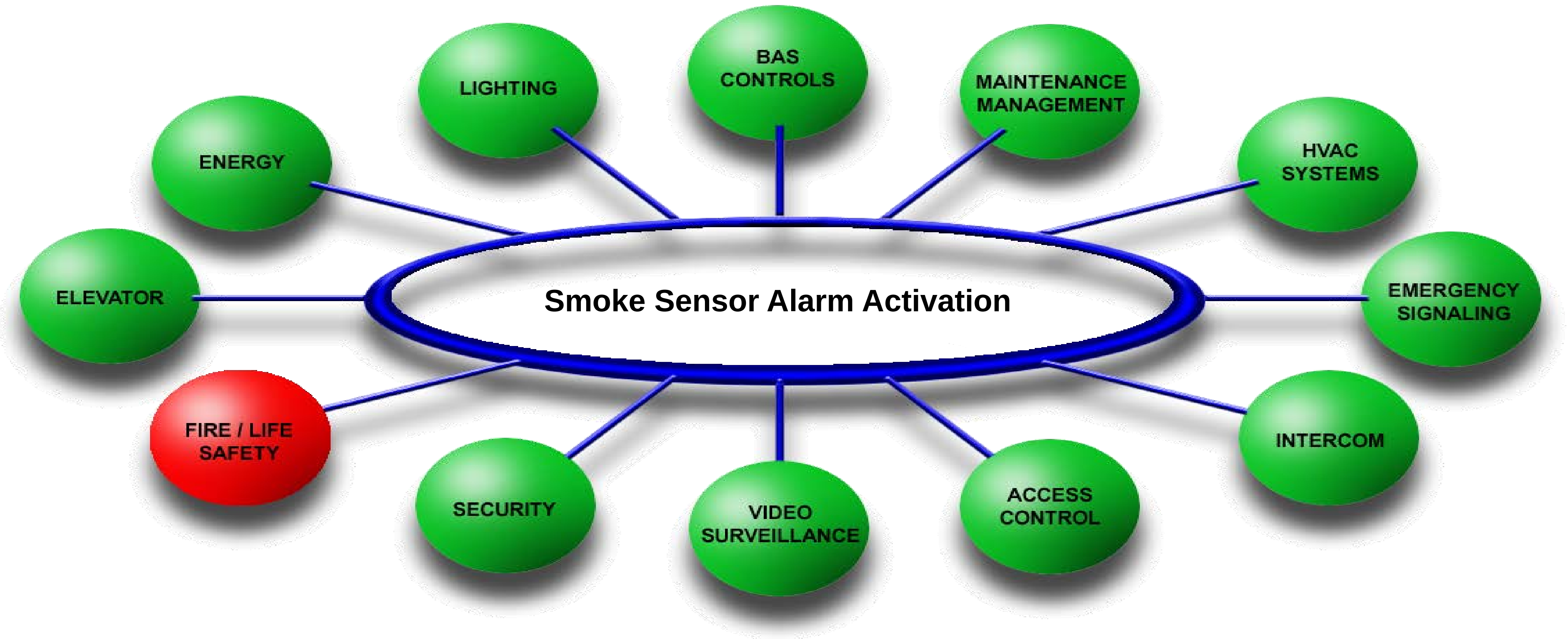

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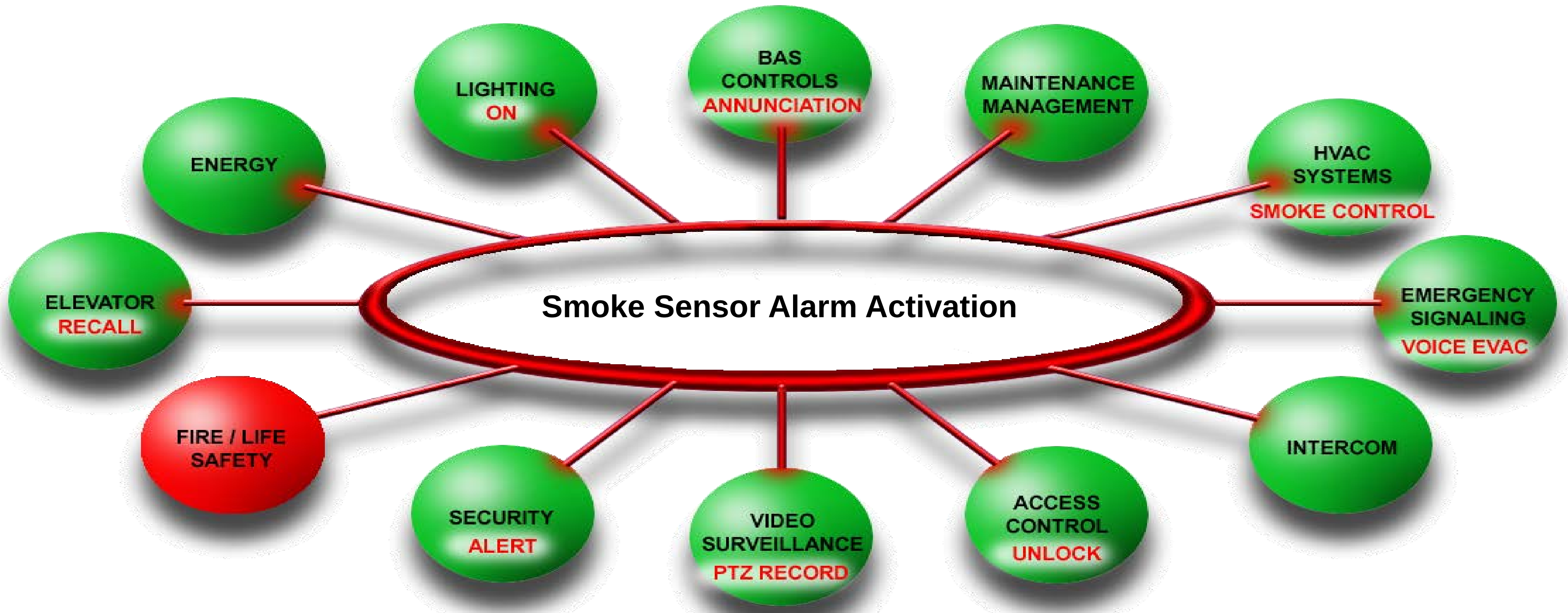


What is BACnet ?

A Data Communication Protocol for

Building Automation and Control Networks

What is BACnet? (1)

- BACnet is the abbreviation for Building Automation and Control network
- BACnet is the registered trademark of ASHRAE
- BACnet is a data-transfer protocol for exchanging information between different systems and equipment in building automation systems
- BACnet supports numerous network standards and topologies, including the internet protocol
- BACnet is licence-free, i.e. anybody can implement it

LON Technology

Building Controls Integration using LON

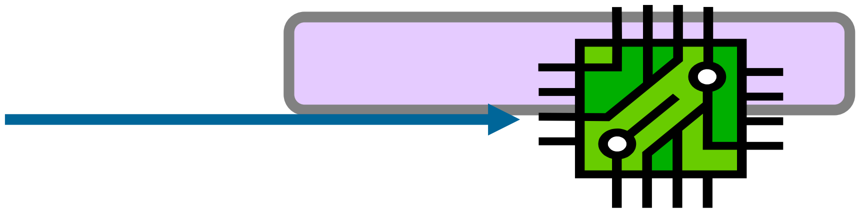
LONMARK™

LONtalk Fundamentals

Neuron : Micro-processor with LonTalk embedded (Like CNN)

LonWorks device

Neuron chip



Unique Neuron ID (NID)

Neuron **The heart of LonWorks technology**

LONtalk Profile

Standardization of inputs & outputs types

Standard Network Variable Type (SNVT)

- ✧ facilitate interoperability by providing a well-defined interface for communication between devices made by different manufacturers.

Simplify the data transmission

Defines data type, data unit, data resolution...

Temperature
in °C

Pressure
in Pa

Energy
in kW

Occupancy
occupied, unoccupied, standby, bypass

Time
in seconds

Voltage
in Volts

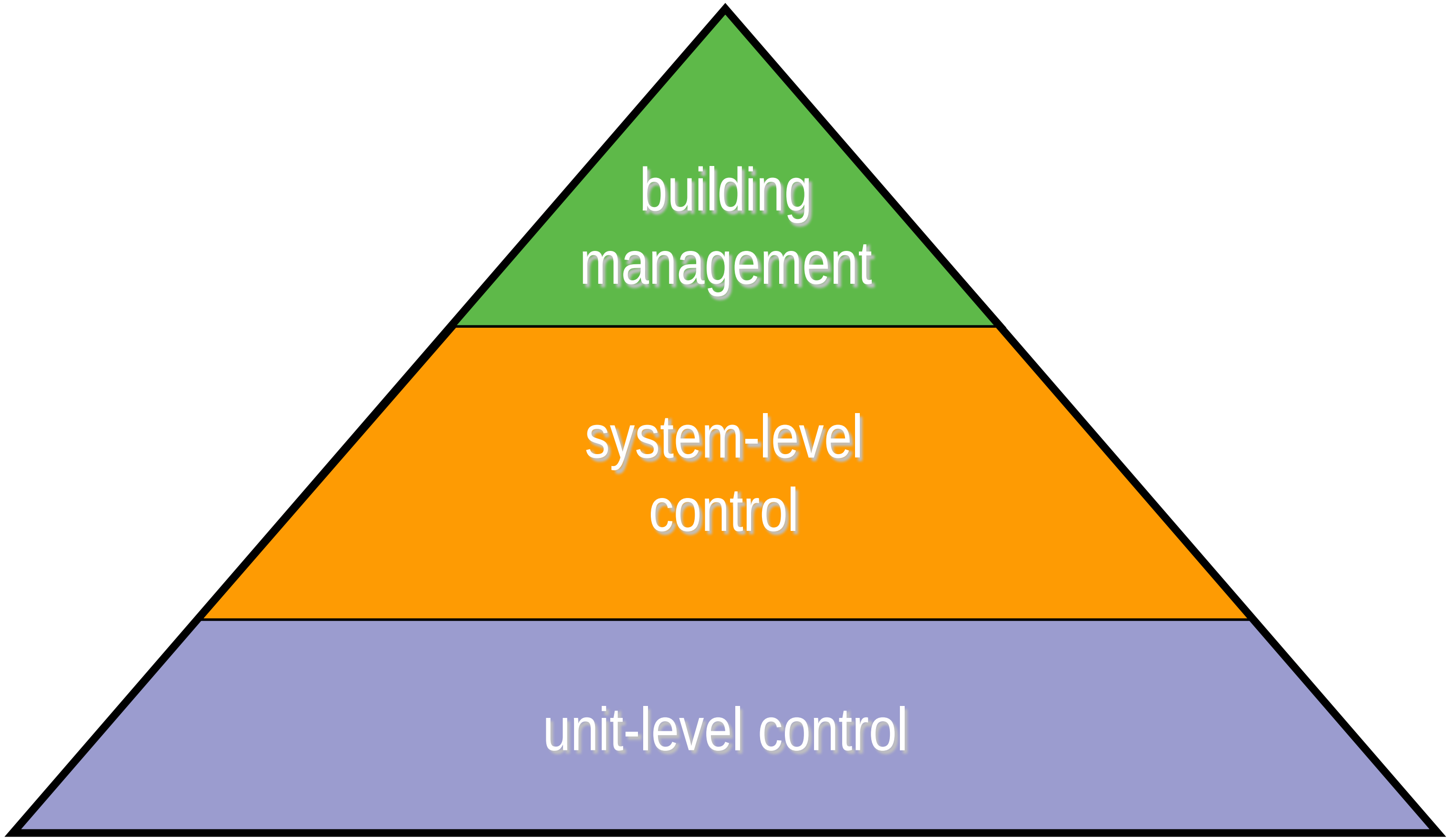
Length
in meters

HVAC Mode
auto, heat, cool, FreeCool, FanOnly...

ModBus

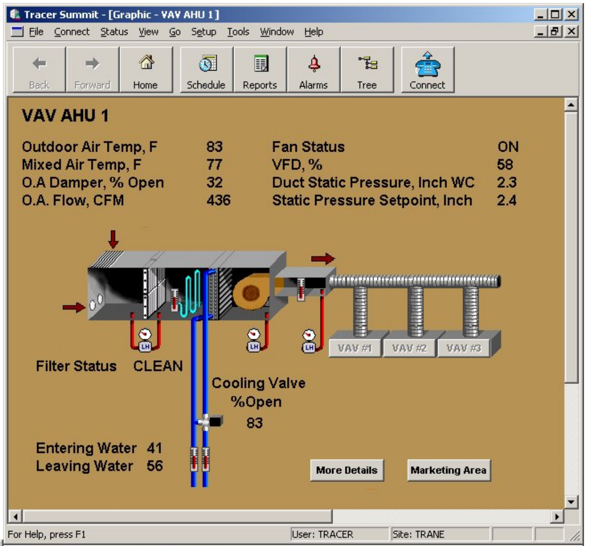
- Industrial “defacto” standard
- Developed originally by Modicon
- Allows data exchange
- Many variations exist – Modbus RTU (remote terminal unit) is most common
- Implemented in a variety of HVAC and industrial equipment
  - VFDs
  - fume hood controllers
  - **power monitoring equipment**
  - lighting control panels
  - DG Sets
  - UPS
  - Precision Air Conditioners

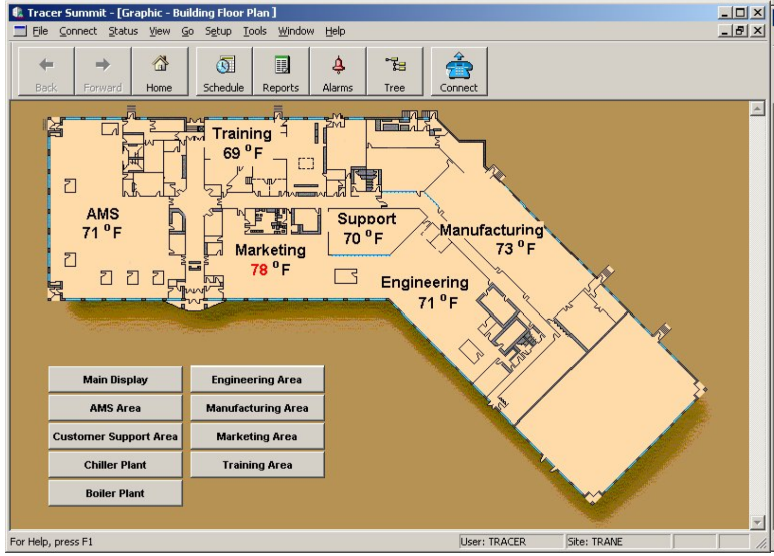
Building Management

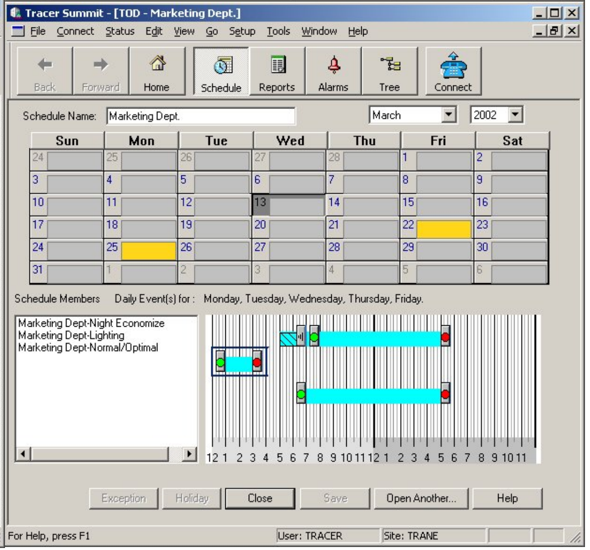


The Day to Day Role of the BMS…

- Control of Building Systems and Services
- Graphic User Interface - Dashboards
- Real Time Monitoring of Building Operation and Performance
- Trending and Logging of Building Operation and Performance
- Time Scheduling of Building Systems
- Fault Management and Alarming
- Control Application Programming
- User Event Management
- Energy Management, Reporting & Analytics





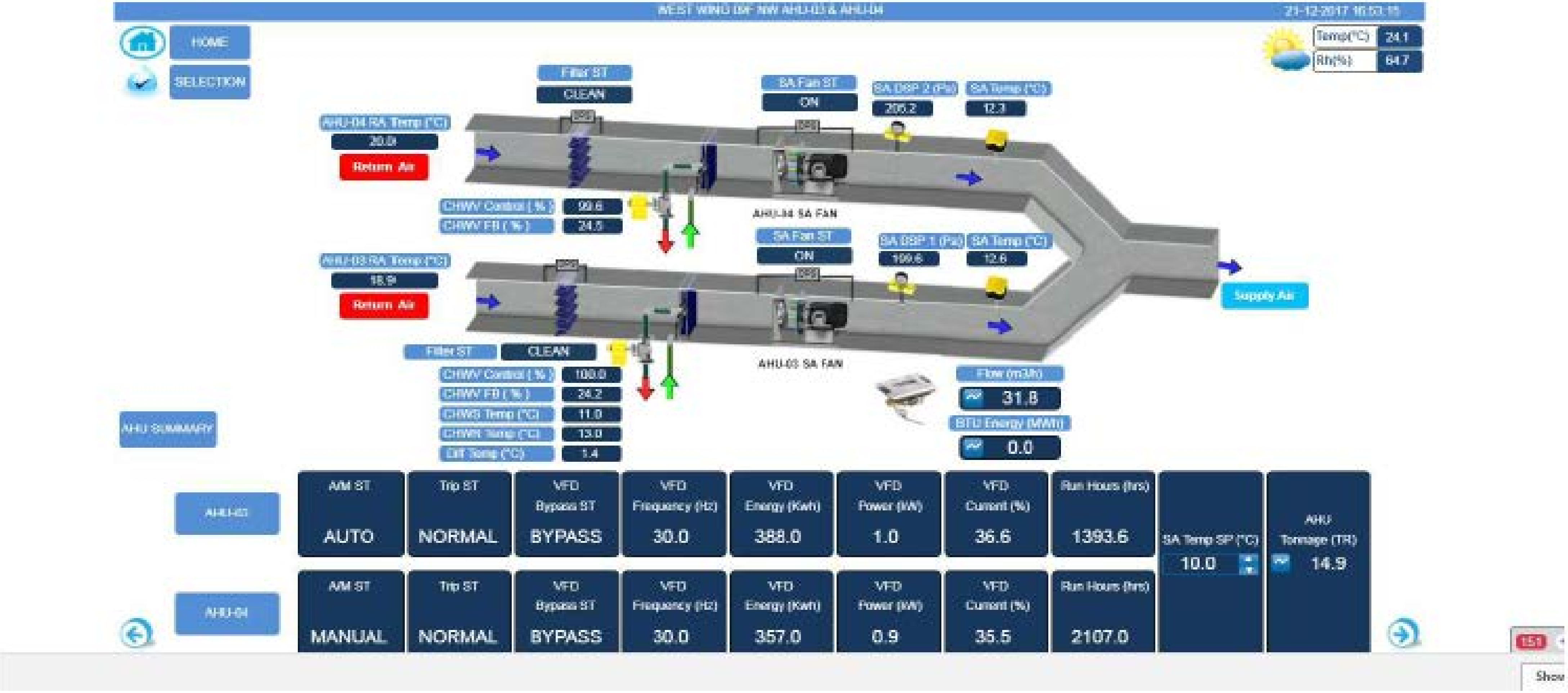


AHU Screen

AHU

AHU Room with 2 AHU's Screen

AHU



AHU Summary Screen

AHU

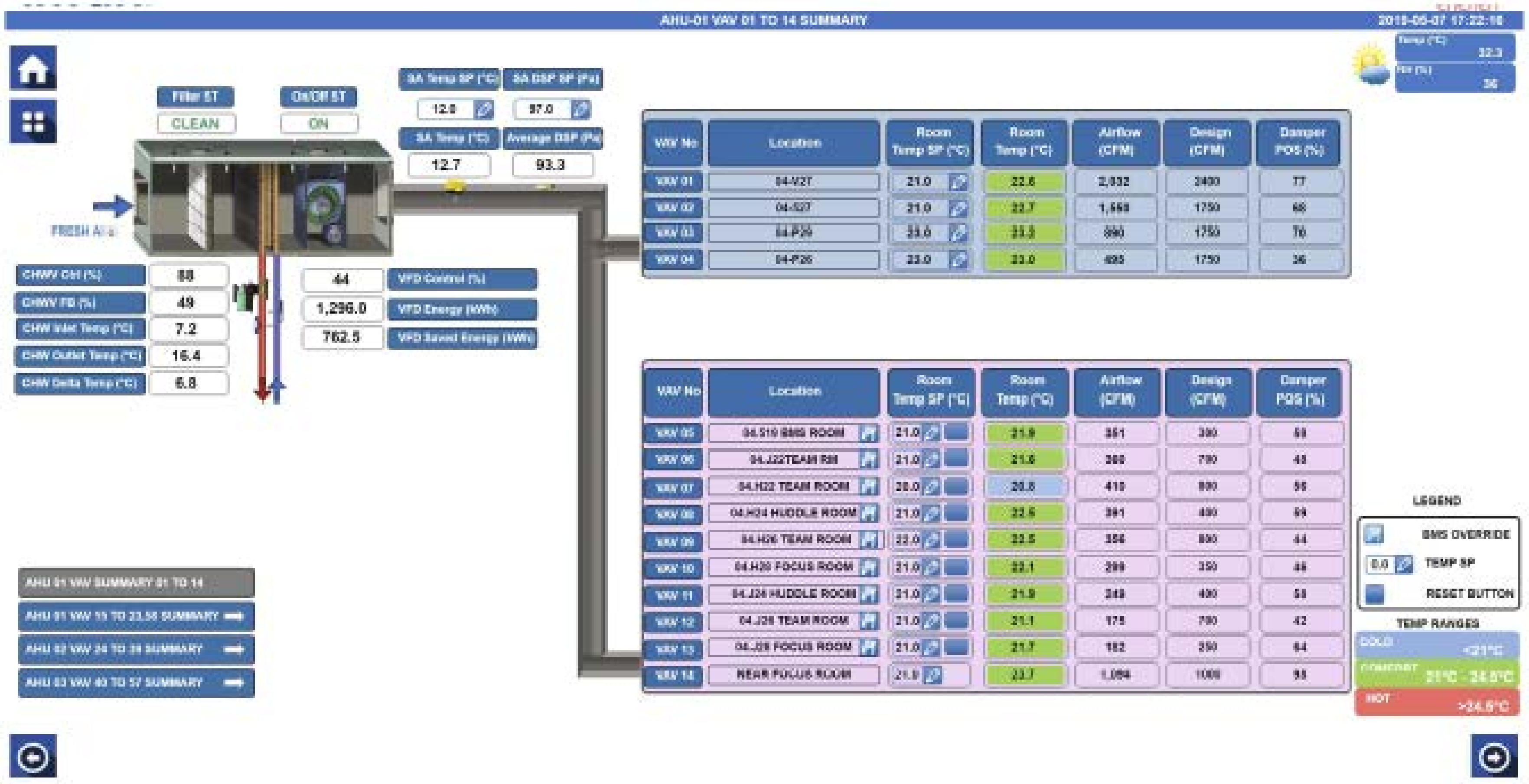
		SEVENTH FLOOR				EIGHTH FLOOR			
PARAMETER	UNIT	AHU 01 - SS	AHU 02 - SS	AHU 03 - NS	AHU 04 - NS	AHU 01 - SS	AHU 02 - SS	AHU 03 - NS	AHU 04 - NS
FA Fan Command	---	SEQ		SEQ		SEQ		SEQ	
FA Fan On/Off Status	---	OFF		OFF		OFF		OFF	
FA Fan Auto/Manual Status	---	AUTO		AUTO		AUTO		AUTO	
Return Air CO2 Setpoint	ppm	750.0		750.0		750.0		750.0	
Return Air CO2	ppm	403.9		421.4		434.4		404.8	
AHU On/Off Status	---	ON	ON	OFF	OFF	OFF	ON	ON	ON
VFD Trip Status	---	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SA Fire Damper Status	---	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
RA Fire Damper Status	---	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
SA Temperature Setpoint	°C	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
SA Temperature	°C	160.0	0.0	160.0	160.0	165.0	165.0	160.0	160.0
CHWV Control	%	100.0	100.0	0.5	0.5	0.5	0.5	100.0	100.0
CHWV Feedback	%	1.4	1.1	1.0	1.0	22.9	0.0	0.8	0.8
SA DSP Setpoint	Pa	72.0	115.0	72.0	95.0	72.0	92.0	98.0	148.0
AVG SA DSP	Pa	70.5	110.7	74.4	93.8	6.5	91.6	97.3	146.8
SA DSP 01	Pa	65.5	110.7	83.5	93.8	8.0	91.6	71.2	146.8
SA DSP 02	Pa	77.7	---	70.4	---	5.2	---	124.3	---
VFD Speed	Hz	34.1	36.7	0.0	0.0	0.0	26.9	33.7	35.9
VFD Control	%	60.7	77.6	0.0	12.4	100.0	12.9	59.5	72.8
VFD Run Hours	%	77.4	79.6	4.9	4.3	85.8	62.1	79.6	81.7

CSU Screen

CSU

VAV SUMMARY SCREEN

VAVs

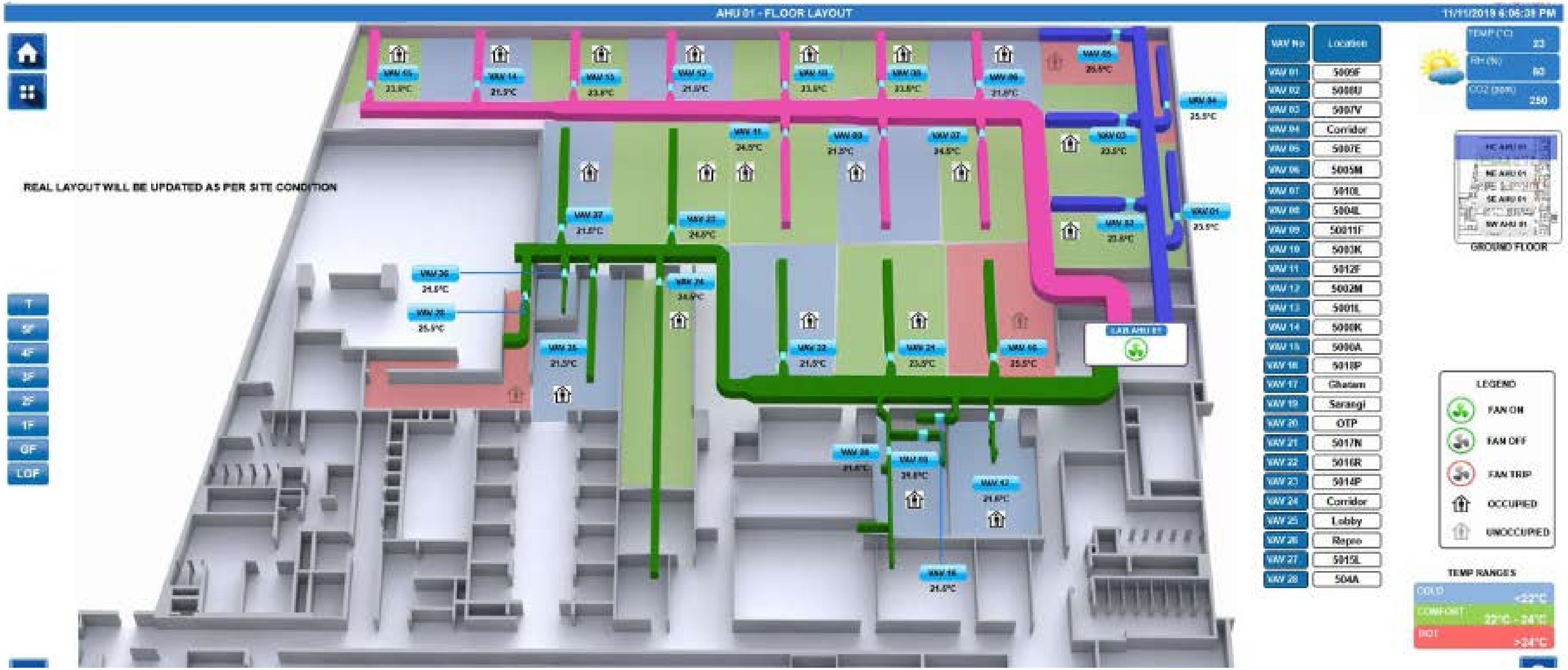


VAV & Occupancy Layout Screen

VAVs

Floor Heat Map Screen

Temp

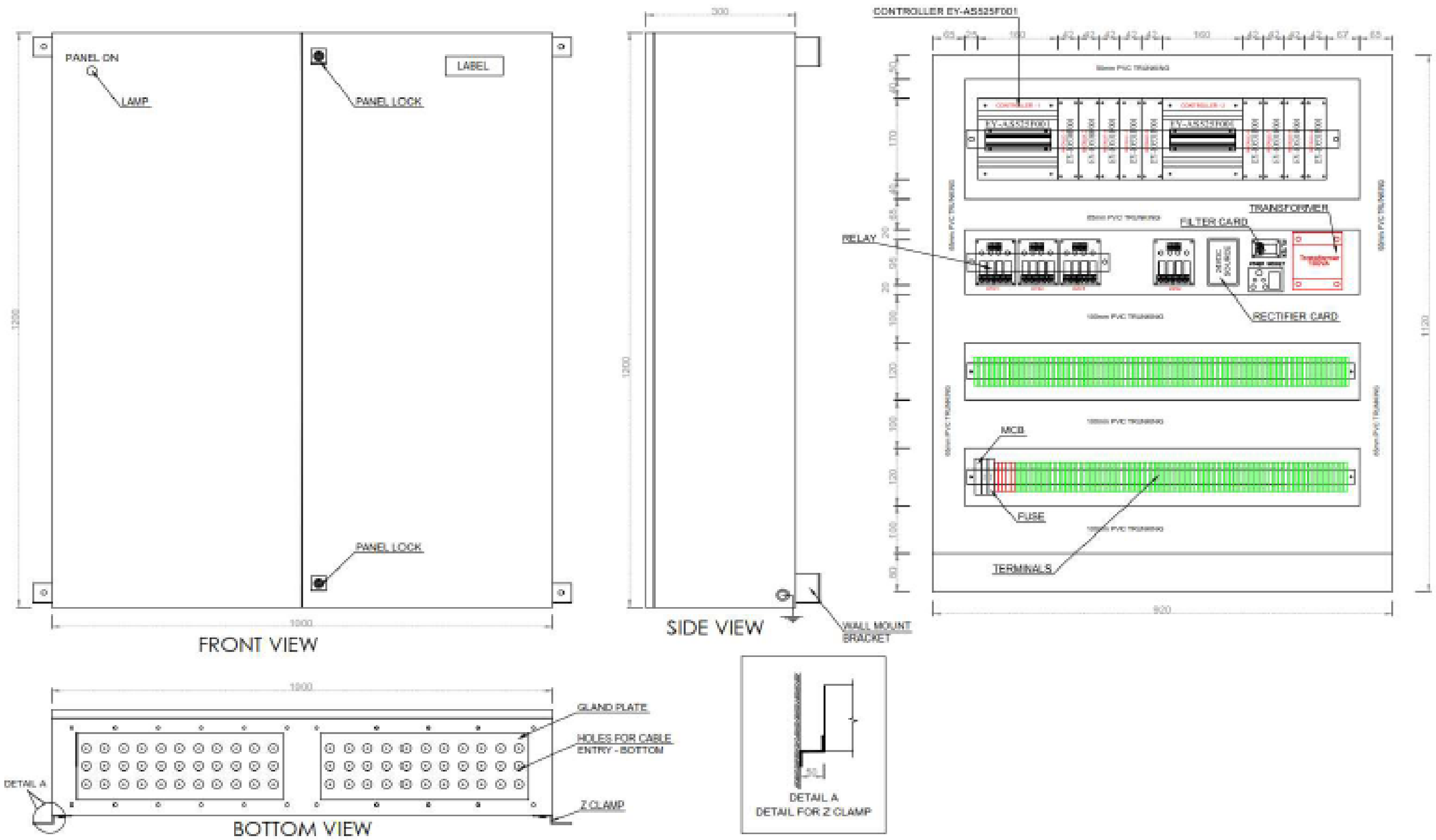


Floor LMS Map Screen

Lux

Sample Panel Design

DDC Panels

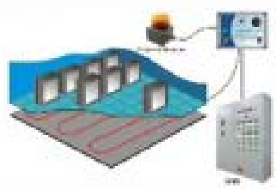


WLD Integration

WLD

WATER LEAK DETECTOR (WLD) 6/13/2018 8:53:30 PM

TEMP	0.0
RH	0.0
CO2	0.0



real image will be placed later

PARAMETER	UNIT	WLD 01	WLD 02	WLD 03	WLD 04	WLD 05
Alarm ST	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Hooter Healthy ST	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Door ST	--	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE
Zone-01 Leak Alarm	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Zone-01 Open	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Zone-01 Short	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Zone-02 Leak Alarm	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Zone-02 Open	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Zone-02 Short	--	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL

Rodent System Integration

RRS

RODENT REPELLENT SYSTEM (RRS) 2019-12-05 20:35:09

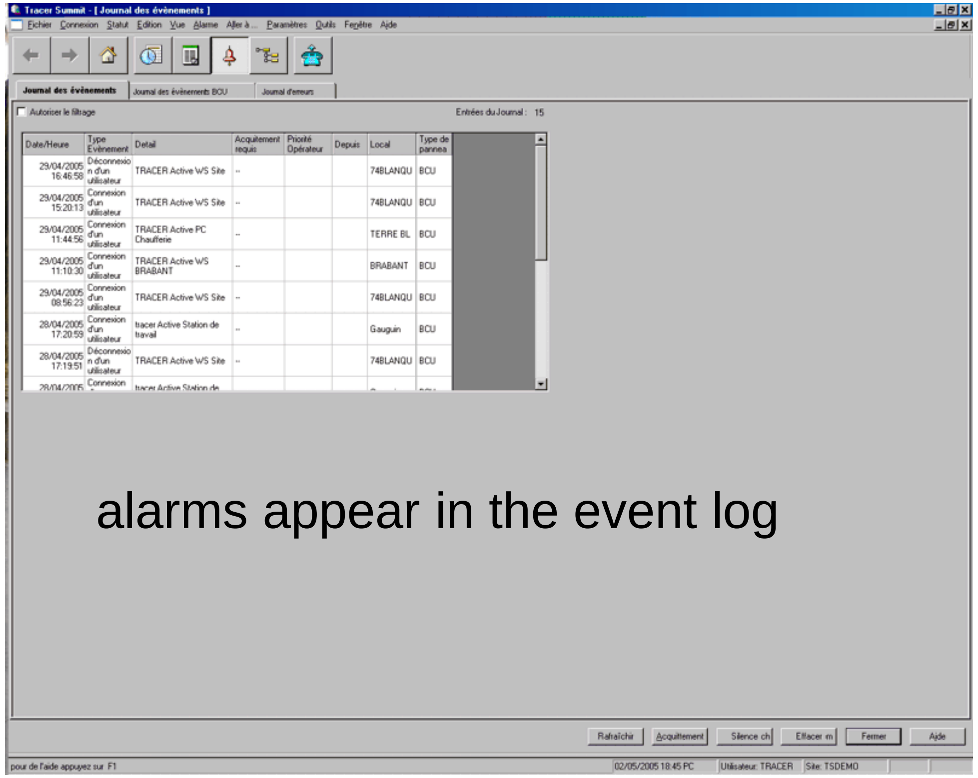
PARAMETER	UNIT	UPS & BATT Rm RRS-01	DC,Comms & PAC RRS-02	TE 4F HUB RM RRS-03	TE 2F&3F HUB RM RRS-04	TD 2F&3F HUB RM RRS-05
Wave Speed	wps	0.0	0.0	0.0	0.0	0.0
Wave Density	kHz	0.0	0.0	0.0	0.0	0.0
Current Band	—	0.0	0.0	0.0	0.0	0.0
Total Transducers	Qty	0.0	0.0	0.0	0.0	0.0
Faulty Transducers	Qty	0.0	0.0	0.0	0.0	0.0

Normal

Comm. Fault

Improved Tenant Comfort Conditions

- Real time monitoring of tenant conditions
- Greater load based control strategies
- Trend data of performance, improved fault finding
- Air quality management (CO_2)
- After hours operational requests, tenant billing
- Alarm notifications of faults reduce downtime
- Automated change over of failed equipment

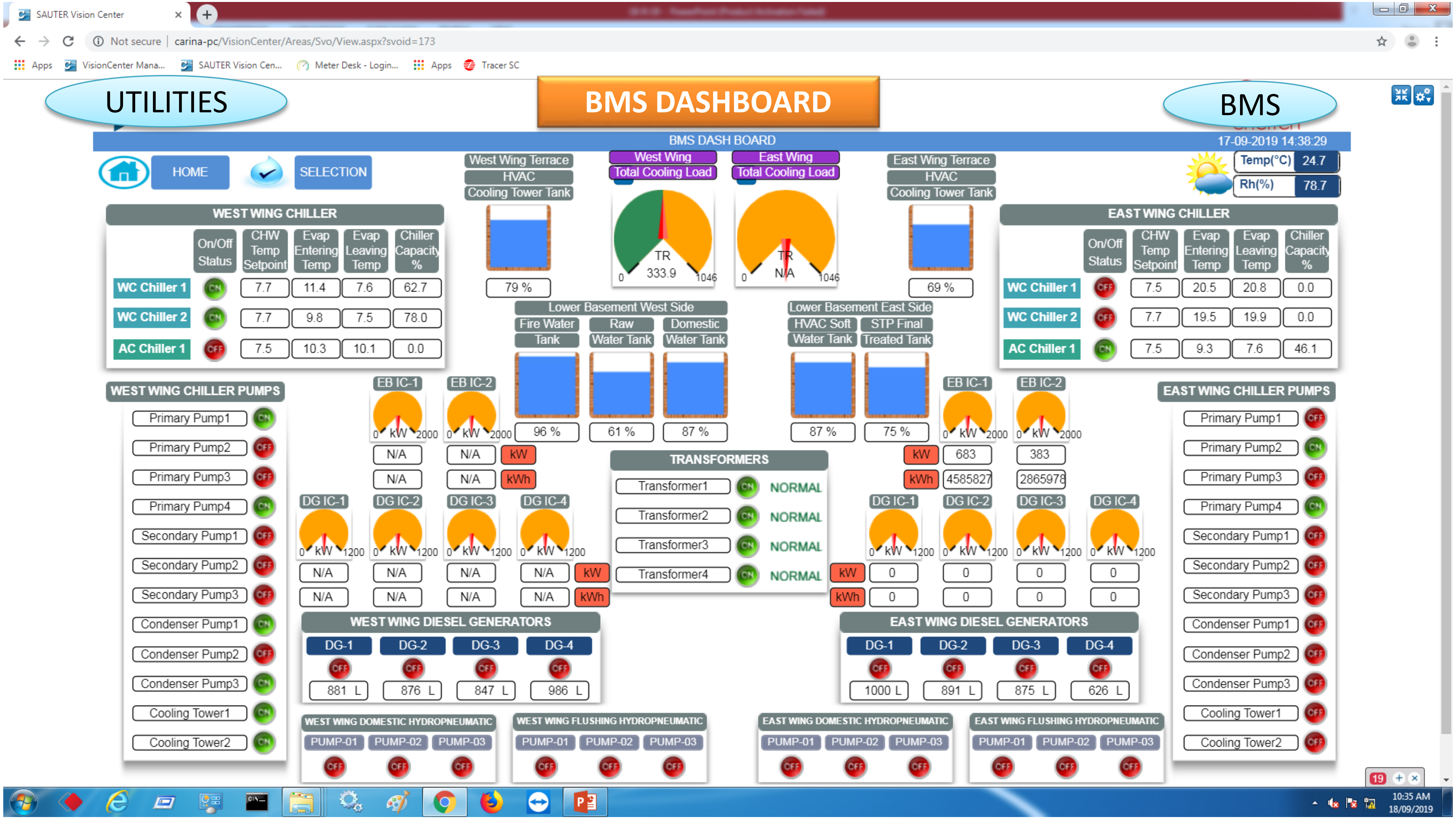


alarms appear in the event log

Energy Management and Reduce Operational Costs

- Optimal start and stop of plant
- Building warm up and cool down cycles
- Night purge
- Automatic Seasonal plant sequence selection
- Seasonal temperature setting adjustments
- Load based control strategies
- Economy cycle control including CO_2
- Equipment runtime monitoring and duty cycling
- Occupancy control and control setback

BMS Dashboard



Challenges in Building Operations Today . . .

- **Expectations and Requirements from various stakeholders in a building are very different**
- **Scale is increasing**
- **Owner wants centralized Operations and Management**

Facility Manager

Energy Manager

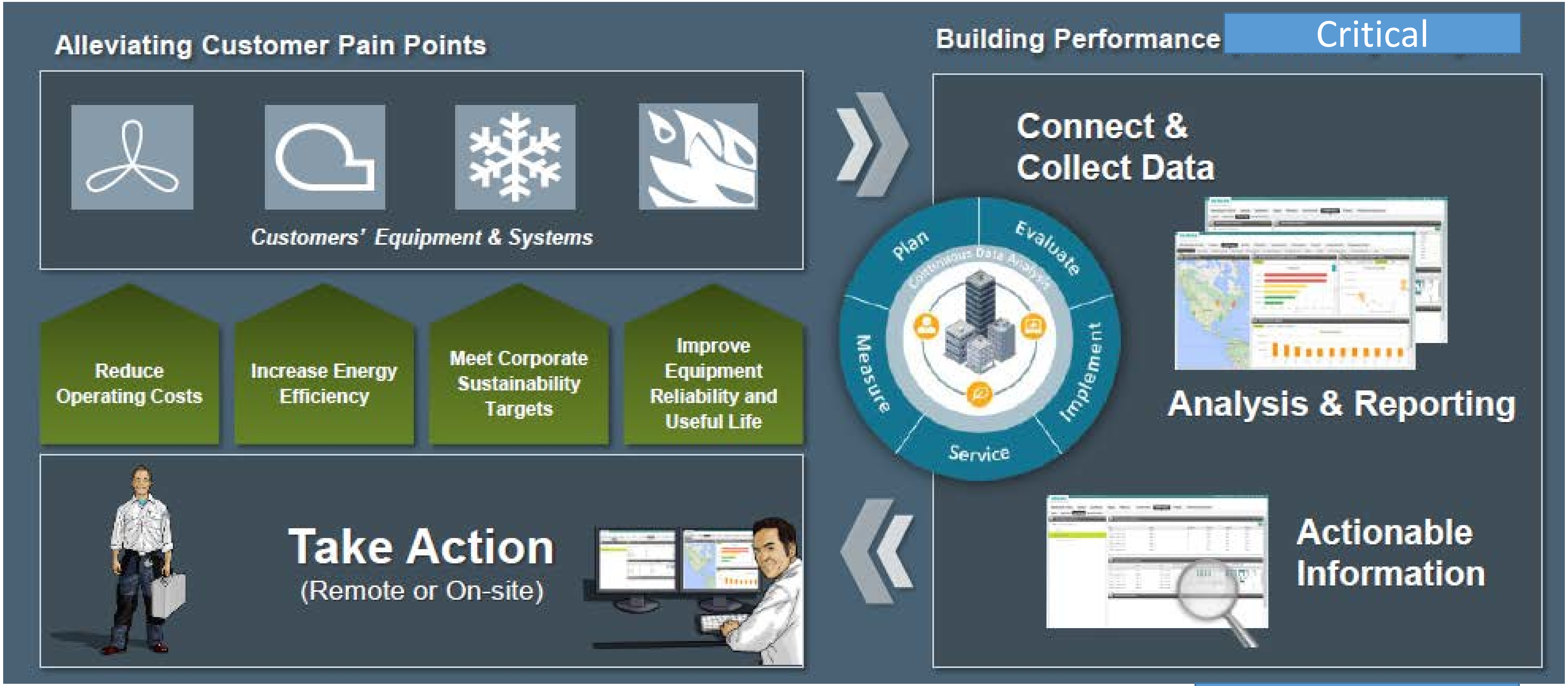
Building Tenant

Maintenance Personnel

Building Owner

Building Occupant

Analytics of Data for efficient Building Operation



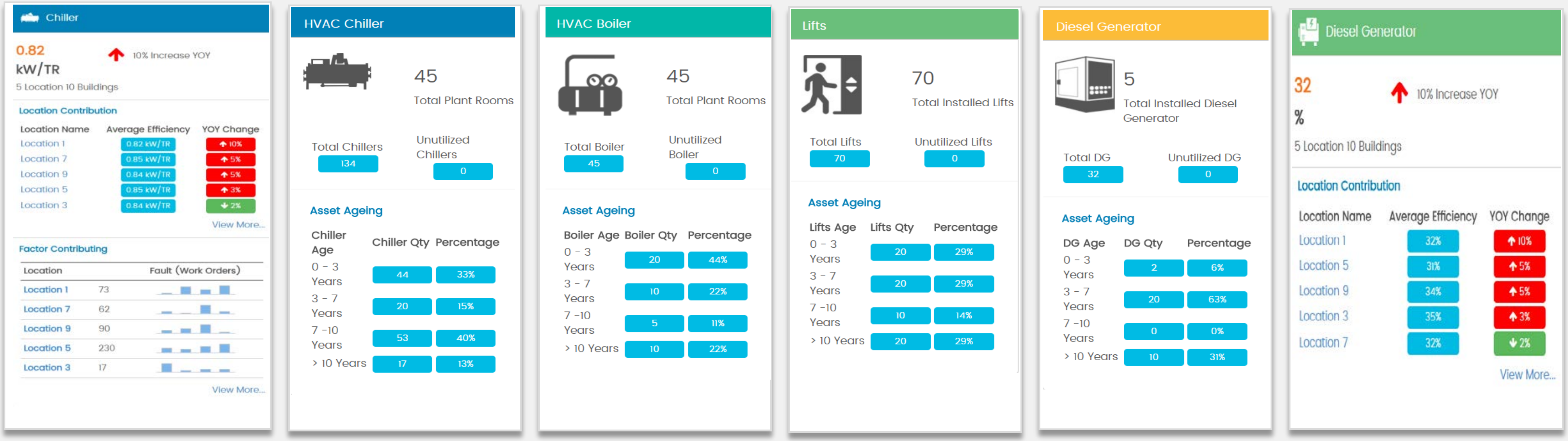
Analysis of HVAC Data ?

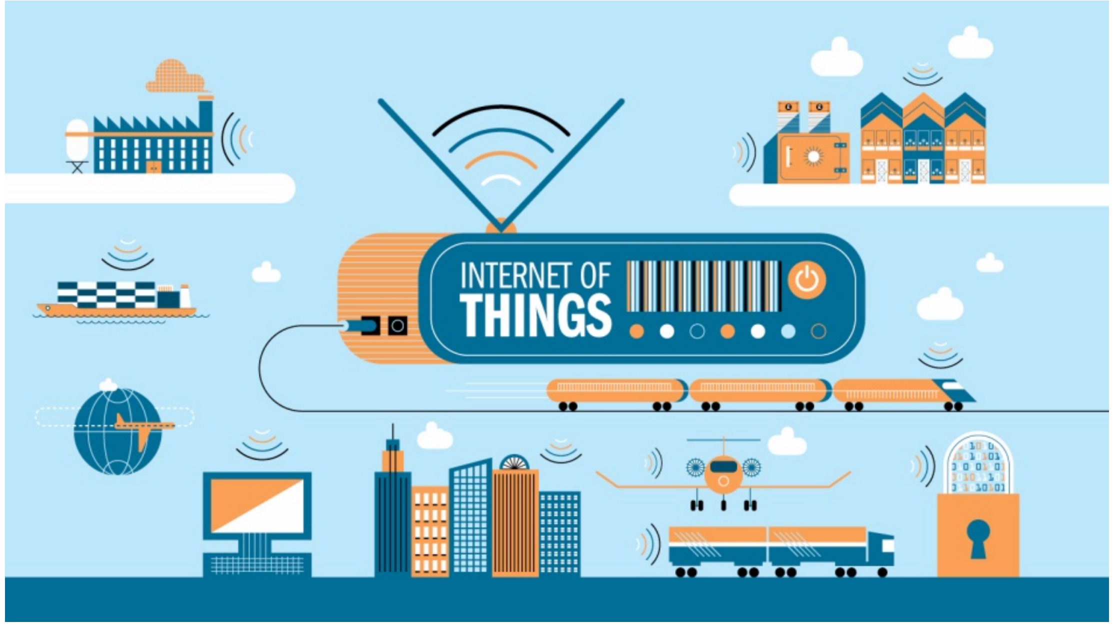
Data Analytics

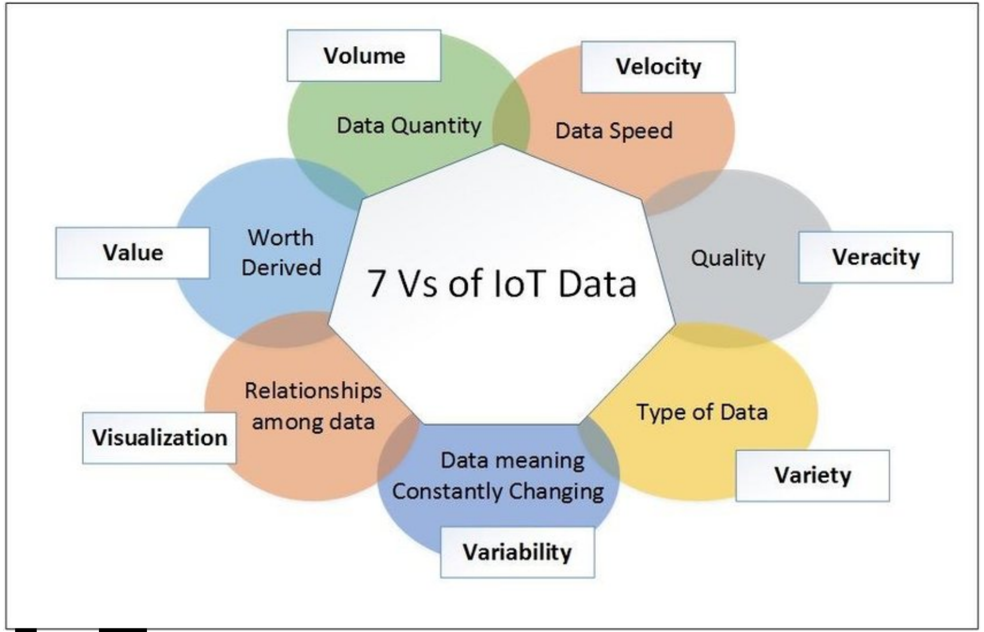
Asset Performance

Equipment KPI Cards

View to better understand equipment-specific efficiency, asset age analysis and any changes with respect to baseline from the previous year.

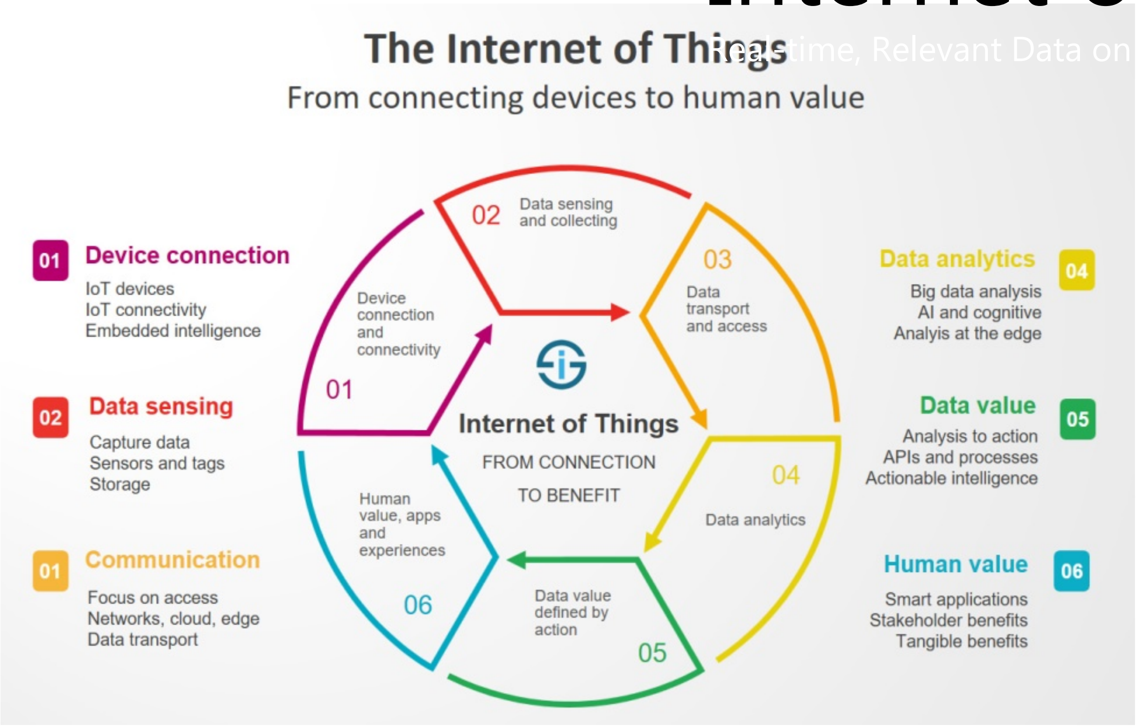






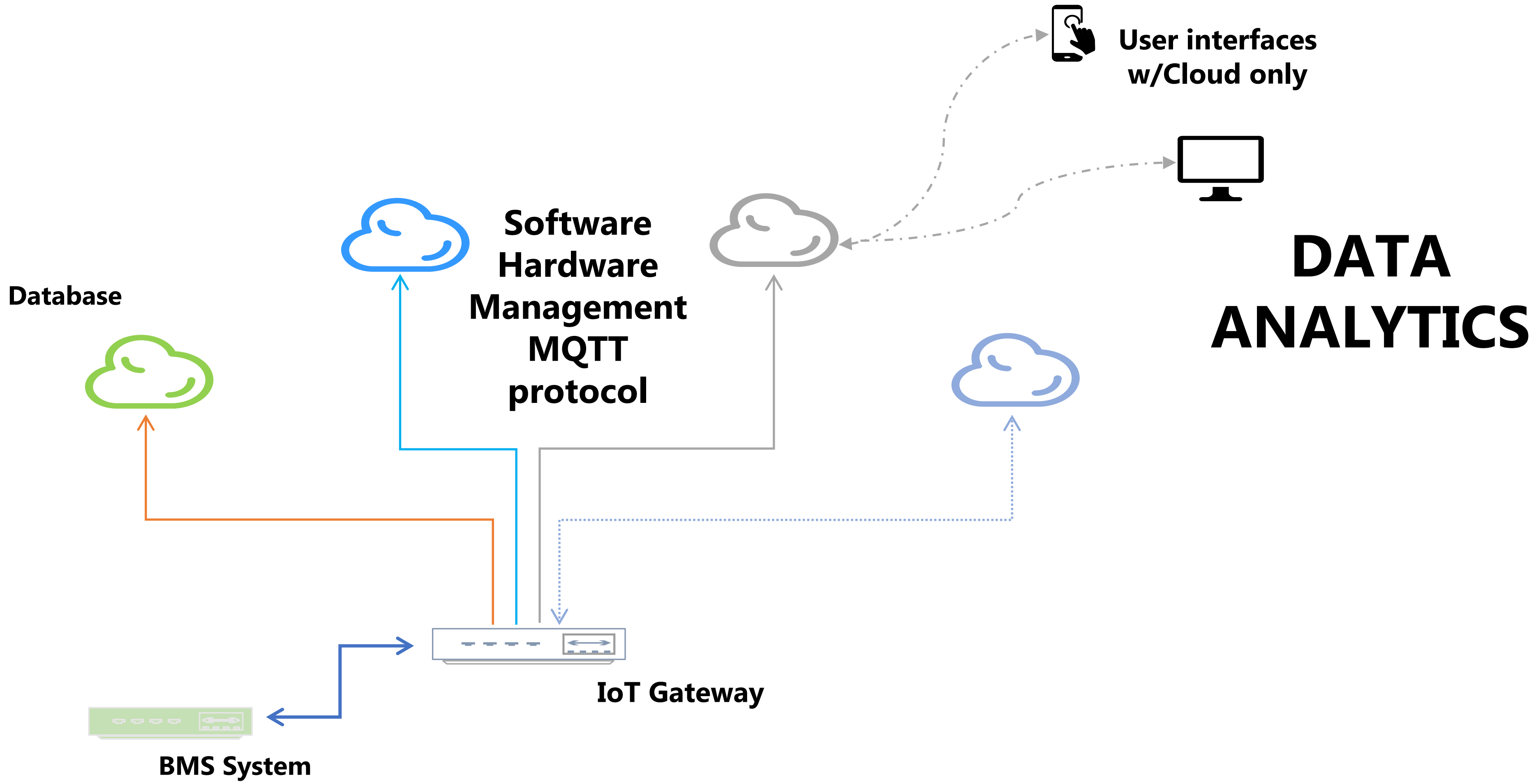
Internet of Things - IoT

Real-time, Relevant Data on



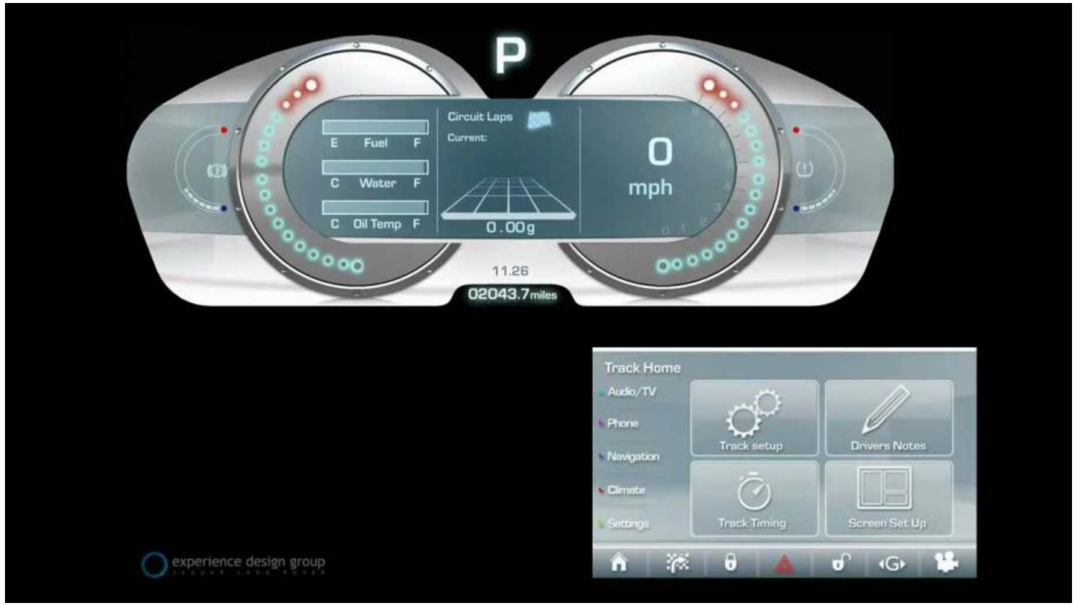
The **Internet of Things**, or **IoT**, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

System Architecture for IoT



Dashboard of Cars in 1914

Dashboard Cars of today



Buildings and Cars are similar – because both run on FUEL

Summary

- ❖ BMS helps control and monitor all assets
- ❖ helpful tool in the hands of a Facility Manager
- ❖ Improves Operational response and efficiency
- ❖ helps owner to reduce energy bills
- ❖ enhances life cycle of the equipment
- ❖ multiple sites can be monitored/controlled from a single remote source

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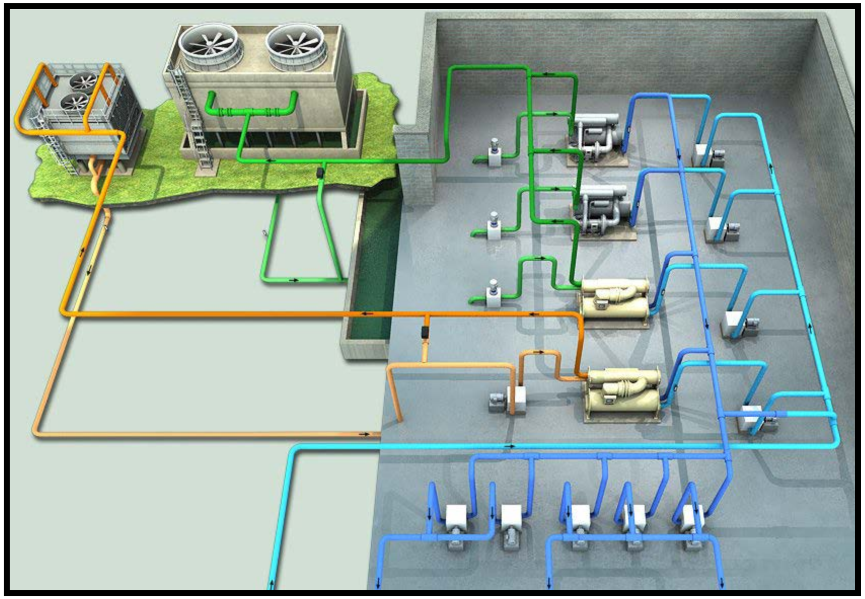
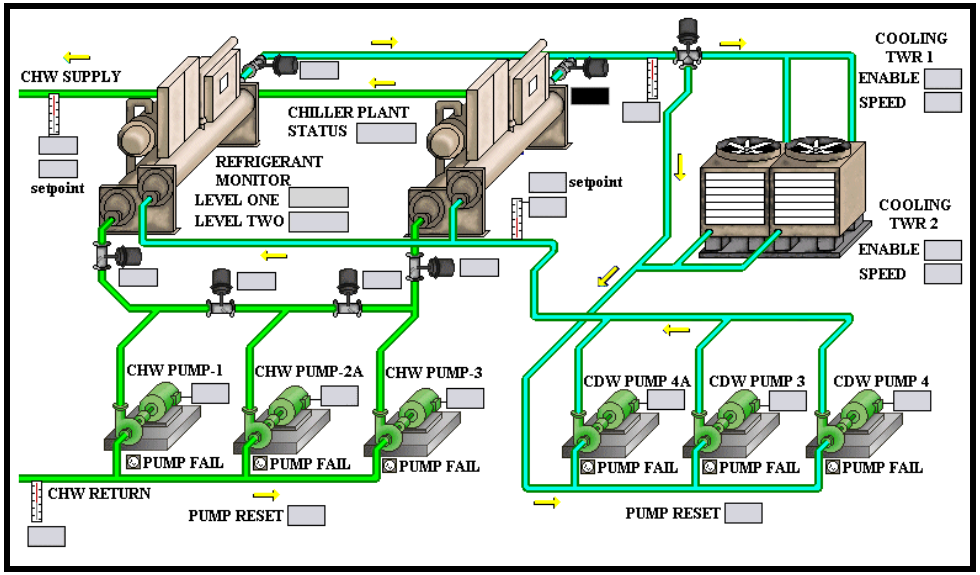
Chiller Plant Management System - how to get maximum out of this

C Subramaniam
LEED Fellow
RAL REGIONAL LECTURER

Chiller Plant Management System – the right way to design & operate





Energy Efficiency and Reliability to the end user

Chiller Plant Management System – the right way to design & operate

Introduction

Different types of CHW Systems

Components of a typical Chiller Plant

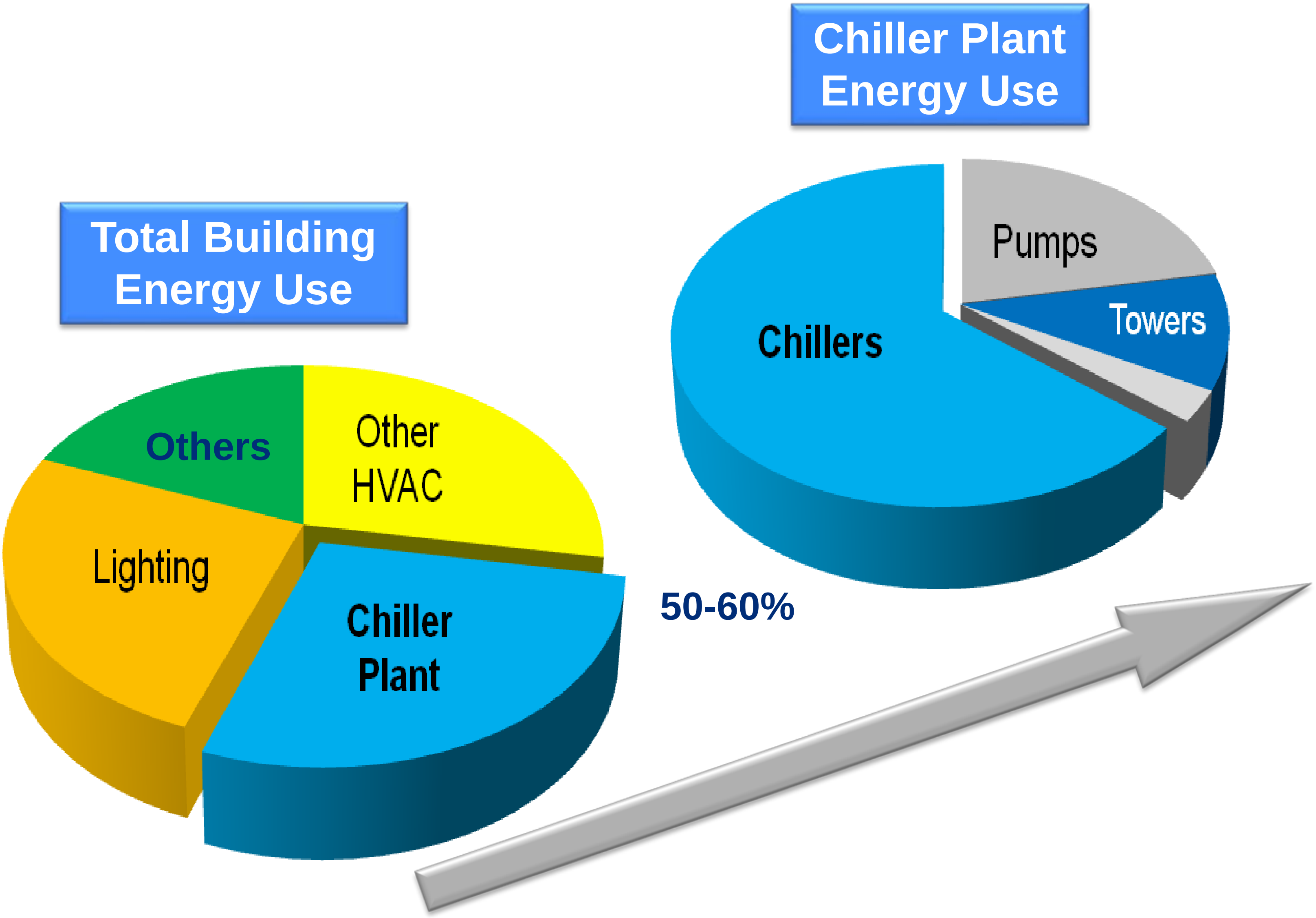
Discussion on the right way to locate Temperature Sensors

How to ensure correct methodology of operation of CPM

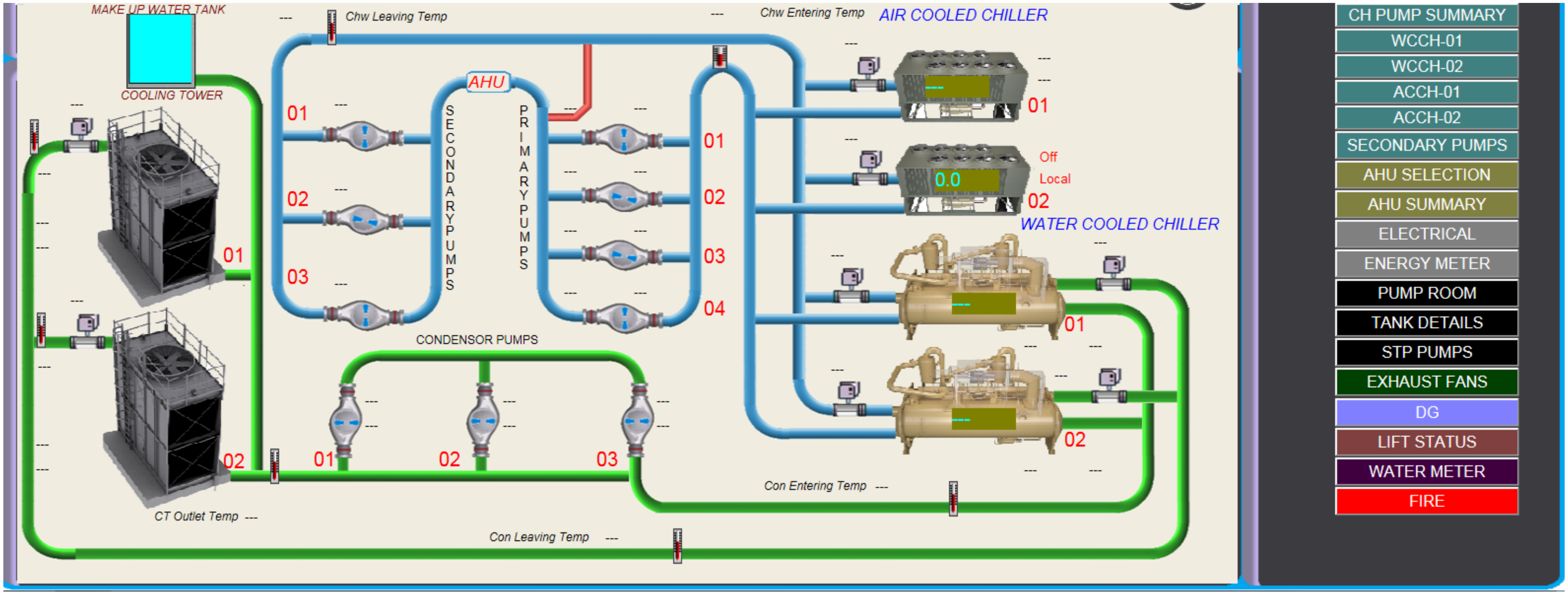
Benefits of having an automated Chiller Plant Management System

Operate the system right
and get Energy Savings

Chiller Plant in a HVAC System is a major energy consuming component



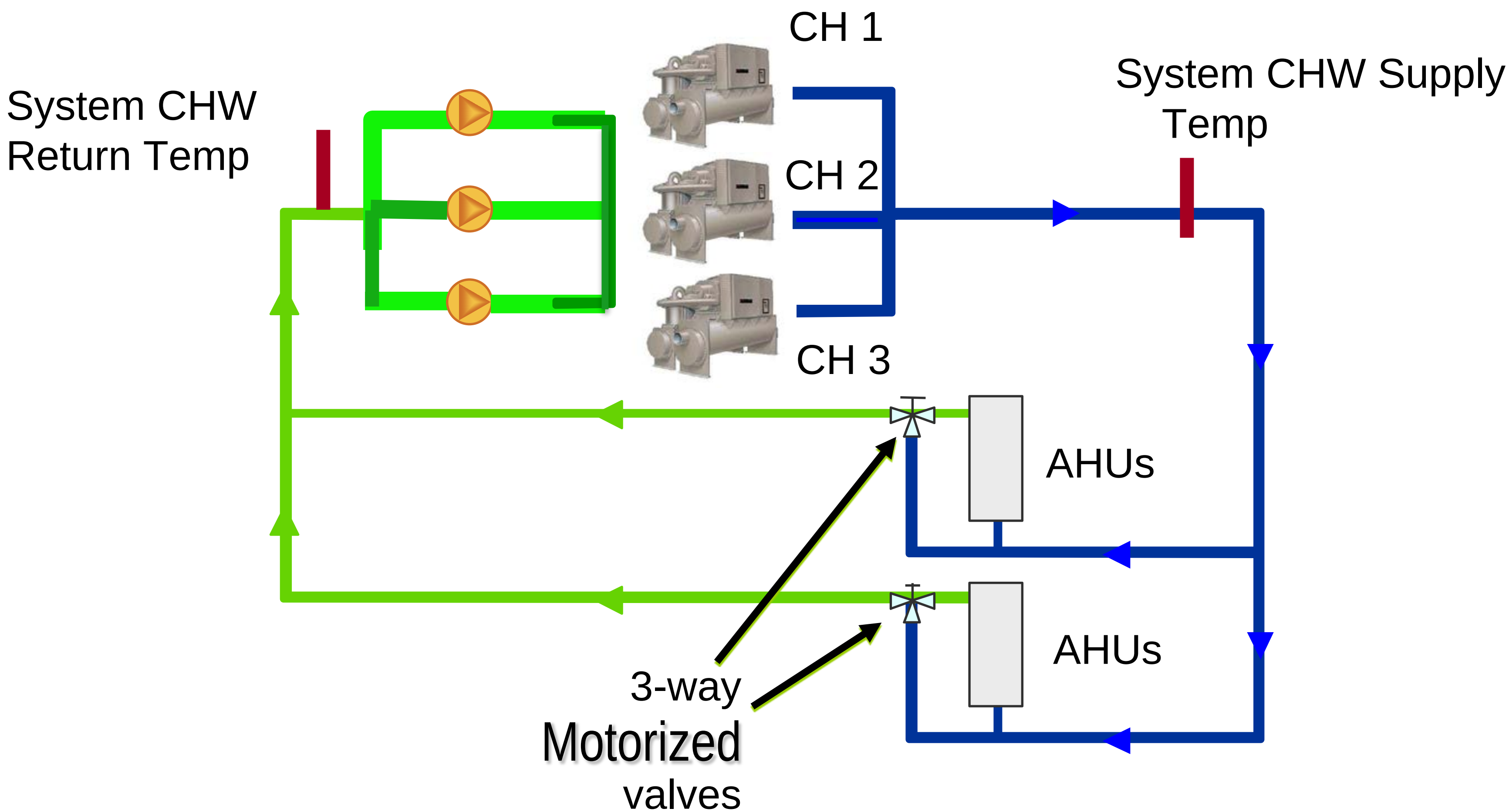
Chiller Plant Control is part of a generic Building Management System (BMS)



Different Types of Chilled Water Systems

- Constant flow CHW System
- Variable Flow CHW System
  - Constant Primary and Variable Secondary
  - Variable Primary Flow
- Chiller Plant Controls

Case I: Constant Flow Chilled Water System



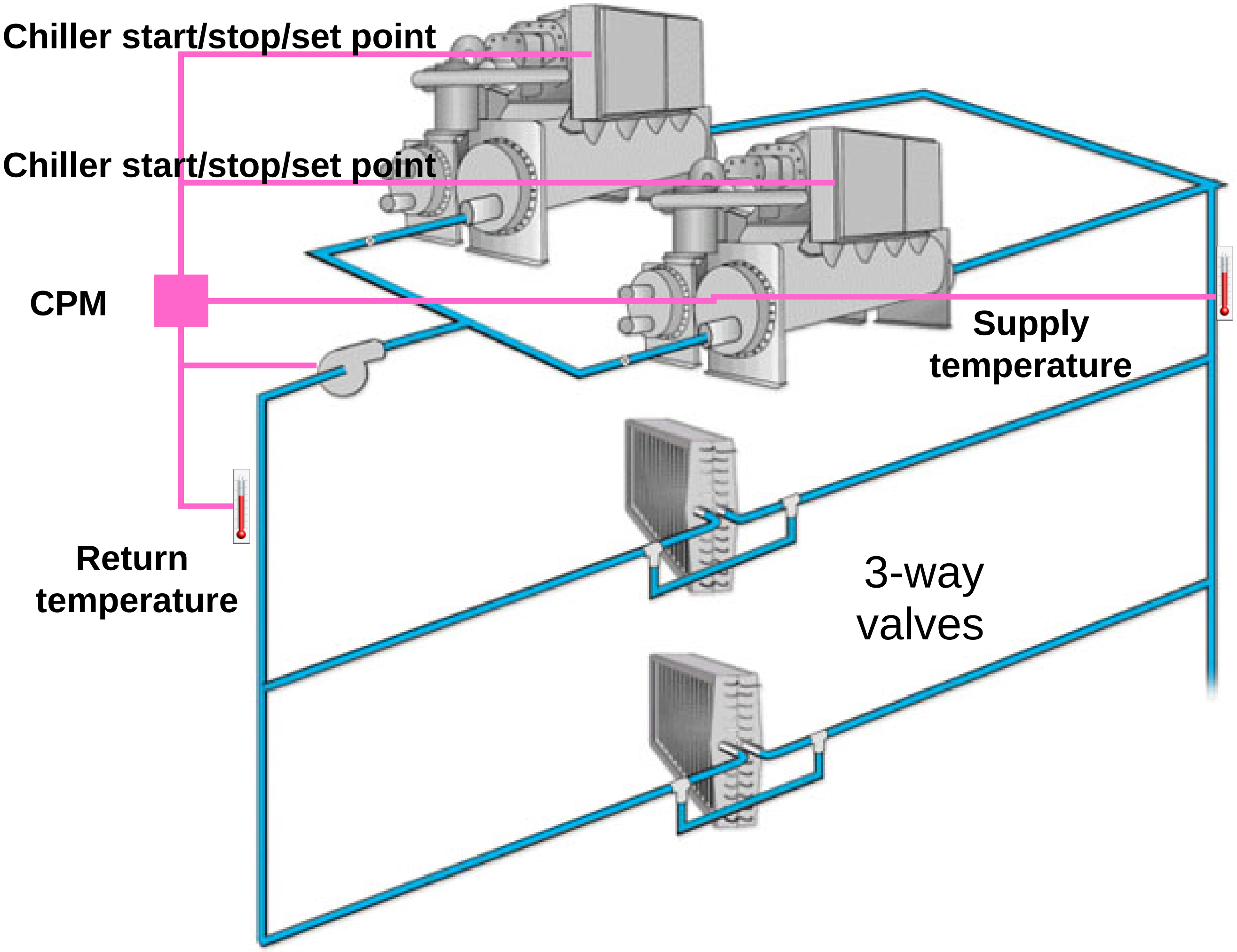
Don't switch off pumps even if chiller one/two chillers are off

Constant Flow Chilled Water System

- Important Points to be noted during operations
- CHW System is designed for 100% CHW flow through the system always
- Whether one chiller works or more at any point of time, all the system pumps should work always
- Chilled Water will bypass the AHU coils through the 3-way Motorized Valves based on demand
- Chiller Leaving Temperature Setpoint Resets for operating chillers

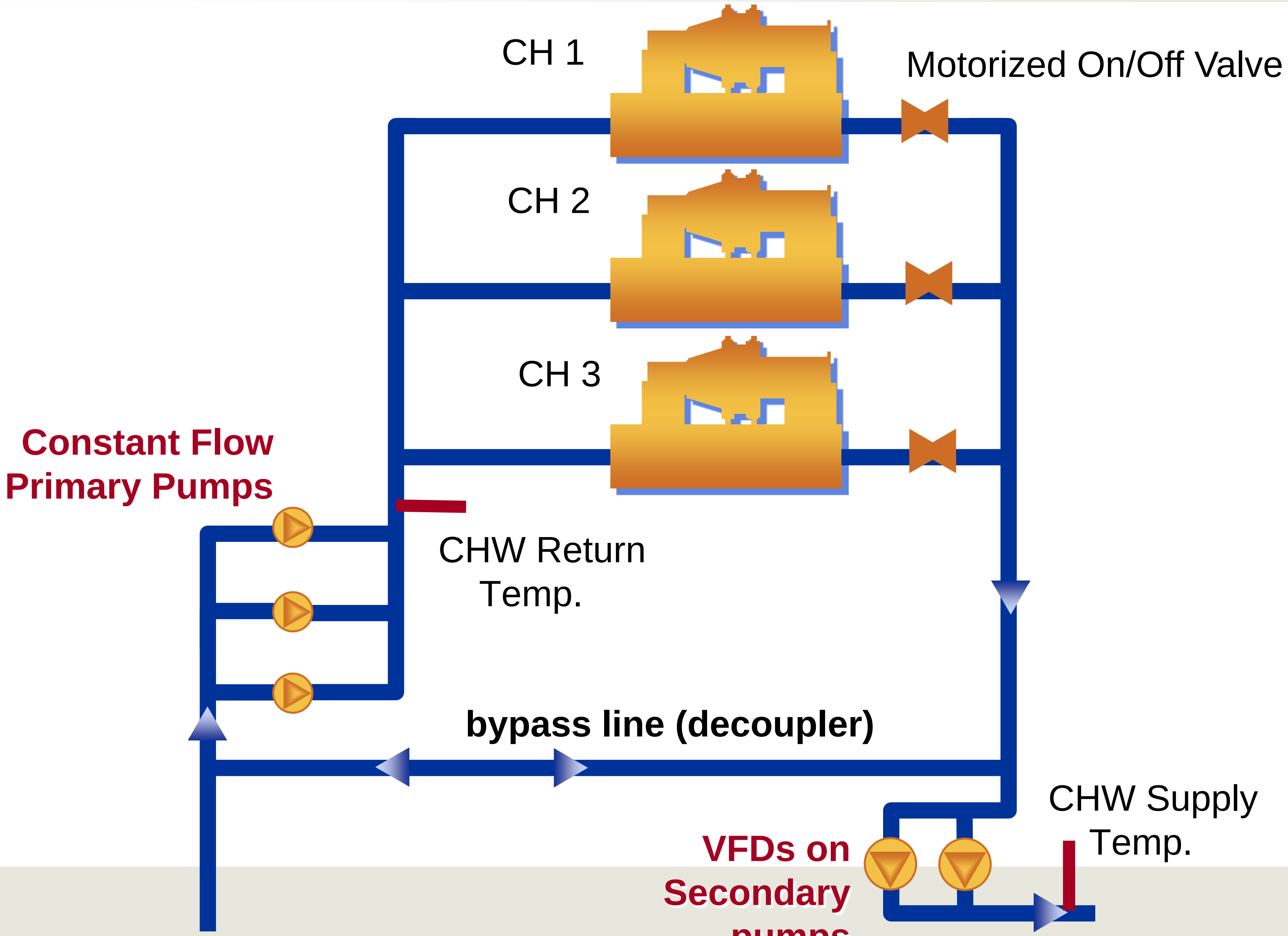
Operators Training required on this

Constant Flow Chilled Water System - Controls



Change chiller set point to regulate the load and have a control on energy consumed

Case II: Primary – Secondary CHW System



Load Determination – key to energy savings in a Chiller Plant

Applies to Constant or Variable Flow systems

Add logic

- Based on Supply Temp and Chilled Water Set point
-Operator editable delay times and dead bands

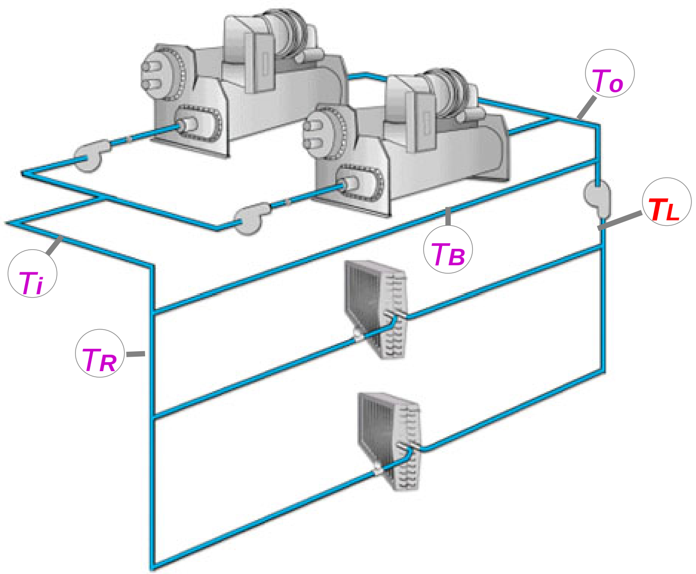
Subtract logic

- Based on Supply/Return Water Temps or Bypass Flow *(for large systems)* and Chiller Capacities
-Operator editable delay times and dead bands

Custom

- Adaptable to suit customer specific algorithm requirements

Add & Subtract Logic



T_L : PROCESS TEMPÉRATURE

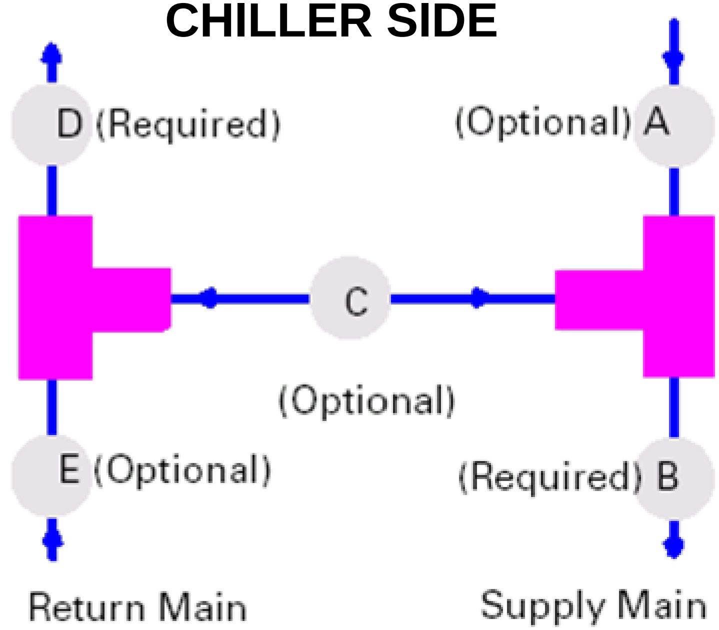
T_R : Process Return Température

T_I : CHILLER INPUT TEMPÉRATURE

T_O : Chiller Output Température

T_B : Bypass Température

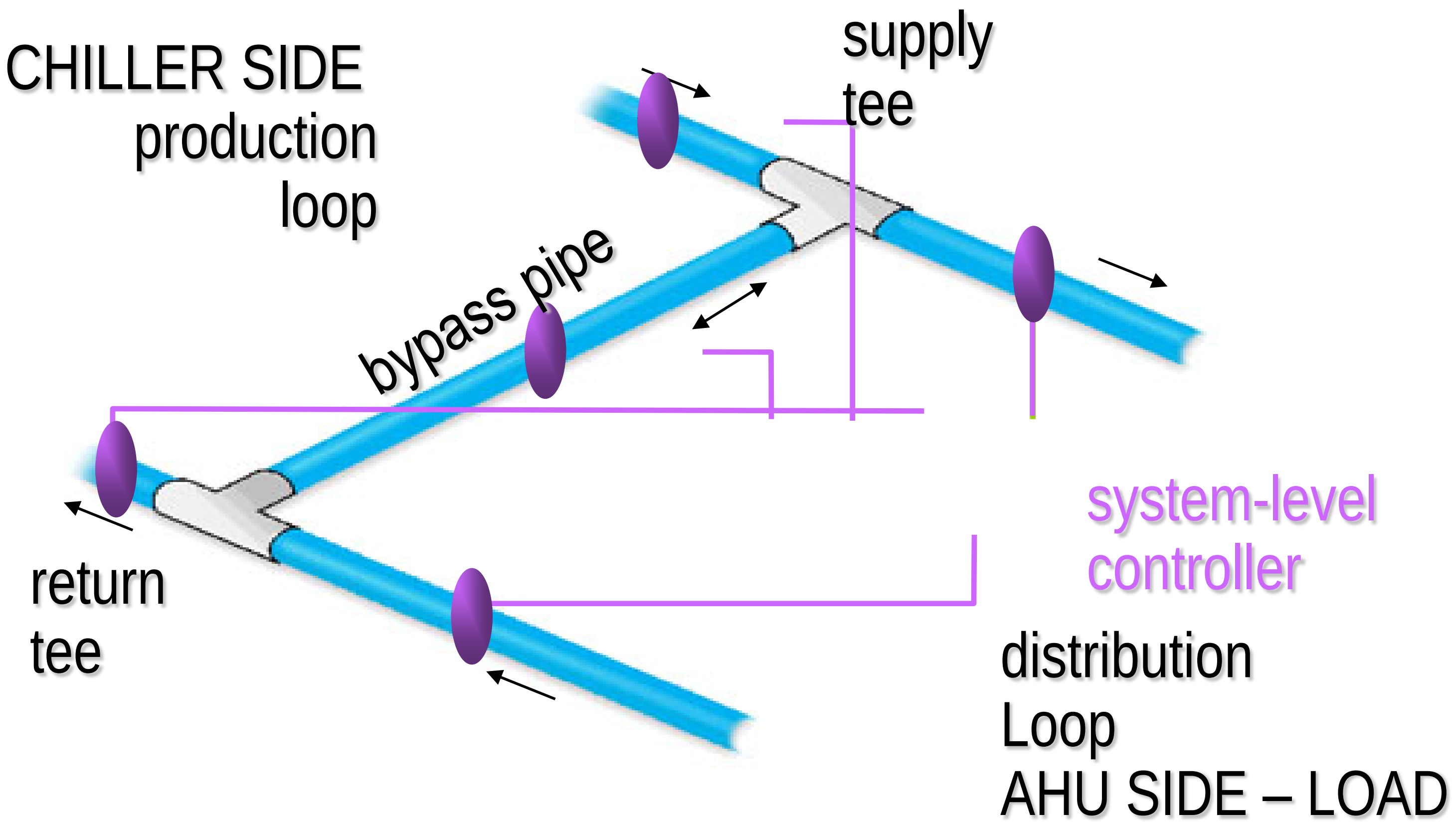
CHILLER SIDE



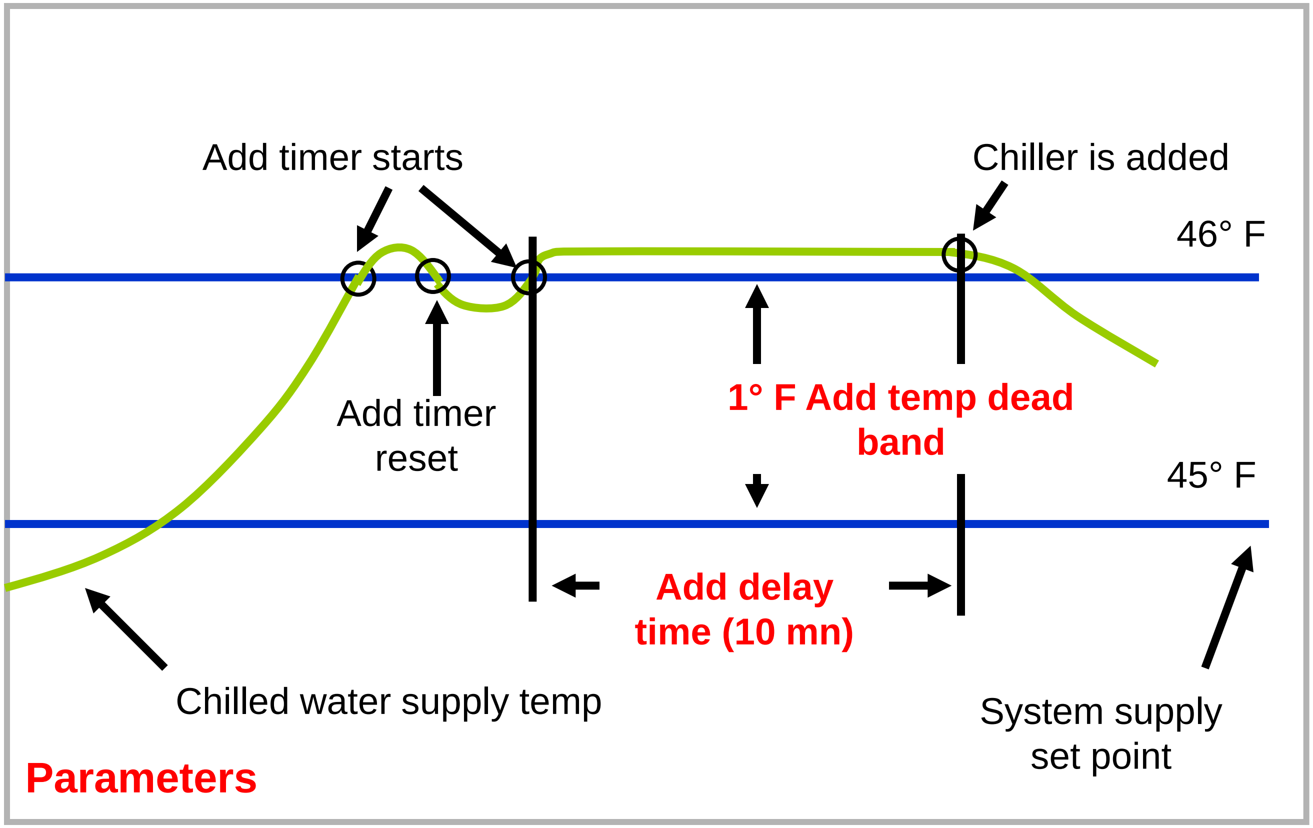
Temperature-sensing

LOAD SIDE - AHUs

Location of Temperature Sensors for proper Chiller Sequencing



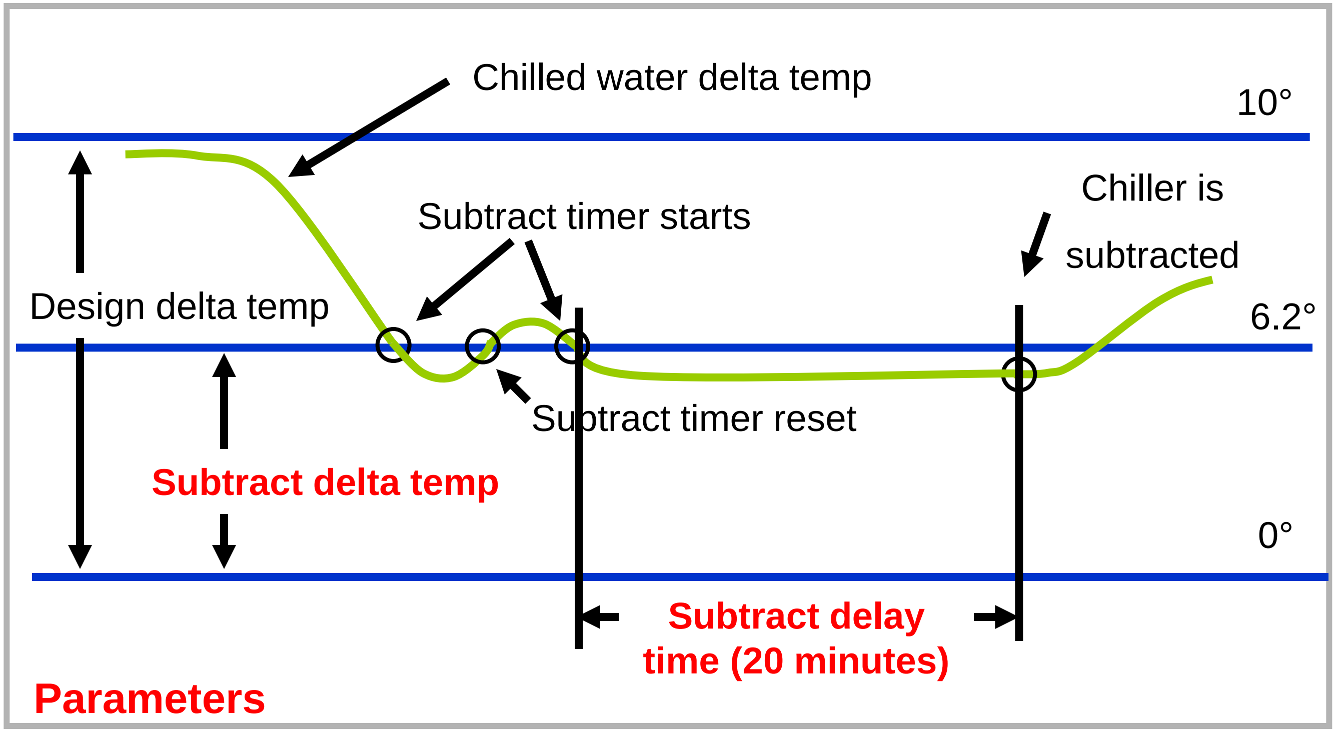
Add Example



Prevents Unnecessary Cycling

Subtract Example

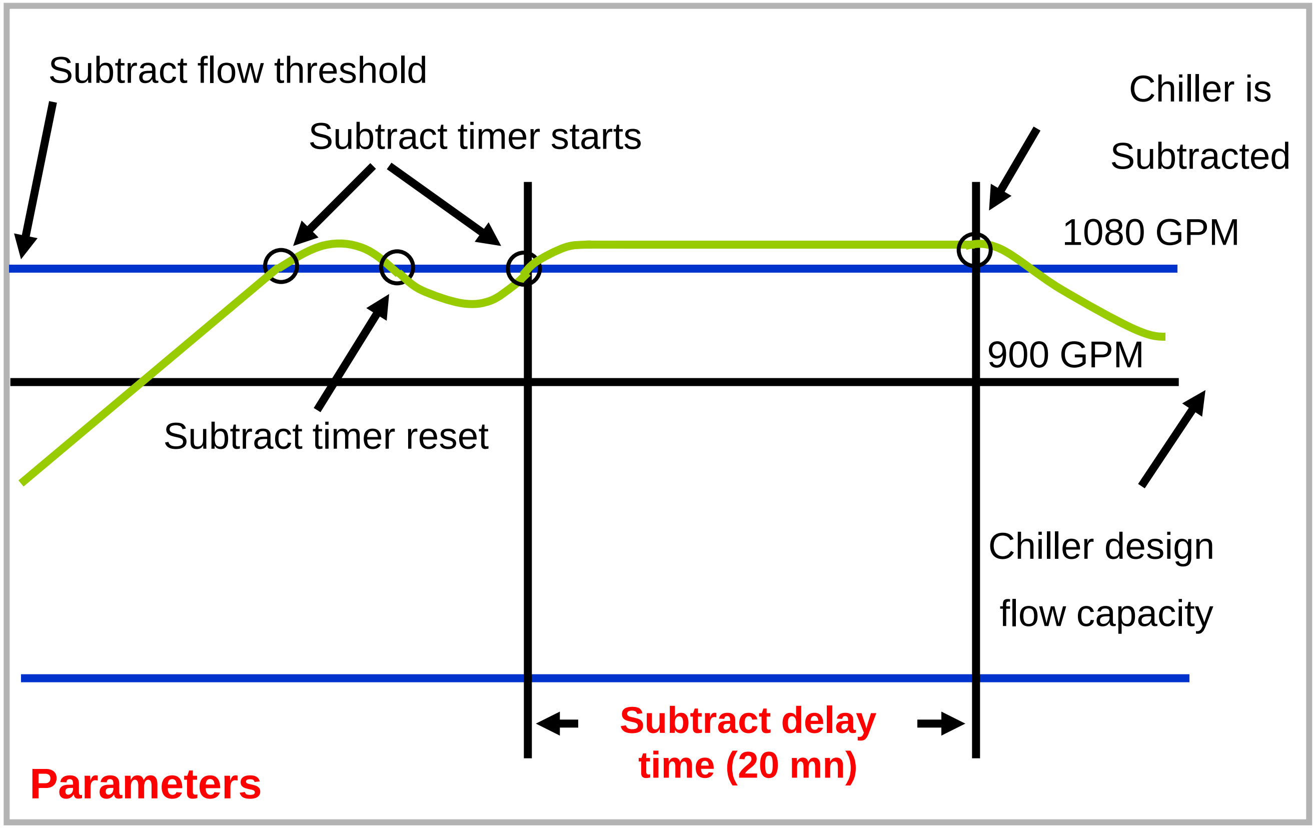
Based on Temperature



Prevents Unnecessary Cycling

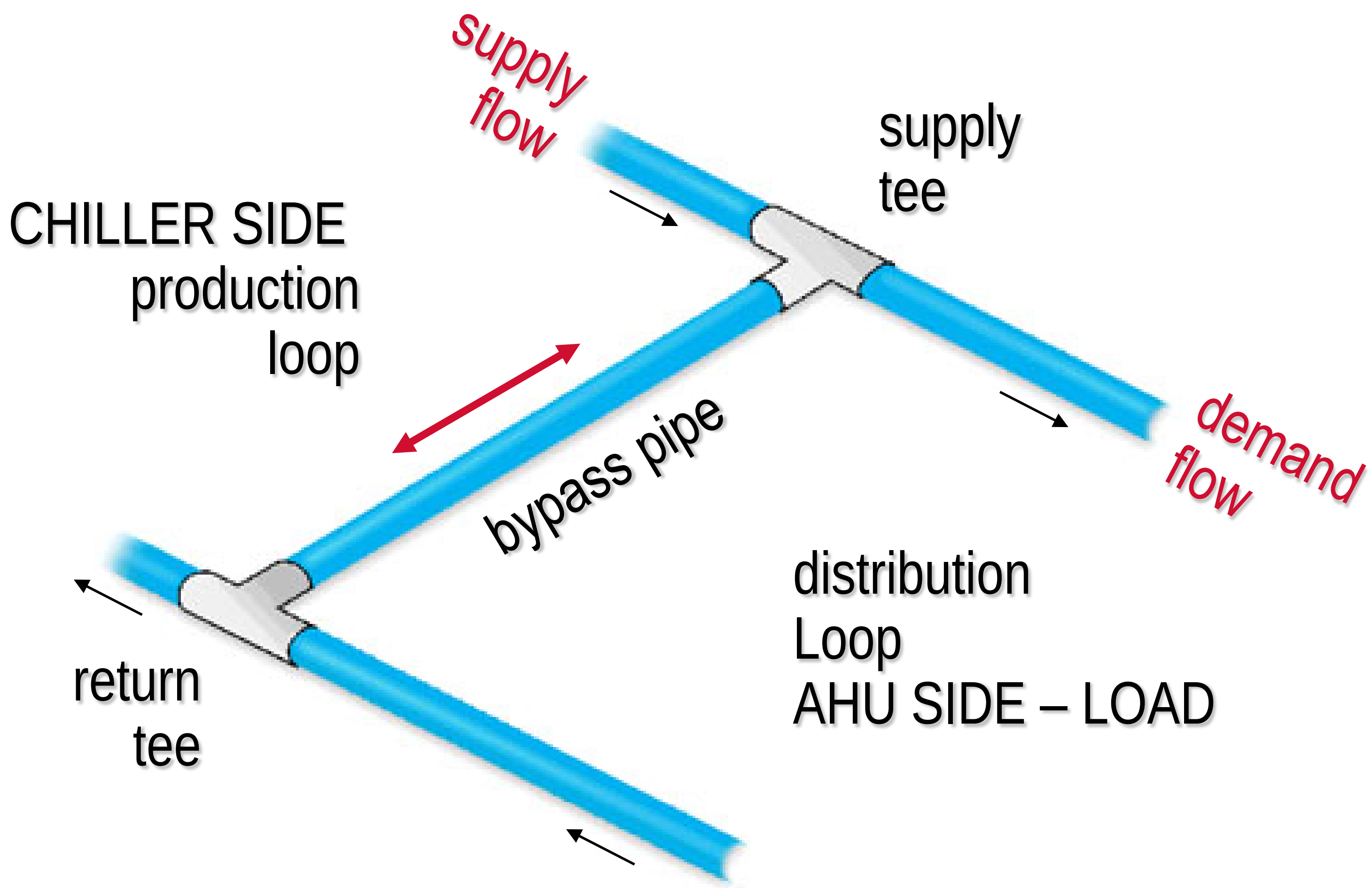
Subtract Example

Based on Flow

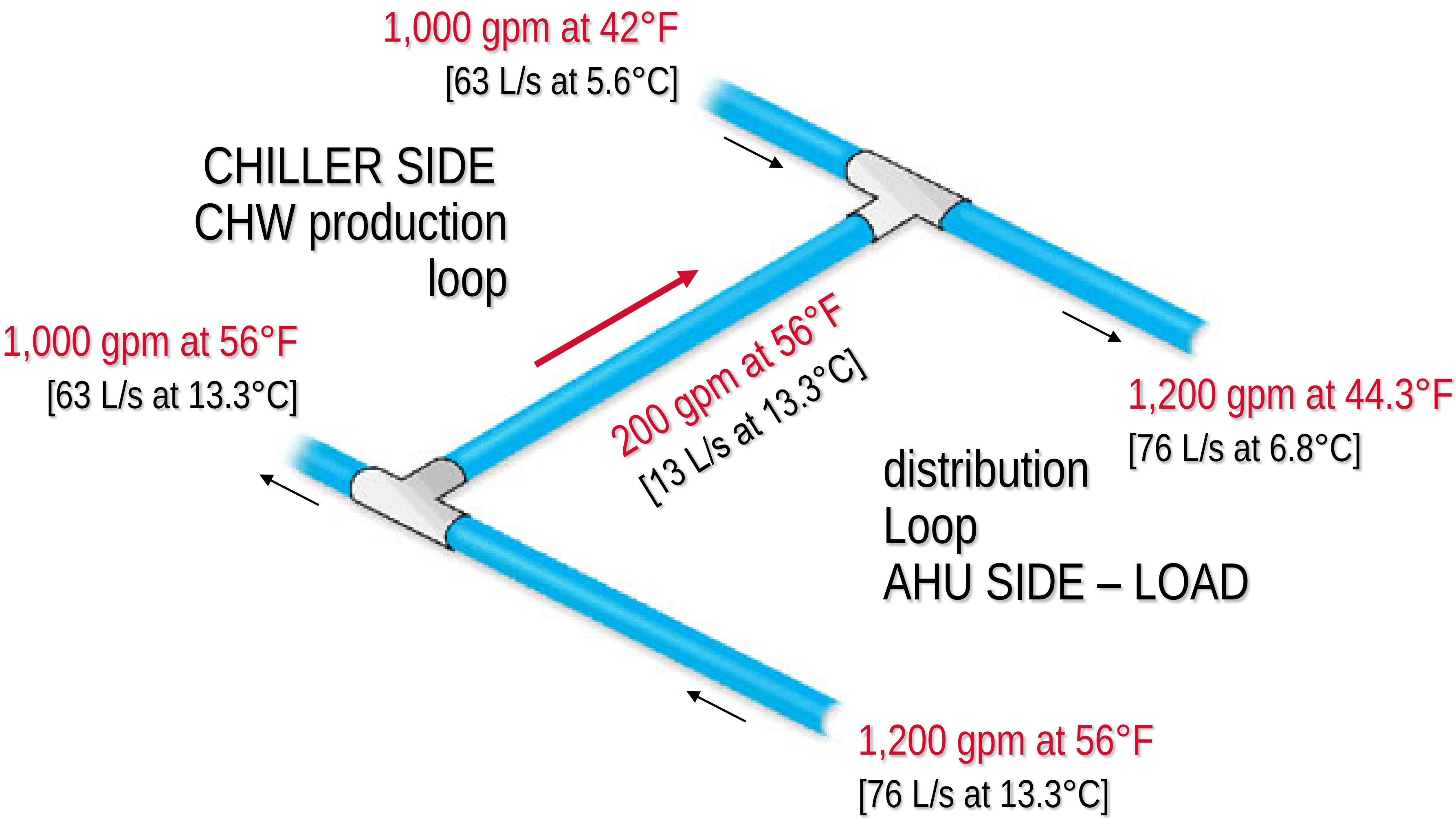


Based on Flow in the Bypass Line if # of chillers are more than SIX . . In a chiller plant

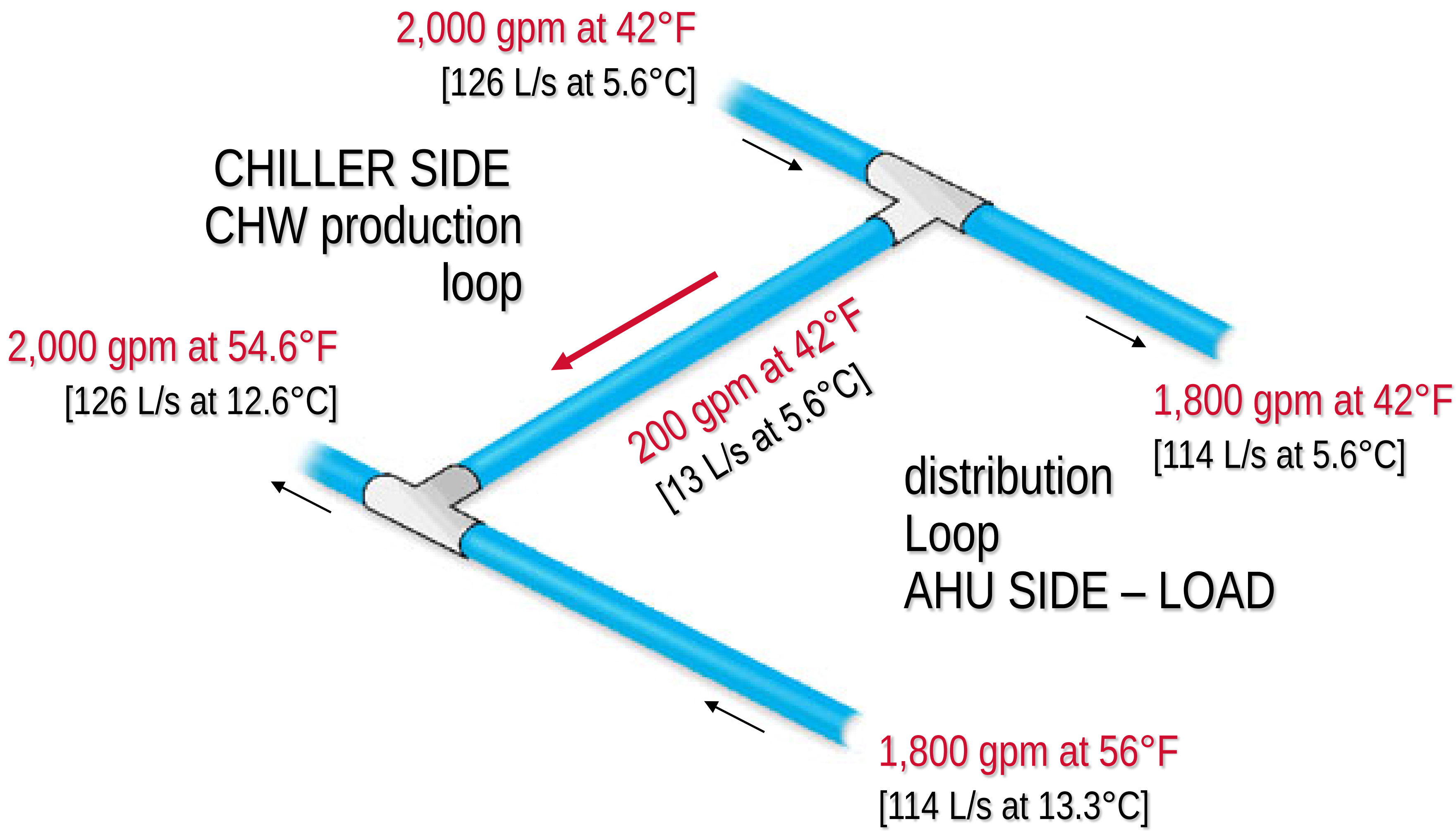
System Operation



Deficit Flow



Excess Flow

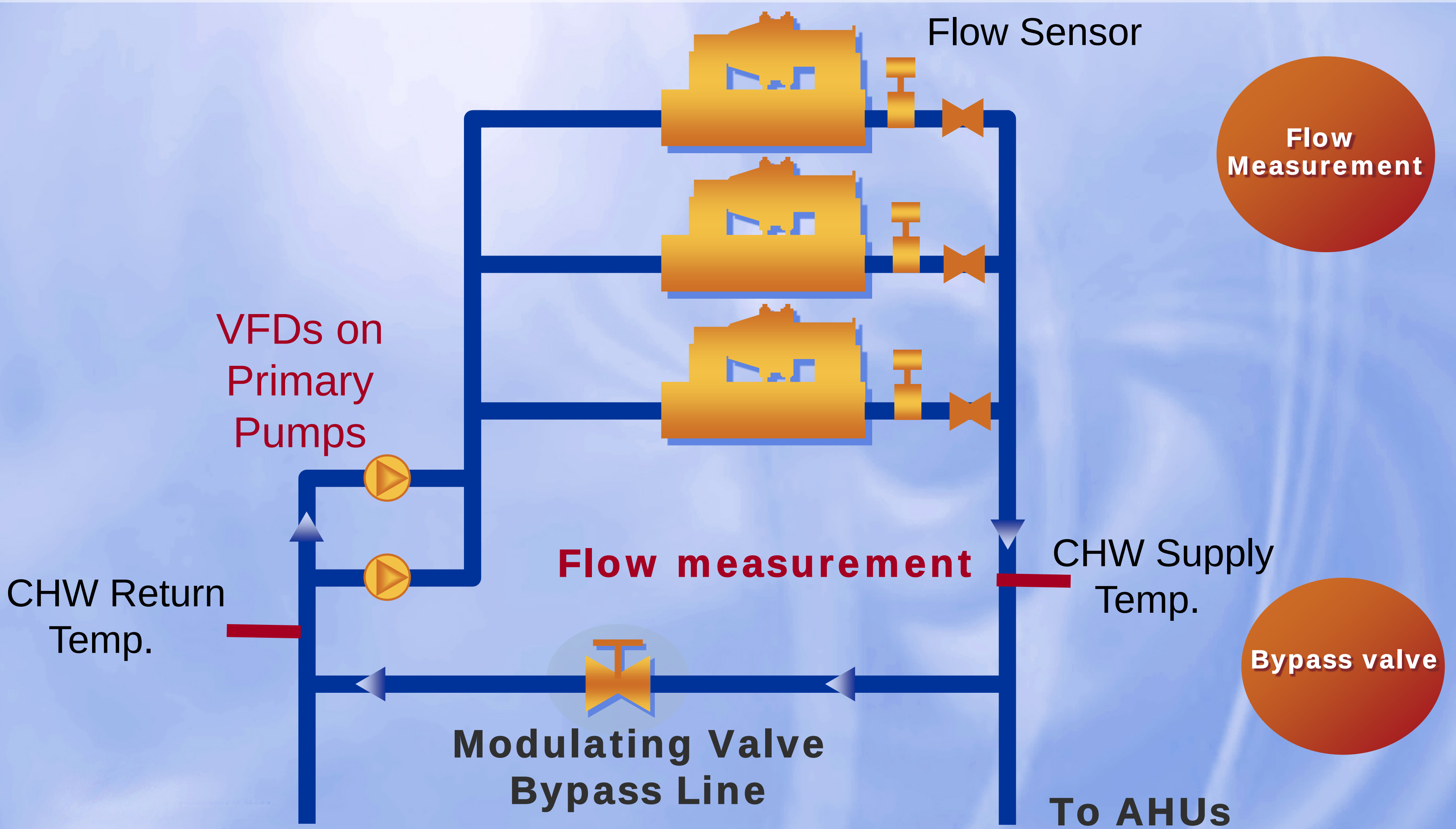


2,000 gpm at 42°F
[126 L/s at 5.6°C]
CHILLER SIDE
CHW production
loop
2,000 gpm at 54.6°F
[126 L/s at 12.6°C]
200 gpm at 42°F
[13 L/s at 5.6°C]
1,800 gpm at 42°F
[114 L/s at 5.6°C]
distribution
Loop
AHU SIDE – LOAD
1,800 gpm at 56°F
[114 L/s at 13.3°C]

Control of Primary-Secondary System

condition	response
deficit flow for specified period of time	start another chiller and pump
excess flow greater than 110% to 115% of next pump to turn off	turn off next chiller and pump
neither	do nothing

Case III:
Variable Primary Flow System



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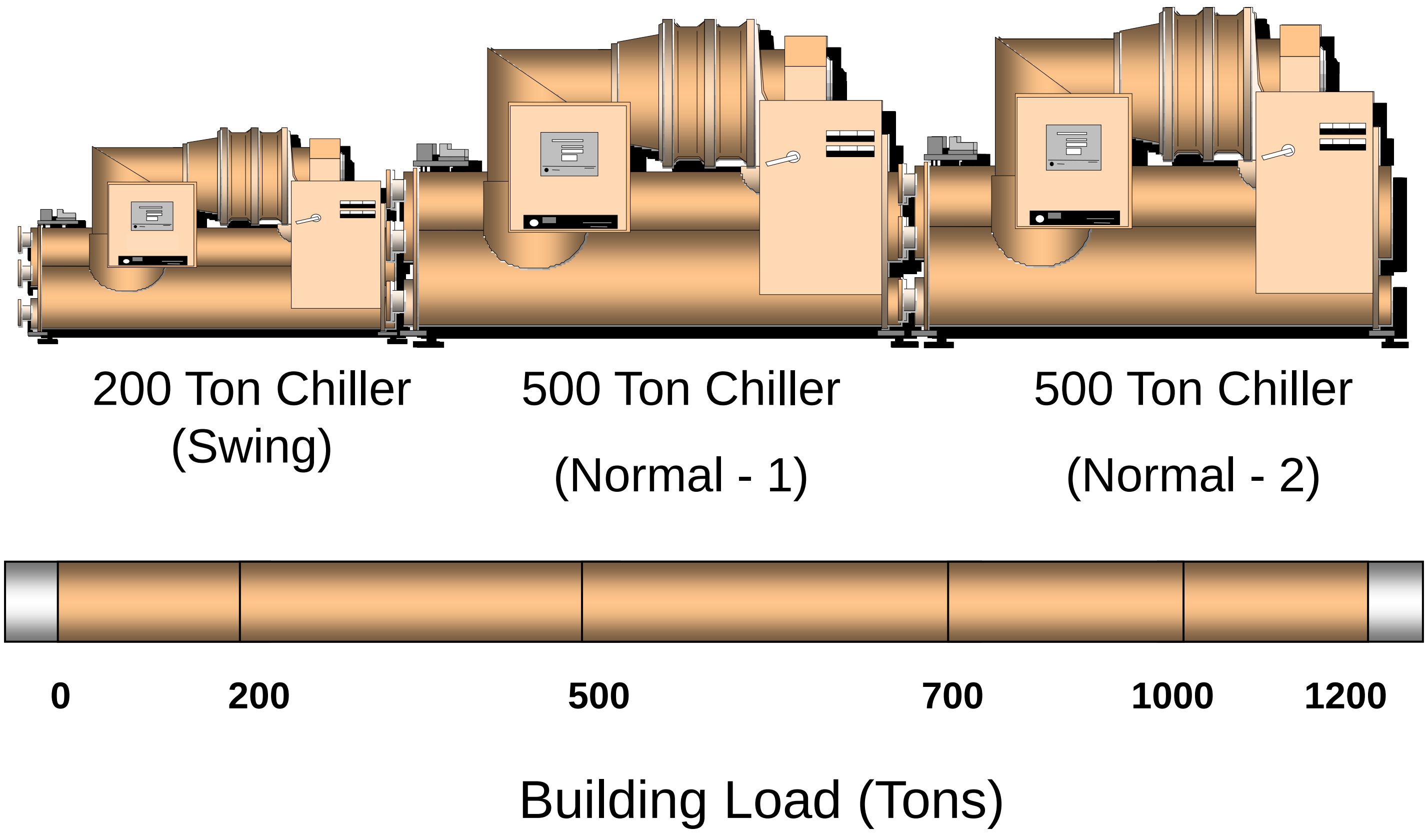
Capacity Matching in Design Stage

Dependent on chiller plant design

- **Normal :** identical chillers
- **Base :** heat recovery / super efficient
- **Peak:** back up / alternate energy source / inefficient
- **Swing:** match the load !
- **Custom:** mix & match Chiller Capacities

Capacity Matching - Swing

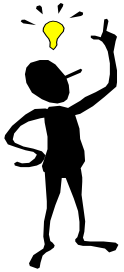


Current Limit and CHW Supply Set point Control

- Raise CHW Setpoints during off demand period = every 1 deg F rise likely to result in approximately 2% energy savings

Benefits of an automated Chiller Plant Control

- Load determination
- Capacity matching between Supply and demand of Chilled Water
- Rotation and Runtime equalization of chillers
- Chiller setpoint control
- Failure recovery of any component
- User specific algorithms for complex chiller plants and graphical interface
- Reports, alarms, trends for analysis



CPM Dashboards for the Facility team

T2 CHILLER DASH BOARD

T2 CHILLER PLANT | Status

Total Chiller Capacity(Tons) 1765 TONS	Current Chiller(kW) 114.0 kW	SQ.FT/TR of Occupied 3,082.9	Total Saleable Area in Sq.Feet. 699,154.0	Total Chiller Plant(kWh) 393.7	Ambient Dry Bulb 22.3 °C
Current Building TR (Tons) 117.2	Current Chiller Plant(kW) 147.0 kW	Watts/Sq.Feet of Occupied 0.4	Total Occupied Area in Sq.Feet. 361,164.0	Kwh/Sq.Feet of ChillerPlant 1.1	Ambient Wet Bulb 19.9 °C
					Ambient Relative Humidity 81.1 %

	Local/ Remote Status	On/Off Status	CND. Flow Status	EVP. Flow Status	CHW SP Temp. Active	EVP. Leaving Temp.	EVP. Entering Temp.	EVP APP Temp. CKT1	EVP APP Temp. CKT2	CND Approach Temp.	KW	KWH
CPM SYSTEM		Off	No Flow	Flow	11.1 °C	12.3 °C	11.1 °C	N/A	N/A	N/A	147.0	393.7
ACCH-01(355TR)	Local	Off	N/A	Flow	11.0 °C	15.0 °C	14.3 °C	0.0	0.0	N/A	0.9	105.3
ACCH-02(355TR)	Local	On	N/A	Flow	11.0 °C	10.9 °C	12.5 °C	0.0	1.0	N/A	112.5	53.4
ACCH-03(355TR)	Local	Off	N/A	No Flow	11.0 °C	14.6 °C	14.1 °C	0.0	0.0	N/A	0.9	98.5
WCCH-01(350TR)	Local	Off	No Flow	No Flow	11.0 °C	15.1 °C	14.0 °C	---	N/A	---	0.0	19.6
WCCH-02(350TR)	Local	Off	No Flow	No Flow	11.0 °C	15.9 °C	14.4 °C	---	N/A	---	0.0	19.7

Recommended Approach Evaporator : <2*C Condeser : <2*C N/A = Not Applicable

HDR CHW S&R TEMP: 11.080 °C, 12.310 °C — Delta T 1.2

HDR CND S&R TEMP: 21.068 °C, 21.044 °C

TAURUS EAST CHILLER PLANT DASH BOARD

Date: 4 12 2,017
Time: 6 47 PM

SECONDARY PUMP DP VALUES — ACTIVE DP SET POINT : 12.0 — ACTIVE DP VALUE (psi) : 12.8

	WCCH-01 350TR	WCCH-02 350TR
Load in %	0.0 %	0.0 %
Run Hours	175	164
Kw :	0.0	0.0
KWh :	19.6	19.7
TR :	0.0	0.0
KW/TR :	0.6	0.5

DESCRIPTION	Run Status	A/M Status	Trip Status	Run Hours	Frequency in HZ	KW	KWH
Primary Pump-01	Off	Manual	Normal	316.7	N/A	N/A	N/A
Primary Pump-02	Off	Auto	Normal	358.4	N/A	N/A	N/A
Primary Pump-03	Off	Auto	Normal	252.0	N/A	N/A	N/A
Primary Pump-04	On	Auto	Normal	244.3	N/A	N/A	N/A
Primary Pump-05	Off	Auto	Normal	253.3	N/A	N/A	N/A
Condenser Pump-01	Off	Auto	Normal	114.8	N/A	N/A	N/A
Condenser Pump-02	Off	Auto	Normal	109.3	N/A	N/A	N/A
Condenser Pump-03	Off	Manual	Normal	108.2	N/A	N/A	N/A
Cooling Tower Fan-01	Off	Auto	Normal	170.6	---	---	---
Cooling Tower Fan-02	Off	Auto	Normal	148.7	---	---	---
Secondary Pump-01	On	Auto	Normal	17.1	32.5	19.0	409.0
Secondary Pump-02	Off	Auto	Normal	17.5	0.0	0.0	994.0
Secondary Pump-03	Off	Auto	Normal	1.7	0.0	0.0	304.0
Secondary Pump-04	On	Auto	Normal	13.1	32.5	19.0	179.0

	ACCH CHILLER-01				ACCH CHILLER-02				ACCH CHILLER-03			
	COMP-01		COMP-02		COMP-01		COMP-02		COMP-01		COMP-02	
COMP	CKT1	CKT2	CKT1	CKT2	CKT1	CKT2	CKT1	CKT2	CKT1	CKT2	CKT1	CKT2
Load in %	0.0	0.0	0.0	0.0	0.0	0.0	73.5	45.4	0.0	0.0	0.0	0.0
Run Hours :	378	368	323	362	156	148	213	219	333	312	365	367
KW :	0.9				112.5				0.9			
KWH :	105.3				53.4				98.5			
TR :	0.0				117.2				0.0			
KW/TR :	0.0				1.0				0.0			

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Chiller Plant Management System – the right way to design & operate

Different types of CHW Systems

Various Components of a typical Chiller Plant

How to locate the Temperature Sensors and decoupler lines

Methodology of operation of CPM

Energy Savings as a direct benefit by having an automated Chiller Plant Management System and increased reliability of the System

Various benefits of the Chiller Plant Management System