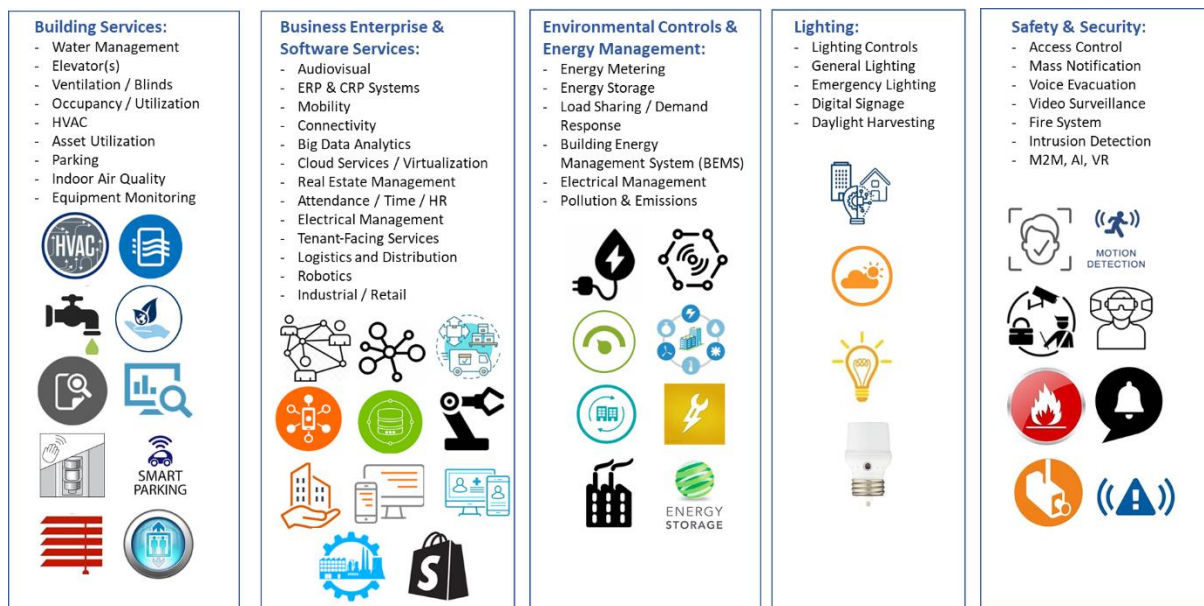
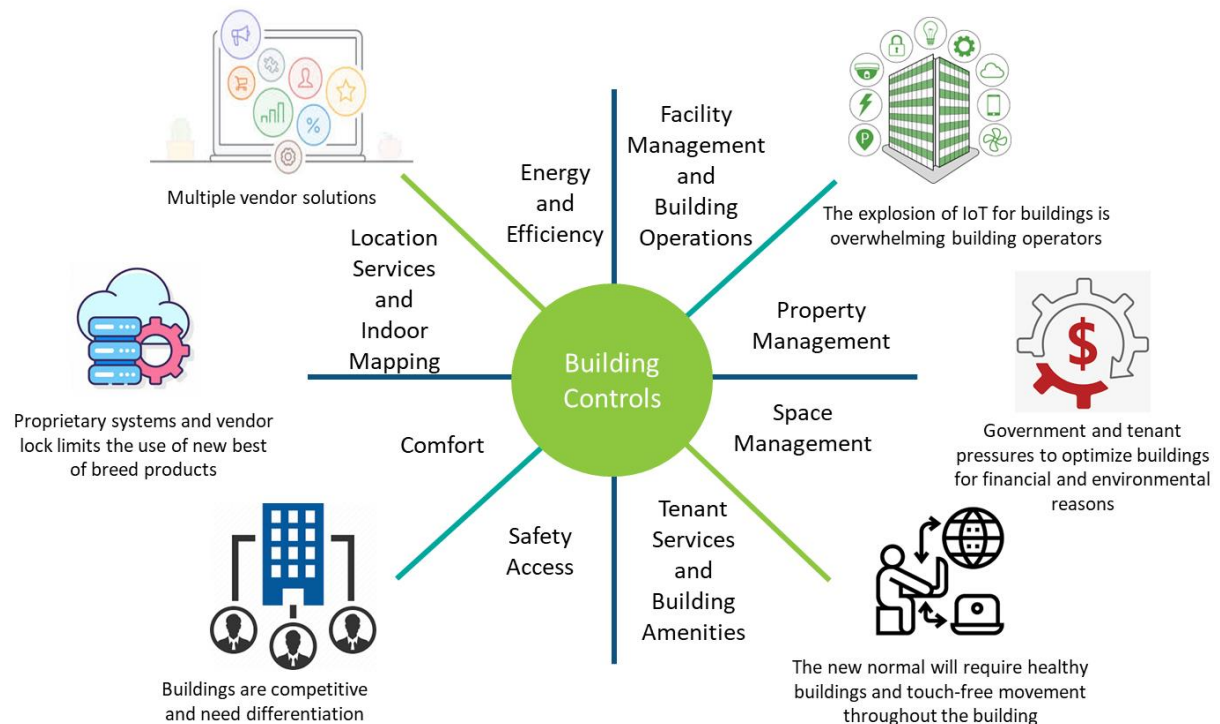
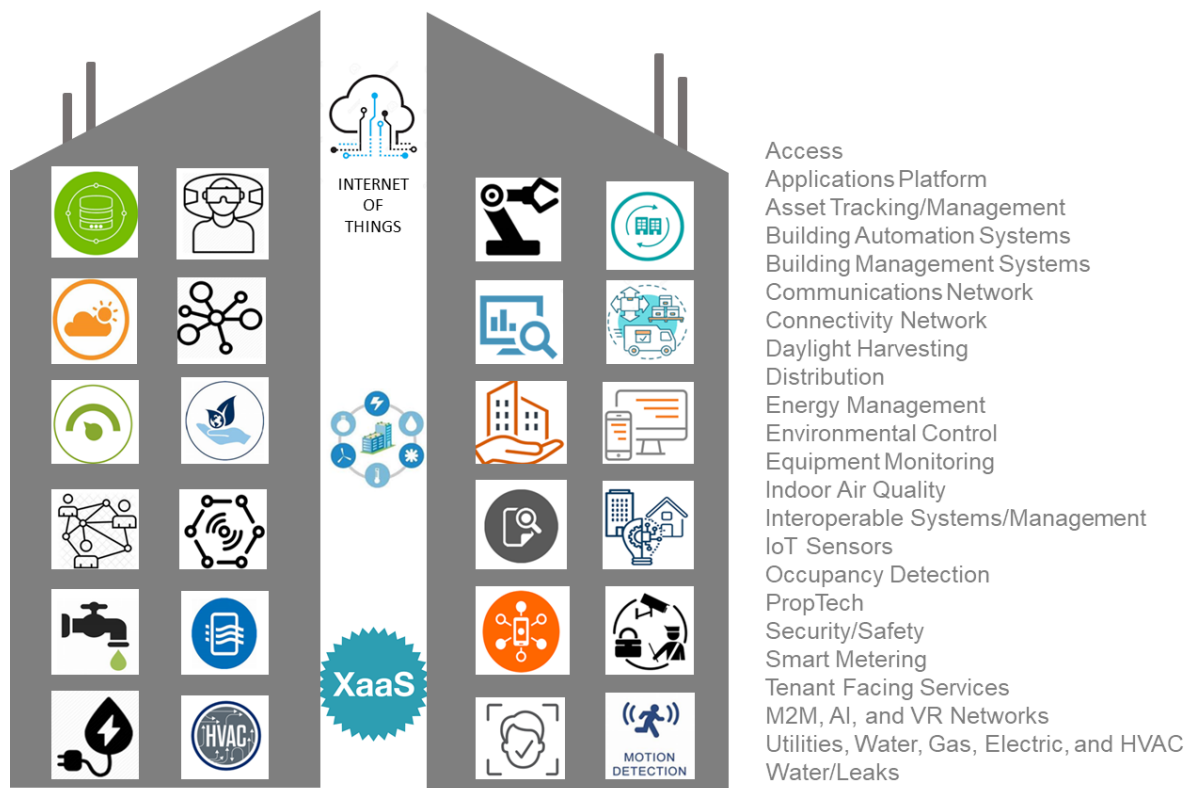
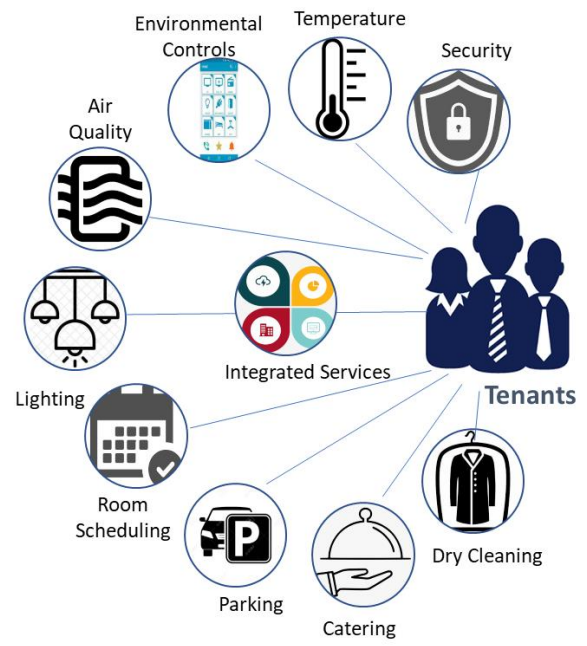
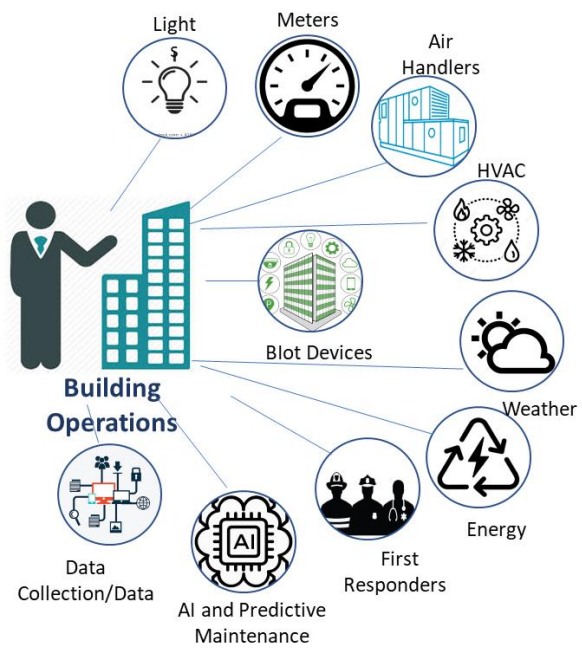


Chapter 1: An Introduction to IoT and Smart Buildings

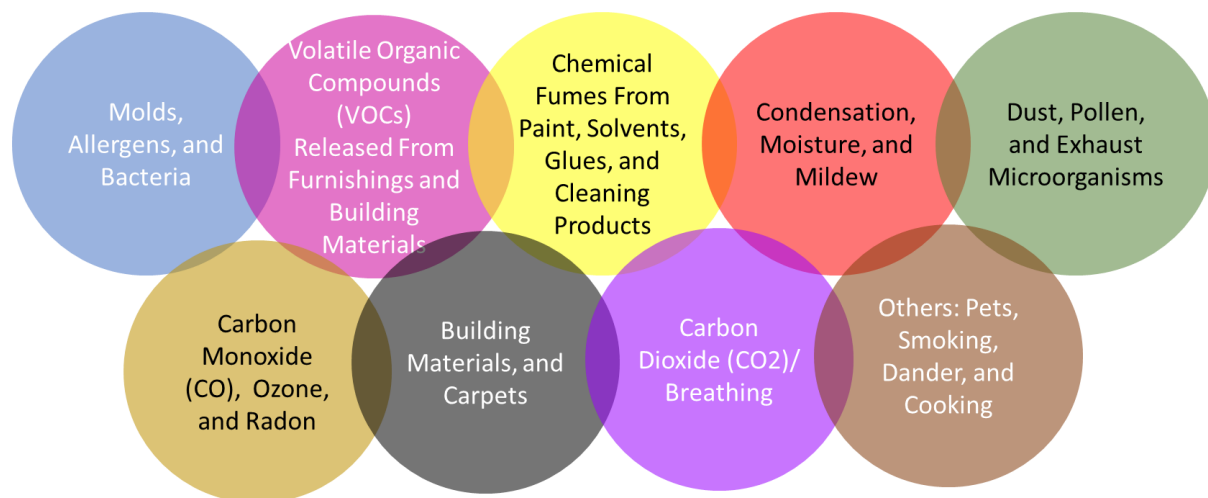
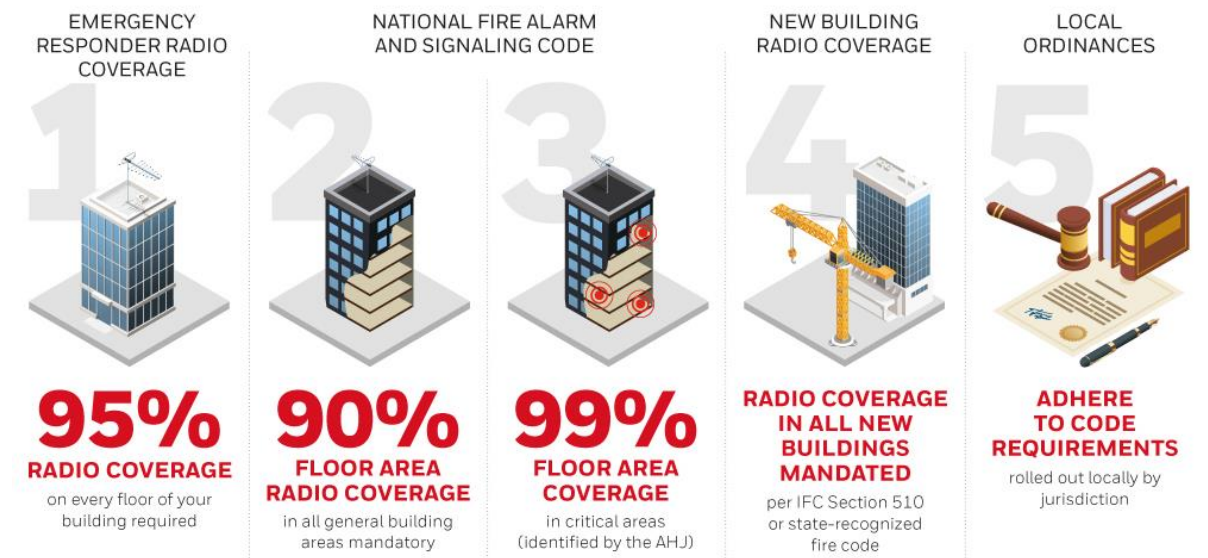


Chapter 2: Smart Building Operations and Controls





Chapter 3: First Responders and Building Safety



Chapter 4: How to Make Buildings Smarter with Smart Location



 <p>Barcodes/QR</p>	 <p>RFID</p>	 <p>Ultra-Wideband</p>	 <p>Wi-Fi Positioning</p>	 <p>BLE</p>
 <p>Low-Power Wide-Area Network (LPWAN)</p>	 <p>Long Range (LoRa)</p>	 <p>Citizens Broadband Radio Service (CBRS)</p>	 <p>Near-Field Communication (NFC)</p>	

Chapter 5: Tenant Services and Smart Building Amenities

TENANT MAINTENANCE REQUEST FORM

TENANT INSTRUCTIONS

All general maintenance must be reported to our office in writing. In order for a repair to be attended to, please complete this form and fax, post, email or deliver to our office.

In the event of an emergency repair, contact our office immediately!

Once we have received the request, either our office or a tradesperson will contact you.

Date: _____

Time: _____

Address: _____

Concern: _____

ACCESS DETAILS

Tenant Name(s): _____

Phone Home: _____ Work: _____ Mobile: _____

Access to property: ☐ Take office key ☐ Tenant will be home

Tenant preferred time and date: _____ Tenant authorises entry Yes ☐

I hereby authorise your office and/or the tradespeople to enter the property with the keys in order to carry out the repair or view the repair.

Signed _____

If the repair relates to any of the following appliances, please list the make and model

Stove _____

Oven _____

Dryer _____

Dishwasher _____

Hot Water Service _____

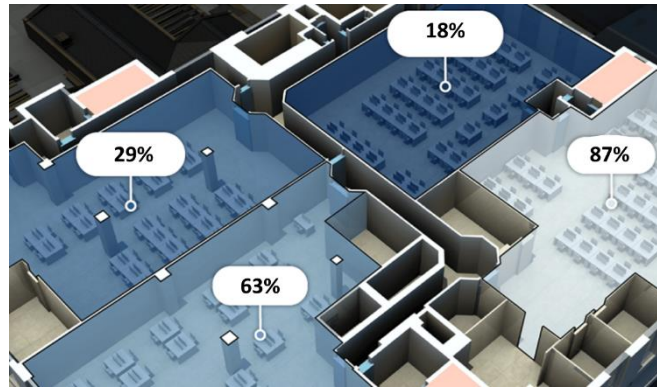
Washing Machine _____

Microwave _____

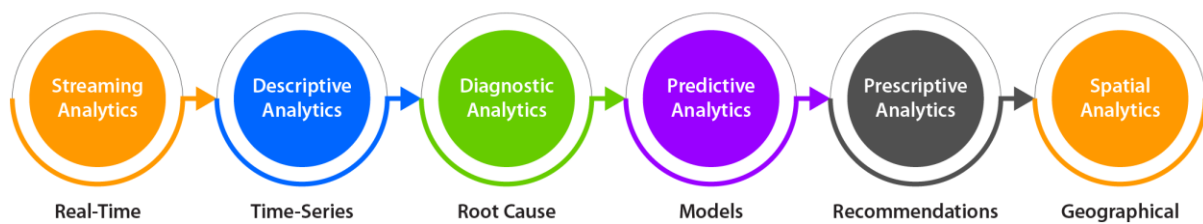
Fridge _____

Air Conditioning _____

☐ Gas ☐ Electric



Data Analytics Types





- Online Reservation
- Automatic HVAC and Lighting
- Smart Glass and Privacy Glass
- Smart Windows with IP
- Collaborative Conferencing Technology
- Audio and Visual Presets
- Presentation-Ready
- Conference call Autocall
- Shared Data
- Airplay
- Smart Jamboard
- Wireless Broadband
- Auto-Transcription
- AI Tools

Chapter 6: The Smart Building Ecosystem


	BACnet	LonWorks	DALI	KNX	EnOcean	Zigbee	MQTT	AMQP
Applications	HVAC, lighting, security, and fire systems	HVAC, lighting, process control, and automation	Lighting, motion detectors, and gateways to other protocols	HVAC, lighting, remote access, security, and energy management	Occupancy sensors, key cards, lighting controls, and other room controls	HVAC controllers, room controllers, and occupancy sensors	IoT messaging, HVAC controllers, occupancy sensors, and other room controllers	IoT messaging, HVAC controllers, occupancy sensors, and other room controllers
Developed and supported by	ASHRAE	Echelon Corporation	Philips	Konnex Association	Siemens AG	Zigbee Alliance	OASIS and ISO Standard	OASIS and ISO Standard
Type	Wired and Wireless	Wired and Wireless	Wired and Wireless	Wired and Wireless	Wireless	Wireless	Wired	Wired
Medium	Twisted-pair, wireless mesh, and fiber optic	Twisted-pair, wireless mesh, fiber optic, and power lines	Single cable pairs create the network bus	Twisted-pair, radio frequency, IP/Ethernet, and power lines	Wireless	Wireless	Hardwired	Hardwired
Transmission Mode	IP, Ethernet, LonTalk, ARCnet, Zigbee, and MS/TP	Predictive p-persistent CSMA	Gateways	Gateways	Carrier Sense Multiple Access (CSMA) with collision detection	TCP or UDP	TCP/IP	TCP/IP
Security	Transport layer security (TLS) and Open Authorization (OAuth)	No data encryption. Implements sender authentication	No security measures	Implements data encryption and authentication	Encrypted data using AES algorithm with 128-bit key	Encrypted data using AES algorithm with 128-bit key	TLS encrypted messaging and authentication, OAuth	Integration of TLS and Simple Authentication and Security Layer (SASL)

Wired


BACnet 
1987 – this low cost, has no licensing fees, and is used to communicate between building devices. Defines 60 standard object types. The protocol services include Who-Is, Who-Has, I-Have.


Modbus 
1979 – as a communications protocol, this is a common means of connecting electronic devices. It is low-cost, has no usage fees, and is used in HVAC, lighting, life safety, access controls, transportation and maintenance.


LonWorks 
1990 – designed as a low-bandwidth protocol that supports five communications media: twisted pair, power line, radio frequency, coaxial cabling, and fiber optics. It is the highest costs and comes with licensing fees.

MQTT 
A lightweight, publish-subscribe network protocol that transports messages between devices and usually runs over TCP/IP. Designed for connections with remote locations or where the network bandwidth is limited.


Wireless

Wi-Fi 
With wireless internet available, Wi-Fi is one cost-effective and easily accessible way to connect IoT devices. Drawbacks include interference, limited bandwidth due to many connected devices, and the amount of power it requires. Used for thermostats, lighting, smart devices, and broadband internet access.

Bluetooth 
1989 – Bluetooth uses radio waves to communicate. Bluetooth devices contain computer chips with radios to allow everything to talk to each other. Hundreds of products are compatible with Bluetooth automation. The main drawback is its range restriction.

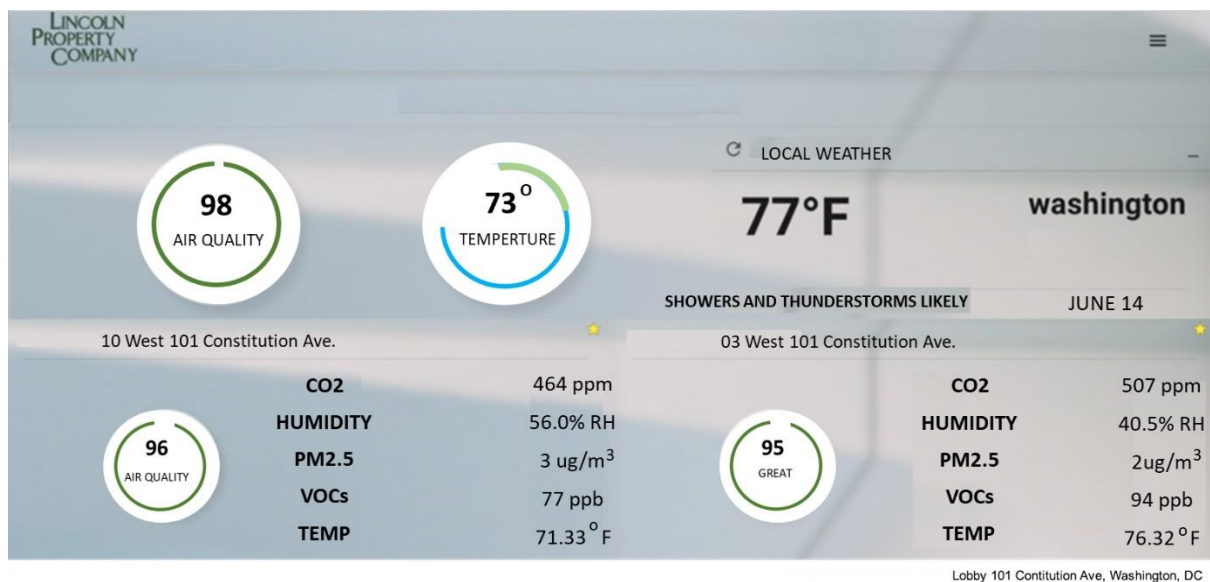
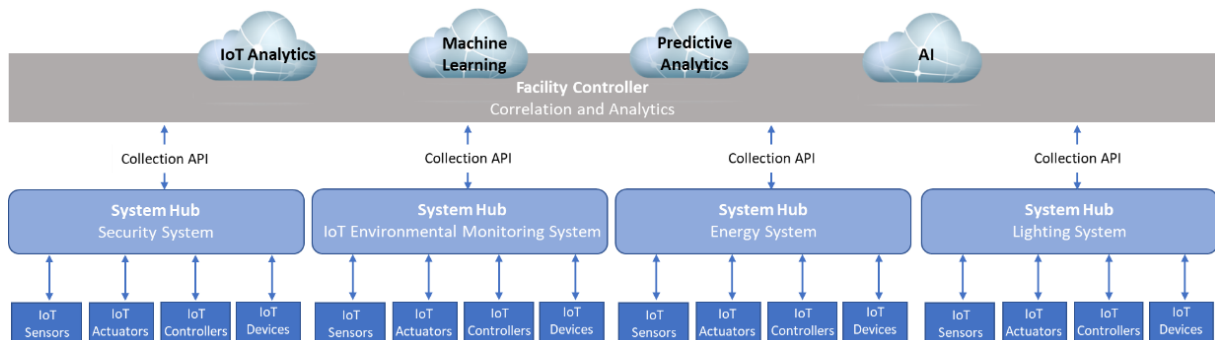
Zigbee 
1998 – a protocol created specifically for commercial use, this is the most widely used for building automation. It uses a mesh network to create long ranges and fast communications via radio frequency with minimal power usage, lasting several years on a single set of batteries.

LoRa 
A proprietary low-power, wide-area network modulation technique. It is based on spread-spectrum modulation techniques derived from **chirp spread spectrum (CSS)** technology.

Near-field communication (NFC) 
A set of communication protocols that enables communication between two electronic devices over a distance of 4 cm (1 1/2 in) or less. NFC offers a low-speed connection through a simple setup that can be used to bootstrap more-capable wireless connections.

Narrowband Internet of things (NB-IoT) 
A low-power wide-area network (LPWAN) radio technology for cellular devices and services. Focuses specifically on indoor coverage, is low cost, and has a long battery life and a high connection density. NB-IoT uses a subset of the LTE standard.

Chapter 7: Smart Building Architecture and Use Cases

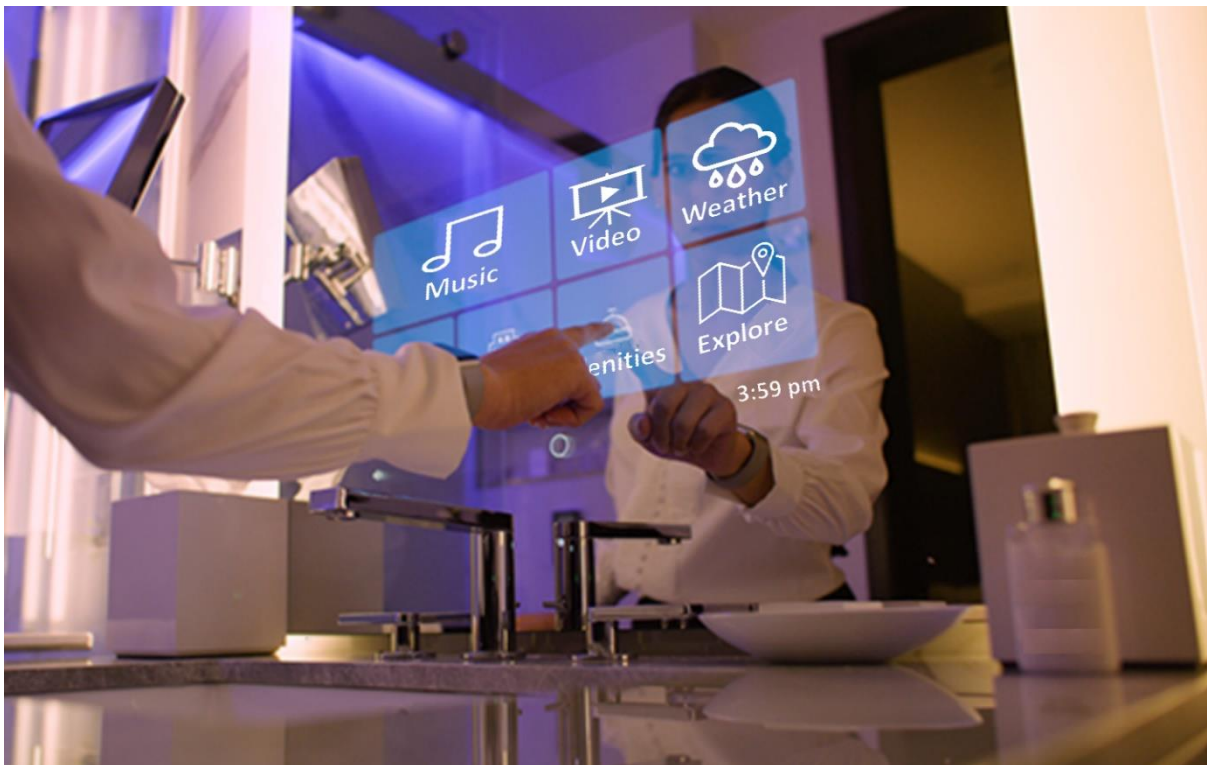
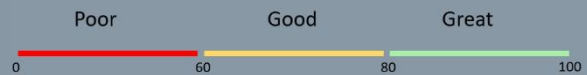


Average Indoor Air Quality

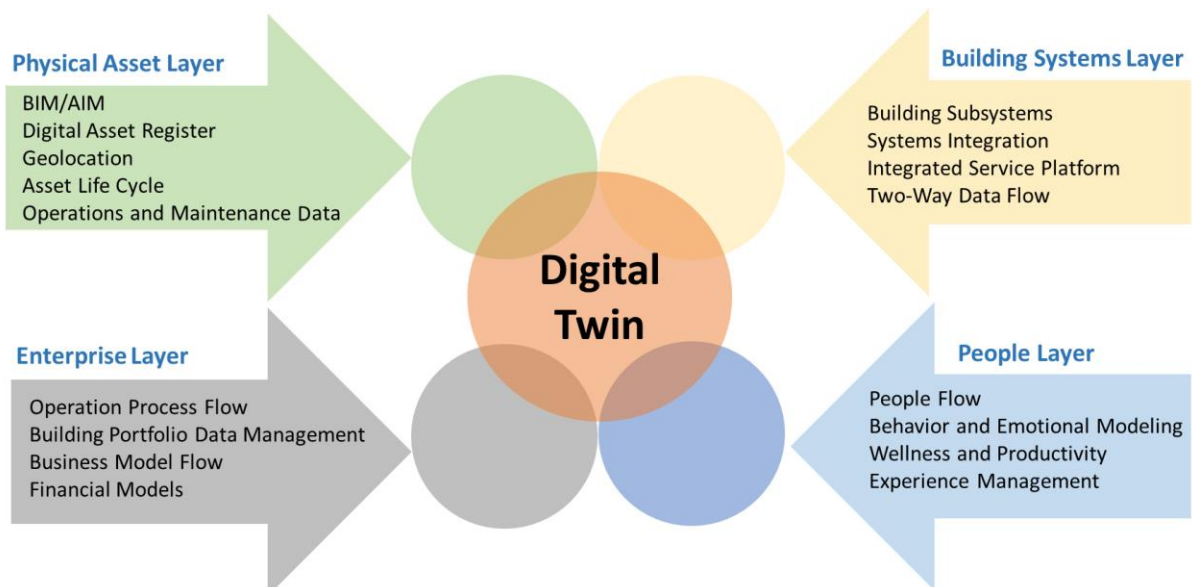
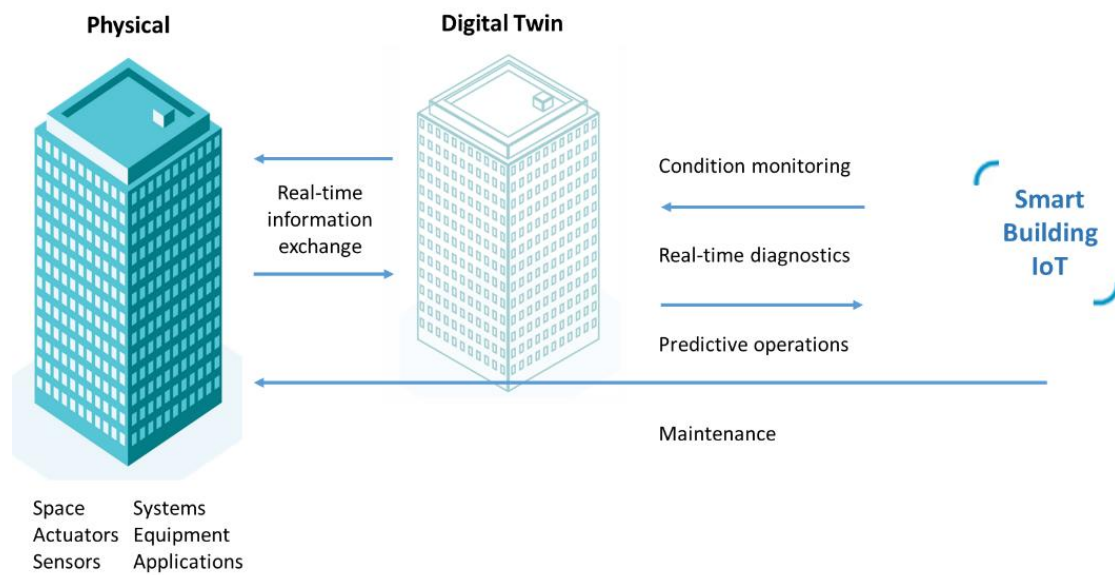
For your safety and comfort, we are constantly monitoring Temperature, Humidity, Carbon Dioxide, Particulate Matter, and Total Volatile Organic Compounds on each floor and quickly adjusting air quality to any changing conditions.



The Tapa IAQ Score™ provides an at-a-glance assessment of your air quality, on a simple 0 – 100 scale. When these measured environmental factors deviate outside our recommended ranges, the score decreases. The score is based on Guidelines from the ASHRAE, CDC, WHO, and EPA. This is part of the White House Clean Air in Buildings Challenge.



Chapter 8: Digital Twins – a Virtual Representation



Chapter 9: Smart Building IoT Stacks and Requirements

Users		All those who occupy, operate, own, or otherwise consume the building.	Needs buildings to be operated to be safe, healthy and productive environments.
Smarts	Apps	The applications designed to make buildings smart.	Needs to deliver apps to users and access data about the building.
	Data	The data about the building regardless where it is located.	Need to securely gather, store and make available for applications and users.
Building		The building and its control and automation systems.	Needs to be available 24/7.

Purpose Why is this being done?		The outcomes desired by owners, managers and occupants
Operations How it is operated daily?		The operations to manage the building on a daily basis
Smarts	Delivery How the smarts is delivered?	The delivery of smarts to the operations and other users
	Apps What makes it smart?	The smart digital applications designed to improve the building
	Exchange What makes it work together?	The exchange, integration & matching of apps, data, & services
	Data What makes it valuable?	The storage, normalization, governance & management of data
	Systems What makes it work 24/7?	The automation/control & devices to operate the building
Physical What is being made smarter?		The steel, concrete and equipment that makes the building

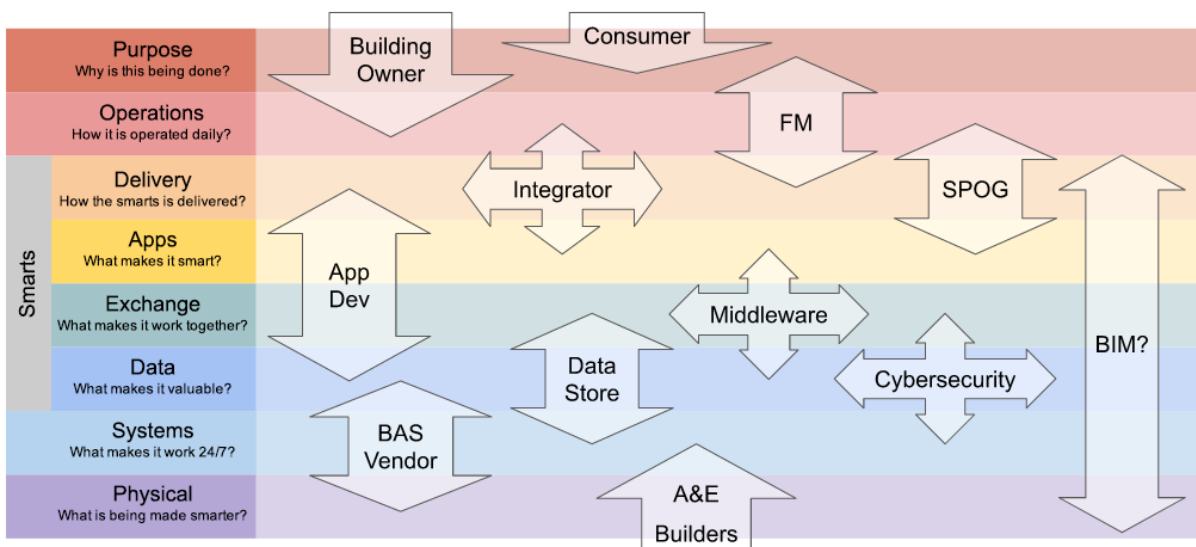
Smarts	Purpose Why is this being done?	In House	Owner's Needs	Occupant App
	Operations How it is operated daily?		Facility Mgmt	Digital Twin
	Delivery How the smarts is delivered?	Vertically Integrated BAS Offering	SI/MSI/MSP	SPOG
	Apps What makes it smart?		Analytics	IAQ
	Exchange What makes it work together?		OpenADR	Middleware
	Data What makes it valuable?		Cloud	On-Prem
	Systems What makes it work 24/7?		HVAC	Security, etc.
Physical What is being made smarter?		123 Main St		

Smarts	Purpose Why is this being done?	Profit	Happy Students	Tenant Exp	Wellness	Safety
	Operations How it is operated daily?	Facility Mgmt	Property Mgmt	Energy Mgmt	Maintenance	Janitorial
	Delivery How the smarts is delivered?	Srv Providers	SPOG	MSI & MSP	Consultants	Vertically Integrated BAS/BMS Providers
	Apps What makes it smart?	Analytics	Energy Mgmt	AI/ML	FM & IWMS Applications	
	Exchange What makes it work together?	Gateways	Middleware	Semantic Tagging	Integration	
	Data What makes it valuable?	Cloud	Cybersecurity	Weather	Data Warehouse	
	Systems What makes it work 24/7?	Control Systems	Physical Security	IoT/BAS	Lighting Systems	
Physical What is being made smarter?		Schools	Retail	Pharma	Elevators	Airports

Smarts	Purpose Why is this being done?	Bandwidth	Latency	Reliability	Economics	Availability
	Operations How it is operated daily?	WiFi	5G	Satellites	QR Codes	Humans
	Delivery How the smarts is delivered?	Websites	Mobile	Digital Twin	VR & AR	Kiosks & Digital Signs
	Apps What makes it smart?	Firewalls	SDN	Management Consoles	Monitoring	SIEM/SASE
	Exchange What makes it work together?	Gateways	Middleware	Brokers	Protocol Converters	Internet
	Data What makes it valuable?	APIs	Data Security	Servers	Syslogs	Databases
	Systems What makes it work 24/7?	Hub/Switch	VPN Devices	NAT	Routers	POTS
Physical What is being made smarter?		Antenas	Cat 5	Cable (TV)	Twisted Pair	Conduit

Smarts	Purpose Why is this being done?	Defense in Depth	CIA/AIC Triad	Zero Trust	Security Policies	Nominal Operation
	Operations How it is operated daily?	2FA/MFA	LDAP/SAML	Islanding	Penetration Testing	
	Delivery How the smarts is delivered?	SSO	Patches & SW Updates	Scorecards & Security Reports		
	Apps What makes it smart?	Next Gen Firewalls	SIEM/SASE	Management Consoles	Threat Intelligence	IAM (Users/Devices)
	Exchange What makes it work together?	Firewalls	Data Diode & Air Gap	Security Certificates	Trust Vectors	Asset Mgmt Back/Restore
	Data What makes it valuable?	API Keys	Encryption	Syslogs	Backups	
	Systems What makes it work 24/7?	VPN/VLAN	TLS Encryption	Secure Config	Obscurity	
	Physical What is being made smarter?	Physical Access	Hardware Security Key	Conduit Protection		

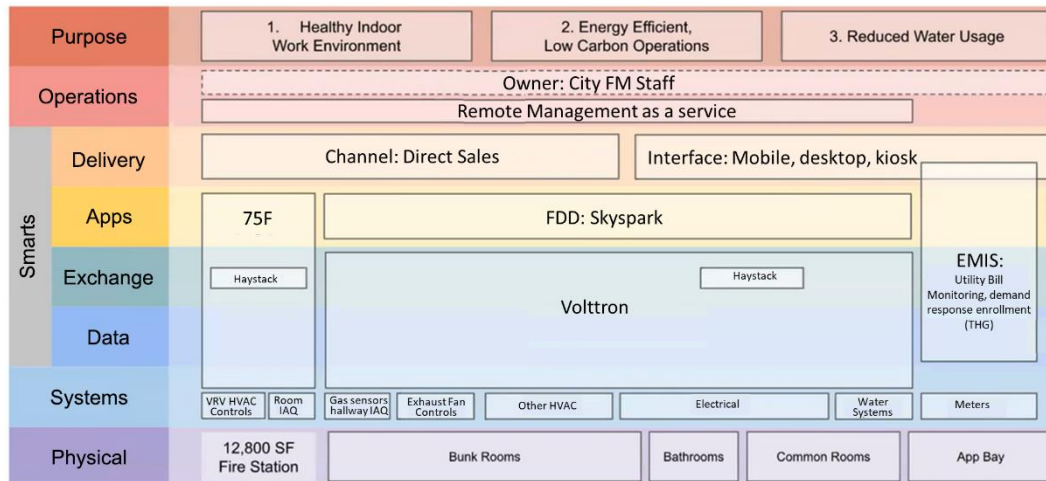
Smarts	Purpose Why is this being done?	Scheduling	Comfort	Social	Critical Safety	
	Operations How it is operated daily?	School Dashboard	HVAC Engineer	CCTV Monitoring	Energy Dashboard	Trouble Tickets
	Delivery How the smarts is delivered?	MSP	Local HVAC	Console		
	Apps What makes it smart?	DER	WELL	FDD	IAQ	EMS
	Exchange What makes it work together?	Configurator	Integration	DER Agg		
	Data What makes it valuable?	Cloud	Weather	Video Storage		
	Systems What makes it work 24/7?	HVAC	Access	Lighting	Fire System	
	Physical What is being made smarter?	Elevators	123 Main	Sport Stadium		



Purpose Why is this being done?		Add Value		Daily		
Operations How it is operated daily?				Contract or Project	Bid	\$10k-1m/M
Smarts	Delivery How the smarts is delivered?		Expense (Liability)		Relationship	\$1-100k/M
	Apps What makes it smart?	OpEx		SaaS (Monthly)	App Store	\$1-100k/M
	Exchange What makes it work together?				Tech Specs	\$1k-\$1m
	Data What makes it valuable?		Asset	Forever	Capture / Buy	Priceless!
	Systems What makes it work 24/7?			20 Years	RFP or D-B	\$10k-10m
	Physical What is being made smarter?	CapEx		100 Years	Major Deal	\$1m-100m
		What is it?	Balance Sheet?	Engagement	Procurement	Value

Purpose Why is this being done?			LEED	ANSI/APPA 1000-1	WELL	ASHRAE 180	
Operations How it is operated daily?				Safety Standards	NFPA	ASHRAE 55	Digital Twin
Smarts	Delivery How the smarts is delivered?		K8S			VR/AR	
	Apps What makes it smart?	HTML	Linux & Node.js				
	Exchange What makes it work together?	Connection Profiles		Haystack	IP	APIs	MQTT?
	Data What makes it valuable?	DLT / Blockchain	SQL & NoSQL				
	Systems What makes it work 24/7?	BACnet		Modbus		5G	
Physical What is being made smarter?			Building Standards	Zoning	Building Code		

Chapter 10: Understanding Your Building's Existing Smart Level and Systems



Beams	Framing systems	Roofing system
Concrete	Landscaping	Soils
Curtain walls	Lintels and chajjas	Stairs and lifts
Fencing and external works	Loads and load paths	Utilities
Floor system	Pathways	Wall systems
Foundation	Plinth	

Building framing types	Footings and foundations
Doors and frames	Interior design
Exterior insulation	Roofing
Exterior wall types	Seismic bracing
Floor systems	Windows

Annunciation (alarms)	Elevators	Induction systems
Blowers	Equipment	Laboratory fume hoods
Building central plant systems	Escalators	Life safety systems
Chillers	Evaporative coolers	Mechanical distribution systems
Compressors	Fire protection/smoke detection	Mechanical penthouse
Conduit	HVAC	Motors
Cooling source components	Human thermal comfort	Specialty air systems
Direct expansion systems	Hydronic systems	Variable air volume systems
Dual-duct systems	IAQ systems	Ventilation
Duct system components		

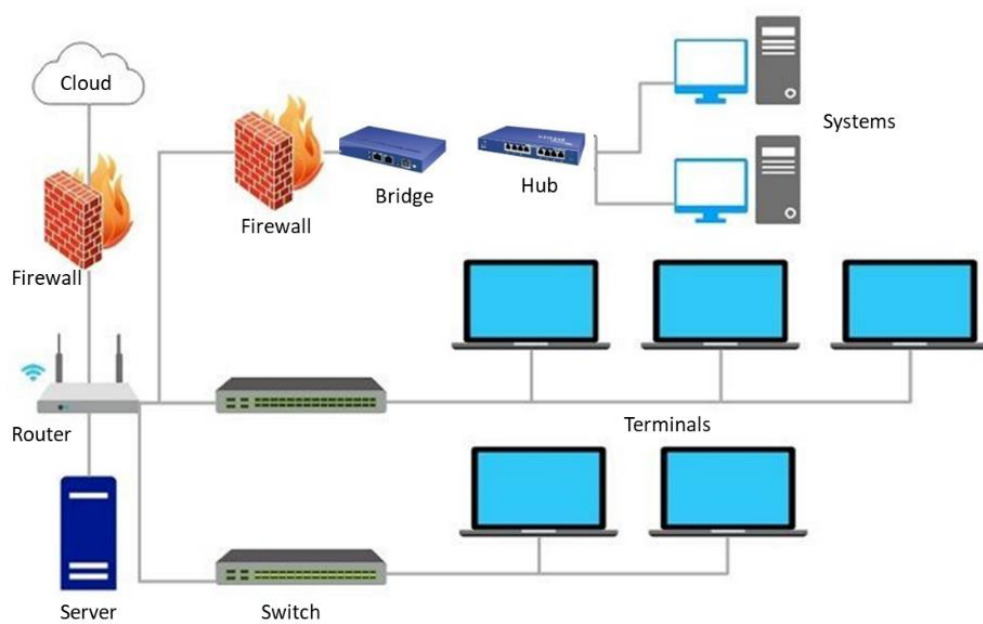
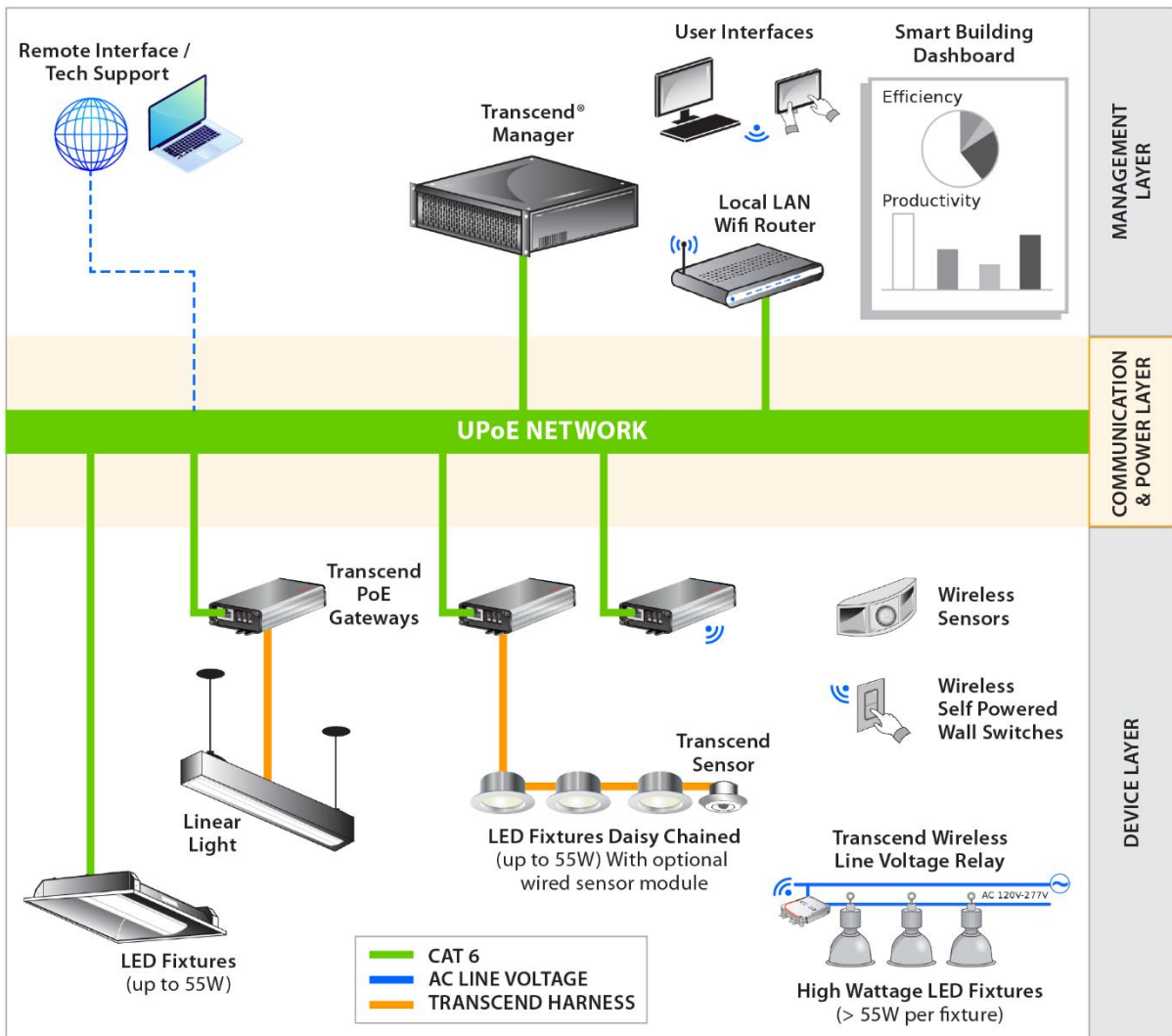
AC/DC systems	Electrical wiring	Lighting sources
Conduit systems	Fans	Power distribution
Electric motors	Fire alarm systems	Power system modeling
Electric power	Grounding	Switches
Electric power quality	Lighting applications	Transformers
Electric vehicle (EV) charging		

Backflow systems	Sewage treatment systems	Vent pipes/ventilation
Drainage systems	Sprinklers	Wastewater systems
Pressure systems	Stack systems	Water cooling/heating systems
Pumps and pipes	Steam and condensation systems	Water heaters and boilers
Re-circulation systems	Storm water systems	Water supply
Septic system	Tanks	Well systems

Backflow systems	Sewage treatment systems	Vent pipes/ventilation
Drainage systems	Sprinklers	Wastewater systems
Pressure systems	Stack systems	Water cooling/heating systems
Pumps and pipes	Steam and condensation systems	Water heaters and boilers
Re-circulation systems	Storm water systems	Water supplies
Septic system	Tanks	Well systems

Asset tracking systems	Centralized clock systems	Robotics
Audio visual equipment	Computing systems	Security systems
Building automation systems	Data networks	Servers
Building management systems	Digital signage	Software
Building purpose equipment	Exchange systems	Space planning systems
Cameras	Energy management systems	Television systems
Card access systems	Enterprise systems	Wayfinding/navigation systems
CCTV	Information technology systems	Workflow systems
	Operational technology systems	

Bi-directional amplifiers	EnOcean	Private networks
Bluetooth	GPON optical fiber networking	Signal boosters
Broadcast systems	Intercom systems	Small cells
Cellular coverage system	Internet, gateways, and routers	Telephone system
Communication closets	IoT network	Wireless internet system
Distributed antenna systems	LoRa/LoRaWAN	Zigbee
Emergency communication systems	Neutral host systems	Z-Wave



Chapter 11: Technology and Applications



IoT Devices



Connectivity



Computing
and Analytics



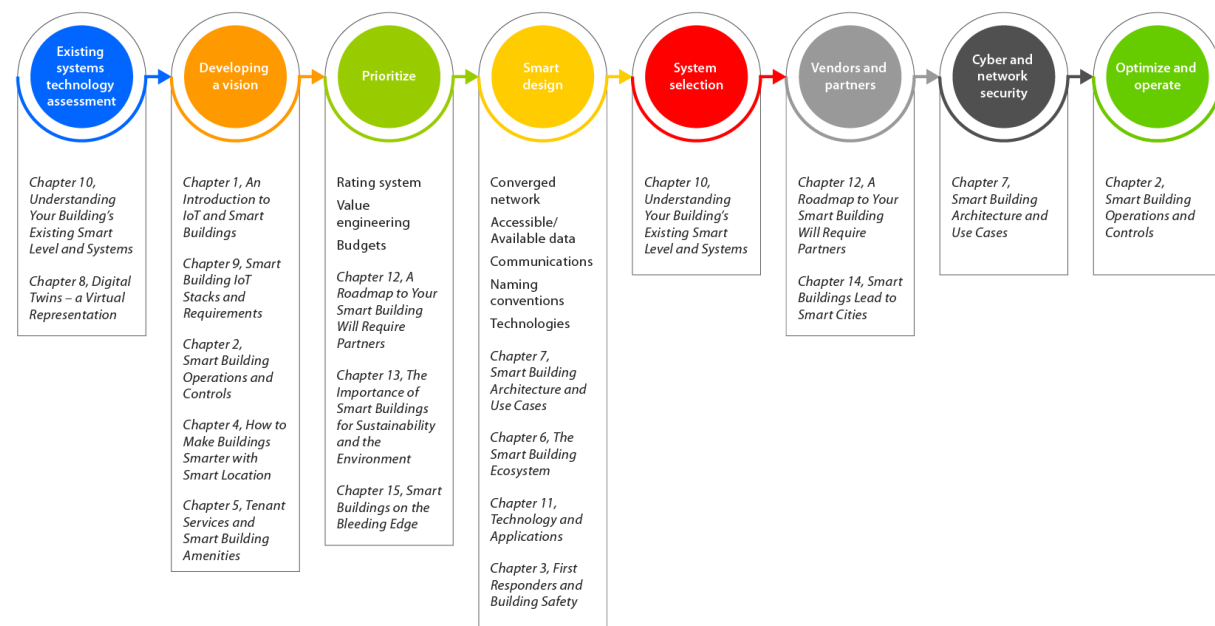
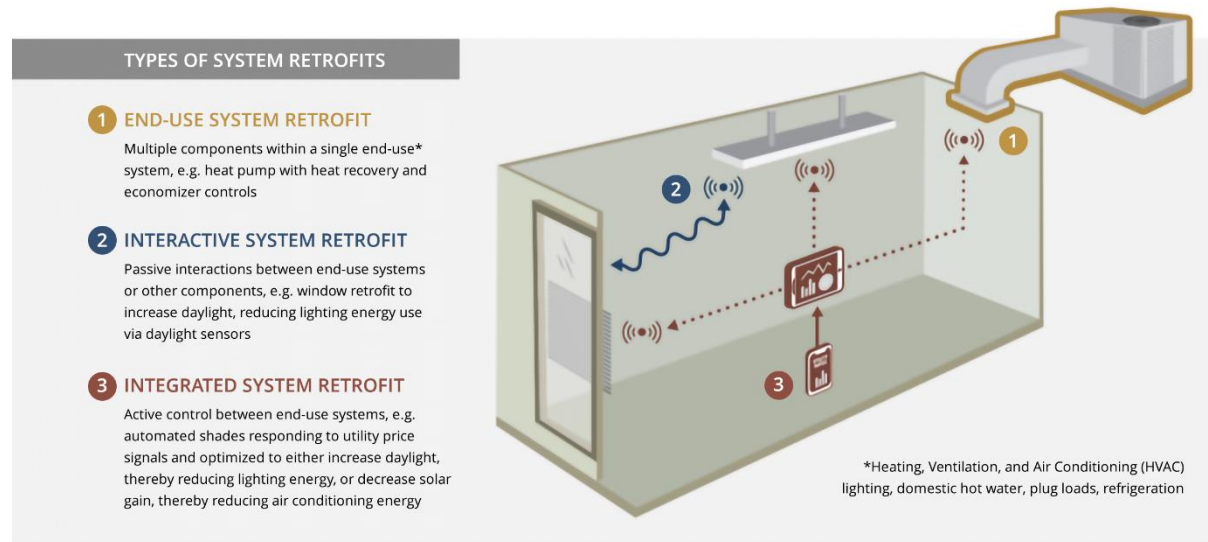
Output
Devices



User
Interface

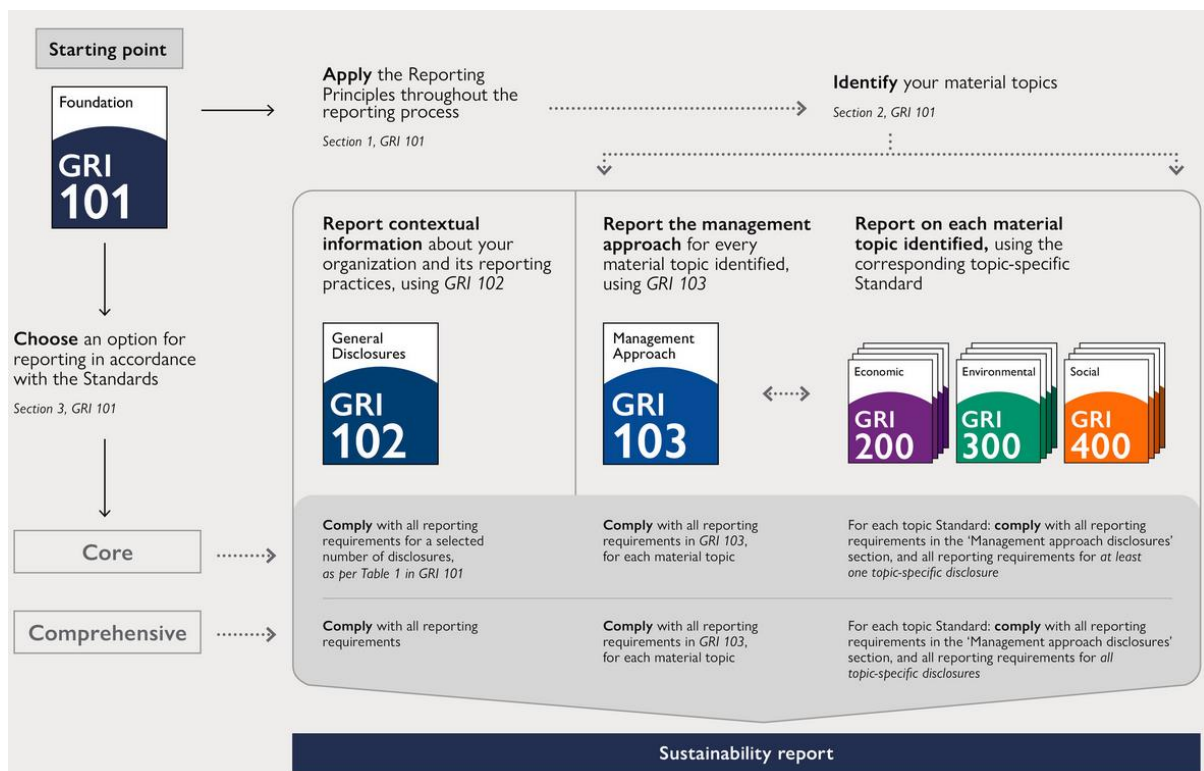
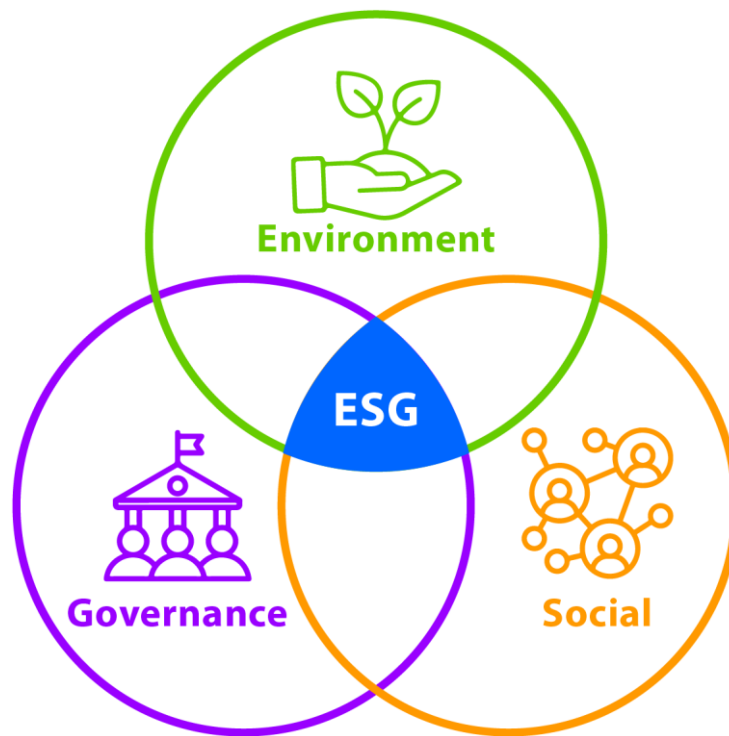


Chapter 12: A Roadmap to Your Smart Building Will Require Partners





Chapter 13: The Importance of Smart Buildings for Sustainability and the Environment





Chapter 14: Smart Buildings Lead to Smart Cities



Economy-Related KPIs	Environmental KPIs	Society and Culture KPIs
Core smart city economic performance KPIs:	Core smart city environmental performance KPIs:	Core smart city society and cultural performance KPIs:
• Household internet access	• Air pollution	• Cultural expenditure
• Fixed and wireless broadband subscriptions	• Greenhouse gas (GHG) emissions	• Informal settlements
• Wireless broadband coverage	• Electromagnetic fields (EMF) exposure	• Gender income equality
• Smart water meters	• Green areas	• Gini coefficient
• Smart electricity meters	• Renewable energy consumption	• Disaster-related economic losses
• Dynamic public transit information	• Electricity consumption	• Police service
• Traffic monitoring	• Residential thermal energy consumption	• Fire service
• R&D (Research and Development) expenditure	• Public building energy consumption	• Violent crime rate
• Patents		
• Public transport network		
• Bicycle network		

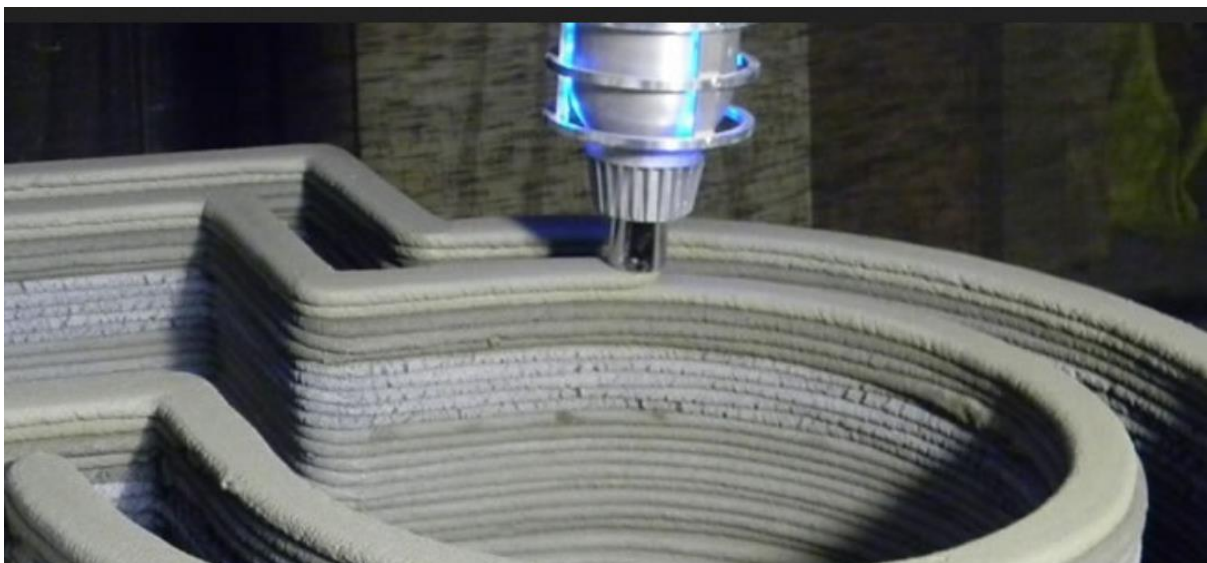
Economy-Related KPIs	Environmental KPIs	Society and Culture KPIs
Advanced smart city economic KPIs:	Advanced smart city environmental KPIs:	Advanced smart city society and culture
• Public Wi-Fi	• Noise exposure	• Electronic health records
• Electricity supply ICT monitoring	• Green area accessibility	• In-patient hospital beds
• Open data	• Protected natural areas	• Health insurance/public health coverage
• E-government	• Recreational facilities	• Cultural infrastructure
• Public sector e-procurement	• Residential thermal energy consumption	• Housing expenditure
• Transportation mode share		• Child care availability
• Travel time index		• Resilience plans
• Shared bicycles and vehicles		• At-risk population
• Low carbon emission passenger vehicles		• Emergency service response time
• Public building sustainability		• Traffic fatalities
• Urban development and spatial planning		• Local food production

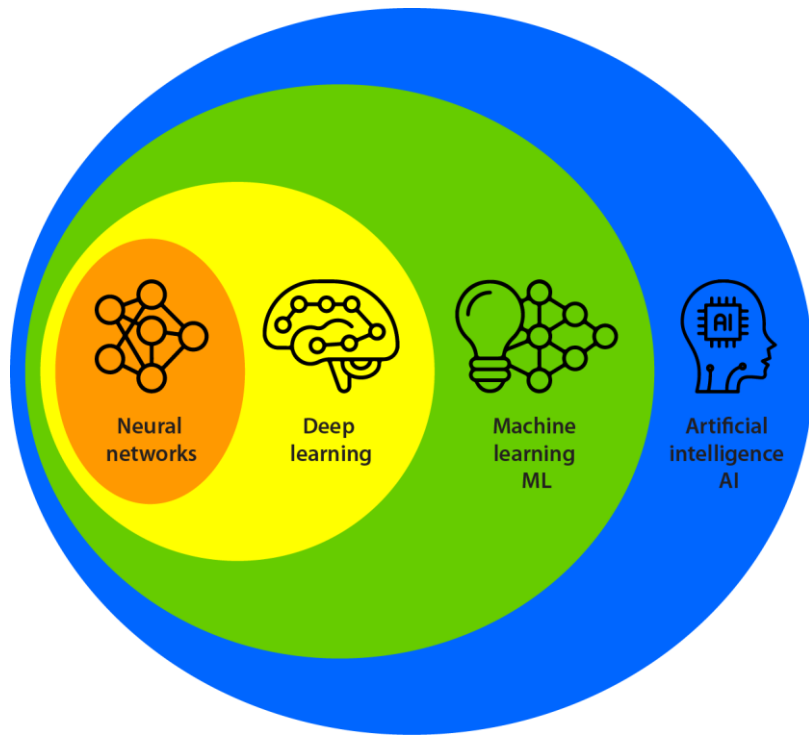
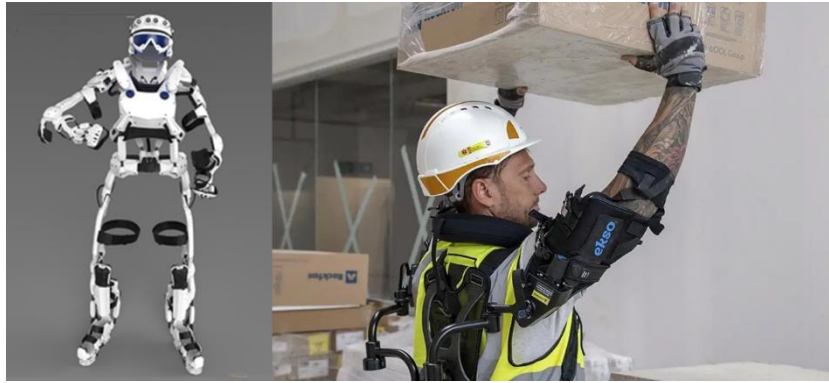
Chapter 15: Smart Buildings on the Bleeding Edge

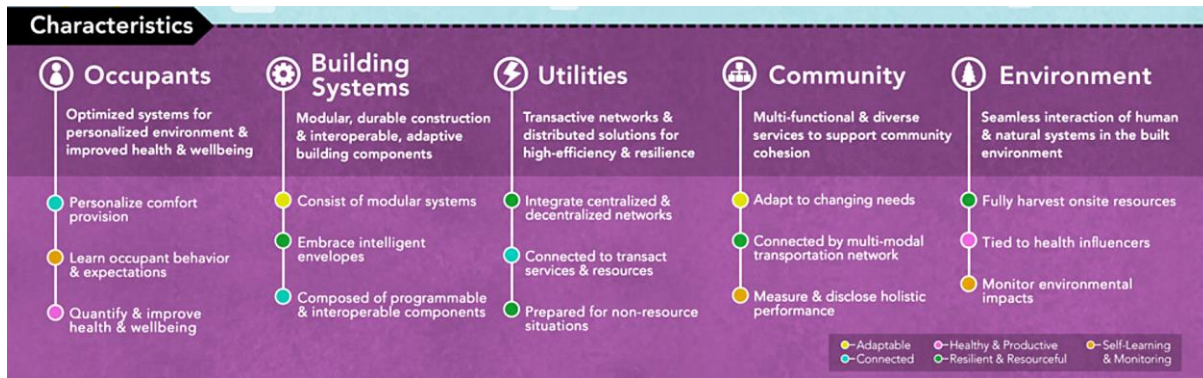
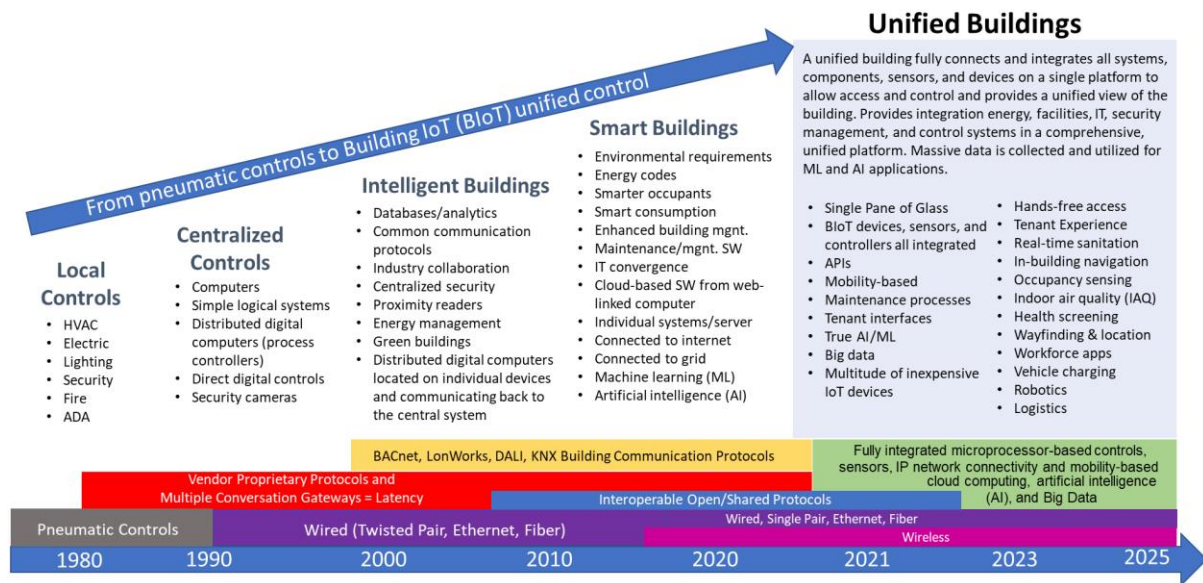
Net Operating Income

NOI Formula = Operating Revenue – Operating Expense

NOI Formula = Operating Revenue – COGS – SG&A







casa

connectivity
standards
alliance

