

# GEE5303 Green and Intelligent Building

<http://ibse.hk/GEE5303/>



## Intelligent buildings

**Thei**

*Ir. Dr. Sam C. M. Hui*

Faculty of Science and Technology

E-mail: [cmhui@vtc.edu.hk](mailto:cmhui@vtc.edu.hk)

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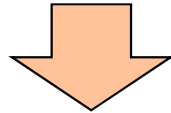
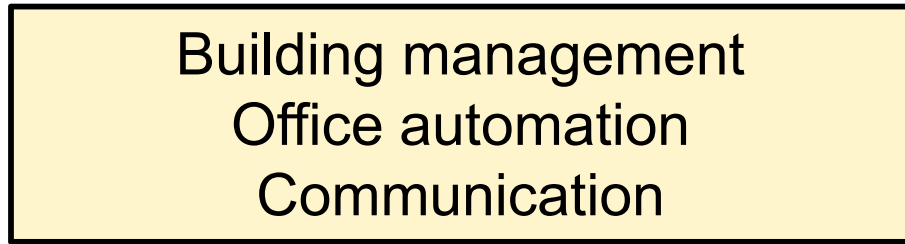
*“Integrating green building design and intelligent technology”*  
*“Combine information and communication technology (ICT) and the  
concept of green building”*

# What is intelligent building (IB)?

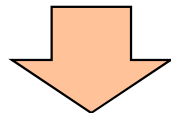
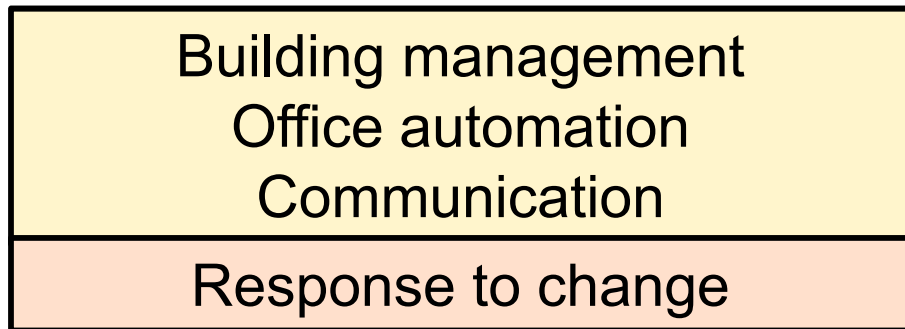
- Intelligent building (IB)
  - First coined in USA in early 1980s; its definition/model is changing/evolving
    - Automated buildings (1981-85)
    - Responsive buildings (1986-91)
    - Effective buildings (1992-)
    - Intelligent and green buildings (2000-)
  - Development of IB
    - Closely linked with computers and information technology (IT); high-tech related
      - But, IB ≠ high-tech building

智慧型大廈  
智能建築

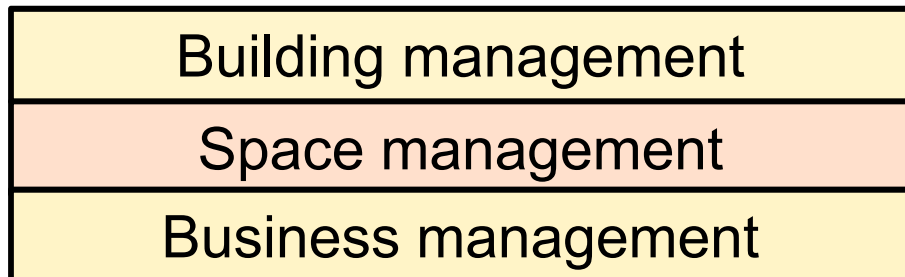
## Automated buildings (1981-1985)



## Responsive buildings (1986-1991)



## Effective buildings (1992- )



An intelligent building is a collection of innovative technologies

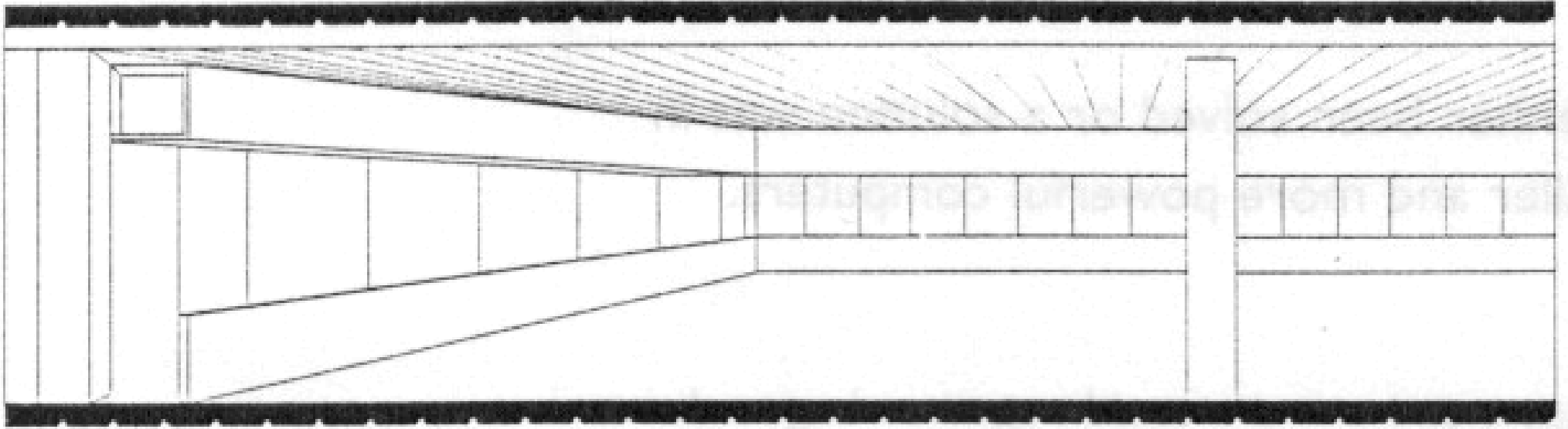
An intelligent building is a collection of technologies able to respond to organizational change over time

An intelligent building provides a responsive, effective and supportive environment within which the organization can achieve its business objectives. The intelligent building technologies are tool that help this to happen.

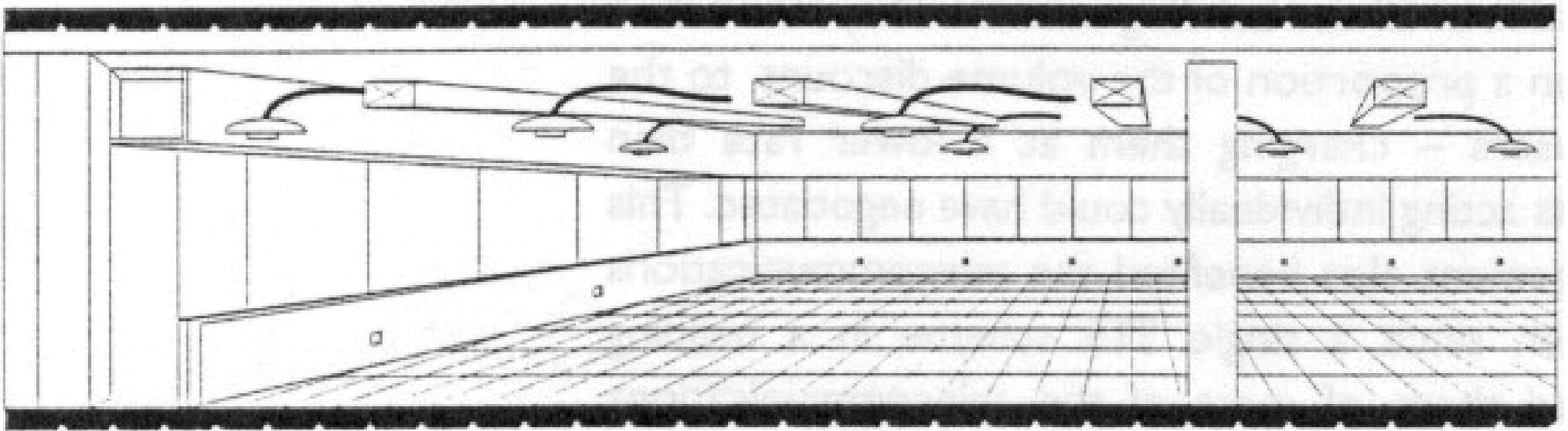
# What is intelligent building (IB)?



- IB in Europe study (early 1990s)
  - IB “... provides a responsive, effective and supportive intelligent environment within which the organization can achieve its business objectives.” -- DEGW (1992)
- Intelligent Buildings Institute (IBI) study:
  - Optimization of its four basic components - **structure, systems, services and management** - and the interrelationships between them

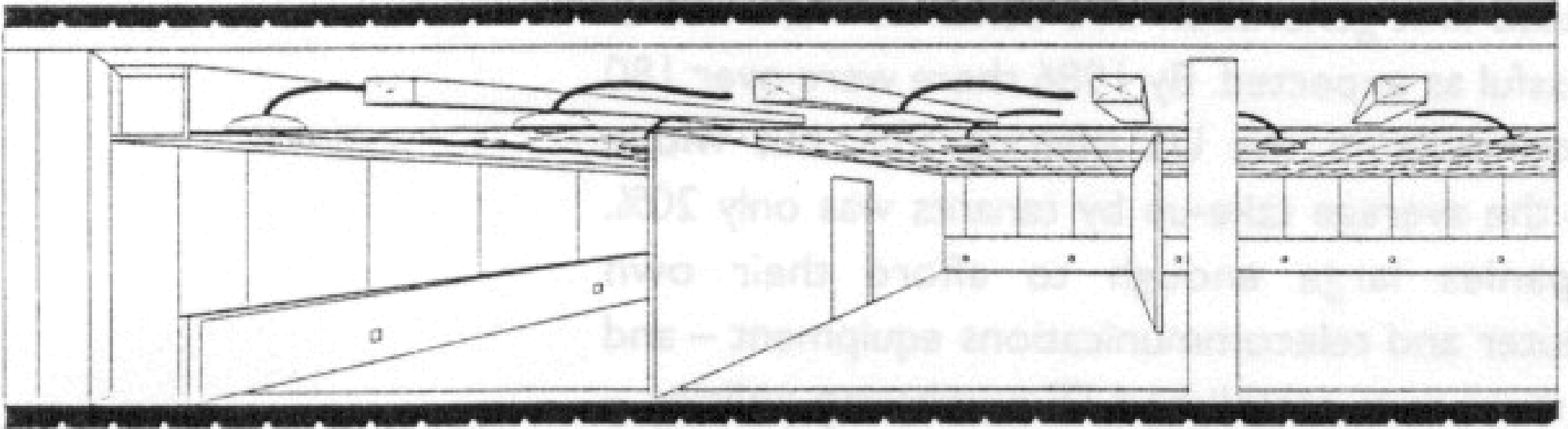


Building shell: 50-75 years (structure cladding)

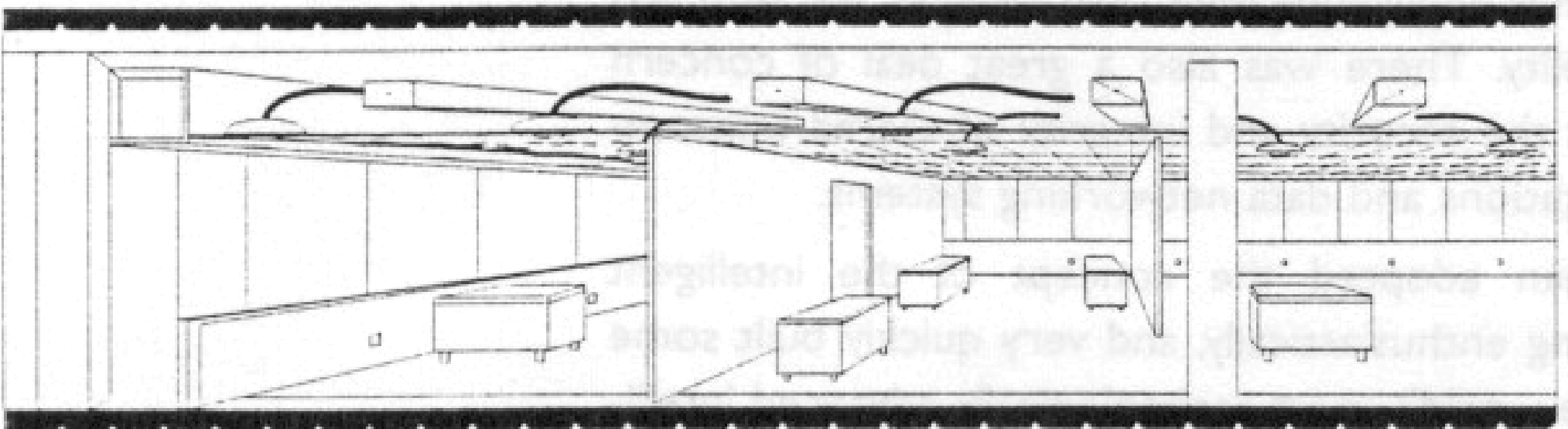


Building services: 15 years (HVAC, light, power)

[Source: Harrison, A., Loe, E. and Read, J., 1998. *Intelligent Buildings in South East Asia*]



Fitting-out elements (scenery): 5 years (fixed interior elements, ceiling, partitions, finishes, IT equipment)



Office furnishings (settings): day-to-day rearrangement

# What is intelligent building (IB)?

- Late 1990s and 2000s
  - IB definition: tilted towards **energy efficiency** and **sustainability** with the introduction of green building assessment methods (e.g. BREEAM and LEED)
  - Increasing convergence of intelligence and sustainability: “**Bright Green Buildings**”
  - Buildings that are **both intelligent and green**



# What is intelligent building (IB)?

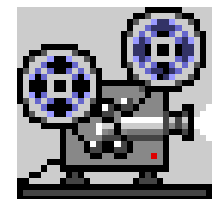
- Current understanding of IB
  - Address both **intelligence** and **sustainability** issues by utilising computer and intelligent technologies to achieve the optimal combinations of overall comfort level and energy consumption
  - Intelligent buildings combine and leverage 5 key aspects of building management:
    - Enhanced financials, operational efficiency, occupant experience, energy conservation, sustainability

**Intelligent + Green**



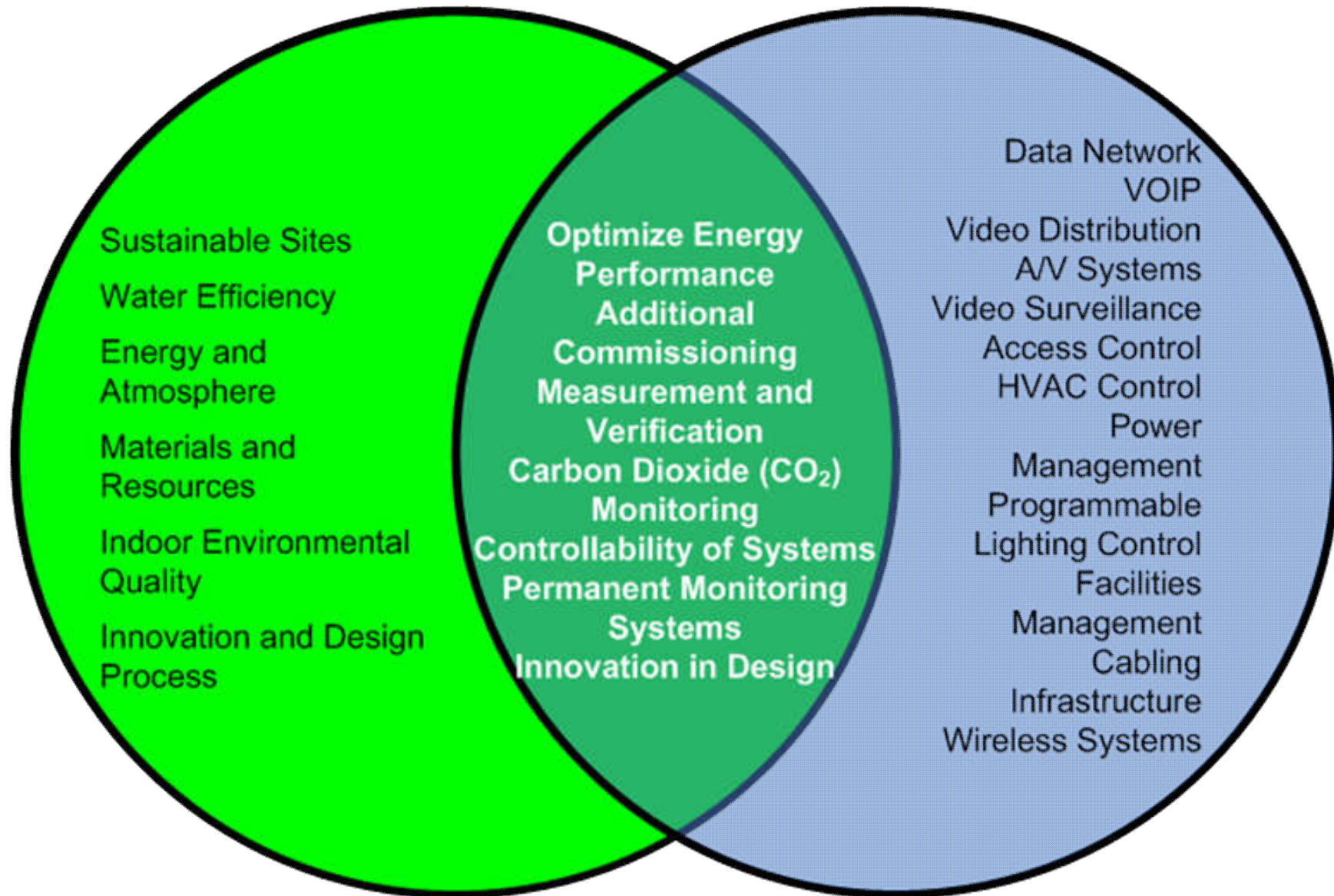
# What is intelligent building (IB)?

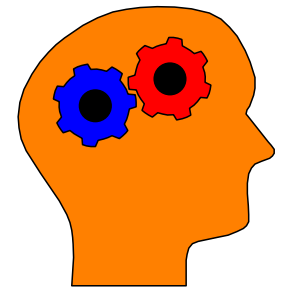
- Definition of IB by CABA (Continental Automated Buildings Association)
  - An Intelligent Building uses both technology and process to create a facility that is safer and more productive for its occupants and more operationally efficient for its owners
- Videos:
  - Intelligent buildings by CommScope (5:22)  
<http://youtu.be/wlumbLlSxp4>



# THE COMMONALITY OF SMART AND GREEN BUILDINGS

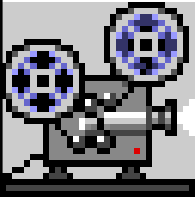
**GREEN BUILDINGS**

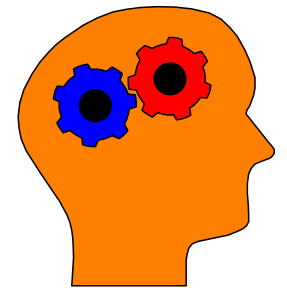




# Intelligent and Smart

- Smart building technologies can improve buildings' energy efficiency and indoor environmental quality
- Future outlook:
  - Smart buildings - the future of building technology (7:26) <http://youtu.be/gCuPx9shWT0>
  - Can you identify all the technologies in the video?





# Intelligent and Smart

- Intelligent (Smart) buildings are part of an increasingly integrated built environment
  - Smart homes, smart cities, smart electricity grid, intelligent transport



# SMART BUILDINGS CONNECTED BY A SMART GRID

## Benefits of increased building performance

- cost savings
- comfort optimization
- increased flexibility in energy demand
- CO<sub>2</sub> reduction

### Smart Sensors

- humidity
- temperature
- light
- CO<sub>2</sub> level
- occupancy

## SMART BUILDING

personal comfort and increased building performance

### Room Control

sun blinds  
building properties  
ventilation

air conditioning  
heating  
lighting  
power consuming devices

combined heat and power system

ev-charging poles

### Building Management System

- real time energy prices
- load occupancy forecasts
- weather forecast anticipation
- demand response signals
- insight in energy usage of devices

## SMART GRID

bi-directional energy and communication flows

district heating

gas network

water supply

thermal (heat and cold) storage

uninterruptible power supply  
meters and sub-meters

electricity storage

electricity grid

industrial area

sub station

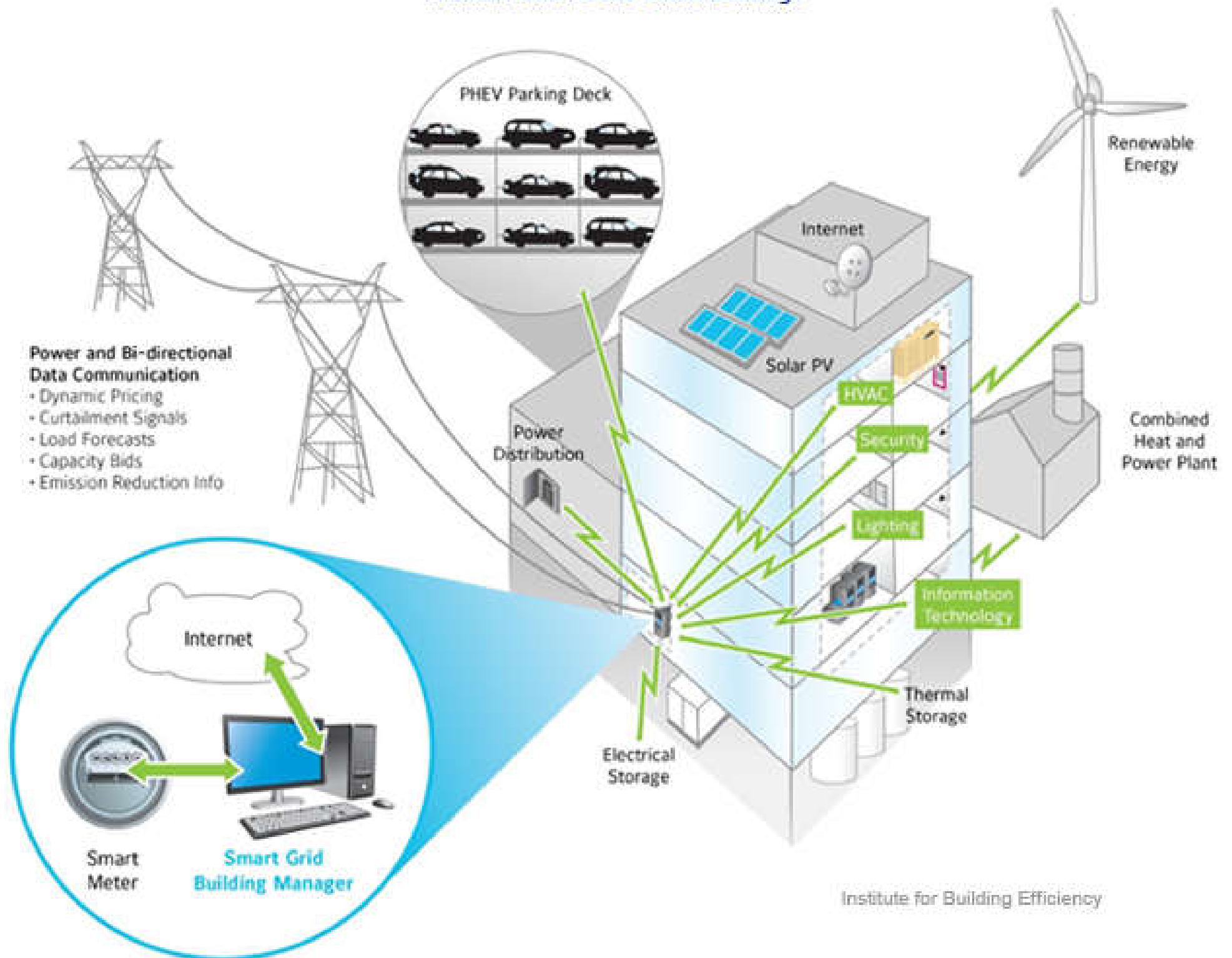
wind turbine

residential area

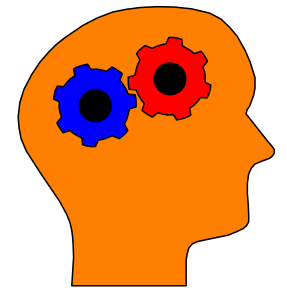
greenhouse



# A Smart Grid Needs Smart Buildings





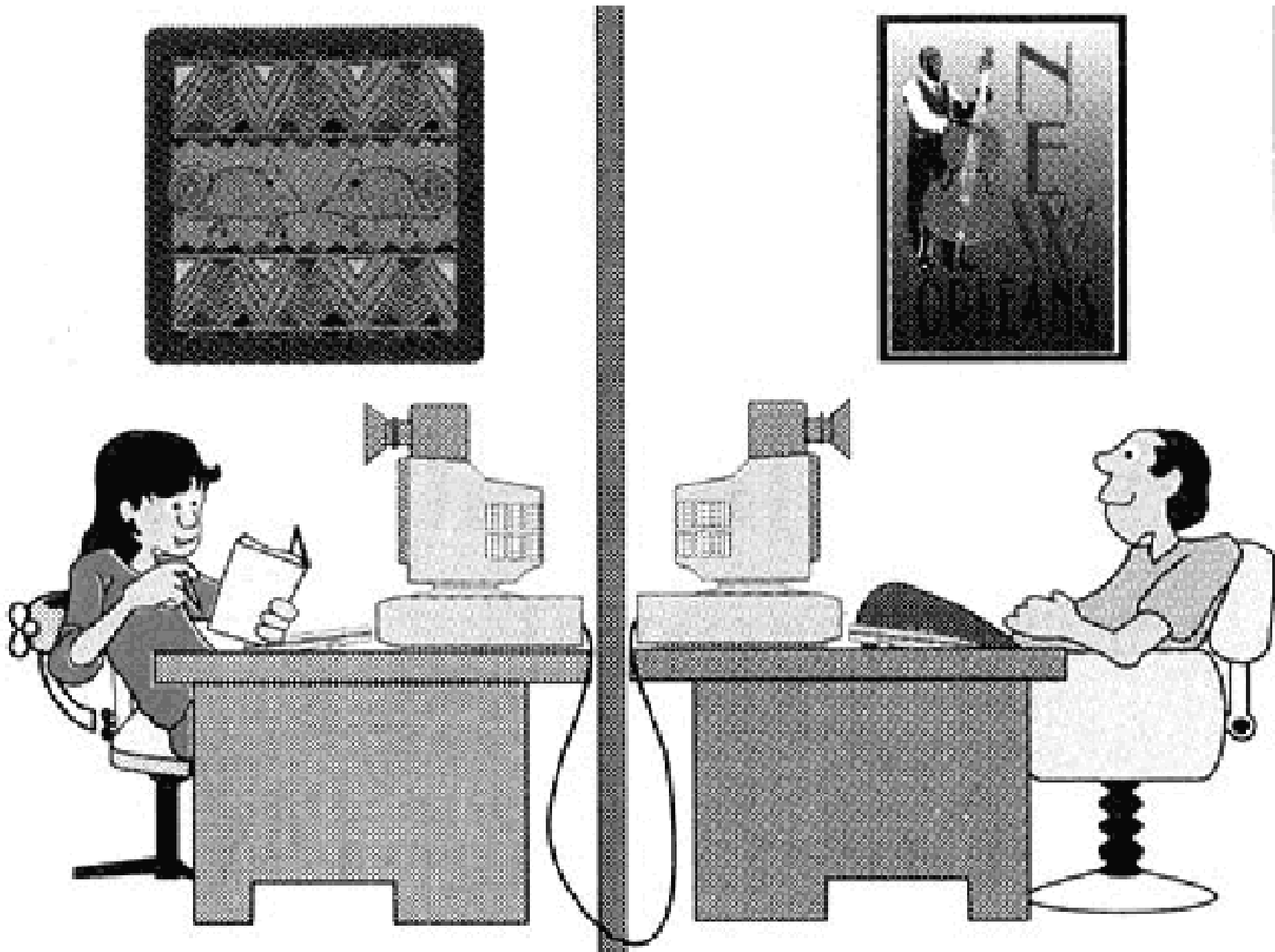


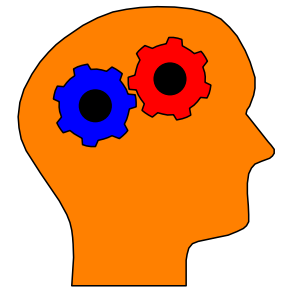
# Intelligent and Smart

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- Major IB features
  - Automatic reactions (adjust internal conditions)
  - Effective communication & IT management
  - Responsiveness to changes
- Integrated pyramid
  - Single function/dedicated systems
  - Multifunctional systems
  - Integrated systems
  - Computer integrated building

# Is this Effective Communication ?





# Intelligent and Smart



- My own definition: “An intelligent/smart building is one that doesn't make the occupants look stupid.”
  - Maximizes the efficiency of its occupants and allows effective management of resource with minimum life costs
  - More responsive to user needs and has the ability to adapt to new technology or changes in the organizational structures

# Components of an IB



- Building management:
  - Building automation and the physical environment
- Space management:
  - Building's internal space & operating costs
  - Capabilities & flexibility of the building to accommodate changes, personal moves & connectivity
- Business management
  - Management of the organization's core business

# The Intelligent Building

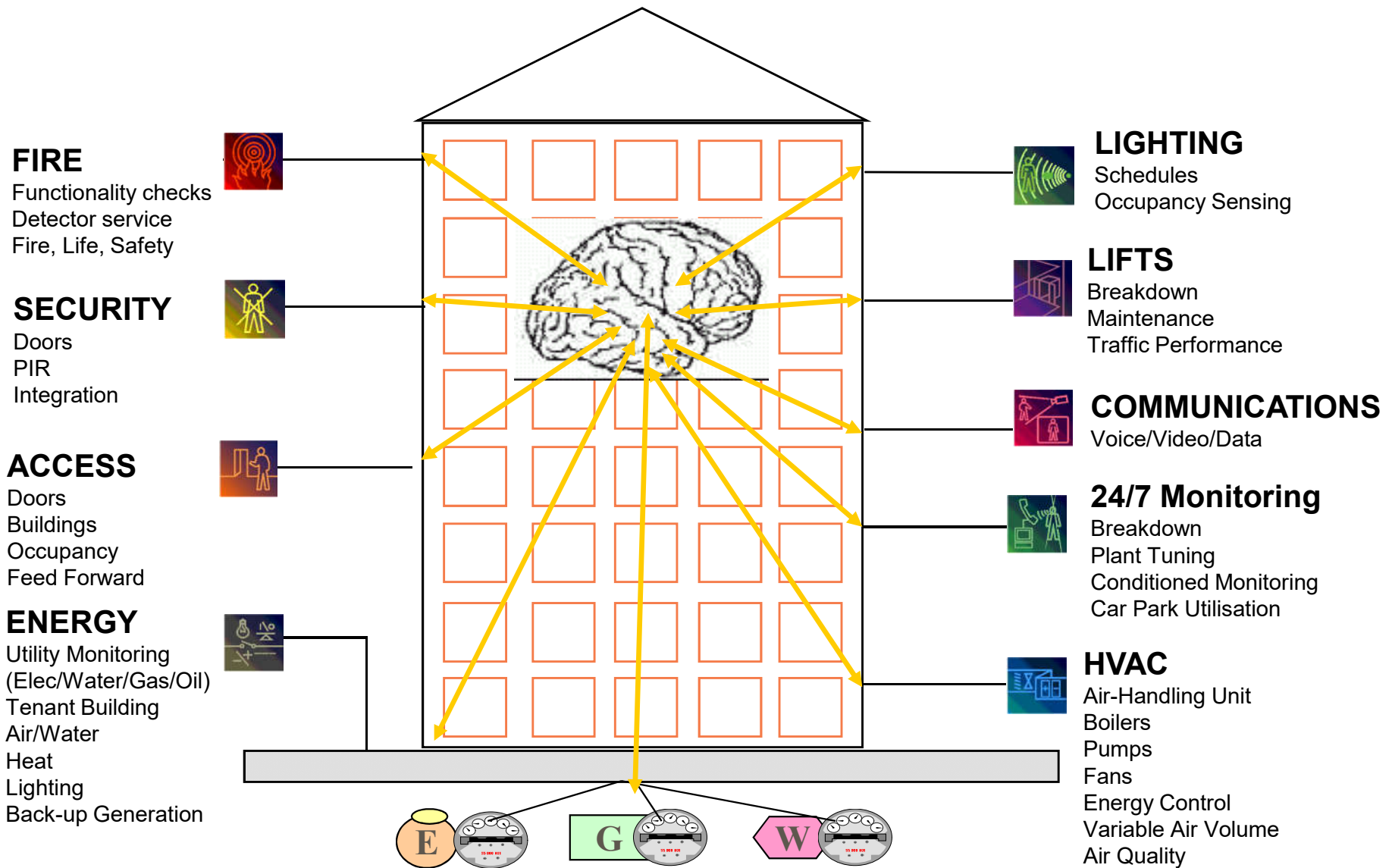
IB Goals	IB Tasks	IB Attributes	
<b>Building management</b>	Environmental control of building 	<b>Design strategies and building shell attributes</b> <b>Facility management strategies</b>	<b>Building Automation systems (BA)</b>
	User control of building systems		
<b>Space management</b>	Management of change (capacity, adaptability, flexibility, manageability) 		<b>Computer Aided Facility Management systems (CAFM)</b>
	Minimization of operating costs		
<b>Business management</b>	Processing of information		<b>Communications</b>
	Storage of information		
	Presentation of information		
	Internal communications		
	External communications		
		Office automation	
		Audiovisual systems	
		Business systems	

# Components of an IB



- Major categories:
  - Energy efficiency
    - Energy management and control
  - Lifesafety systems
    - Fire alarm and security
  - Telecommunications systems
    - PABX telephone, videotext, cablevision, e-mail
  - Workplace automation
    - Data processing, word processing, computer-aided design (CAD), information services

# Major elements of intelligent buildings



# Building automation systems for intelligent buildings





# Components of an IB



- Four main aspects:
  - **Facility management**
    - Take care & maintain various functions for occupant comfort & operation
  - **Information management**
    - Office automation (OA), LAN, wiring
  - **Communication**
    - Tel/Fax, e-mail, Internet, video telecommunication
  - **Control**
    - Building automation system, direct digital control

# Components of an IB



- Integration of various building systems
  - Energy management system
  - Lighting management system
  - Security systems & fire safety
  - Telecommunications & office automation
  - Local area networks (LANs)
  - Cabling management
  - Intelligent maintenance mgt. system (IMMS)
  - Computer aided facility management (CAFM)

# IB @ Work



- Office space and commercial buildings
  - Such as speculative high-tech offices
  - Organizational/functional requirements
  - Impact of IT and business strategy
- Objectives
  - Responsive (to user needs / to climate)
  - Efficient (building design & systems)
  - Effective (operation & management)
  - Better integration (with IT & within systems)

# IB @ Work



- Major systems
  - Building automation system (BAS)
  - Office automation system (OAS)
  - Communication automation system (CAS)
- Criteria
  - Business value/benefits
  - Efficiency
  - Effectiveness



# The Building Information Network



## Tenant Services

- High Speed Internet
- Wireless
- Unified Communications
- Interactive Media
- Digital Signage
- IP Telephony

## Dashboards



## Building Services

- Lighting
- Elevators
- 24/7 Monitoring
- HVAC Sensors
- Fire Control
- Video Security
- Energy Management
- Maintenance Management

# IB @ Work



- IB + IoT (Internet of Things)
  - Video: Smart Buildings with Internet of Things Technologies (2:58) <http://www-ssl.intel.com/content/www/us/en/smart-buildings/overview.html>
  - The Internet of Things for Smart Buildings (5:07) <https://youtu.be/N-I0vr-bEuE>
- Major impact of building intelligence
  - Modern and flexible space design, improved comfort, productivity, and pervasive connectivity

# IB @ Work

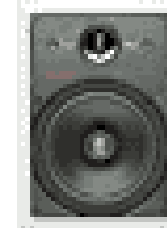


- Current and future development
  - New ways of working
    - More interaction
    - More collaboration (physically or electronically)
    - More individual autonomy
  - New patterns of space use
    - More group spaces
    - More shared spaces
    - More space for concentration
    - More intermittent space use

# IB @ Home

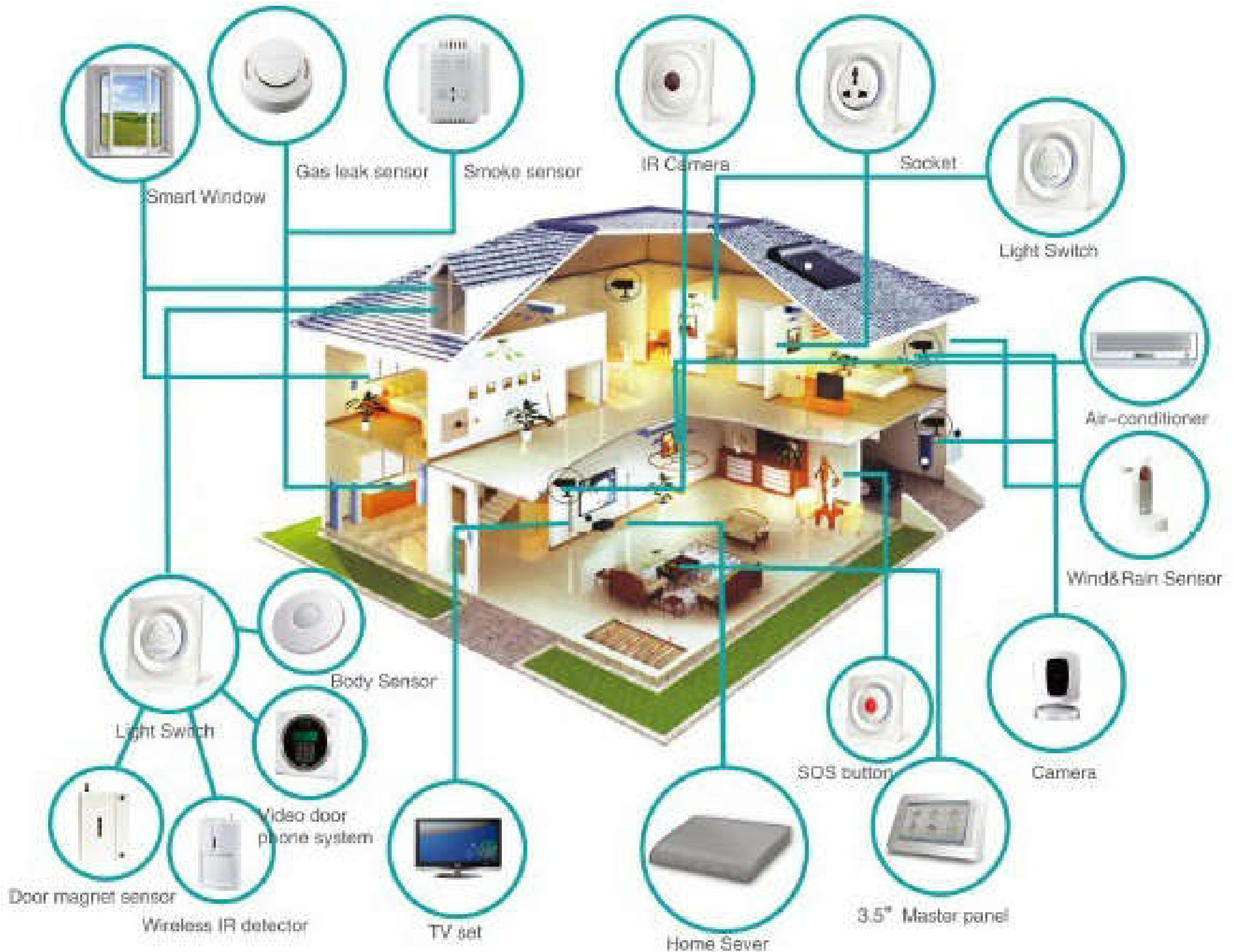


- Present technology
  - Phones and intercoms
  - Home automation
  - Audio distribution (e.g. hi-fi speaker)
  - Video distribution (e.g. TV)
  - Video surveillance (e.g. security)
  - Structured wiring
  - Home theater, game station





# Intelligent home/house



# IB @ Home



- Home automation
  - Climate control and energy management
  - Home networking
  - Home theatre
  - Integrated lighting control
  - Multi-room A/V systems
  - Residential gateways
  - Safety and security
  - Structured wiring
  - Whole house automation



# Remote control with smart plugs in intelligent home



# IB @ Home



- Future home
  - Home networking
  - Internet appliances
  - Webcam, web phones
  - e-books, video walls
  - Home office
  - Virtual clinic/hospital
  - .....



*Surf the web without wires!*