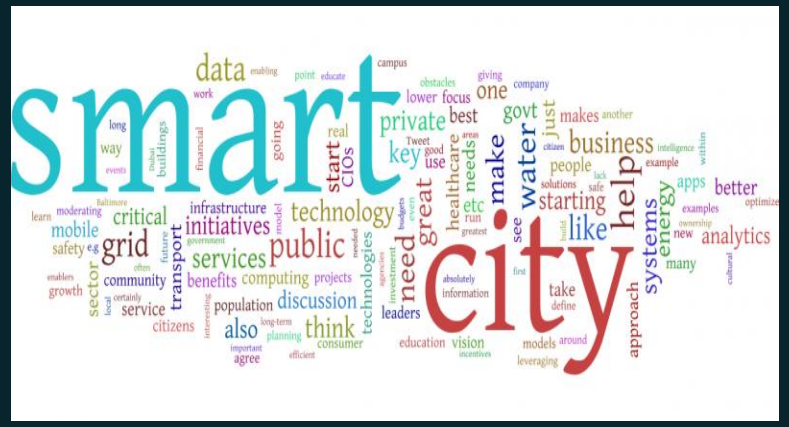
Smart Buildings, Smart Cities and Sustainability



ITU Joint Coordination Activity on ICT & Climate Change (JCA-ICT&CC)

Geneva, Switzerland

February 05 2013

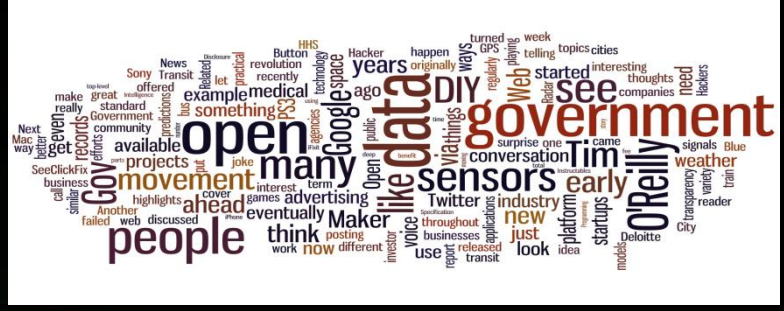
Sekhar N. Kondepudi Ph.D.

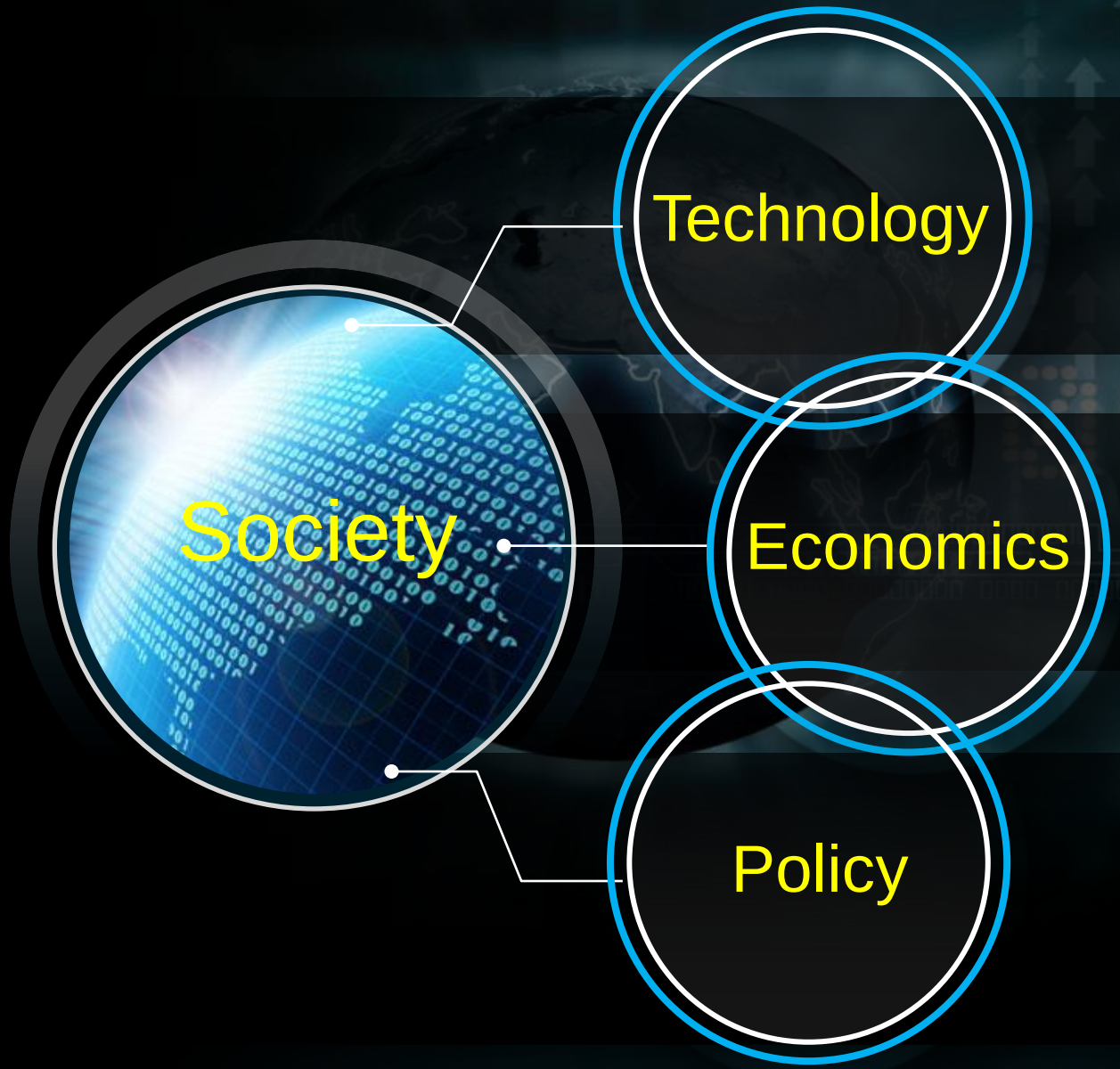
Associate Professor

Sustainable Smart Buildings & Smart Cities

NUS National University of Singapore

LANDSCAPE





- Data Convergence
- Sustainability & Green
- Internet of Things

- Aging Workforce,
- Need for Renewed Infrastructure
- Evolving Business Models

- Regulatory Framework
- Global Standards
- Incentivization

TRENDS

Green Consciousness

Rising Energy Costs

Internet of Things

Flexible Working

Web 2.0

Collaboration

Video

Globalization

Voice

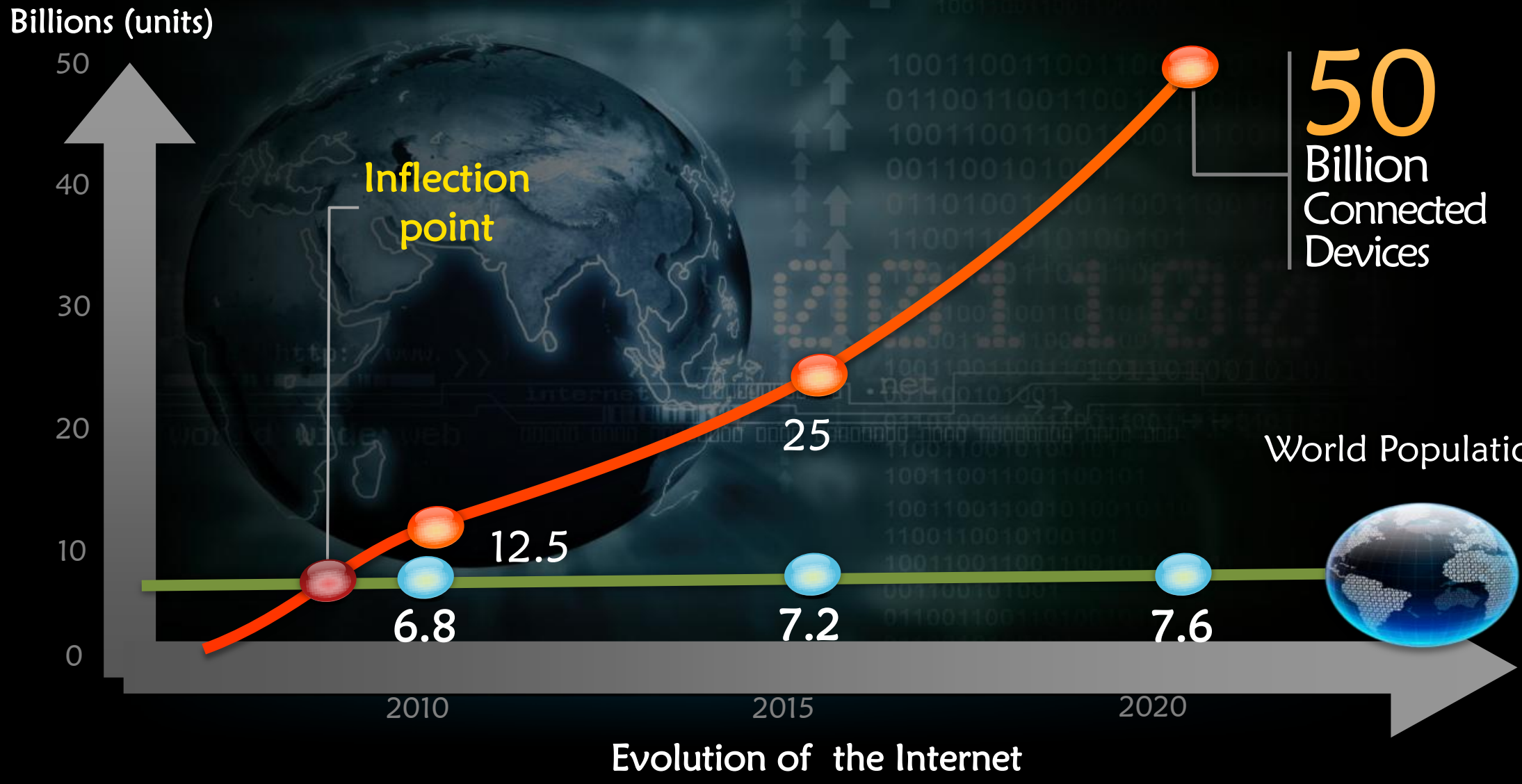
Internet

Email

SCOPE OF ICT TODAY

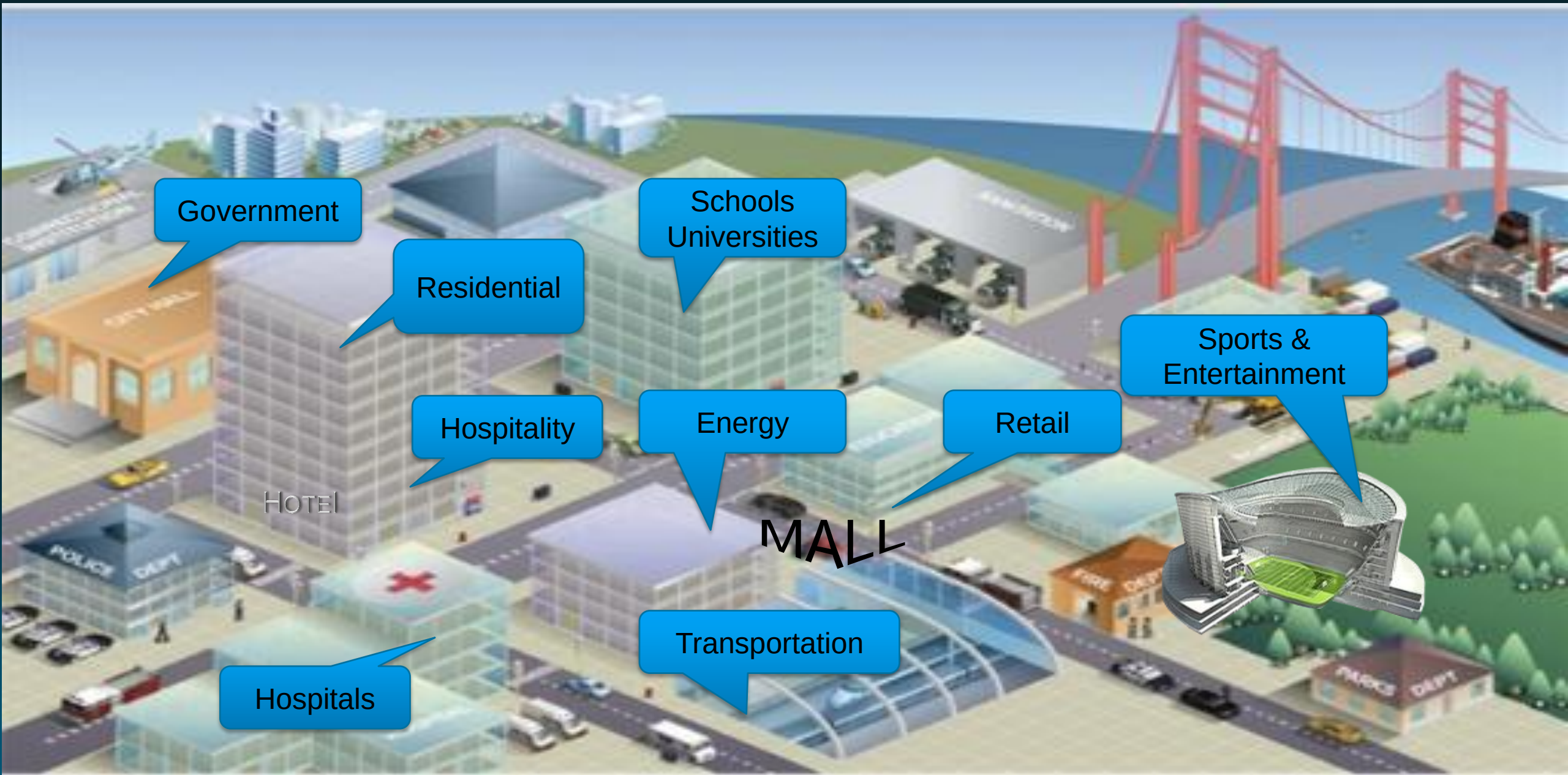
Connected Devices

Everything is Becoming Connected:
The Industrialization of the Internet is Now



Source: Cisco

CITY / COMMUNITY = ∑ BUILDINGS



What are Smart Cities

- A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.
- A city “connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city”
- A city “combining ICT and Web 2.0 technology with other organizational, design and planning efforts to dematerialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability.”
- “The use of Smart Computing technologies to make the critical infrastructure components and services of a city—which include city administration, education, healthcare, public safety, real estate, transportation, and utilities—more intelligent, interconnected, and efficient”

Source : Understanding Smart Cities : An Integrative Framework - Hafedh Chourabi et al

Smart City Customer Needs

- Reduced energy consumption (30-40%) and lower carbon emissions
- Cost reductions (sometimes $1M+)
- Improved inter-agency communication and collaboration
- Improved access to education or healthcare services
- Productivity gains for staff (doctors, teachers, govt employees)
- Easier commutes with improved traffic monitoring and remote worker options
- Improved efficiency e.g. serving more patients, citizens, etc.
- Improved staff educational options (certifications, maintenance of skills)
- Space savings/better use of facility space
- Attract new employers/programs to their city
- Improved public safety

Social

Enhanced quality of life for citizens

Environmental

Protecting the world for future generations

Economic

Continuous job and business growth

Smart City Application Areas

- Innovation Economy
  - Intelligent City Clusters – Manufacturing, Business Services, Health, Tourism
  - Intelligent City Districts – CBD, TechnoPark, Mall, Univ Campus, Airport City
- City Infrastructure & Utilities
  - Smart Transport, Mobility & Parking
  - Broadband, DSL, FTTH, WiFi, Embedded Systems
  - Energy Savings / Smart Grid
  - Environment Monitoring, Real Time Alert, Safety
- Governance
  - Government Services to Citizens
  - Decision Making / Participation / Direct Democracy
  - Monitoring & Measurement – The City as a Database

Source : Smart Cities & the Future Internet – Towards Cooperation Frameworks for Open Innovation. Schaffers et al

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; be secure in knowing that you are protected through the 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 to determine the best way to travel to and from work

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, from anywhere safety and securely

Wellness

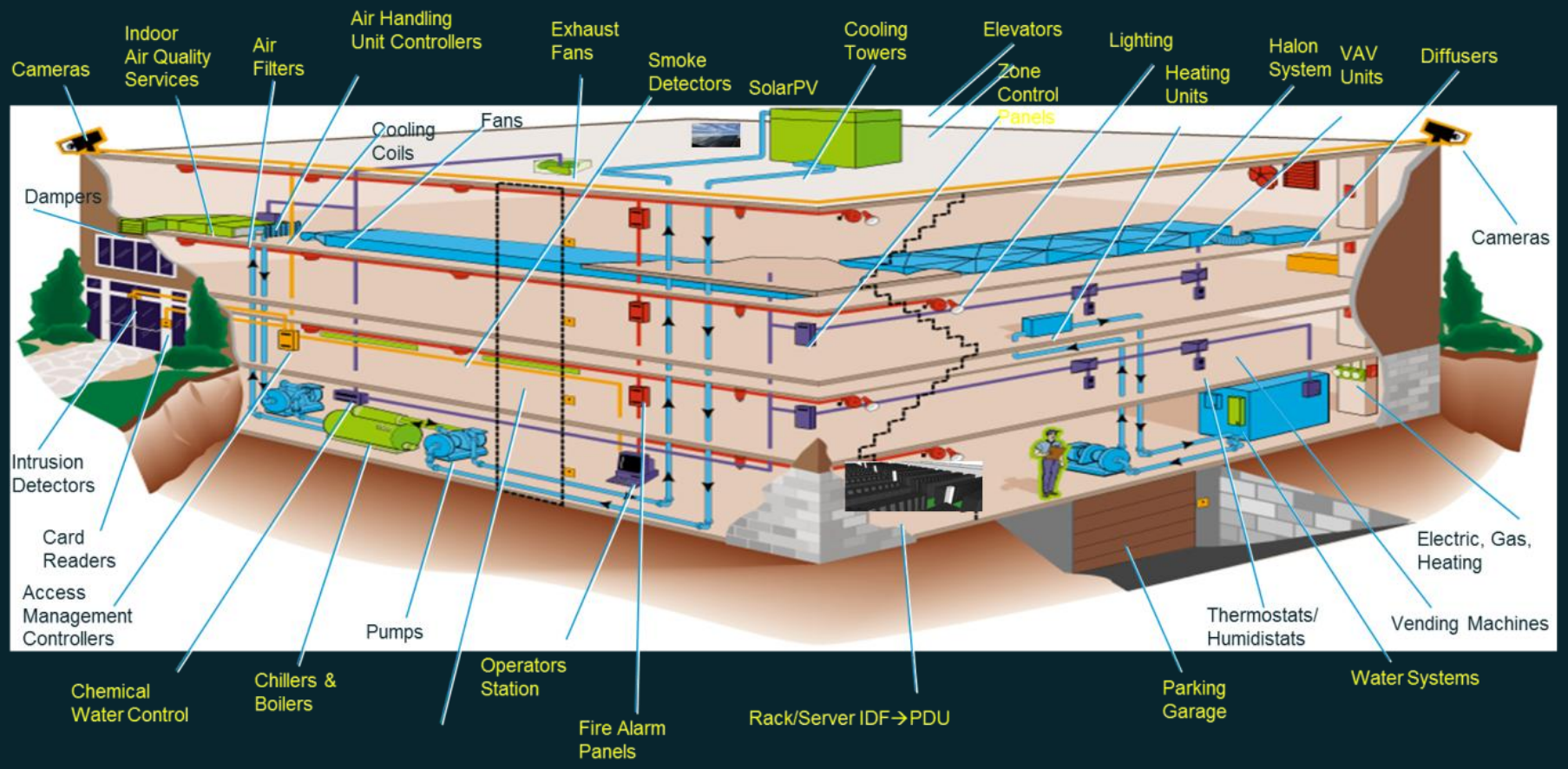
Receive services from best-in-class healthcare organizations that provide an enhanced patient experience, privacy, and safety. Where they deliver affordable and accessible healthcare services improve the quality of care

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

BUILDINGS

Σ Many Devices & Sub-Systems



ICT CONVERGENCE IN A BUILDING

Logical View

Collaboration Layer: Instant Messaging IPCC Unified Messaging IP Phone Meeting Place Video Rich Media
Building Management - Energy, Environment Lighting HVAC Safety & Security Facilities

Applications & Middleware

Voice & Collaboration Services Compute Services Identity Services
Storage Solutions Mobility Services Security Services

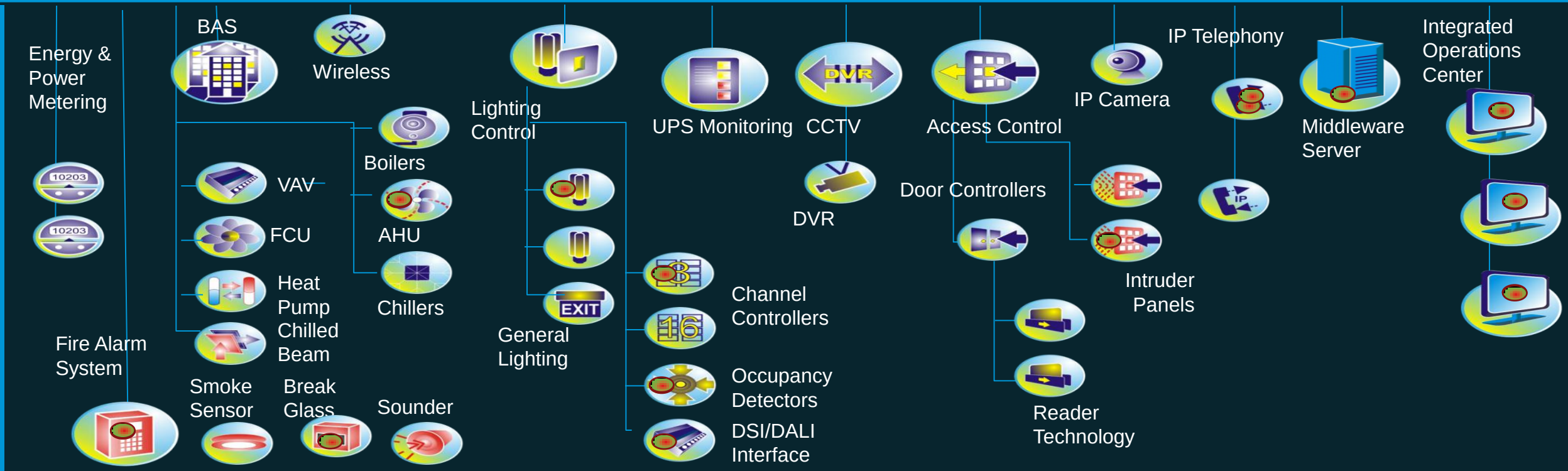
Interactive Services

Campus Branch Data Center Enterprise Edge WAN/MAN Teleworker
Building Control Physical Security Enterprise Systems
Server Storage Clients

Network Infrastructure

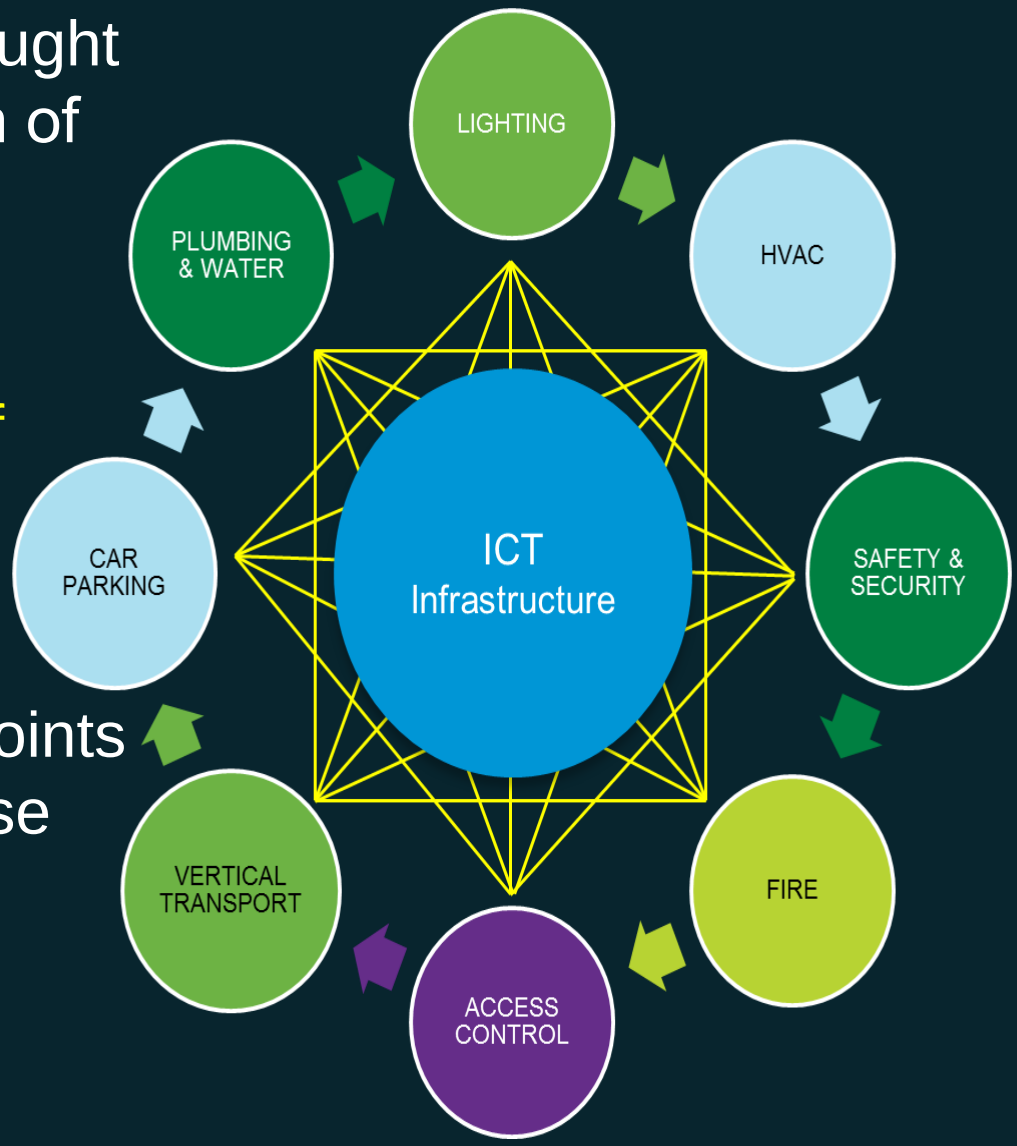
Common Network Plane

Physical View



THE BUILDING AS A NETWORK

- The multiple systems within a building can be thought of as sub-networks of a larger network ie “System of Systems” or a “network of networks”
- When these sub-systems are integrated with one another, they can be thought of as the “Internet of Things” (IoT) for buildings.
- All of these systems comprise of 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.
- This is completely analogous to an IT or Data Communications network



ATTRIBUTES OF A SMART BUILDING

SUSTAINABILITY

MOBILITY

LONGEVITY

SECURITY

RELIABILITY

EFFICIENCY

FLEXIBILITY

TECHNOLOGY

INTEROPERABILITY

SCALABILITY

A SMART GREEN BUILDING

- Building Portfolio
- Asset Mgmt
- Energy Use
- Maintenance
- Occupancy
- Facilities
- Waste Management
- Carbon Compliance
- Green / Sustainable
- Vertical Aspects

Integration of Building Systems, Communications & Analytics

Analytics and Optimization

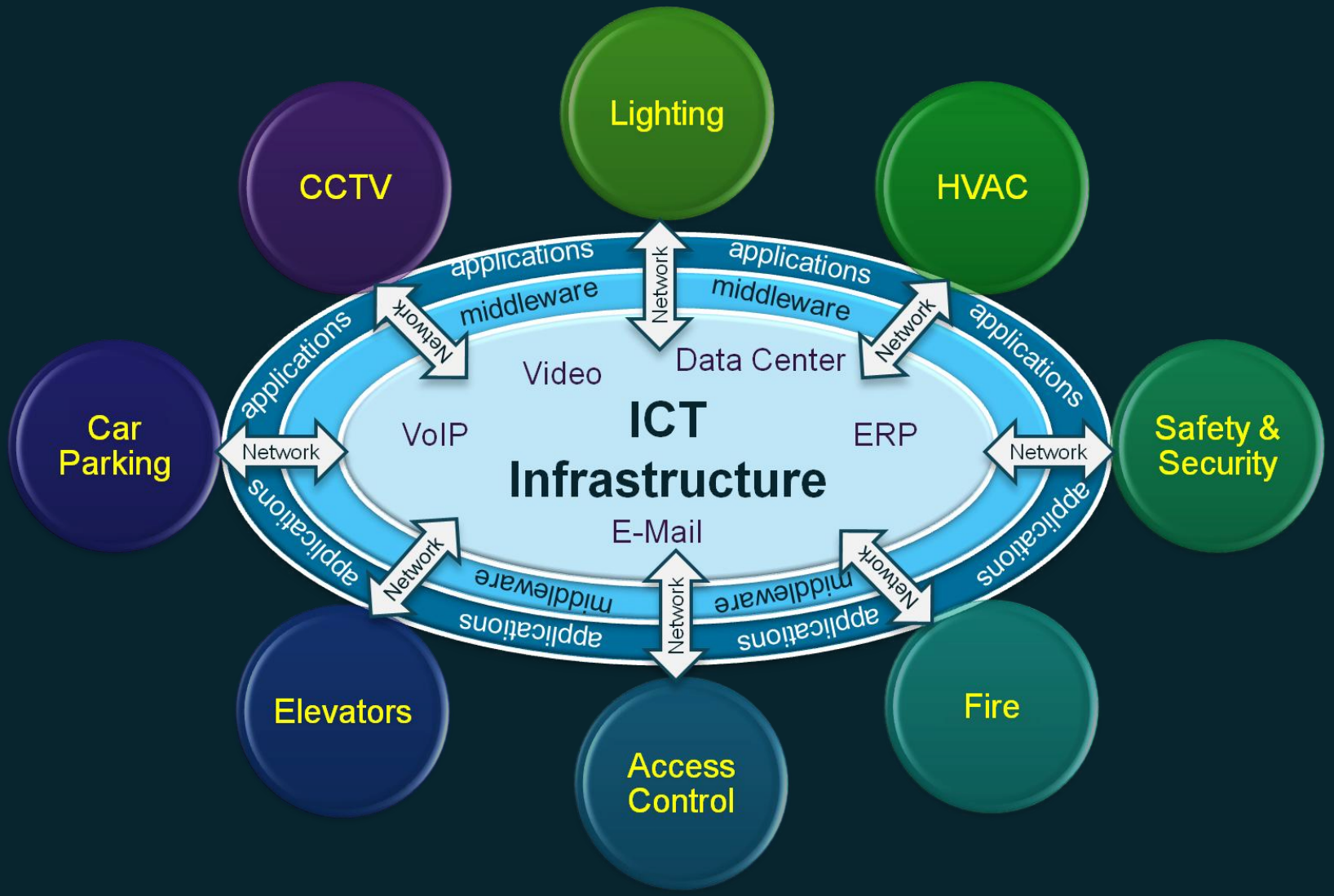
External Integration

Voice / Video / Data

- Weather
- Public Safety
- Utilities
- Citizen / Social
- Advertising

Adapted / Modified from IBM

ICT AT the CORE



INTEGRATION of ICT with BUILDING SYSTEMS

Enhanced user experience

Increased savings due to integration with calendaring tool

Better utilization of meeting rooms

Example: Lighting and HVAC for a 10:00am to 11:00am meeting will start at 9:45am and stop at 11:15am instead of starting at 9:00am and running till 5:00pm

Conference Room Energy Savings Estimated to be ~ 15 to 20 %

Energy Management of IT / Network Devices

IT Infrastructure Power Management

- IP phones,
  IP Cameras
- WAPs, Switches & Routers
- Data Center Gear
- PC/Laptop / Tablets / Servers
- Printers
- Copiers
- Scanners
- Other attached IT devices

Visibility, Control, and Automation

- Enhanced usability
- Consolidated green dashboard
- Partner applications
- Cloud service integration
- Energy supply/demand correlation

Extensible architecture

Operational efficiency

Compatible with future versions

Sustainable growth

Power savings of up to 50%

Reduce greenhouse gas by 15%

Reduce operational costs by 30%

Impact of Smart Technologies in a Workplace

Collaboration, Networking, Mobility, Operational Policies, Environmental Responsibility

Estimated Energy Efficiency Gains	Traditional Workplace	Smart Workspace	Percent Change
Number of Employees	300	400	33% Increase
Connected Electrical Load (watts/sq ft.)	2.6	1.7	36% Reduction
Connected Electrical Load (watts/employee)	432.9	178.7	58% Reduction
Total Connected Electrical Load (watts)	127,169	71,476	44% Reduction
Total Cooling Loads (BTUs)	433,646	243,733	44% Reduction
Total Cooling Provision Tonnage	36	20	44% Reduction

Source : Fortune 500 Company

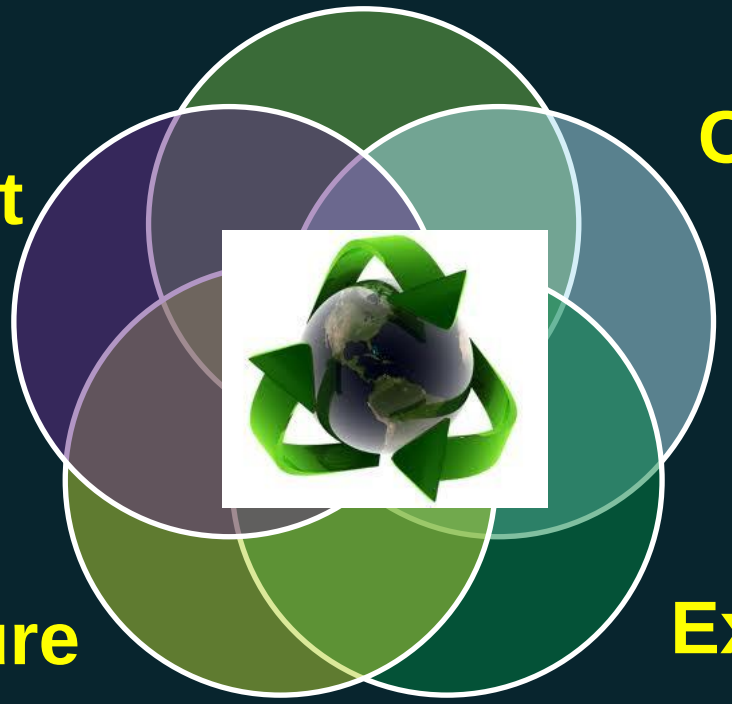
BUILDINGS OF THE FUTURE

Recognizes you and customizes itself based on your preferences

Intelligent

Efficient

Uses hard & soft resources optimally while increasing employee productivity



Collaborative

Ensures that you stay connected to the right people & the right information

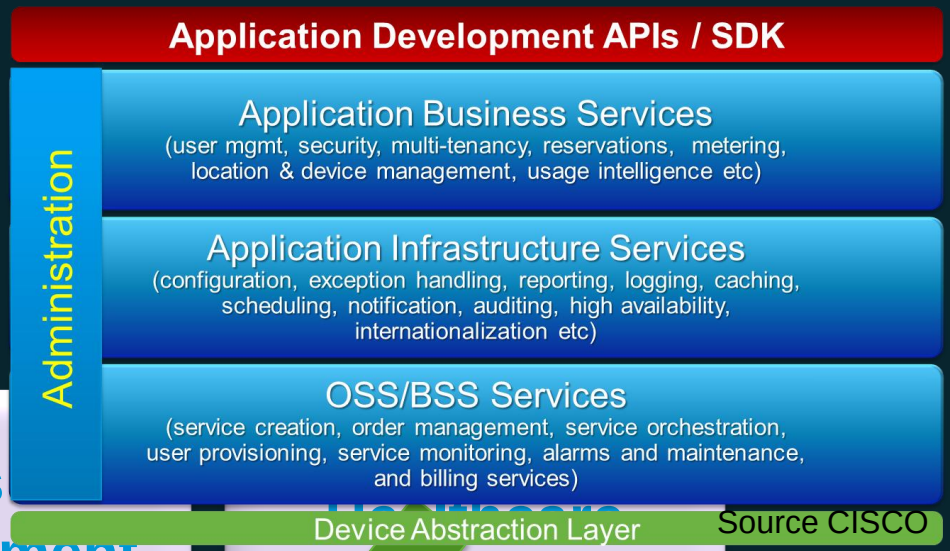
Secure

Assures both information & physical security at all times

Experiential

Delivers goodness in the way you work

EXAMPLE SMART CITY APPROACH



Residential

Retail

Sports Entertainment

Building & Energy Mgt

Core Framework

Physical Security

Utility

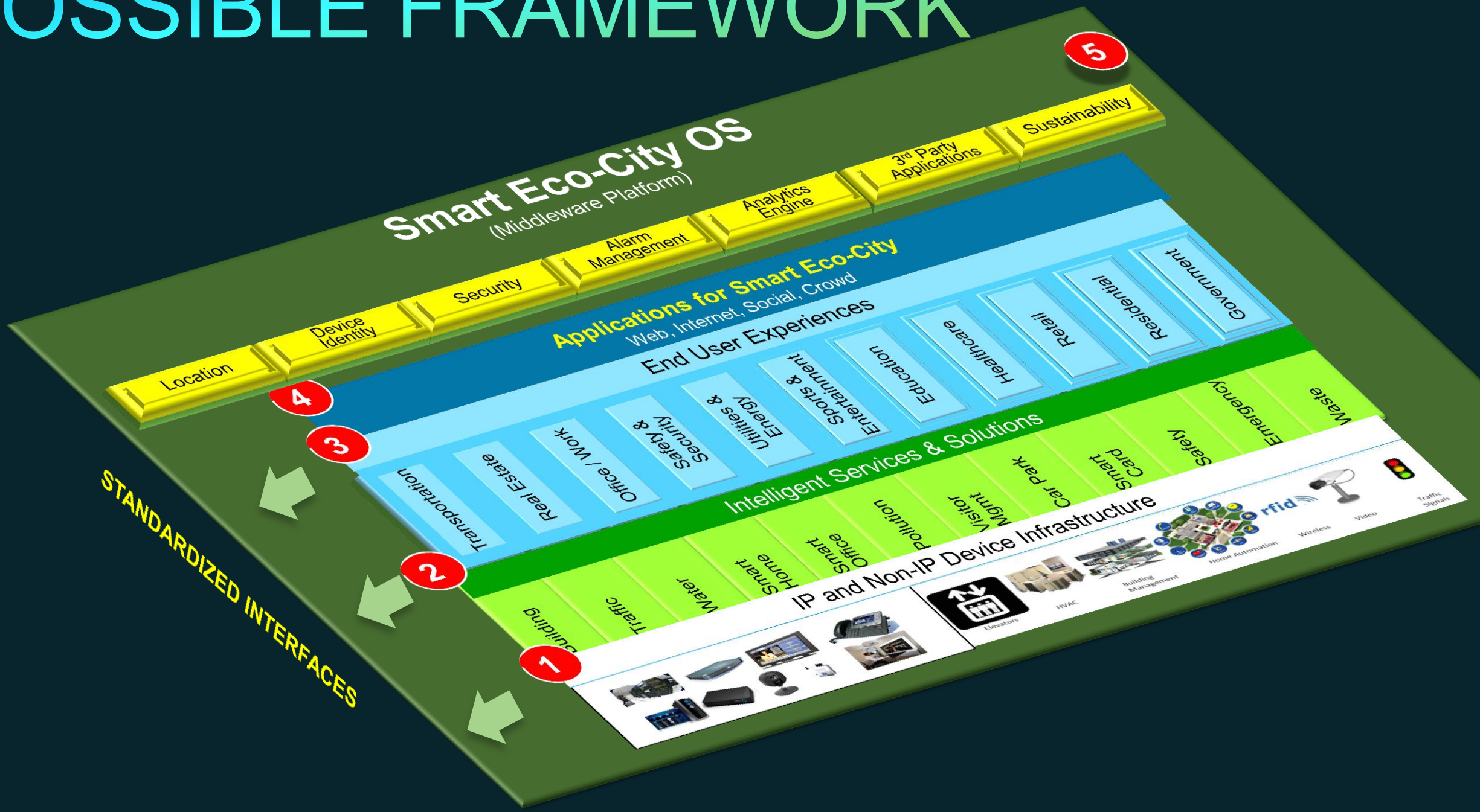
Education

Transportation

Government

NEED FOR STANDARDIZED INTERFACES ACROSS ALL VERTICAL SEGMENTS WITH CORE FRAMEWORK

POSSIBLE FRAMEWORK



ALTERNATIVE SERVICES APPROACH

Guest Management | Local Information | Concierge | Personalized Content

VoD | Executive Security Services | IPTV | Wireless | Video Conferencing

Service Creation

Create Standardized Correlations Between Processes to Create Services

Content Management | Maintenance | Renovation and Upgrades

Systems Integration

Create a Standardized Information Sharing Platform Between Systems

BAS | Safety | Cabling | Asset Management | A/V

Converged Network

Industry Standard Communication Backbone

Lights | Fire Alarm | CAD | Access Control | Cameras

HVAC | RFID | Elevators | Voice Communication

THANK YOU

Sekhar Kondepudi
Associate Professor
Sustainable Smart Buildings & Smart Cities
National University of Singapore

sekhar.kondepudi@nus.edu.sg