



Smart Sustainable Buildings

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Agenda

- 1 Why are Buildings Important ?
- 2 Typical Systems in a Building
- 3 A “Smart” Building
- 4 Examples
- 5 Wrap Up & Discussion





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Buildings ...

- Where we spend 90% of our lives
- Where we spend 70% of our electricity
- Where we spend 50% of our energy
- Where we spend 40% of our CO2 emissions
- *Natural counterbalance to fluctuating renewables*
- where we spend a lot of our \$'s
- 2/3rds of the occupants are uncomfortable

} 1/2 wasted



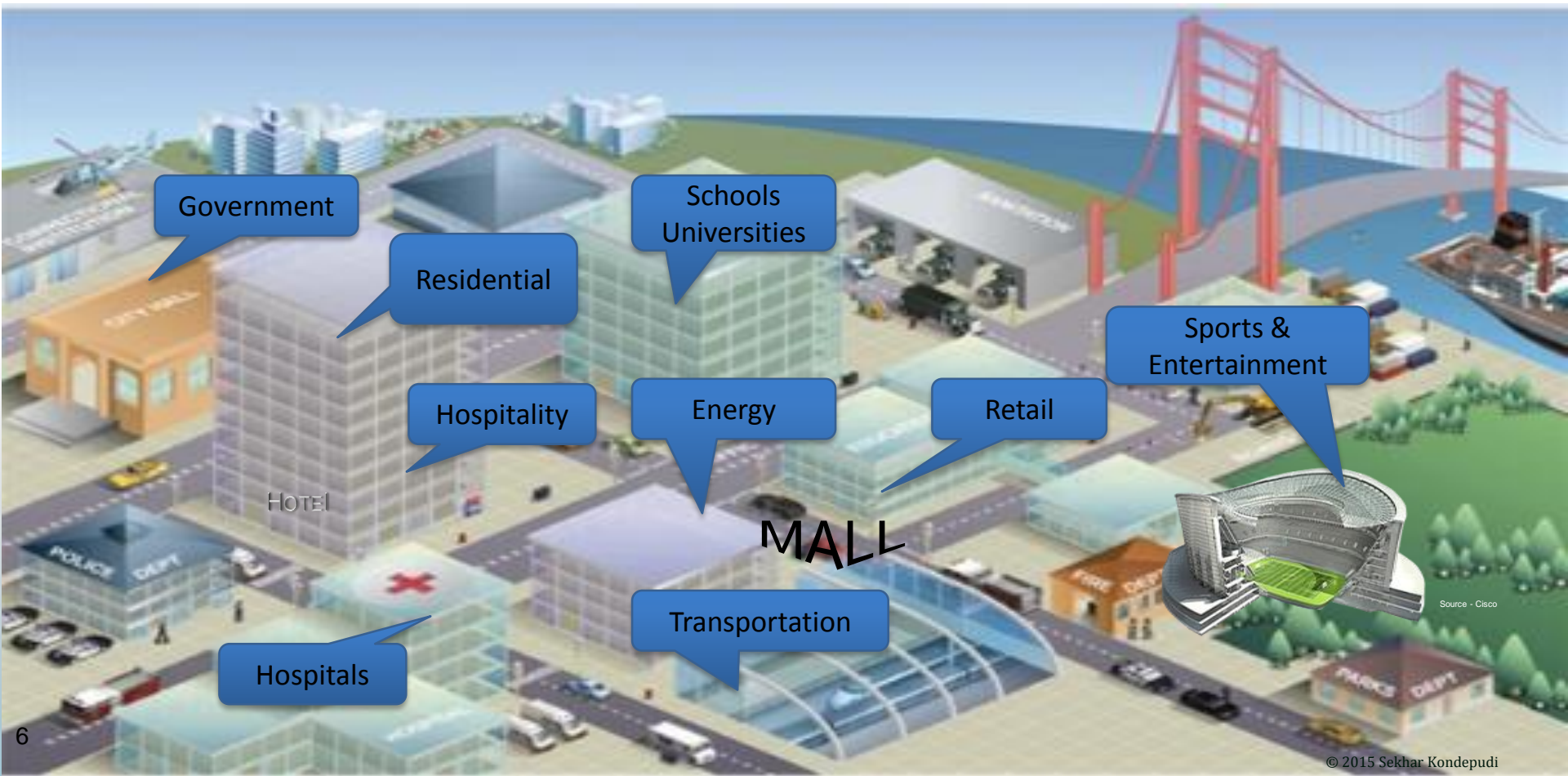


Wide Range of Building Types





City / Community = Σ Buildings



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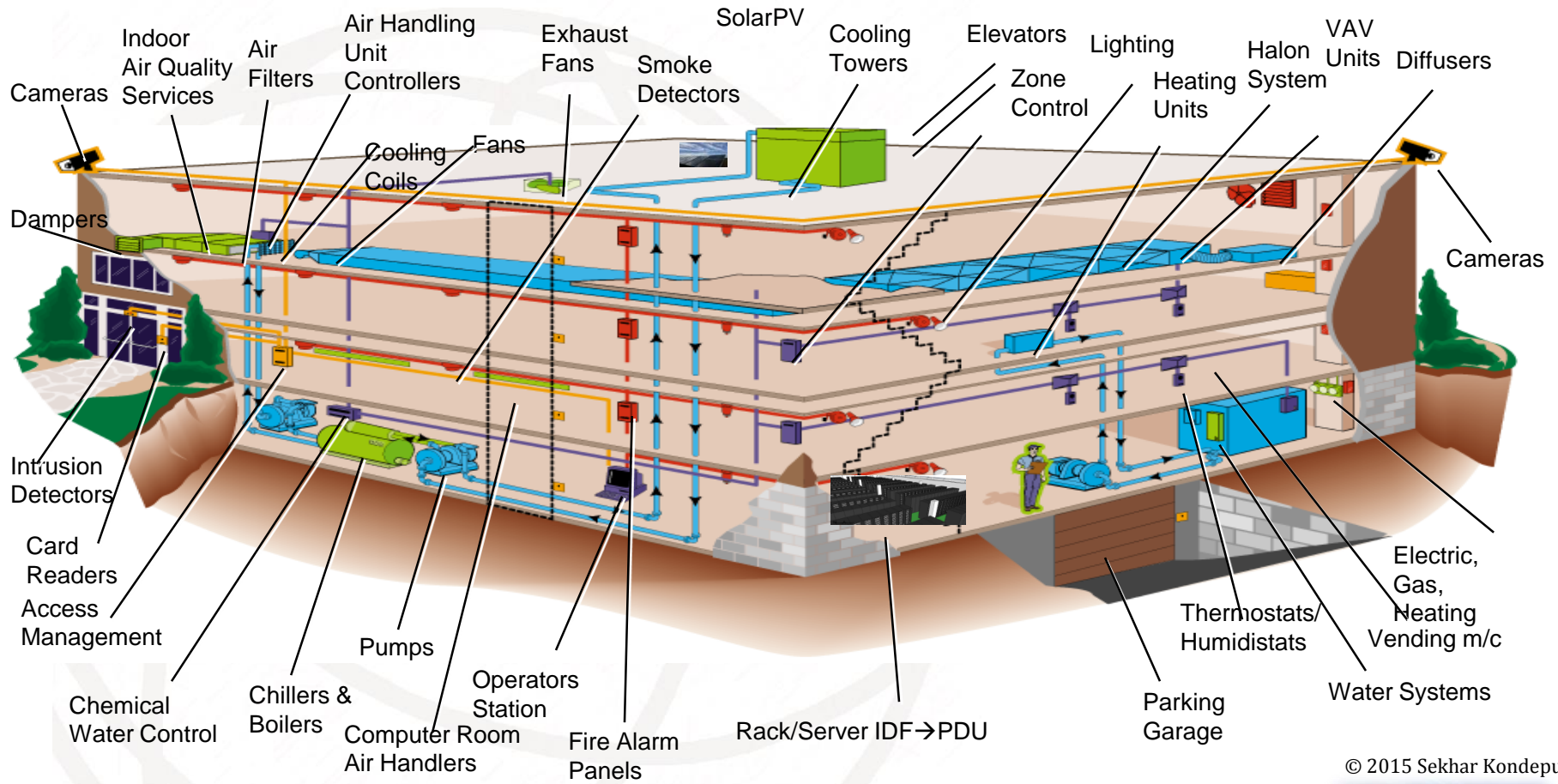
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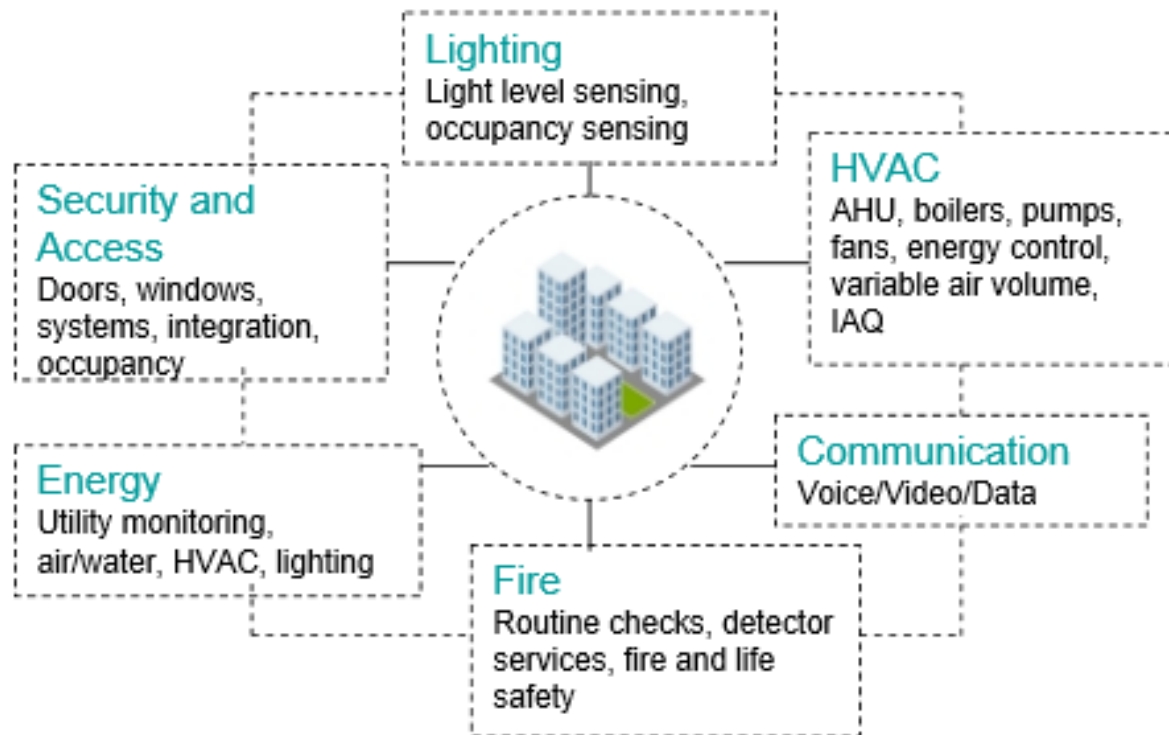
A Building = Σ Many Devices & Sub-Systems



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Systems in a Building





The 4th Utility

- 3 Traditional Utilities

- Gas
- Water
- Electricity



- 4th Utility is Here and Now :

- “Communications”





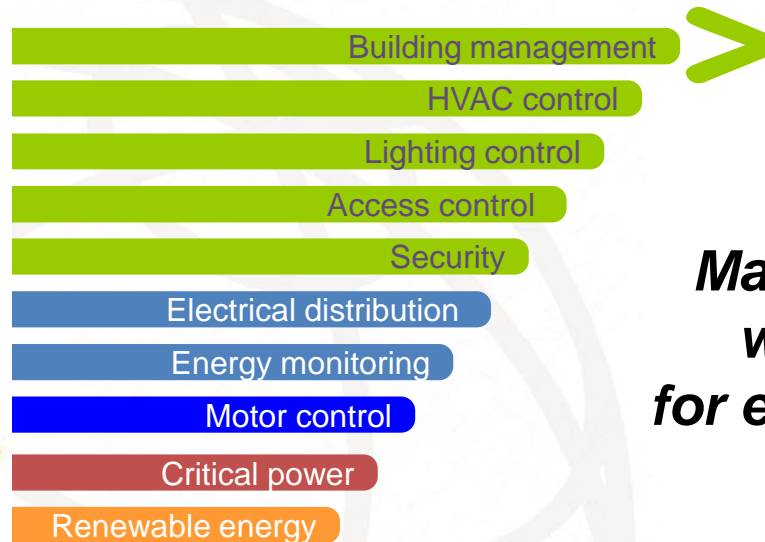
Integrated Approach towards Buildings

Integrating Across Silos = IBMS

Power	HVAC	Lighting	Access	Video Security	Life Safety	IT	Network
Power Monitoring Control Systems	Building Automation Systems	Lighting Control	Active Access Control Biometrics	Network Digital Video Recorder Video Analytics	Life Safety Systems	White Space IT Apps	Network Mgmt Systems
Emergency Power Supply Utilities	Chillers Boilers Air Handlers	Lighting	Locks Doors Gates Man-traps	Cameras Housings	Fire & Smoke Detectors, Sprinklers	Servers Computers Wiring Closet	Routers Switches Phones



Need for an Integrated View for Buildings



***Making the parts
work together
for energy efficiency***

Simple Integratio 1



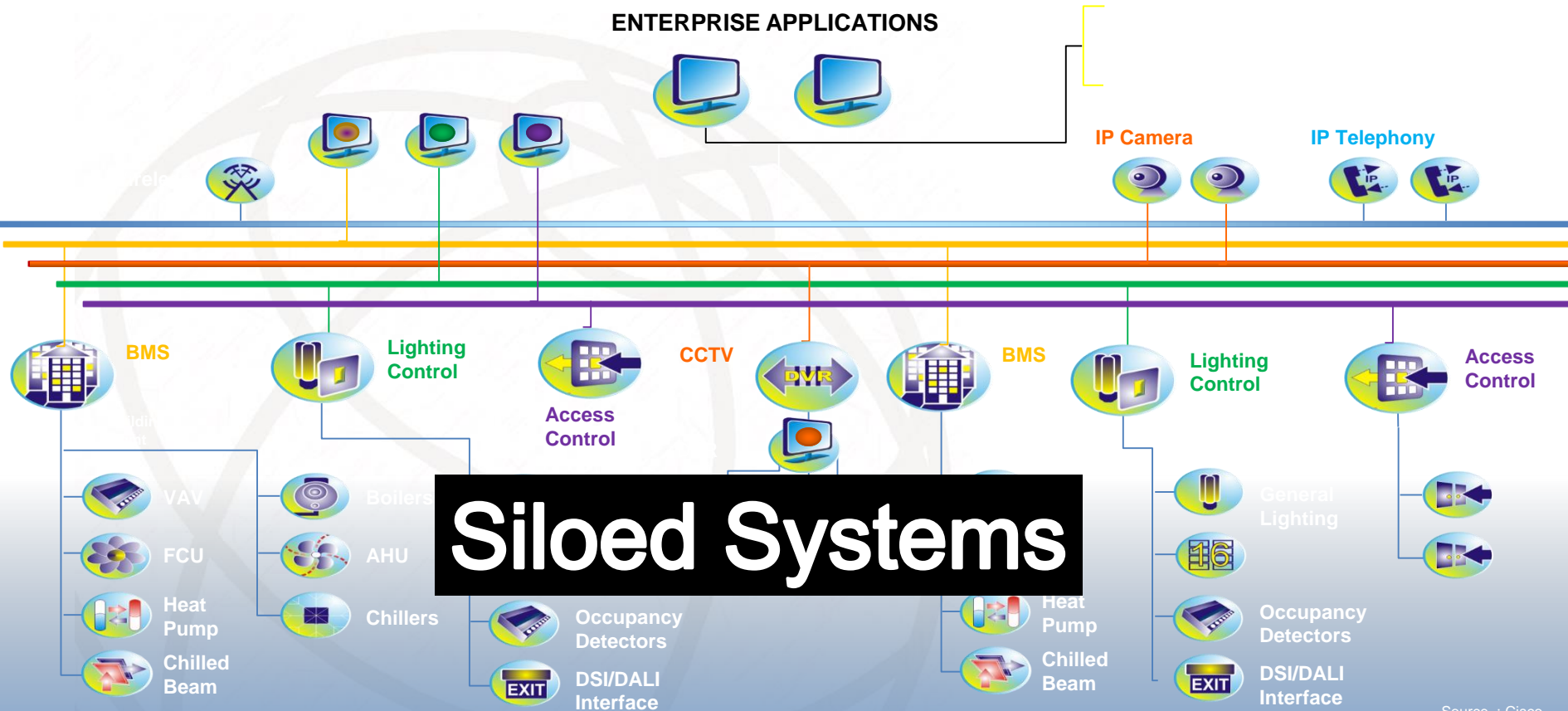


Common Building Communications Standards

- Common Building Communications Standards include BACNet, LonWorks, ModBus and KNX.
- The concept of using a digital IP backbone which can interface to almost any control or monitoring system has gradually become pervasive. So the above protocols are converted to IP
- Advantages of a common IP backbone is the immediate and seamless convergence with other IP based systems such as Data Networking, Voice over IP, Video and also Enterprise based systems.
- Examples of systems which are readily compatible with an IP backbone include:
 - Audio paging;
 - Fire alarm systems;
 - Telephone systems;
 - HVAC systems;
 - Surveillance systems;
 - Access control and intrusion alarms;
 - Lighting control systems;
 - Elevator control systems;
 - HVAC systems.



Before Convergence



Source : Cisco





After Convergence

Middleware Server
Disparate Protocols to Common Format +
ICT Integration

ENTERPRISE APPLICATIONS

- Energy Management
- Building Management
- Facility Management
- Security Management
- Maintenance Management
- IT Network Management

Wireless



IP Camera



IP Telephony



Energy & Power
Metering



Fire Alarm
System



BMS



Lighting
Control



UPS Monitoring



CCTV



Access Control



VAV



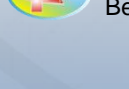
FCU



Heat
Pump



Chilled
Beam



Boilers



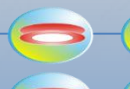
AHU



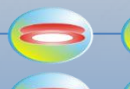
Chillers



Smoke
Sensor



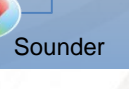
Break
Glass



General
Lighting



Sounder



DVR



Door Controllers



Channel
Controllers



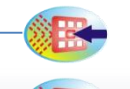
Occupancy
Detectors



DSI/DALI
Interface



Intruder
Panels



Intruder
Panels



Reader
Technology



Reader
Technology



Source : Cisco

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User Experiences

Home/Residential

Imagine having quick and easy access to the information and government services you need to enhance your personal and professional life



Office

A building that knew when you arrived and left, automatically turned business applications on and off, sends a security alert when an unidentified package is left, or notifies you about peaking energy use



Shopping

Reserve and pay for parking before leaving home; receive real-time sales incentives on your mobile device upon entering the store; real-time video surveillance system



Transportation

Road, railway, and air transportation is the heart of any community. Where transportation services are smart, safe, energy efficient. Where you could access real-time transit information



Sports

Connecting fans with their favorite teams--and each other--in entirely new ways with more immersive, interactive, and personalized experiences



School

Imagine a school where learning extends beyond classroom walls, students are exposed to a wider world of information and experience, and people can collaborate in real time,



Wellness

Receive services from best-in-class healthcare organizations that provide an enhanced patient experience, privacy, and safety.



Government

Imagine a government experience that is engaging, where you can access the information you need to live, work, learn and play in that community





Vision of a Smart Building

- A small group of individuals given the right tools have the ability to monitor the security, the temperature, the lighting, the occupancy, the safety, the ventilation and the electrical consumption of the building.
- These individuals can monitor, manage, diagnose (and sometimes correct) most building operational issues without ever leaving their desks which are equipped with little more than a computer screen.
- The economies of reduced staffing, immediate response and operational statistics are significant.
- The ability to perform maintenance on the basis of actual hours used or defects which have been identified will provide considerable savings.
- The ability to use electronic controls which ensure smooth starting and stopping of all machines, the gradual activation of luminaires and the smooth shutdown of luminaires all lead to significantly reduced operational failures and significantly extended operational life thereby providing further economies.





Possible Definitions

- The use of integrated technological building systems, communications and controls to create a building and its infrastructure which provides the owner, operator and occupant with an environment which is flexible, effective, comfortable and secure;
- Use of technology and process to create a building that is safer and more productive for its occupants and more operationally efficient for its owners;
- A building in which, those responsible for its operation, those benefitting from its operation and those ultimately responsible for the safety of all its occupants can share a view, and a vision of the building status at all times.





Bedroom

Smart books interact with the house's 3D and virtual reality system, bringing to life what you read.

Bathroom

Doctors will be able to give you virtual medical checks
Toilets will analyse waste for medical problems such as colon cancer.



Roof

Power collected through solar panels and stored in backup resources to power house and car.



Bedroom

Clothes made with smart fabrics regulate your temperature and monitor your health
E-commerce will become F-commerce - online consumers will be able to enjoy a tailored shopping experience based on Facebook 'Likes'.

Kitchen

Smart surfaces identify what's on them and have the ability to react accordingly - keeping coffee cups warm and iced-tea cold.
Refrigerators will advise on recipes based on whats in stock and creates personal diets.



Living Room

All appliances connected through invisible networking system
Entertainment system creates life like sounds, images and experiences to completely envelop you in near 4D experience.



Garage

Camera at entrance has facial recognition software which is linked to criminal database
Car which is able to drive itself.

Office

See-through electronics, screens, touch panels and tactile displays deliver 3D holographic experiences
Contact lenses allow you to access infinite information resources instantly before your eyes.



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Smart Hotel





HOSPITAL ROOM OF TOMORROW

STEP INTO THE HOSPITAL ROOM OF THE FUTURE – OK, SO MAYBE ALL OF THESE COOL GADGETS WON'T BE IN ONE HOSPITAL ROOM (AND CERTAINLY NOT BY TOMORROW), BUT **ADVANCES IN MEDICAL SCIENCE AND TECHNOLOGY PROMISE TO PROVIDE YOU WITH BETTER MEDICINE AND A MORE PLEASURABLE EXPERIENCE.**

1 SMART PILL

Intelligent pill technology is currently being used to **diagnose digestive conditions** such as Crohn's disease and colon cancer.

2 SMARTPHONE ULTRASOUND

Researchers are working on a **handheld machine that connects via USB to a smartphone**. The device could prove life-changing in developing areas where people have little access to medical technology.

3 TAKING CONTROL

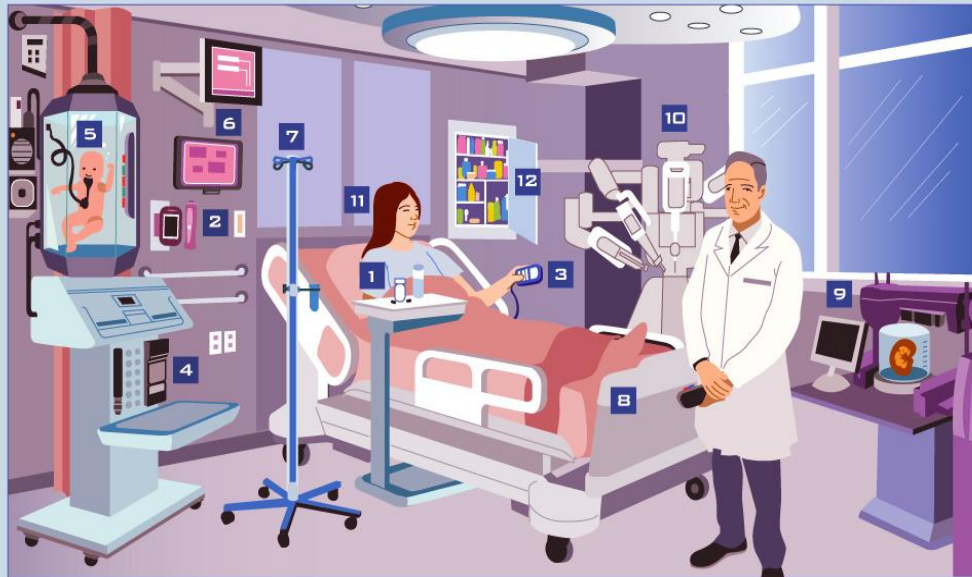
Patients will be able to raise and lower the shades in the room, order food, shut off the lights and access the Web. Prototypes are being tested.

4 MEDICAL TRICORDER

With a name borrowed from "Star Trek," this device would use technology to **collect and analyze data on patients' health** and then compare that data to electronic medical records. It also would run simulations to determine the best course of treatment. Military researchers are currently in the conceptual phase on the technology related to such a device.

5 ARTIFICIAL WOMB

Straight out of "The Matrix," tanks are filled with **amniotic fluid**, and embryonic umbilical cords are attached to pumps that regulate **nutrient intake and waste production**. Such methods have been used for some animals, but they are still a theoretical possibility for use with human babies.



6 HEALTH DISPLAY

With the swipe of a card, **patient information will be displayed on a computer monitor** in the room. Doctors will see data they need to know (such as the full medical record). **Nurses will see information pertinent to their jobs** (like medical history and care requirements). Housekeeping staff will see information that helps them do their jobs. Prototypes are being tested.

7 CENTRALIZED IV SYSTEM

Nurses no longer will need to program your IV manually, as a **centralized system** at the nurse's station or elsewhere **will program them all automatically.**

8 SMARTBED

Without you being hooked up to 25 monitors, **your bed will track key health information:** Temperature, blood pressure, heart rate while you sleep. The information could then be sent wirelessly to health care providers' cellphones or email. Project is in developmental stages in Europe.

12 MEDICATION SECURITY

A medication dispensing system will use **bar codes and scanning technology** to reduce medication errors.

BETTER DRUGS

Research into **gene therapy will provide personalized medication like never before.** Your doctor will have access to your **complete genome**, so she'll be able to predict possible drug interactions and your body's reaction to potential treatments. Toxic reactions to drugs will plummet. Much of this work already is under way, and researchers predict many of the most life-changing advances will come in the next decade or so.

11 MEMORY RESTORATION

This military project is aimed at **restoring memory** by bypassing brain injuries. The theory is that injured soldiers would be able to return to the battlefield with improved performance. Researchers also hope the project will improve overall knowledge of short-term memory and brain functions.



10 ROBOTIC SURGEONS

These guys have been around since the late 1980s, but they are seeing increasing usage in heart, intestinal, brain, pediatric and orthopedic surgery. **Robotic "doctors" mirror human arms, allowing repetitive, controlled actions.**



9 ORGAN PRINTER

A complex 3D printing process can create tissue adequate for transplantation, bypassing the potentially lengthy process of waiting for an acceptable donor. While such devices aren't in use now to create full organs, some of the biological material they can produce has been used to help patients.

SOURCES

<http://www.rhys.org.com/news/145640874.html> <http://www.rwjf.org/qualityequality/digest-08753> http://www.washingtonpost.com/blogs/ezra-klein/post/the-future-of-health-care-today/2011/11/10/BIADA1V3ZEM_blog.html <http://medgadget.com/2008/02/smart-hospital-beds-of-the-future.html> <http://www.infowar.com/the-future-of-organ-printing-and-artificial-biology/> http://www.drnl.gov/sc/techresources/human_genome/medicinal <http://blog.sherweb.com/7-really-cool-medical-tech-advancements-underway/> <http://www.healthymagination.com/blog/new-frontiers-of-military-medical-research/> <http://utopianist.com/2011/03/3d-organ-printer-creates-kidney>

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Measure

Analyze

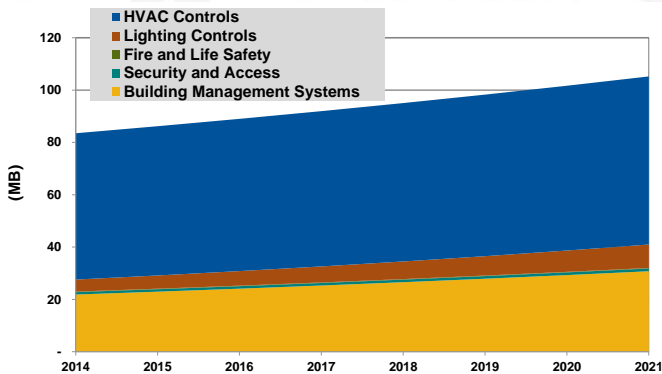
Optimize



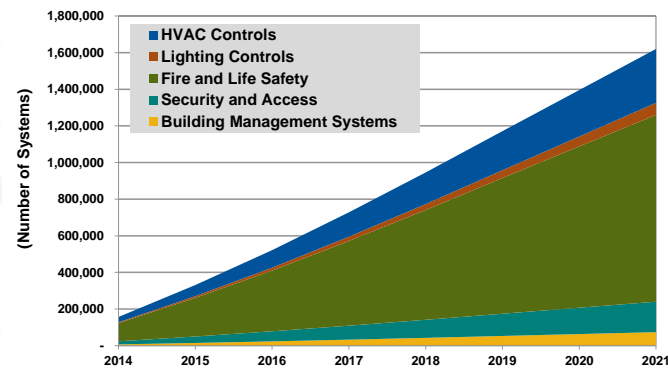
Big Data & Buildings

- By 2015, 17 petabytes per year for all BASs in North America
- By 2021, 52 petabytes per year for new construction alone
- Approximately 2 petabytes: All U.S. academic research libraries

BAS Daily Data Throughput by Controls Segment, North America: 2015-2021



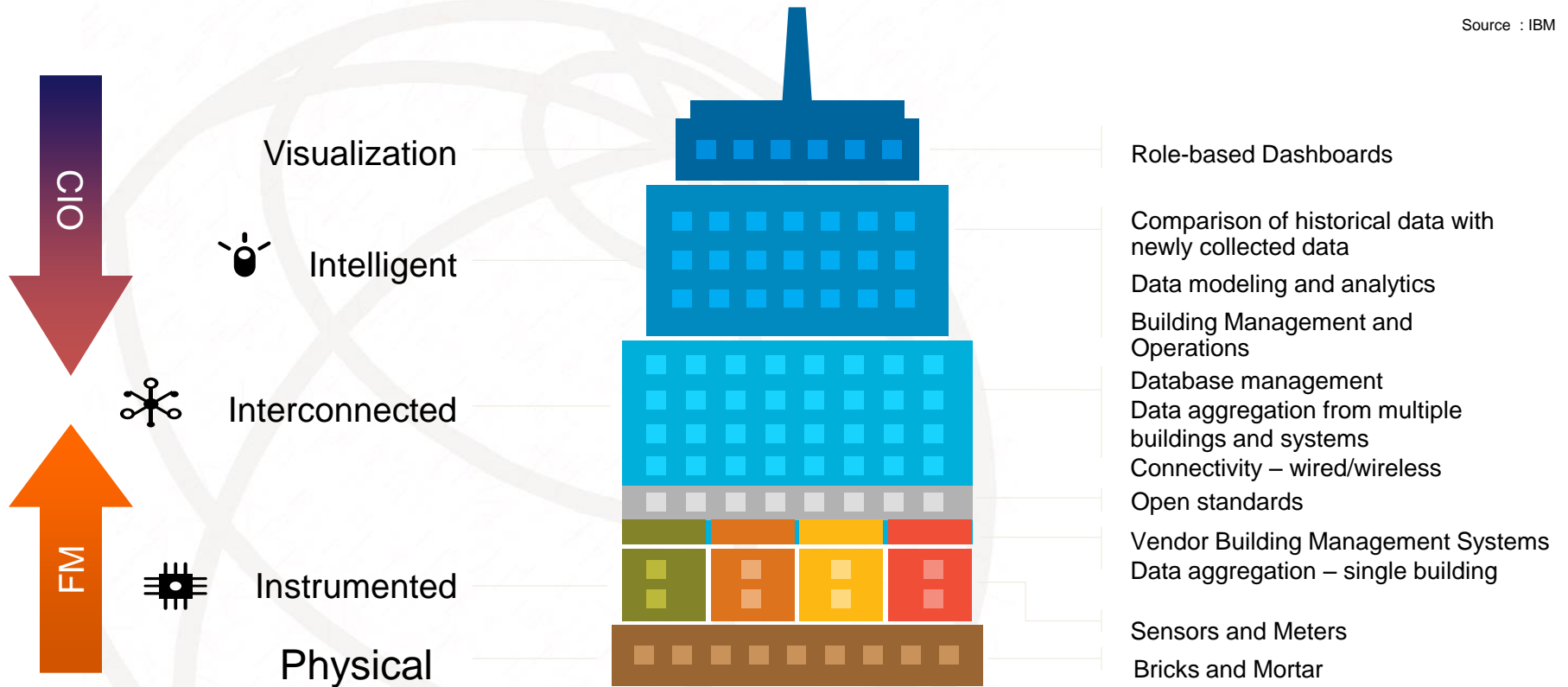
BAS Installations by Controls Segment, New Construction, North America: 2015-2021





Convergence creates a smarter building

Source : IBM

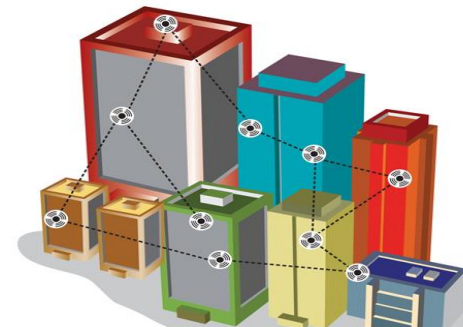
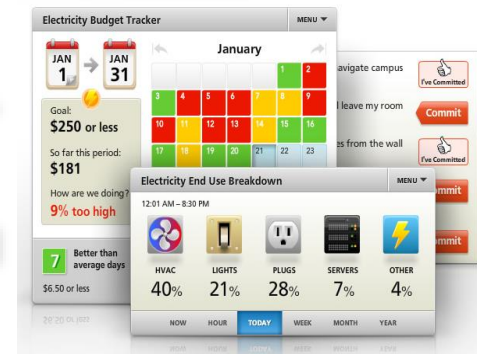
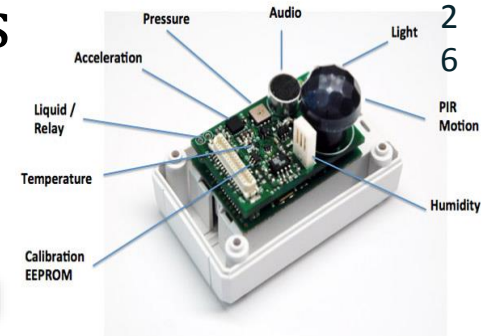


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Analytics, Informatics & Dashboards

- Wireless Sensor Networks
- Energy & Environmental Data
 - View, Compare, Share
- Analytics
 - Prediction
 - Energy Savings Strategies
 - Operational Optimization
- Real-time Information / “Pulse”

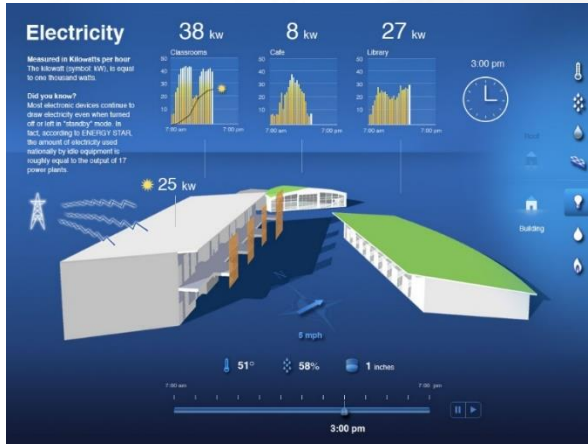


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Dashboards and Visualization is KEY





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SF PUC



Microsoft Headquarters



City Square Mall



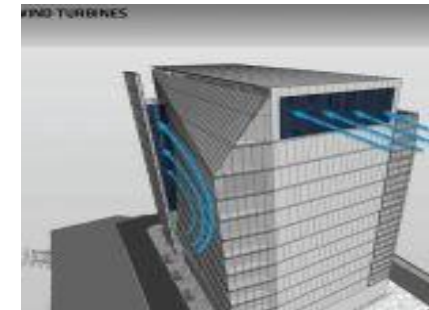
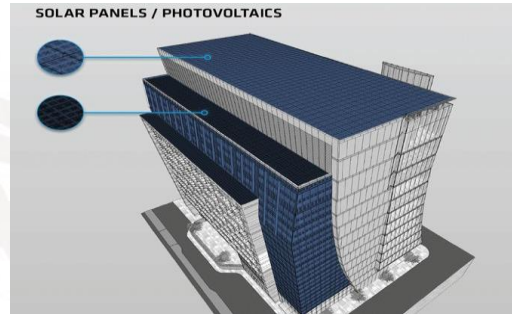
Infosys Building, India



San Francisco Public Utilities Commission



uses 55% percent less energy and consumes 32% less electrical demand than the ASHRAE baseline standard.



- LEED Platinum
- Exterior sun shades
- Natural ventilation with the use of operable windows
- Wind turbines along the façade
- Three roof top solar platforms with 684 panels
- 45% daylight harvesting
- Living machine wastewater recycling for flushing
- Rain harvesting for irrigation





SFPUC

- 13,500 Points
- 450 Dashboards
- Rain harvesting for irrigation
- Elevator Monitoring
- Waste Water Treatment System
- Direct Digital Controls
- Digital Network Lighting Controls
- Power Monitoring and Control System
- Fire Alarm and Detection System
- Solar Energy Collector Metering
- Wind Energy Power Generator Metering
- Interior & Exterior Shade Control System
- Weather Station Monitoring System
- Window Washing System
- Water Reclamation



Public information & Education

Demand Response

Alarm Management

Building Analytics

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Data Secure Buildings

greentech**efficiency:**



◀ PREVIOUS

Nest Labs Acquires
MyEnergy to...

EFFICIENCY:
Energy Management

NEXT ▶

Why Your Energy
Dashboard May Be...



Hackers Penetrate Google's Building Management System

The downside of smarter
buildings: "If Google can fall
victim, anyone can."



The Smart Building Becomes Real as It Comes Alive

"The Skin"

Dense sensor network on building surface and embedded in the systems and materials

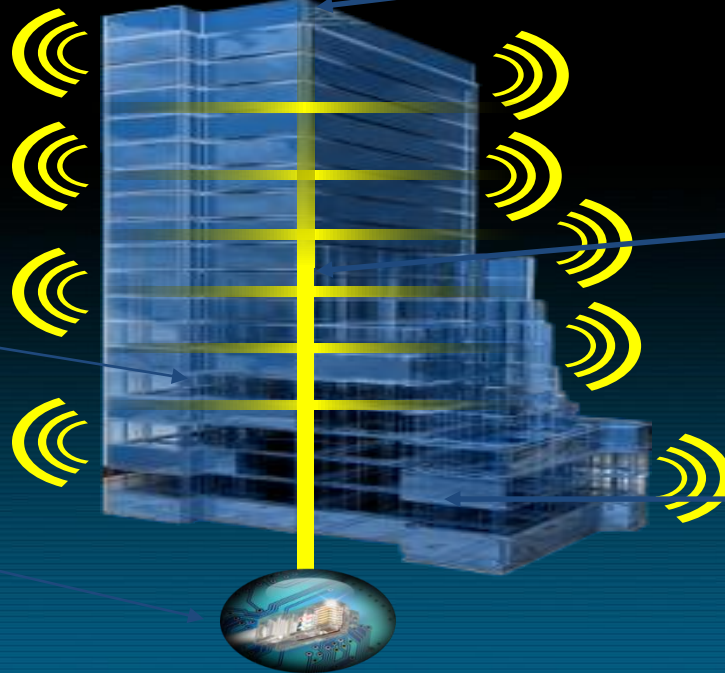
"The Circulatory System"

The electrical system

"The Brain"

A policy engine at the center of the information systems

The Living Building



"The Skeleton"

The physical bricks and mortar of the building

"The Nervous System"

The IP / Communications Network

"The Muscles"

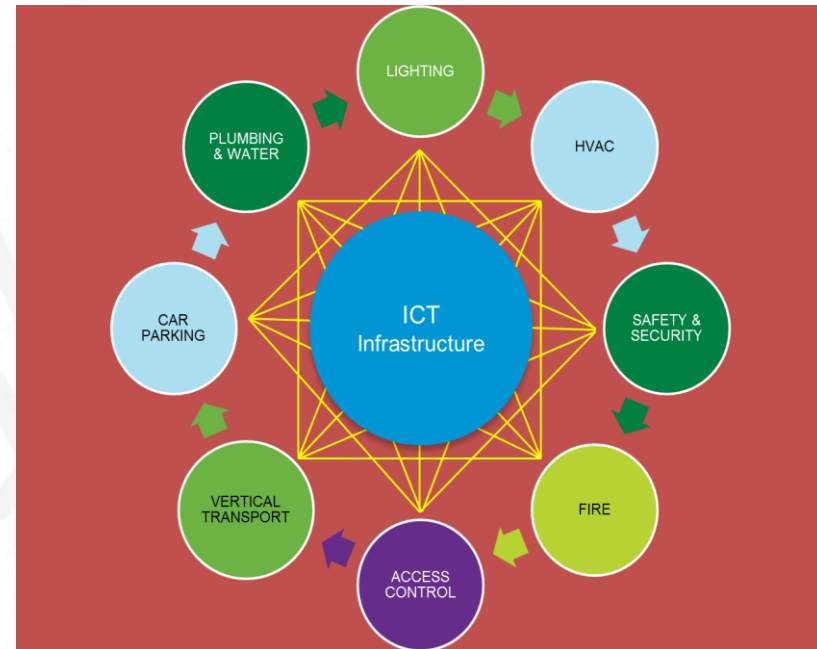
The devices and subsystems attached to the network

Adapted / Modified from CISCO



The Building as a Network

- Variety of Building Functions / Sub-Systems all of which coordinate with one another
- Sub-systems, components & devices which have nodes, end points and behave like a network in terms of their end use characteristics and interactivity with other nodes.
- “System of Systems” or a “network of networks”
- “Internet of Things” (IoT) for Buildings.
- This is completely analogous to an IT or Data Communications network





Buildings of the Future



*Recognizes you and customizes itself
based on your preferences*

Intelligent



Efficient
*Uses hard & soft resources optimally while
increasing productivity*

Collaborative

*Ensures that you stay connected to the right
people & the right information in real time*

Secure

*Assures both information & physical security
at all times*

Experiential

Delivers goodness in the way you work & live

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