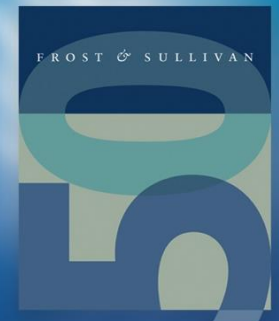


Mega Trends & Transformational Shifts in Buildings Industry

Global Energy & Environment Research Team



2017

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Mega Trends & Transformational Shifts in Buildings Industry

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Mega Trends & Transformational Shifts

What are the trends impacting the future of the buildings industry?

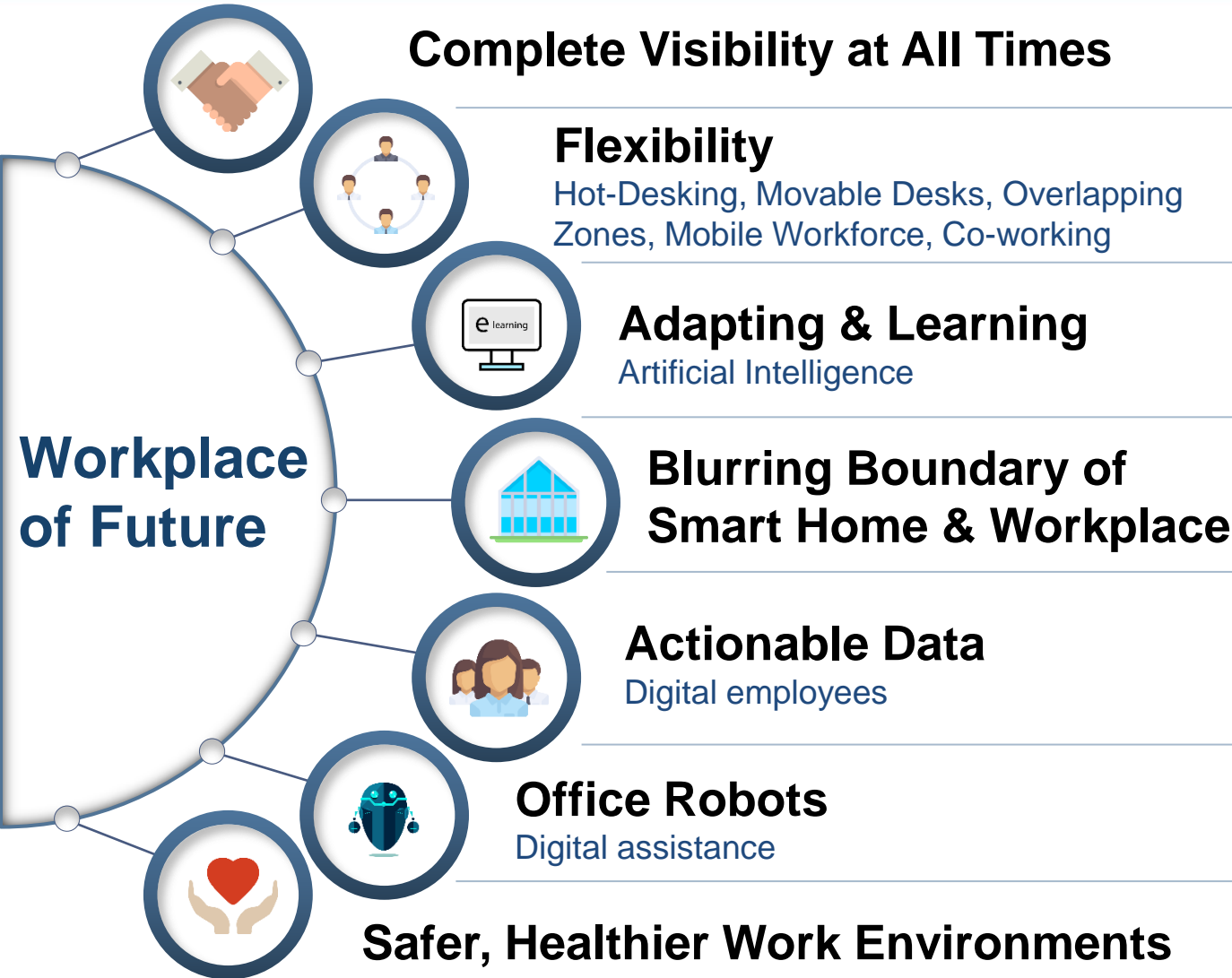
Transformational Shifts in Building Industry



Source: Frost & Sullivan

Transformational Shift #1: Workplace of Future

Technology and the IoT are being harnessed in the workplace as an instrument for businesses to improve performance and occupant experience.



Buildings will adapt to fulfil employees' needs, rather than their behaviour being driven by the building

Work environment should be unconstrained and allow for a more open dialogue

Analysis of BMS data should reveal crucial information on work patterns and people's behaviours, which will translate into optimised office space and a business strategy that will place individuals' needs at the very core of it

Transformational Shift #1: Workplace of Future

EY Centre, Sydney - a vibrant lifestyle destination for workers and the wider community and a building that accommodates workspaces highly responsive to its workforce.



- Developer: Mirvac Projects
- Principal contractor: Mirvac Construction
- Architect: Francis-Jones Morehen Thorp
- A bespoke workspace that supports the diverse and specific needs of the workforce while actively promoting collaboration and flexible working
- >300 bicycle spaces; charging for EVs; completely LED-lit building
- Blurred lines between the interior & exterior
- Closed cavity façade and timber blinds

Source: Facility Management magazine

Transformational Shift #2: Occupant Experience

The next generation of smart buildings is all about finding the right mix of innovation to improve infrastructure, technology, and occupant well-being

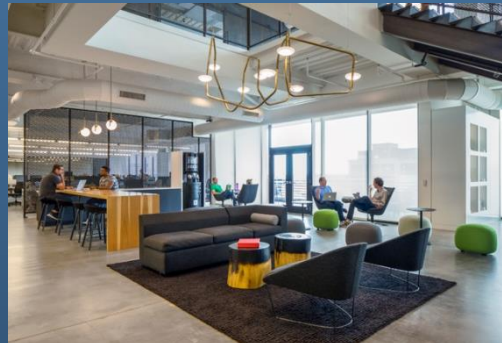
One of the biggest impacts a company makes on an employee or potential customer is the experience they have when they walk into the building

Personalized Comfort



Enabled with integrated central systems and local devices

Quantified Health Benefits



Aggregated via biometric data from building occupants, while preserving personal privacy

Sense of Continuity



Across global offices; between exterior & interior; unconstrained access

Source: Frost & Sullivan
Image source: Metropolismag

Transformational Shift #2: Occupant Experience

The Sentiment Cocoon - an interactive installation which aims to capture people's feelings and depict them through the medium of light.



- The Sentiment Cocoon is a site specific 20m tall interactive installation designed by architect Moritz Behrens and lighting designer Konstantinos Mavromichalis which collects and visualises the emotions of the buildings occupants.
- The focus is on the exploration of architectural form through digital fabrication, with translucent materials and responsive lighting to facilitate social interactions.
- Ultimately, the installation turns its surroundings into a stage for social encounter through interaction and observation.

Source: Moritz Behrens

Transformational Shift #3: Cognitive Era

Impact of Artificial Intelligence on Smart Buildings Industry

What is Artificial Intelligence?

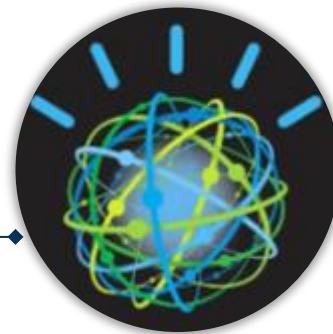
Three Types of Artificial Intelligence Systems



Artificial Narrow Intelligence



Artificial General Intelligence



Artificial Super Intelligence

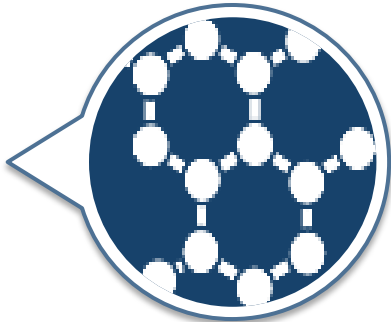
Source: Frost & Sullivan

Transformational Shift #3: Cognitive Era

Following the proliferation of artificial intelligence and machine learning, cognitive buildings will be able to adapt and learn, making employees more efficient, effective and comfortable.



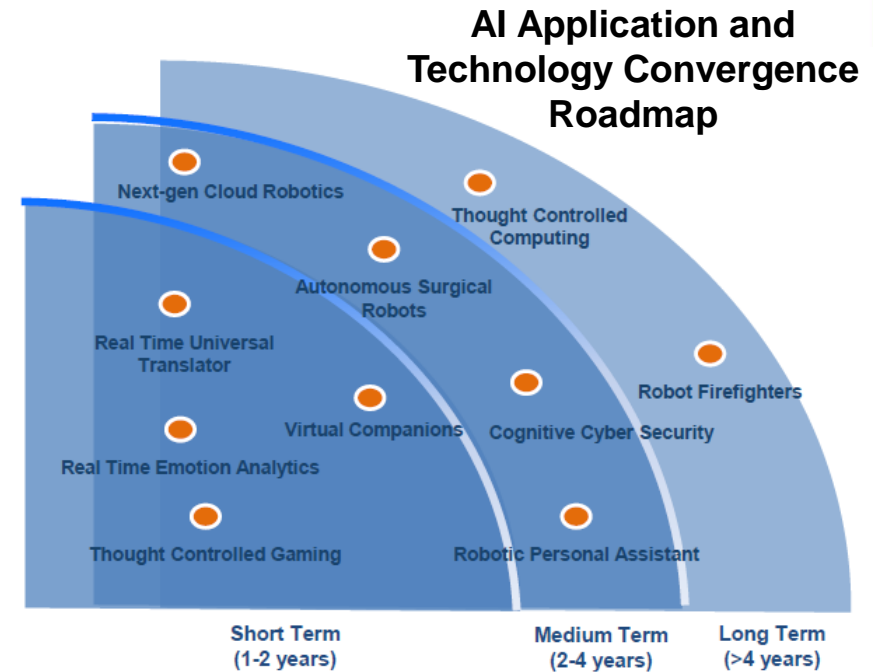
Next-gen smart buildings would marry usage data with information about individual staff movements and work habits to help facilitate collaboration between employees



Offices will soon become part of the management team of any business



Office equipment will know the employees (personality, mood, etc.) in an effort to adapt to individual needs



Source: Frost & Sullivan

Transformational Shift # 3: Cognitive Era

The Edge, Amsterdam - The Smartest Building in the World

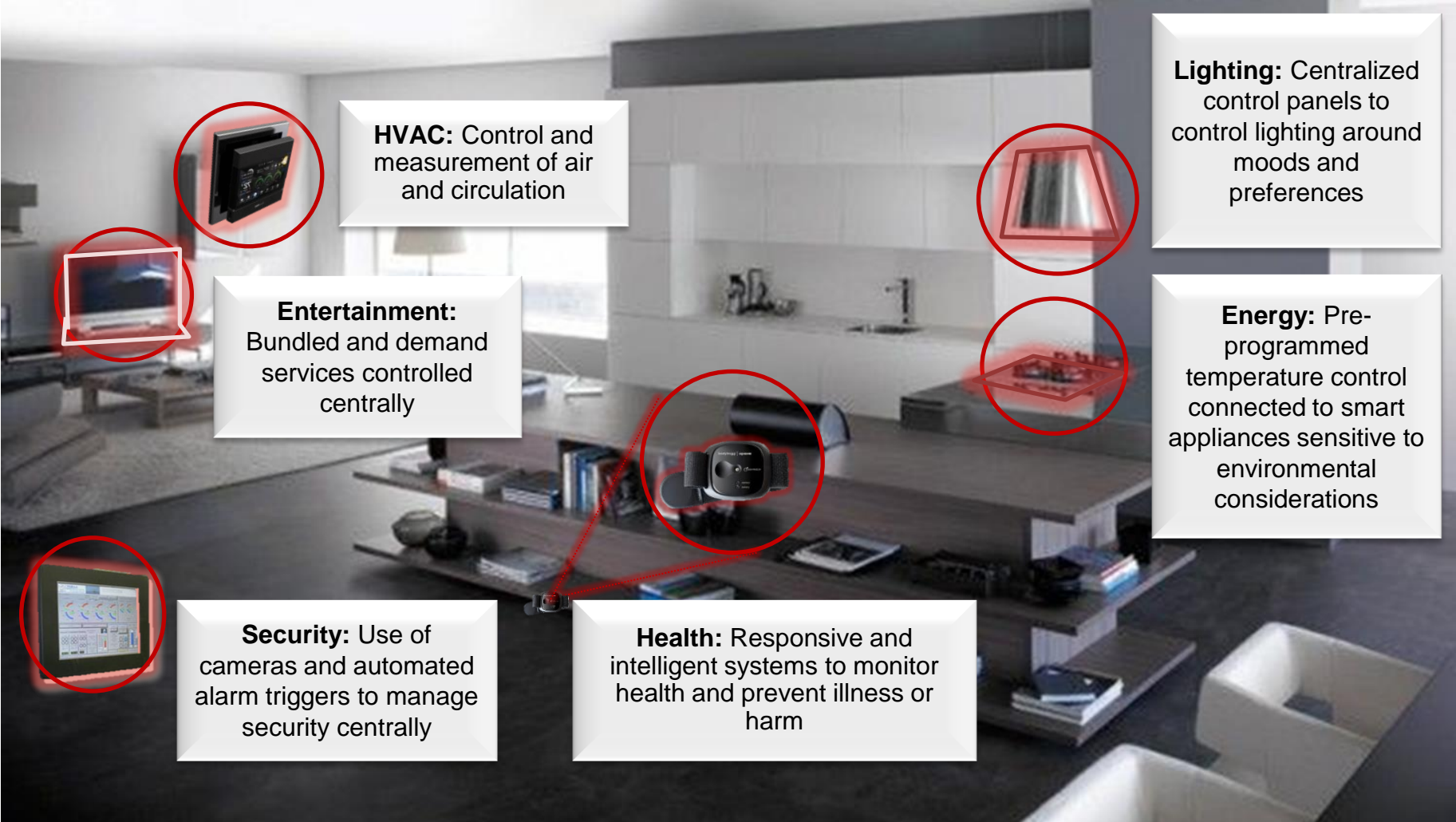


- A comprehensive array of engineering and energy-efficient ecosystems enhanced by **IoT connectivity**
- LED panels, that can be powered using Internet data cables. The panels are filled with 28,000 sensors - motion, light, temperature, humidity, infrared - creating a “digital ceiling” that wires the building like synapses in a brain and continually collecting data on the occupants’ habits and behaviour
- Unparalleled vision into the behaviour of its inhabitants and an artificial intelligence-like ability to provide them whatever is needed when it is needed

Source: PLP Architecture, Schneider Electric

Transformational Shift #4: Connected Living

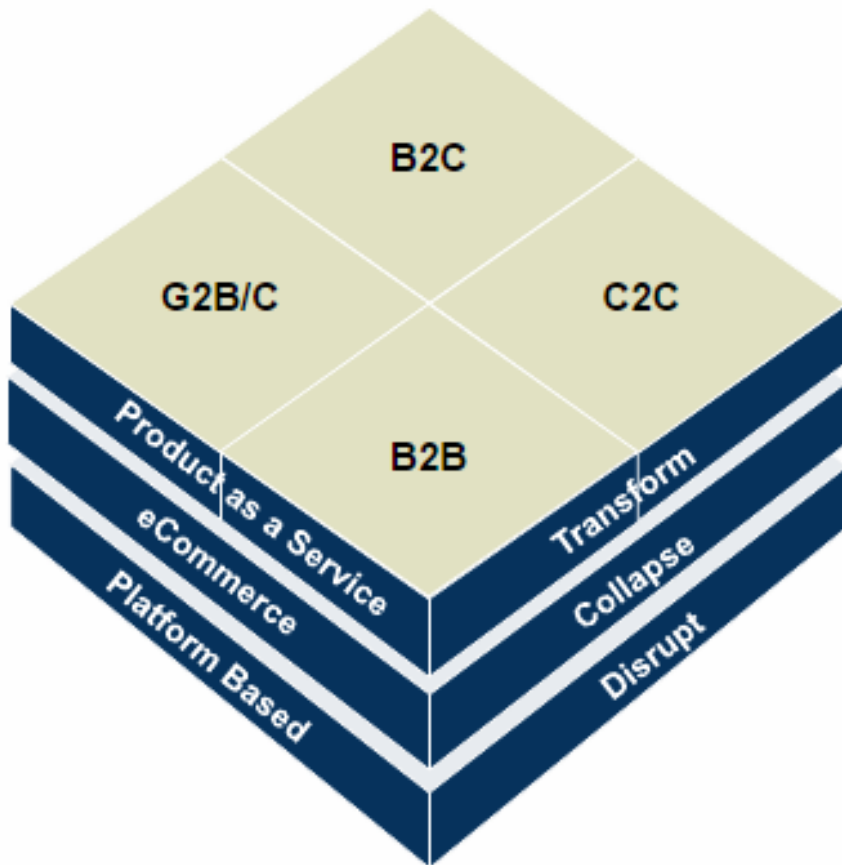
A connected home is embedded with computing and IT that anticipates & responds to the needs of occupants, to promote their comfort, convenience, security, and entertainment.



Source: Frost & Sullivan

Transformational Shift # 5: New Business Models

Around 90% of the business models in 2020 will be driven by the cloud, pushing the global cloud computing market to \$250 billion in 2020



B2B

- Online B2B (Alibaba)
- Platform (AT&T Digital Life)
- Data as a service (Predilytics)

B2C

- Democratisation (Xiaomi)
- 'Crowd' everything (Kickstarter)
- Omnichannel commerce (Tesco)

C2C

- Sharing (Just Park)
- Aggregating (Uber)

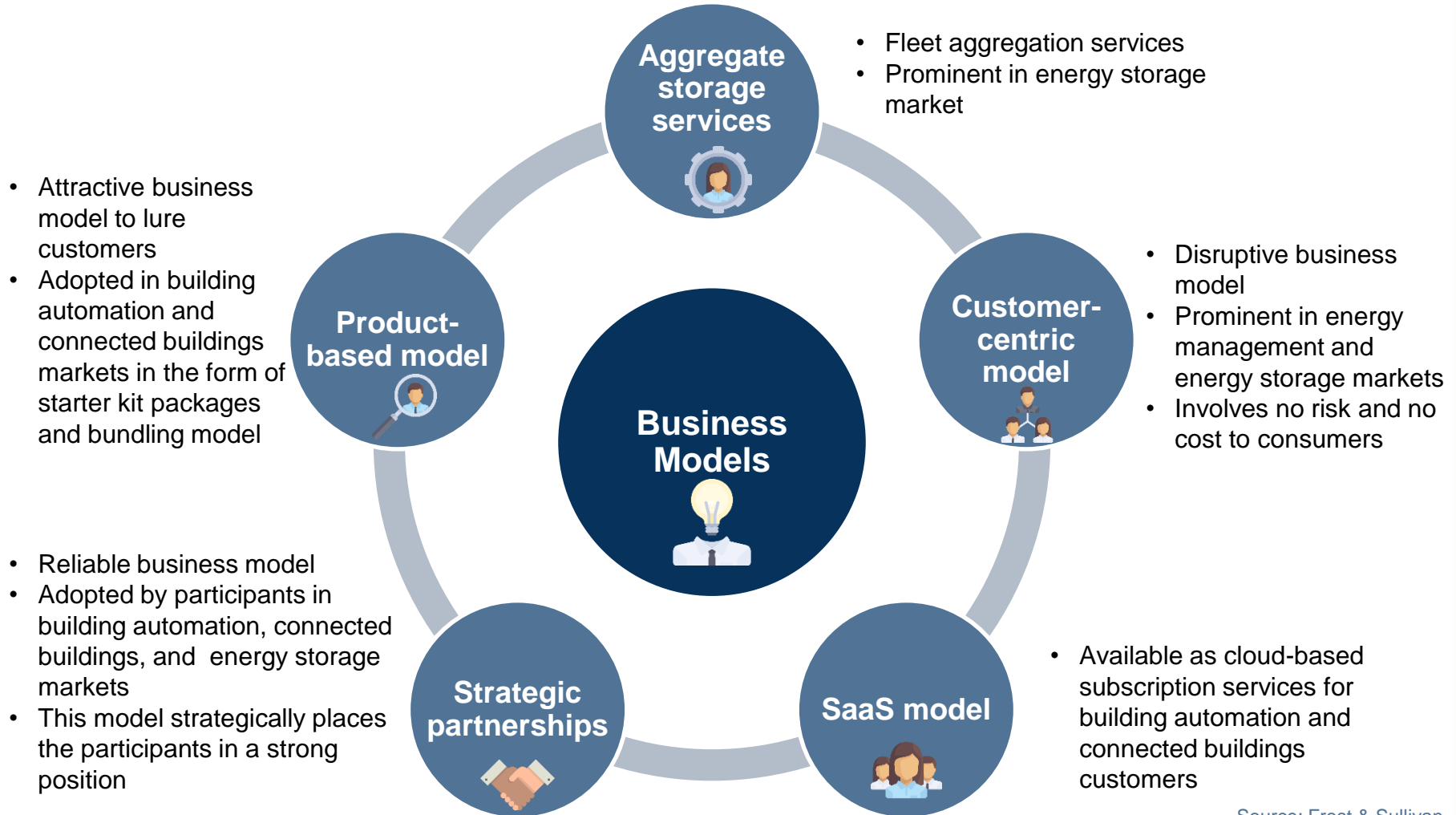
G2G/B/C

- eGovernance Models
- Open Business Models

Transformational Shift # 5: New Business Models

Product-based business model to dominate in 2017, whereas customer-centric model and strategic partnerships will drive competition forward beyond 2017

New Business Models in Buildings Industry

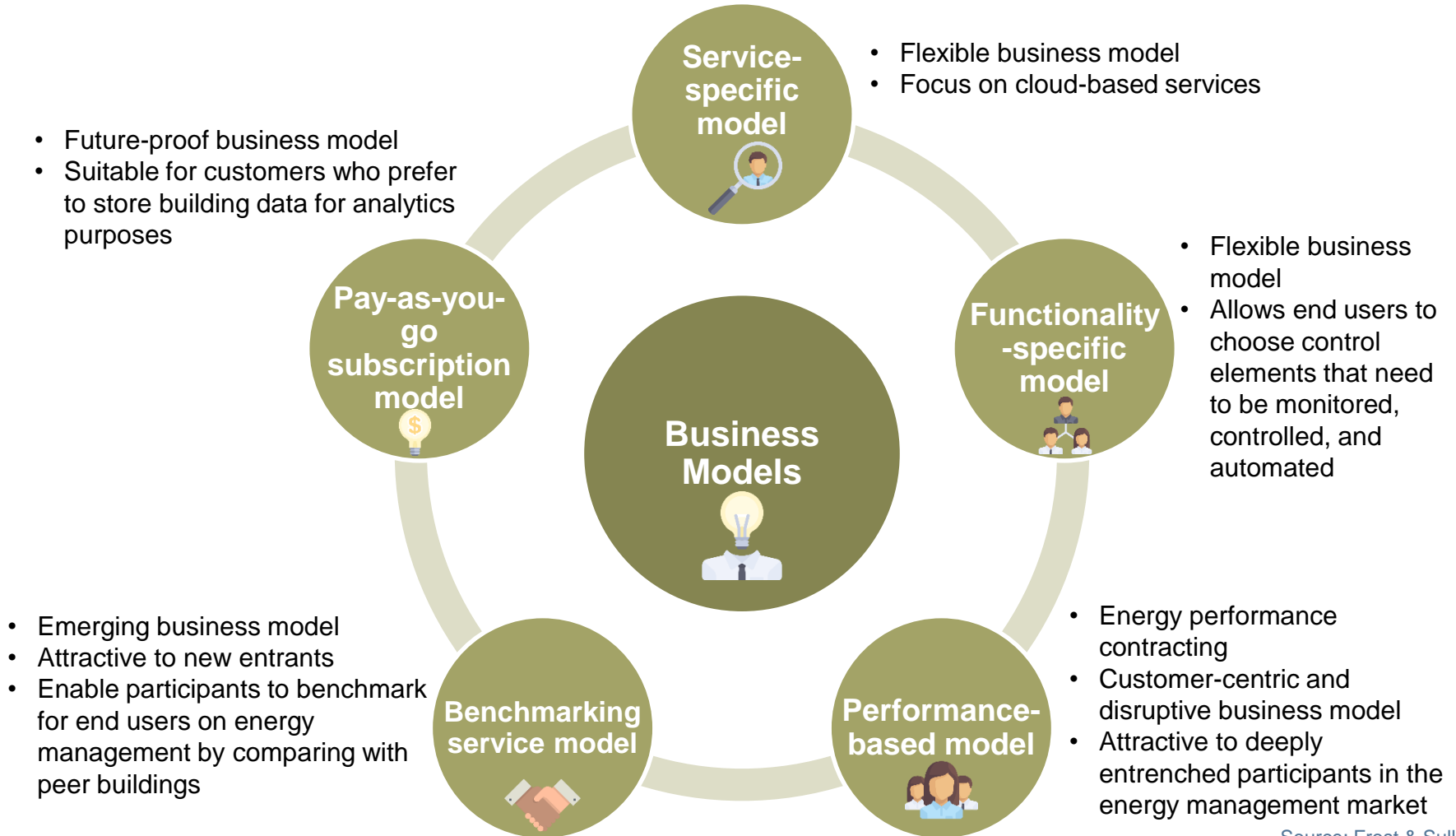


Source: Frost & Sullivan

Transformational Shift # 5: New Business Models

X-as-a-Service model to be more attractive to participants and customers.

Futuristic Business Models in Buildings Industry

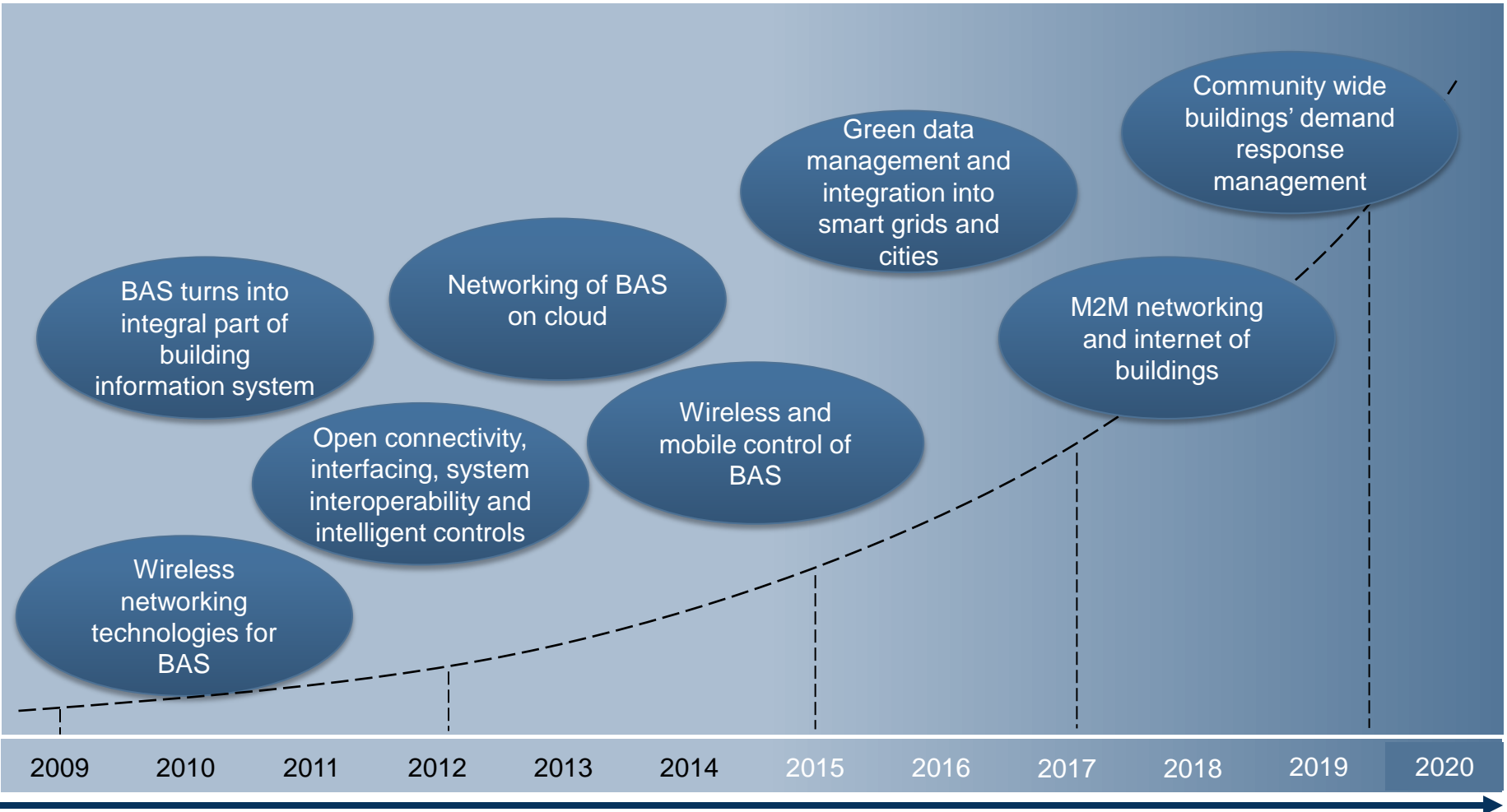


Source: Frost & Sullivan

Transformational Shift # 6: Digital Transformation

Beyond 2020, data on building conditions and occupancy becomes readily available; robotics and virtuality will be new features

Building Automation Technology Roadmap



Source: Frost & Sullivan

Transformational Shift # 6: Digital Transformation

Next-generation IT Solutions - These significant evolution of IT solutions result in increased energy and cost savings for building owners and occupants

Traditional Building Management Systems:

- Building automation
- Building energy management
- Security controls
- Fire and safety controls
- Low-voltage power distribution
- Lifecycle development and deployment process



Benefits of Integrating Next Generation ICT Solutions:



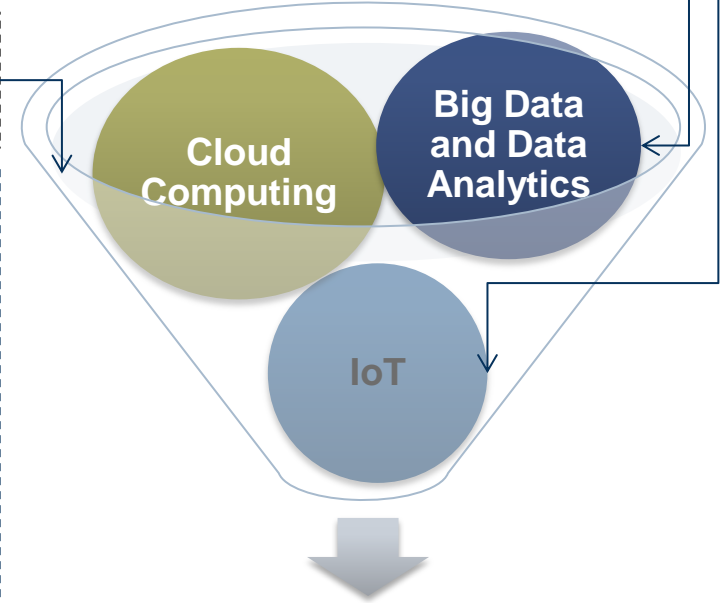
- Energy and cost savings
- Real-time remote monitoring and control
- Predictive and preventive maintenance
- Comfort and assisted living

Green data is gathered from various sensors in a building and converted into useful and actionable data

Internet of Things (IoT) connects devices to gather building data

Useful data is processed for top-level decision making

- The emergence of big data analytics, cloud computing and the Internet of Things (IoT) allows for a new level of focus on both comfort and energy performance.
- They offer great promise for commercial and industrial buildings by facilitating remote monitoring, energy efficiency, and system optimization capabilities.



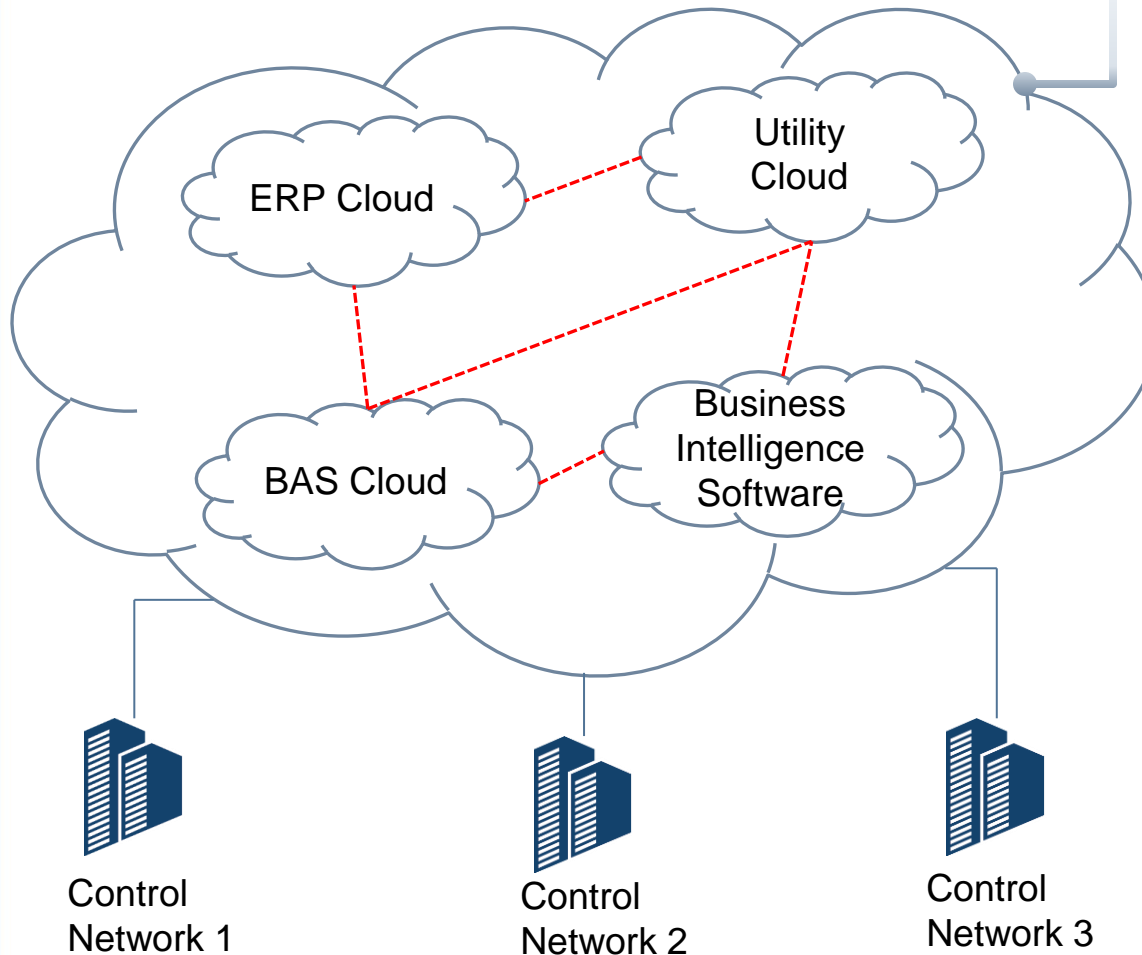
Improved Capabilities of Smart Buildings...

...However, new IoT vulnerabilities are constantly surfacing, due to a lack of security standards and varying capabilities of the individual IoT nodes

Source: Frost & Sullivan

Transformational Shift # 6: Digital Transformation

Cloud Computing - Cloud interconnectivity is the new era of networking. Hybrid-cloud delivery model enables new remote services in building automation



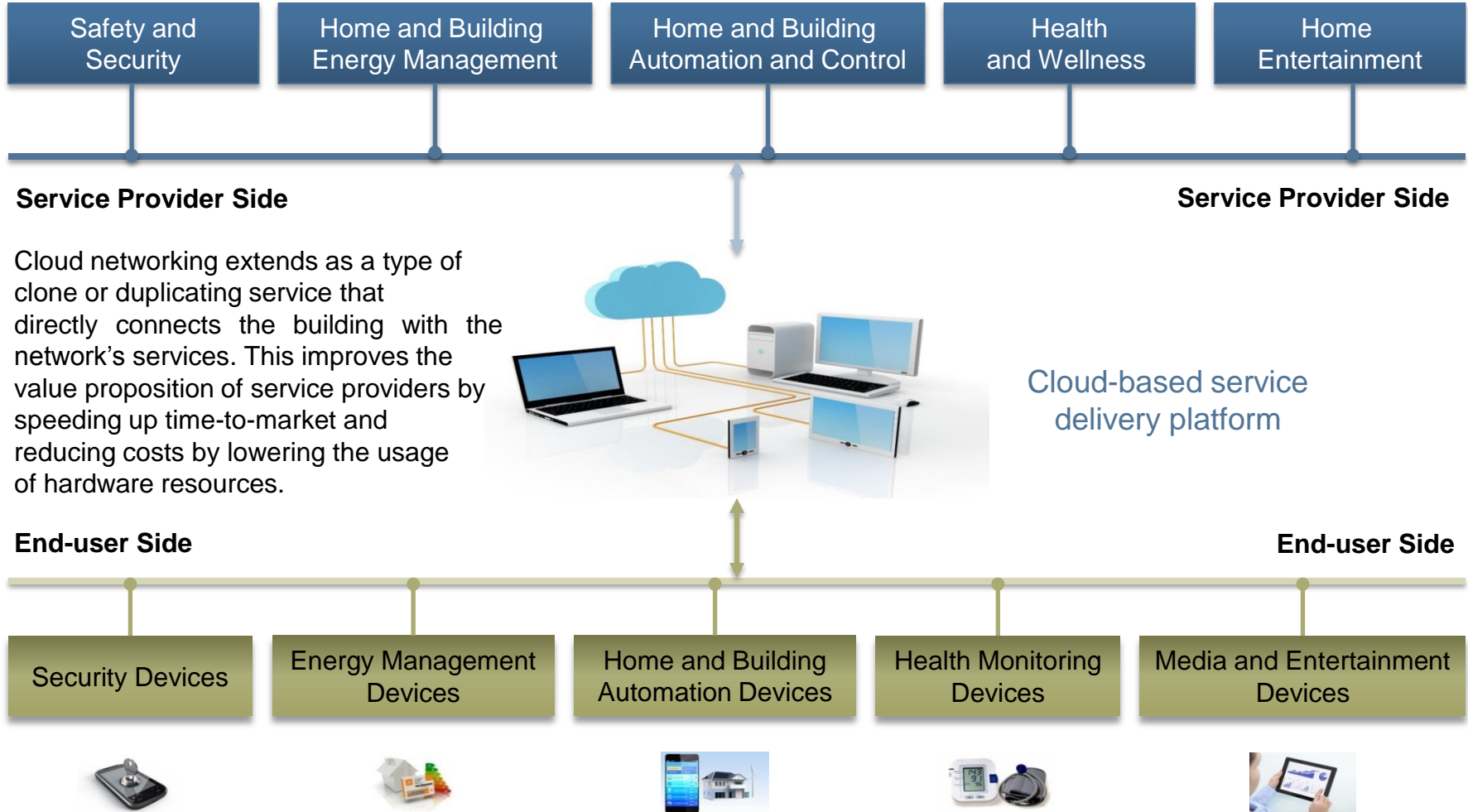
- Control networks in each buildings will be allowed to connect to the BAS software in the private cloud installed at a remote location through web interface.
- The BAS cloud will be in communication with other public clouds such as utility, enterprise resource planning (ERP), and business intelligence software, which enable building managers to obtain real-time energy data, compute cost of energy for each buildings, benchmark it for improving key performance indicators, and generate custom reports for top-level management.
- Hybrid cloud delivery model will be a huge enabler for homes and buildings SaaS providers in 2016.

Source: Frost & Sullivan

Transformational Shift # 6: Digital Transformation

Cloud Computing – Cloud networking works as an enabler of smart and connected communities to speed up time-to-market and reduce cost for building owners

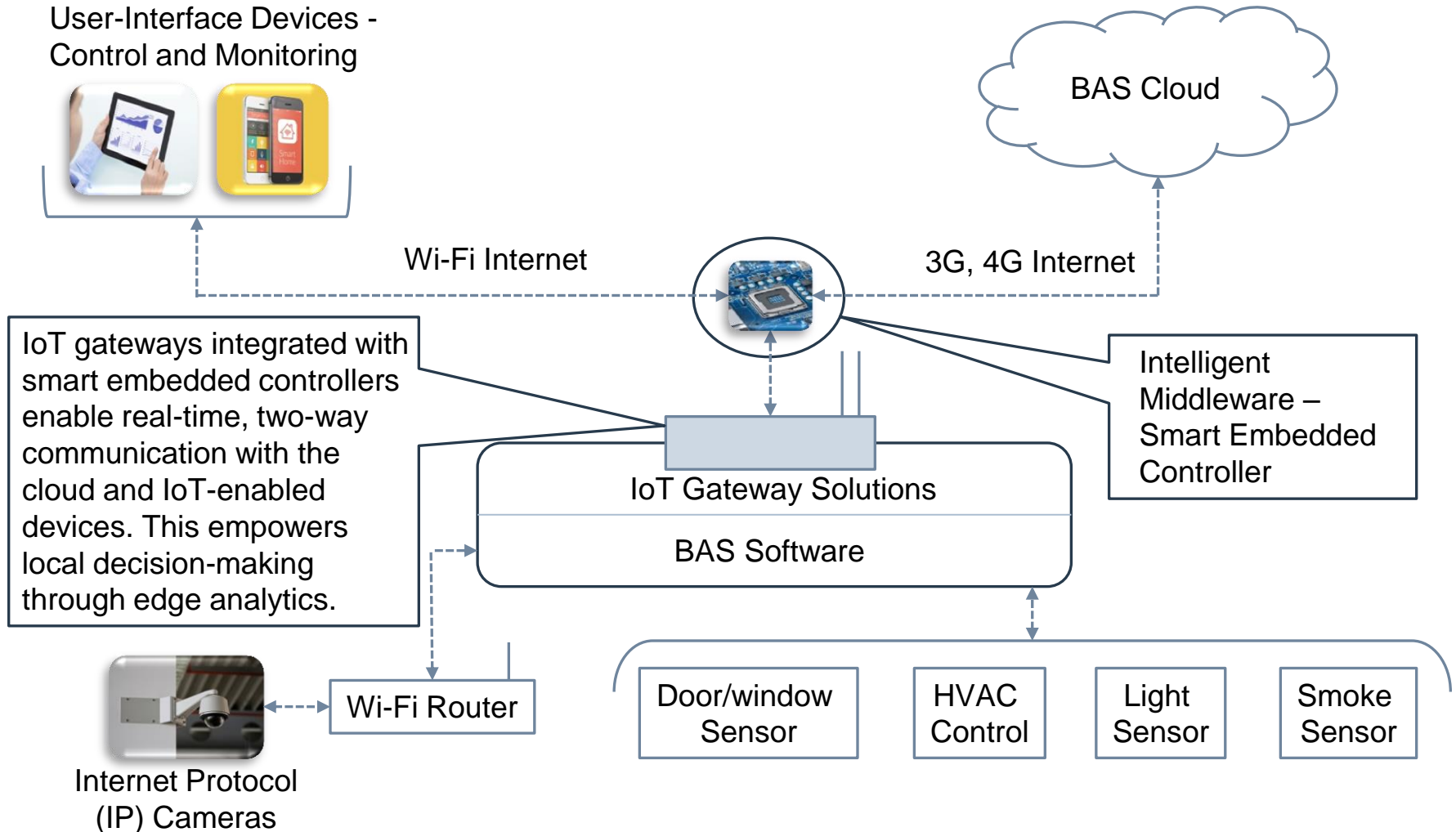
Cloud Networking as a Service Delivery Platform for Homes and Buildings



Source: Frost & Sullivan

Transformational Shift # 6: Digital Transformation

Role of IoT in Intelligent Cloud Networking - IoT to empower cloud networking through edge analytics

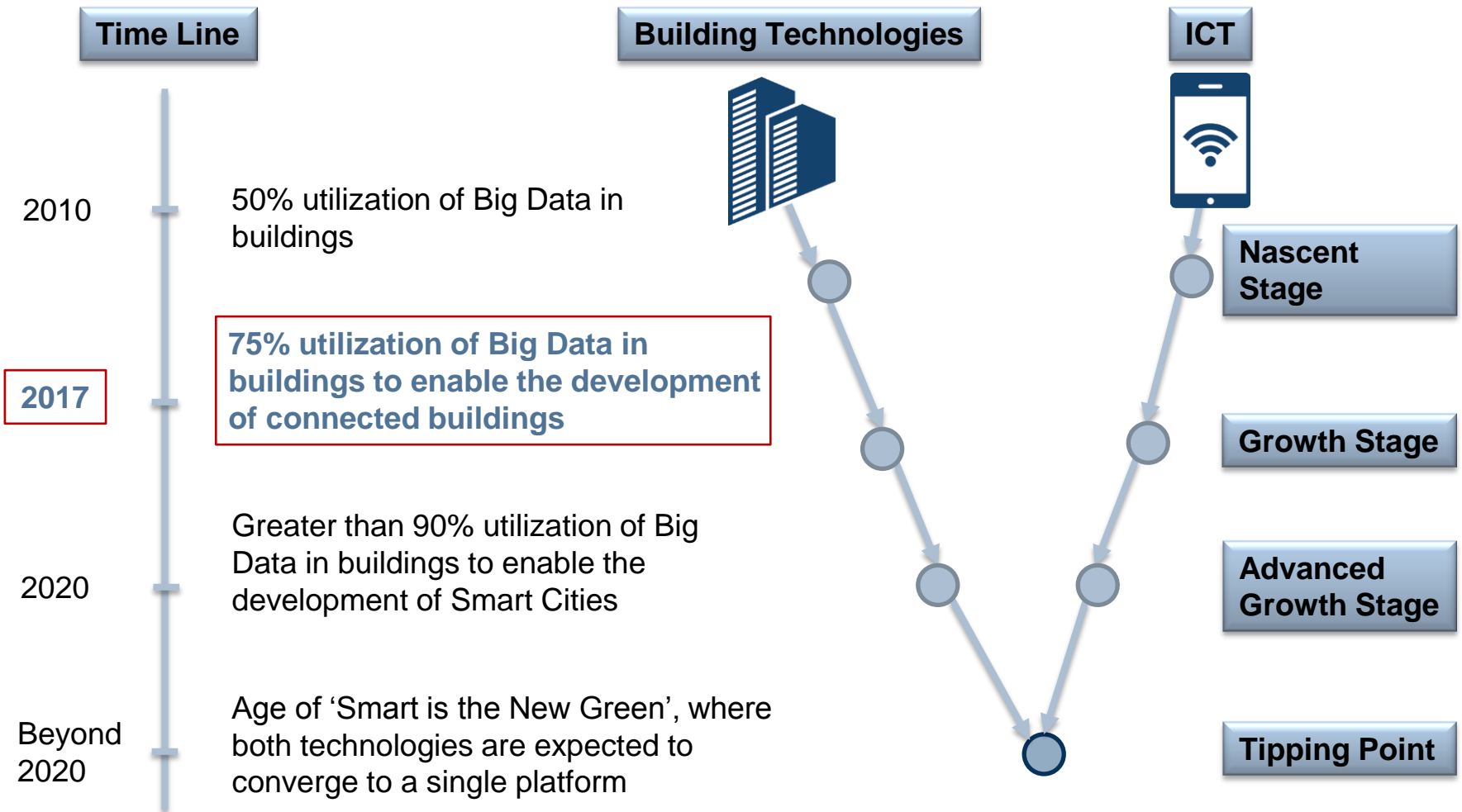


Source: Frost & Sullivan

Transformational Shift # 6: Digital Transformation

Convergence of Building Technologies and the ICT Industry - Big Data utilization in buildings to reach 75% in 2017

Convergence Point in Homes and Buildings Industry

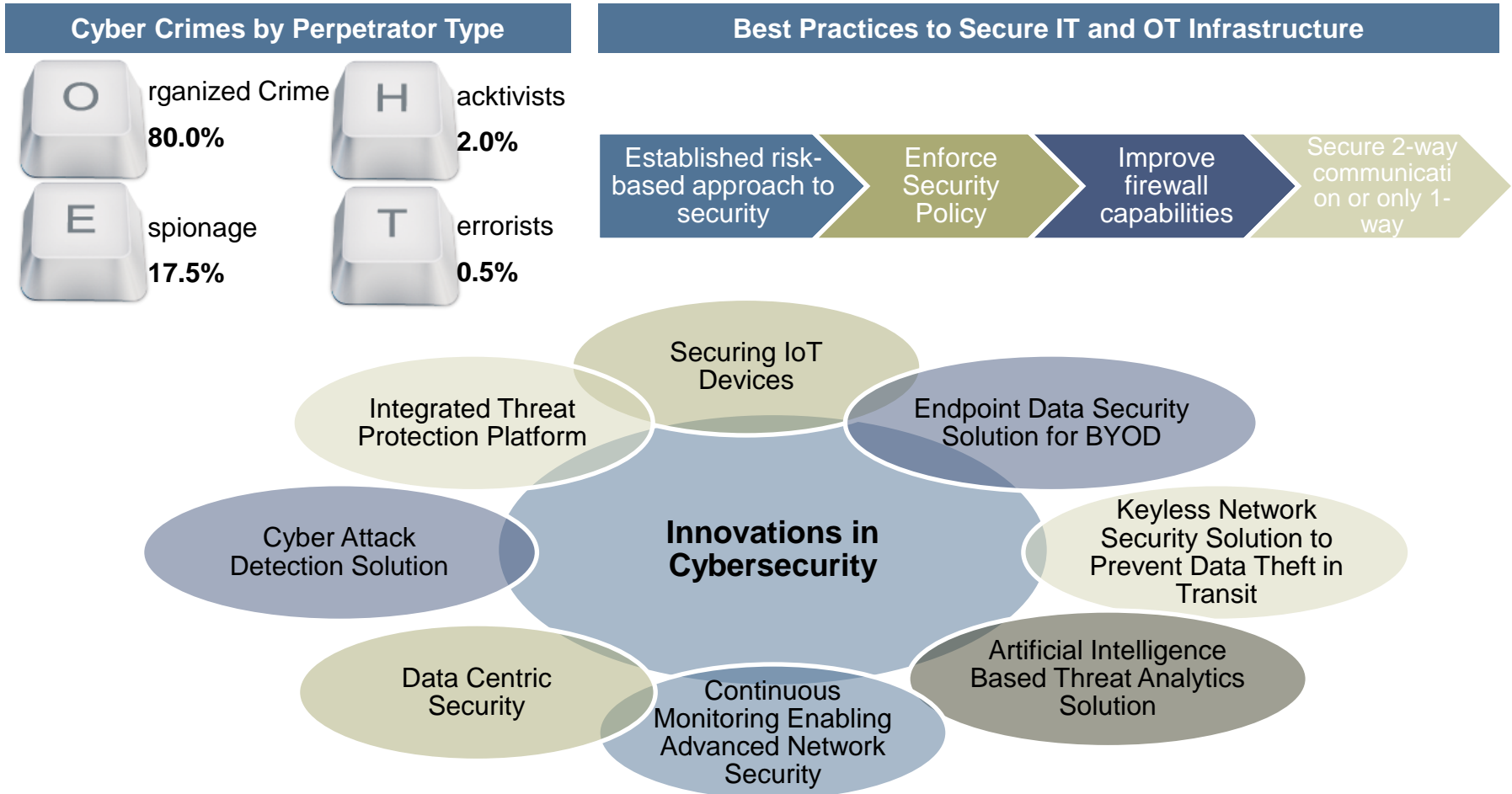


Source: Frost & Sullivan

Transformational Shift # 6: Digital Transformation

Cybersecurity framework includes a set of standards, methodologies, procedures, and processes that align policy, business, and technological approaches to address cyber risk.

Emerging Issue: Cybersecurity



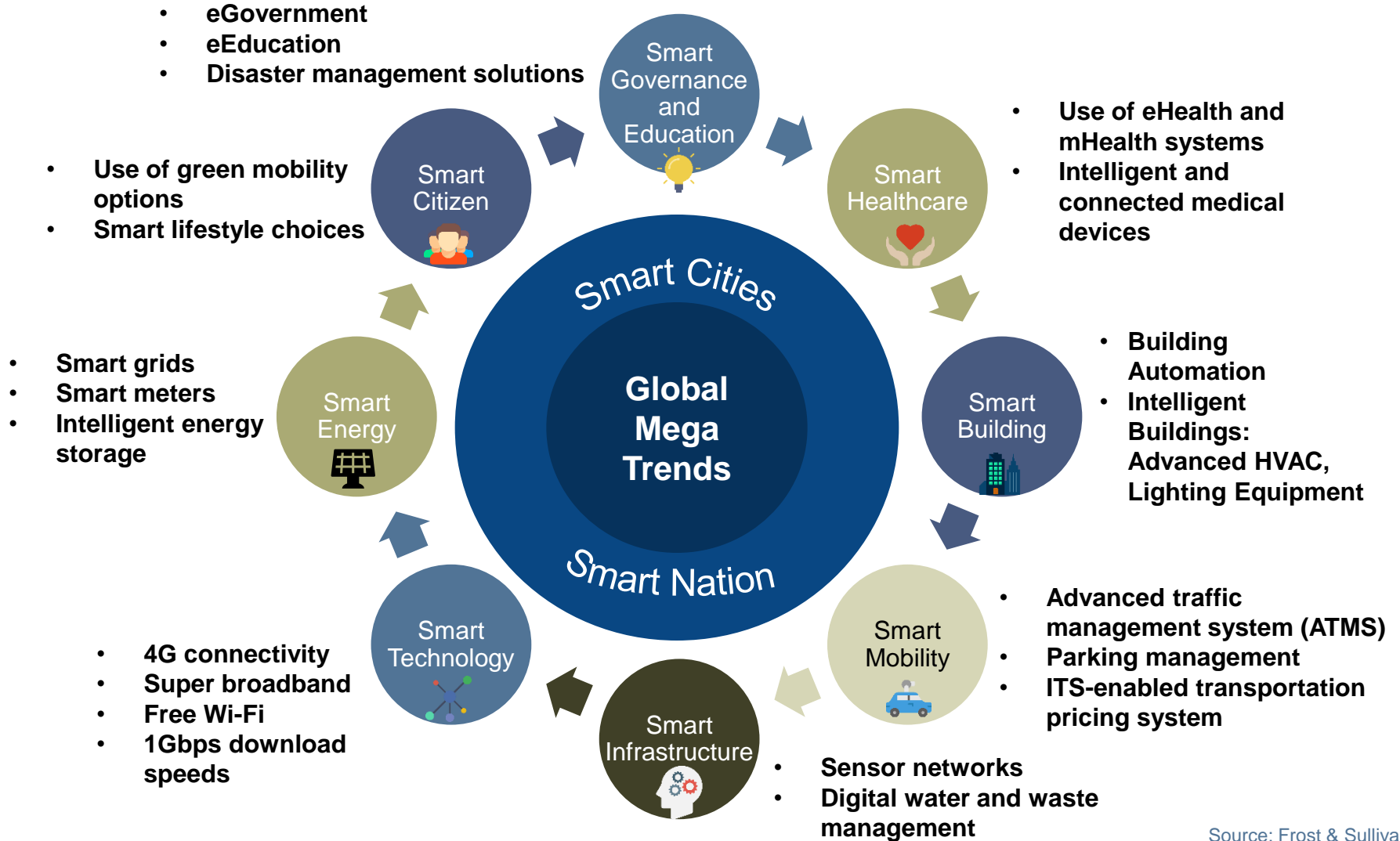
Source: Frost & Sullivan

Industry Value Chain

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Future of Cities – From “Green” to “Smart”

'Green' will evolve into 'Smart' concepts and create a global market value of \$1.565 T by 2020



Source: Frost & Sullivan

Industry Convergence

Companies in the smart buildings space will not only partner and converge among themselves to offer 'smart' capabilities but also start converging with different participants in the ecosystem

Convergence of Competition in Smart Buildings Market

Telecom Participants

- Broadband and Internet service providers
- Phone lines
- Mobile communications
- Networked IT services

Security

- Firewalls, Internet protocol security
- Physical implementation of systems and monitoring
- Managed and monitoring services
- Cloud-based services
- Identify management, smart cards

IT Participants

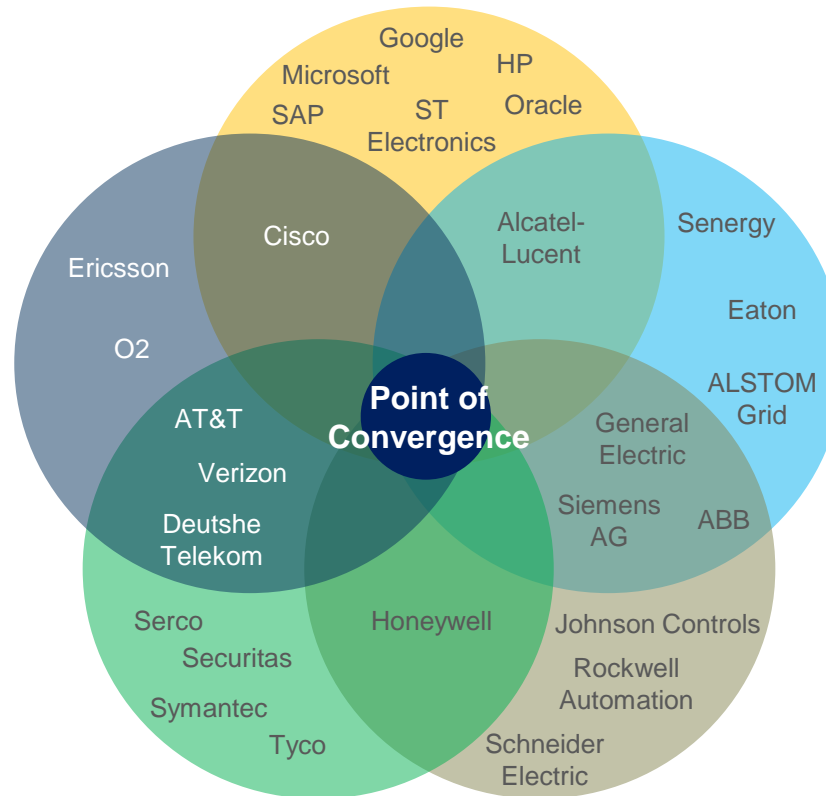
- IP networks
- Digital technology
- Analysis software
- Technology integration
- Network security

Energy and Infrastructure Participants

- T&D technology
- Power electronics
- Renewable energy
- Integrated distribution management
- Substation automation
- AMI-enabled metering

Automation and Building Control Participants

- Building automation
- Demand-side management
- Device connectivity
- Monitoring and sensing
- Smart grid integration



Source: Frost & Sullivan

Emerging Opportunities

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2 Big Market Trends



Integration of building services on a single platform

The individual key product markets and future innovations may be clubbed together, as buildings become increasingly integrated.

Home automation and building automation already combine features such as energy efficient lighting, security, HVAC and lighting control solutions.

Energy management could also emerge as one such umbrella offering.



Consolidation and highly dynamic competitive scenario

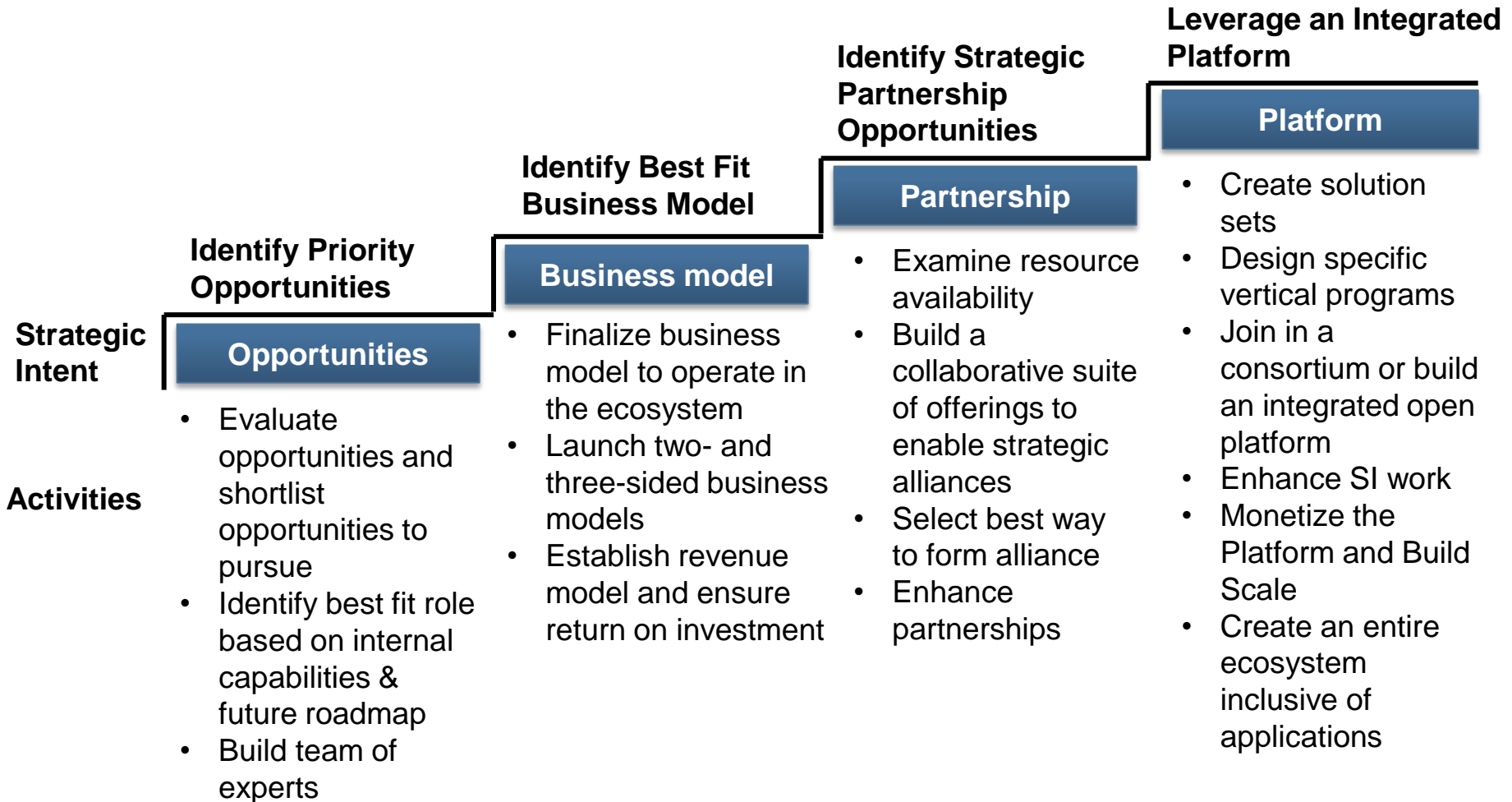
The above-mentioned trend in demand for integrated building systems will be paralleled by a similar trend in the supply chain, where **leading producers diversify to provide complete solutions.**

Consolidation, mergers and acquisitions as well as the entry of manufacturers from the electrical and electronics and the ICT industries will facilitate this trend.

Source: Frost & Sullivan

How to engage in the smart & connected ecosystem?

Smart & Connected Market: Monetizing Opportunities



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