IBM

Internet of things, Machine-to-Machine, Big Data
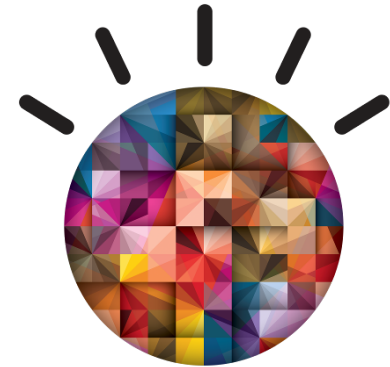
Architectural discussion

Impossible d'afficher l'image. Votre ordinateur manque peut–être de mémoire pour ouvrir l'image ou l'image est endommagée. Redémarrez l'ordinateur, puis ouvrez à nouveau le fichier. Si le x rouge est toujours affiché, vous devrez peut–être supprimer l'image avant de la réinsérer.
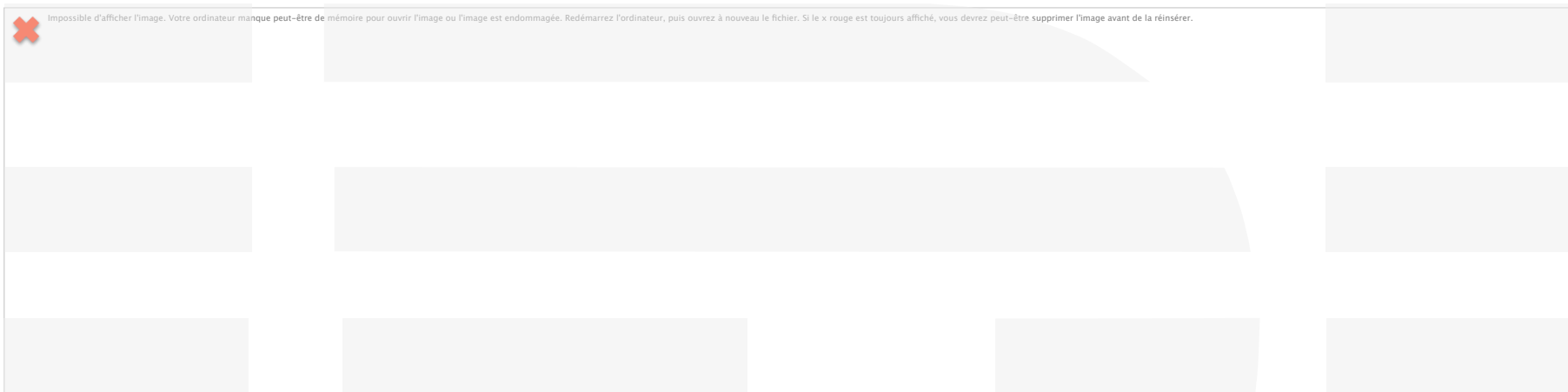
The world is smaller and flatter.

The reality of living in a globally integrated world is upon us.

- Frozen credit markets and limited access to capital.

- Economic downturn and future uncertainty.

- Energy shortfalls and erratic commodity prices.

- Information explosion and risk/opportunity growth.

- Slowing Western powers and emerging economies.

- Increasingly complex supply chains and empowered consumers.

The world is connected:
economically, socially and technically.
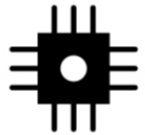
Our world is becoming
INSTRUMENTED

Our world is becoming
INTERCONNECTED

Virtually all things, processes and ways
of working are becoming
INTELLIGENT

INSTRUMENTED

We now have the ability to measure, sense and see the exact condition of everything.

- Today, there are 1 billion transistors for each person on the planet.[1]

- By 2010, 30 billion RFID tags will be embedded into our world and across entire ecosystems.[1]

Everything will become instrumented: supply chains, healthcare networks, cities and even natural systems like rivers.
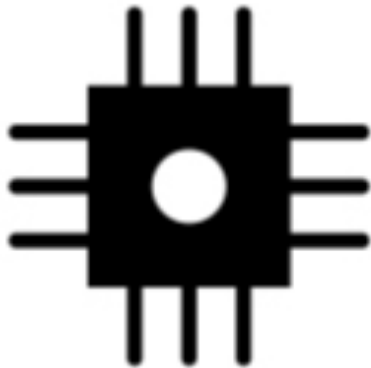
[1] Sam Palmisano speech, November 12, 2008

INTERCONNECTED

People, systems and objects can communicate and interact with each other in entirely new ways.

- The internet of people is 1 billion strong. Almost one third of the world's population will be on the web by 2011.[1]

- There will be nearly 4 billion mobile phone subscribers worldwide by the end of 2008.[1]

The Internet of things—cars, appliances, cameras, roadways, pipeline, pharmaceuticals and even livestock—is headed to 1 trillion.

[1] Sam Palmisano speech, November 12, 2008

INTELLIGENT

We can respond to changes quickly and accurately, and get better results by predicting and optimizing for future events.

- Every day, 15 petabytes of new information are being generated. This is 8x more than the information in all U.S. libraries.[1]

- An average company with 1,000 employees spends $5.3 million a year to find information stored on its servers.[1]

New computing models manage the massive amounts of data generated by the proliferation of end-user devices, sensors, and actuators. Combined with advanced analytics, these technologies are making us smarter.

[1] New Intelligence White Paper from ThinkForward website

An opportunity to think and act in new ways— economically, socially and technically.

Today, more than ever, organizations are under pressure to leverage a wealth of information to make more intelligent choices.

VOLUME OF DIGITAL DATA

With the proliferation of end-user devices, sensors and actuators, the nature of data is changing. Data volumes and network bandwidth are expected to grow tenfold in the next three years.

VELOCITY OF DECISION-MAKING

The market demands that businesses optimize decisions, take action based on good information and utilize advanced predictive capabilities— all with speed and efficiency.

VARIETY OF INFORMATION

With the expansion of information comes large variances in the complexion of available data— very noisy with lots of errors and no opportunity to cleanse it in a world of real-time decision-making.

SHIFT IN WHAT WE ANALYZE

Enterprises need a broader, systems-based approach to the information they examine and optimize. Stream computing and event processing capabilities are enabling the analysis of massive volumes.

Today, organizations can work smarter, supported by flexible processes modeled for the new way people buy, live and work.

ECONOMIC PRESSURES

Increasing strains on the global economy are galvanizing leadership to build visibility and control into their business models to mitigate risk and optimize profit.

THE DEMANDING CONSUMER

Customer expectations have never been higher. By figuring out exactly what people want, companies are tapping into hidden opportunities and rolling out innovative products and services.

GLOBAL COMPETITION

In a global economy, intense competitive pressure is driving more efficient markets. To stay ahead, businesses will need to build more agile models and be the first to seize golden opportunities.

IT INTEGRATION

Breakthrough applications like Cloud and Web 2.0 are empowering the business user, driving the convergence of business and IT, and blurring the lines between companies and their customers.

Mobility, social media, increasing digitization and new analytics capabilities are conspiring to drive broad business change

Major Technology Trends driving Business Change

Mobile revolution
- Connectivity, access and participation are growing rapidly
- Smart devices are becoming the primary route to get connected
- Devices are getting smarter as they are increasingly enriched by mobile apps

Social media explosion
- Social media is quickly becoming the primary communication and collaboration format
- GenY's or "digital natives" use of technology and social media platforms is accelerating adoption
- Enterprises are adopting social media but are struggling to realize the value and manage risk

Hyper digitization
- Digital content is produced and accessed more quickly than ever before
- Internet traffic is growing globally driven by consumer use of video, mobile data, interconnectedness
- An increasing number of connected devices and sensors is further driving growth

The power of analytics
- New capabilities for real time analysis, predictive analytics and micro-segmentation are emerging
- Top performing companies use analytics to drive action and business value
- Analytics are making information "consumable" and is transforming all parts of the organization, from customer intimacy to supply chain management

Source: IBV Analysis

IBM

We Have Entered a New Wave of Innovation

Innovation (vertical axis)

The Industrial Revolution
1st Wave

Age of Steam and Railways
2nd Wave

Age of Steel, Electricity and Heavy Engineering
3rd Wave

Age of Oil, Cars and Mass Production
4th Wave

Age of IT and Telecom
5th Wave

Smarter Products & Services
6th Wave

1770   1830   1875   1920   1970   2010
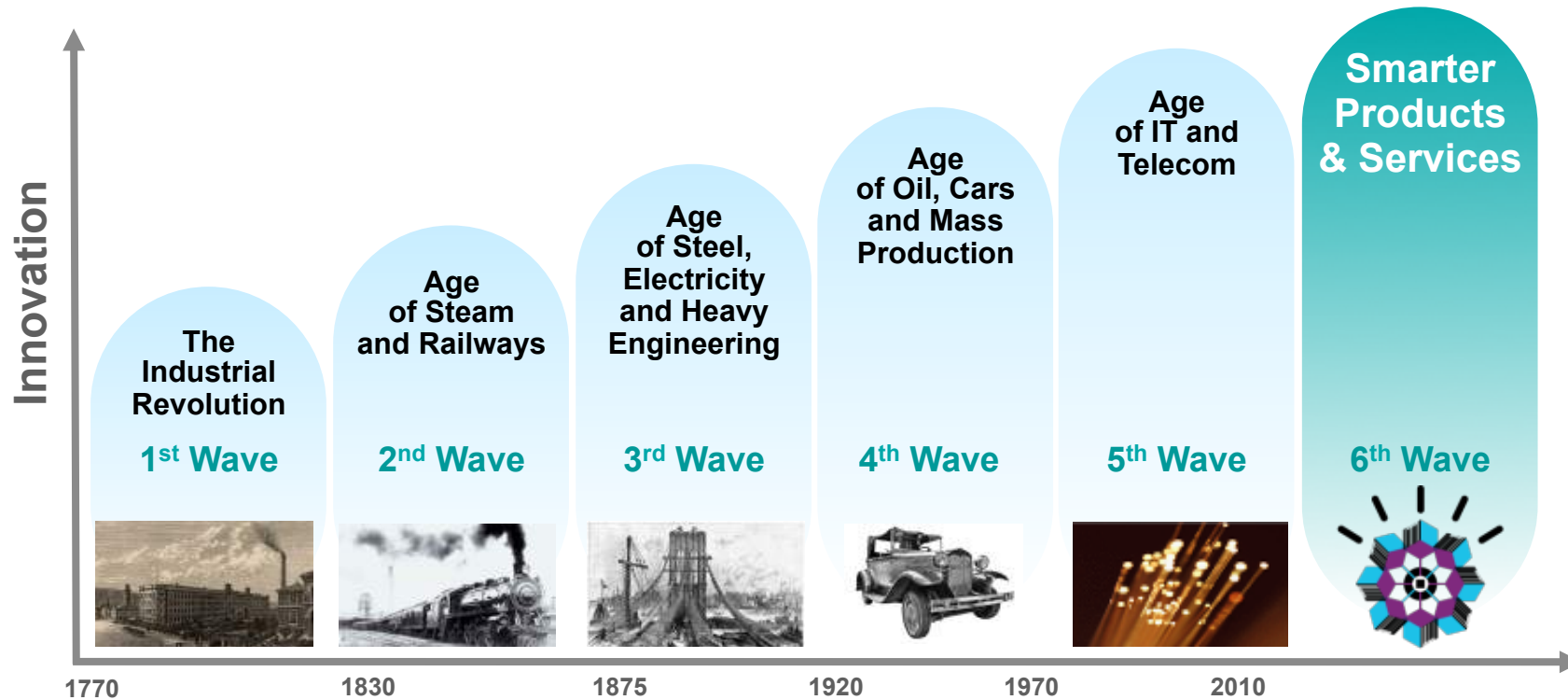
Source: "Next Generation Green: Tomorrow's Innovation Green Business Leaders", Business Week, Feb 4, 2008

12

IoT Scenarios Show a Pattern of Customer Pain Points

Water Management

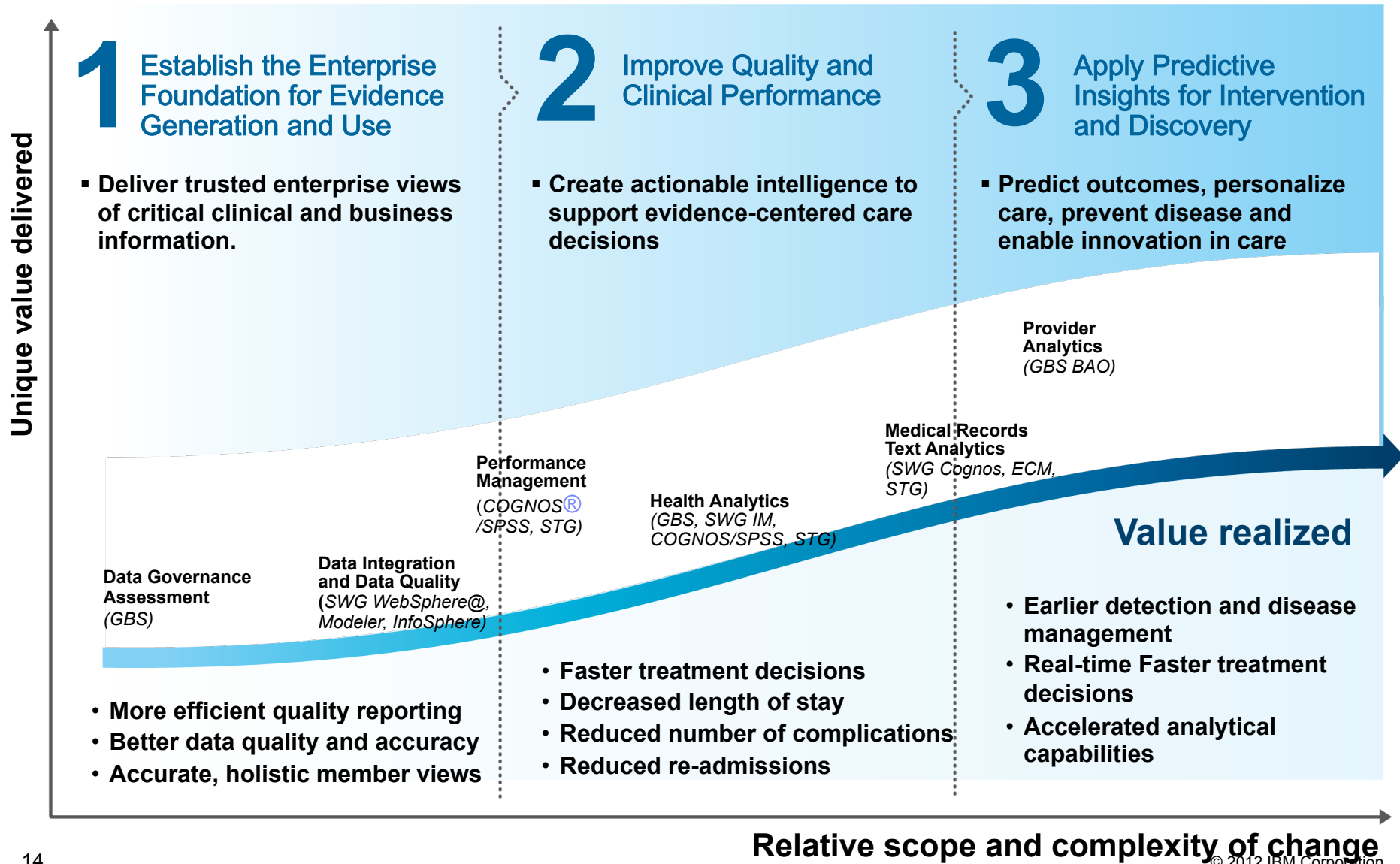**Grid**

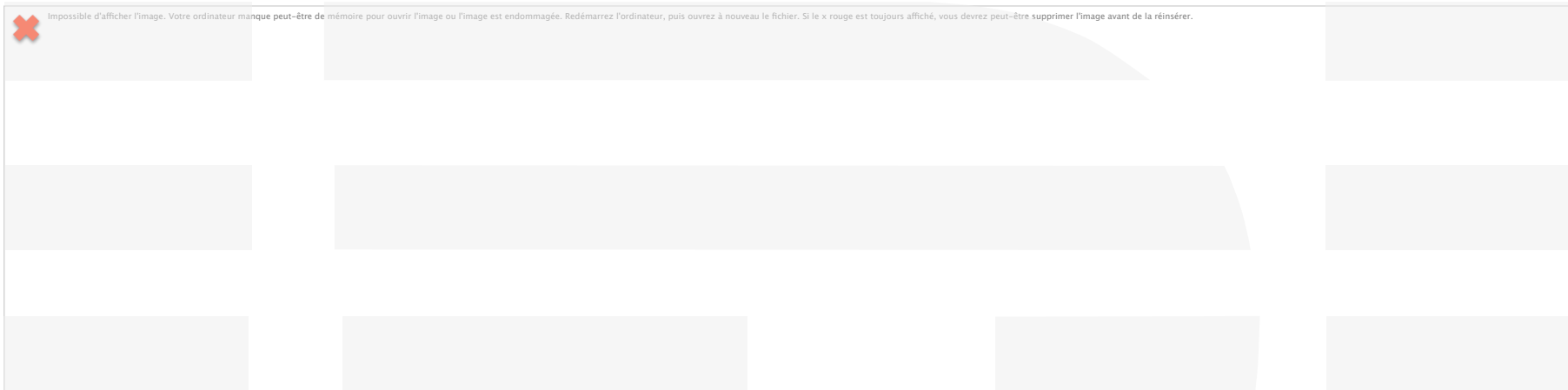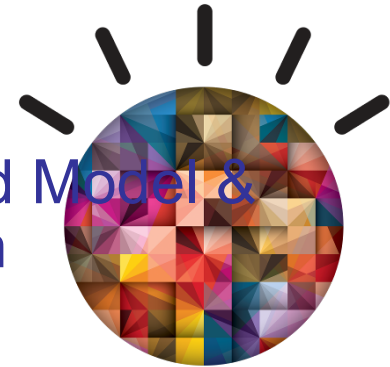**Food Safety**

Logistics

Home Healthcare

Transportation

- Lack of capability to design, implement, deploy, operate and manage complex IoT systems
- Lack of situation awareness leading to unacceptable responsiveness and resilience
- Requirement of end-to-end security

Smarter Planet Solution Progression Paths : *Quality and Performance*

1 Establish the Enterprise Foundation for Evidence Generation and Use

- Deliver trusted enterprise views of critical clinical and business information.

2 Improve Quality and Clinical Performance

- Create actionable intelligence to support evidence-centered care decisions

3 Apply Predictive Insights for Intervention and Discovery

- Predict outcomes, personalize care, prevent disease and enable innovation in care

Provider Analytics *(GBS BAO)*

Medical Records Text Analytics *(SWG Cognos, ECM, STG)*

Performance Management *(COGNOS® /SPSS, STG)*

Health Analytics *(GBS, SWG IM, COGNOS/SPSS, STG)*

Value realized

Data Governance Assessment *(GBS)*

Data Integration and Data Quality (*SWG WebSphere@, Modeler, InfoSphere)*

- **Earlier detection and disease management**
- **Real-time Faster treatment decisions**
- **Accelerated analytical capabilities**

- **More efficient quality reporting**
- **Better data quality and accuracy**
- **Accurate, holistic member views**

- **Faster treatment decisions**
- **Decreased length of stay**
- **Reduced number of complications**
- **Reduced re-admissions**

Unique value delivered

Relative scope and complexity of change

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Electricity Distribution Network :

The needed transformation towards the Smart Grid Model & the ICT role as a key enabler of this transformation

Impossible d'afficher l'image. Votre ordinateur manque peut-être de mémoire pour ouvrir l'image ou l'image est endommagée. Redémarrez l'ordinateur, puis ouvrez à nouveau le fichier. Si le x rouge est toujours affiché, vous devrez peut-être supprimer l'image avant de la réinsérer.

The Traditional Electricity Grid has been built 30 years ago on the power plant centric model :

- **Fully regulated sector with but a few cross-countries interactions**

- **Based on a central generation model with one-way power flow from large (nuclear) power plants, through transmission and distribution lines to end consumers.**

- **The balance consumption-generation based on**
  - **a limited number of inflows**
  - **the vertical integration of the different functions within one single player**
  - **Seasonal historic & stable consumption profiles**
  - **Inertia effect of a few large power plants**
  - **Electricity power assumed as being uncapped**

- **Aging infrastructure with some equipment dating back 30 years+**

- **Limited communications at the distribution level enabling grid automation & monitoring capabilities**

- **Limited consumer participation based on simple & rigid billing scheme**

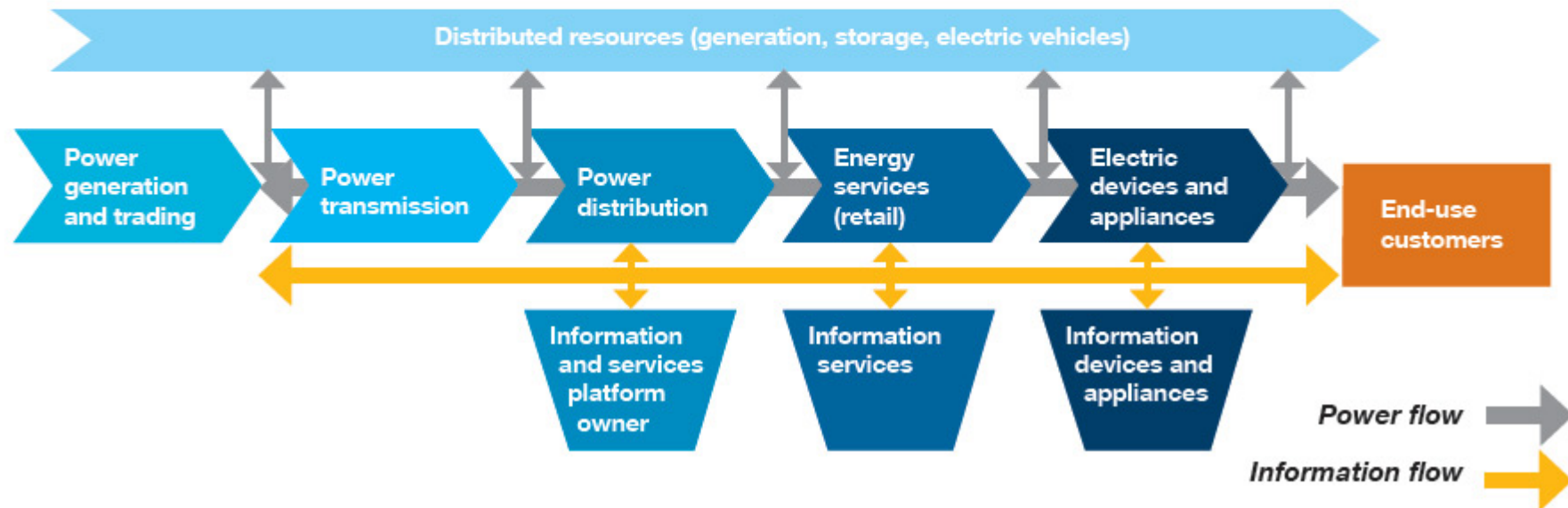- **Green Energy was unknown and not any CO2 regulation**

16
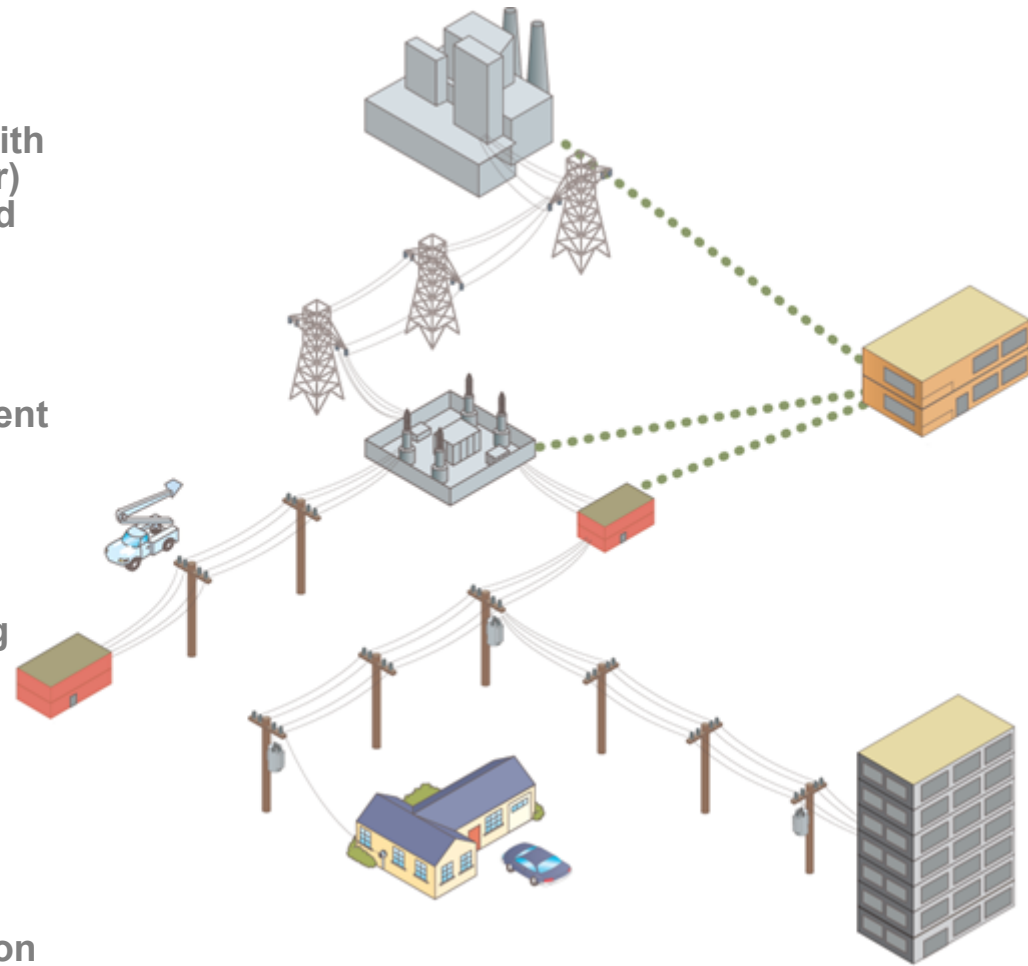
The electric utility industry operated under essentially the same model for years, but change is inevitable

Traditional electricity value chain

Power generation and trading → Power transmission → Power distribution → Energy services (retail) → Electric devices and appliances → End-use customers

Emerging electricity value chain

Distributed resources (generation, storage, electric vehicles)

Power generation and trading → Power transmission → Power distribution → Energy services (retail) → Electric devices and appliances → End-use customers

Information and services platform owner | Information services | Information devices and appliances

Power flow →
Information flow →

- Green energy emergence significantly increases the number of inflows, decreases the power plan weight in the generation mix and will impose a time-based billing scheme

- The security & reliability of supply (balance consumption/generation) requires a E2E coordination including an exchange of huge volume of data at each quarter of hour.

The residential consumer is entering the post-fossil-energy time space and has to cope with an increased complexity coming from :
1/ the obligation to call on a mix of different sources of energy
2/ the number of different players making up the deregulated eco-system :

- **Different sources of energy : sun, wind, ground, fossil energy, electricity**

- **Each client potentially consumer & electricity generator meanwhile**

- **Electricity price will vary in fct of the hour of a day and in fct of the marketing policies of the electricity retailers**

- **Smart electricity meters mandatory to enable a smart consumption & generation of electricity**

- **Distributed generation, such as solar panels and other m**

- **Dedicated energy display units and smart thermostats**

- **Direct load control of heat and cooling**

- **Smart appliances with connectivity**

- **Plug-in vehicles as a both source and consumer of energy**

- **Greater connection to the in-home network and home PCs**
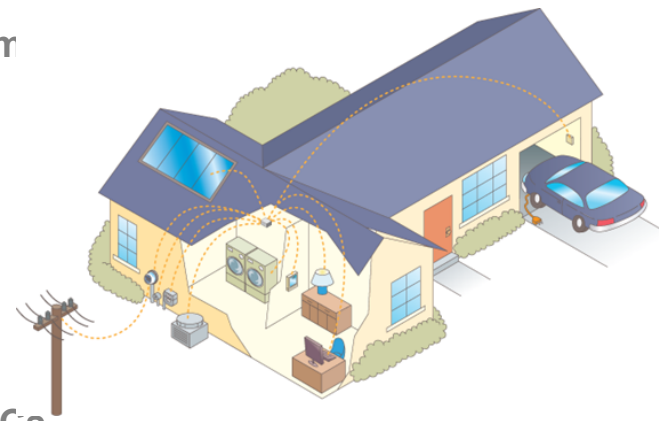
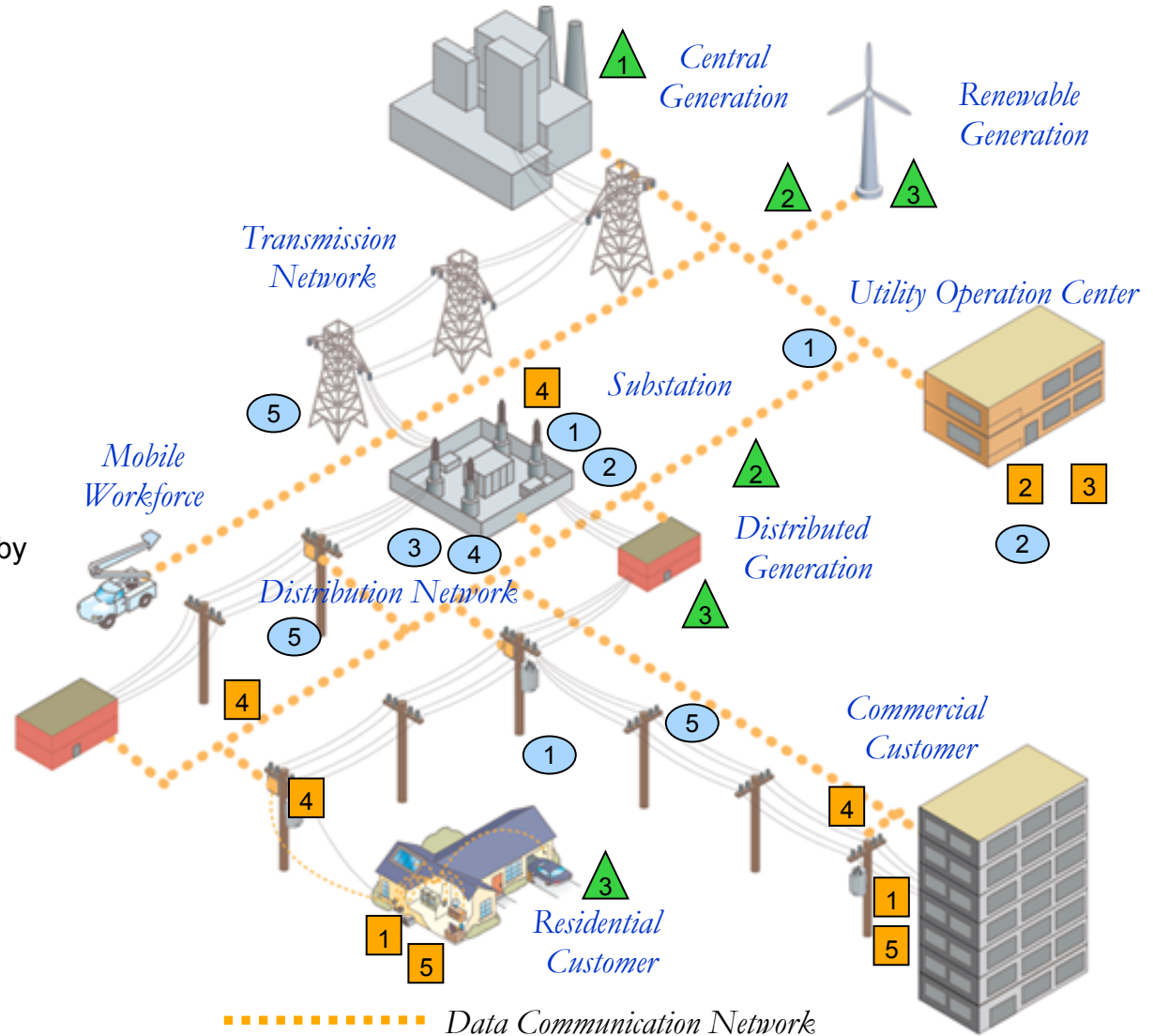# Utility Network : components

Advanced Meter Infrastructure

1 • Meter
2 • Head-End Device
3 • Meter Data Management System (MDMS)
4 • Communications Layer
5 • Home Area Network

Transmission & Distribution Network

1 • Communications Layer
2 • Data Historians
3 • SCADA RTU
4 • Substation Assets (not managed by SCADA)
5 • Electrical Grid Field Assets (downstream of substation)

Power Generation

1 • Fossil / Nuclear plant devices monitoring (Non-Operational)
2 • Distributed Generation Communications Layer
3 • Distributed Generation Assets (Wind, Solar, Hyrdo, Diesel)

Central Generation

Renewable Generation

Transmission Network

Utility Operation Center

Substation

Mobile Workforce

Distributed Generation

Distribution Network

Commercial Customer

Residential Customer

Data Communication Network

The Smart Grid copes with the following challenges :

- **Permanent balance consumption/generation :**
    - **Control of inflows & outflows**
    - **Energy sources mix management**
    - **Proper working of the deregulation**
    - **Consumer-centric model**
    - **Switch on/off of auxiliary generation capacity**

- **Collection & Management of huge data volume**
    - **Conversion of data into smart info enabling environmental sustainability**
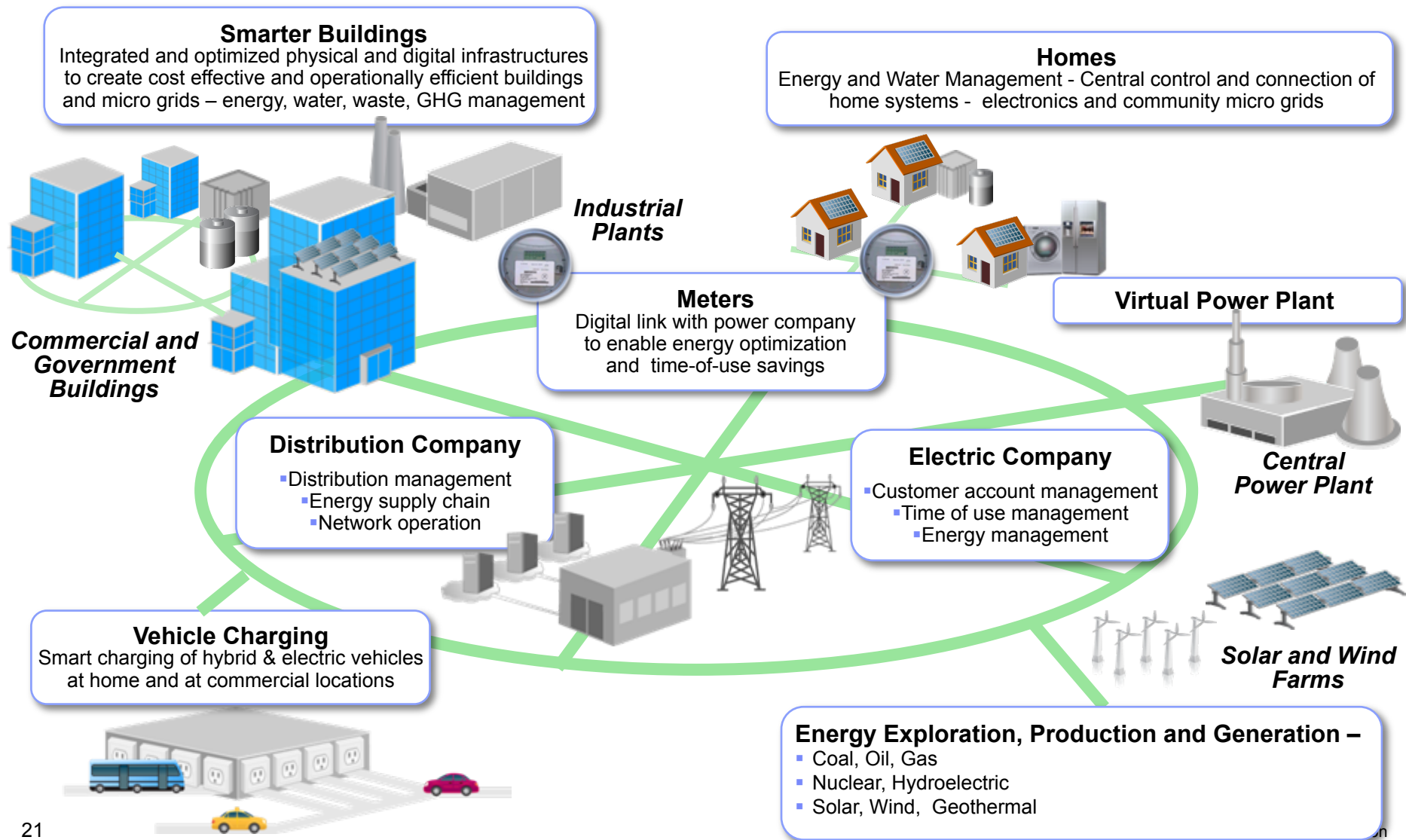
- **Optimized Asset Management**

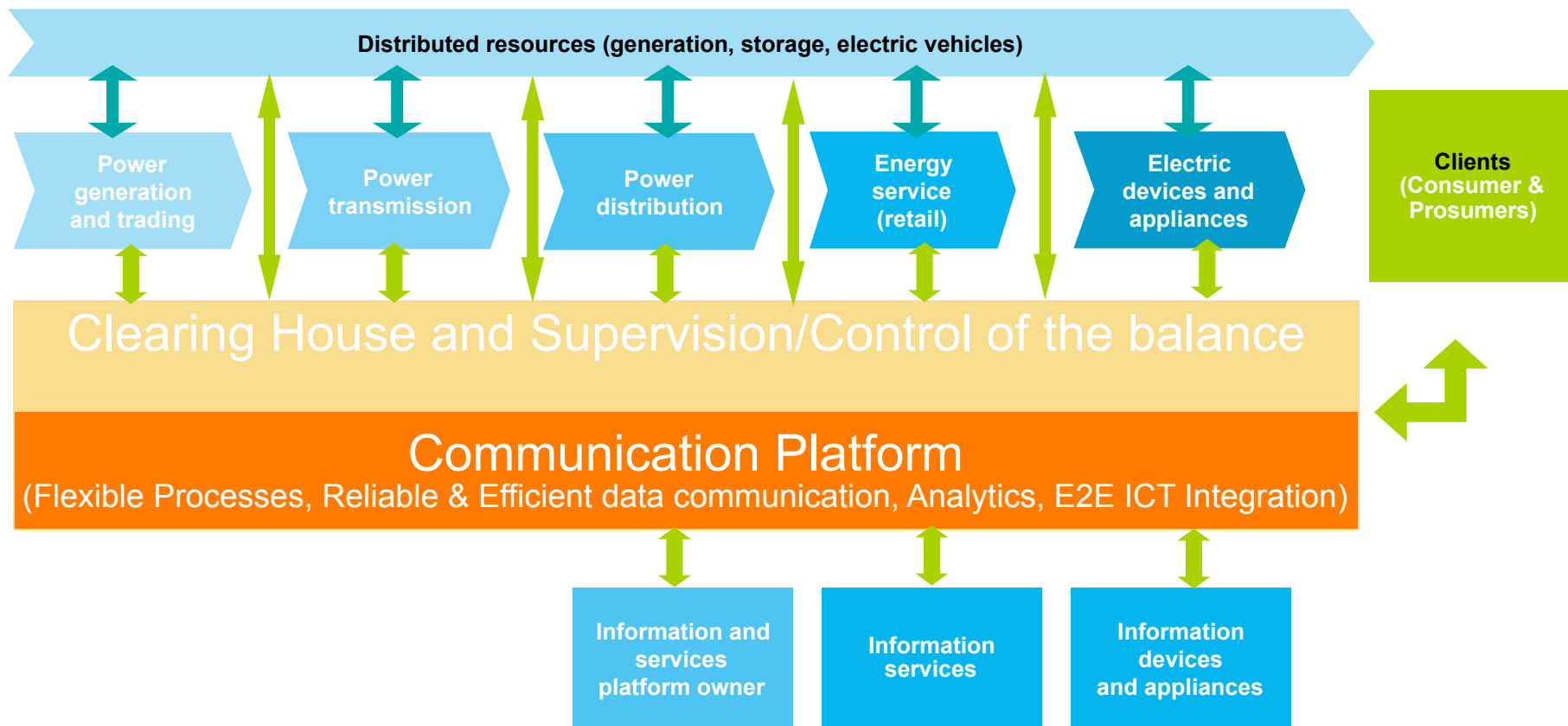- **Coping with emergence of micro generation sites and micro-grids**
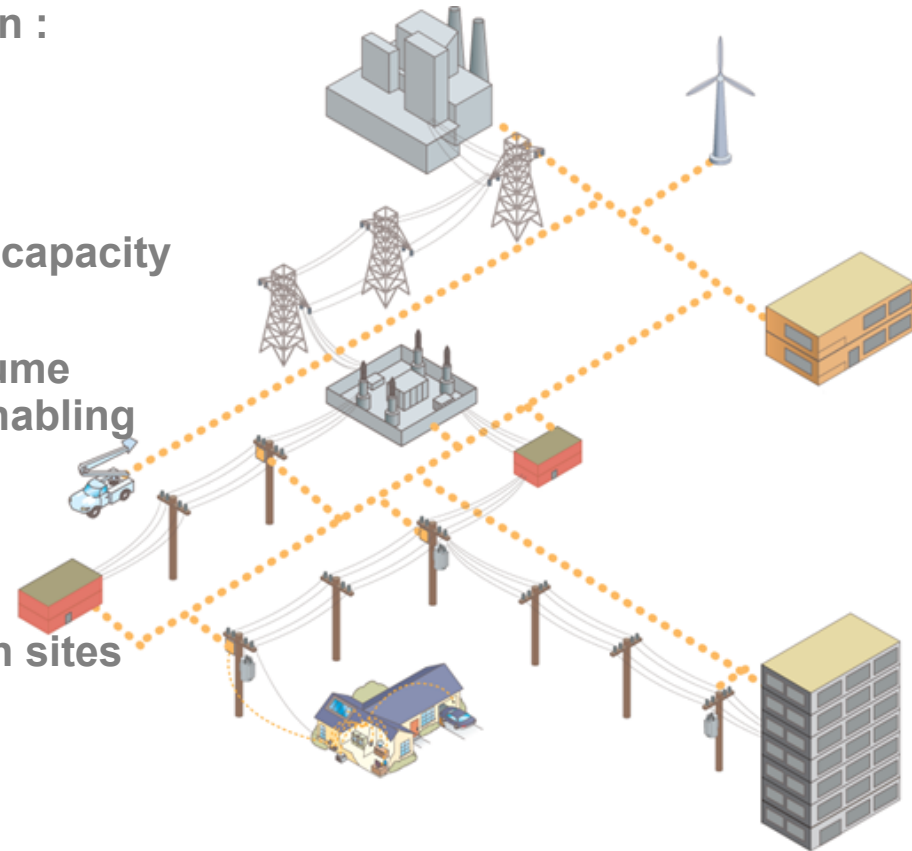
Grids are being transformed into an elaborate interconnected network that will provide citizens with a secure and cost-effective supply

IBM

The interconnection of physical assets and information technology can optimize energy production, energy-mix-management, distribution and consumption

Smarter Buildings
Integrated and optimized physical and digital infrastructures to create cost effective and operationally efficient buildings and micro grids – energy, water, waste, GHG management

Homes
Energy and Water Management - Central control and connection of home systems - electronics and community micro grids

Industrial Plants

Commercial and Government Buildings

Meters
Digital link with power company to enable energy optimization and time-of-use savings

Virtual Power Plant

Central Power Plant

Distribution Company
- Distribution management
- Energy supply chain
- Network operation

Electric Company
- Customer account management
- Time of use management
- Energy management

Vehicle Charging
Smart charging of hybrid & electric vehicles at home and at commercial locations

Solar and Wind Farms

Energy Exploration, Production and Generation –
- Coal, Oil, Gas
- Nuclear, Hydroelectric
- Solar, Wind, Geothermal

A Communication platform enables the E2E proper working of a deregulated electricity market that is dealing with the post-fossil-energy world challenges :


Distributed resources (generation, storage, electric vehicles)

| Power generation and trading | Power transmission | Power distribution | Energy service (retail) | Electric devices and appliances | Clients (Consumer & Prosumers) |

Clearing House and Supervision/Control of the balance

Communication Platform
(Flexible Processes, Reliable & Efficient data communication, Analytics, E2E ICT Integration)

| Information and services platform owner | Information services | Information devices and appliances |

Example of early IBM work in IoT: Wireless Distribution Grid Monitoring

Client Requirement

- **Distribution grid monitoring, for ~150 cities, with ~100 substations deployed per city, and ~200 terminal units managed per substation**

- **Large-scale device and network management**

- **Private wireless network for monitoring & control**

Solution

- **Embedded technology for access appliances, edge appliances and application gateways**

- **Integrated management solution to automate grid monitoring and reduce management cost**

- **Embedded technology for Wireless system for capability and reliability**
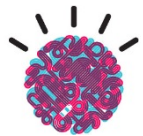

23
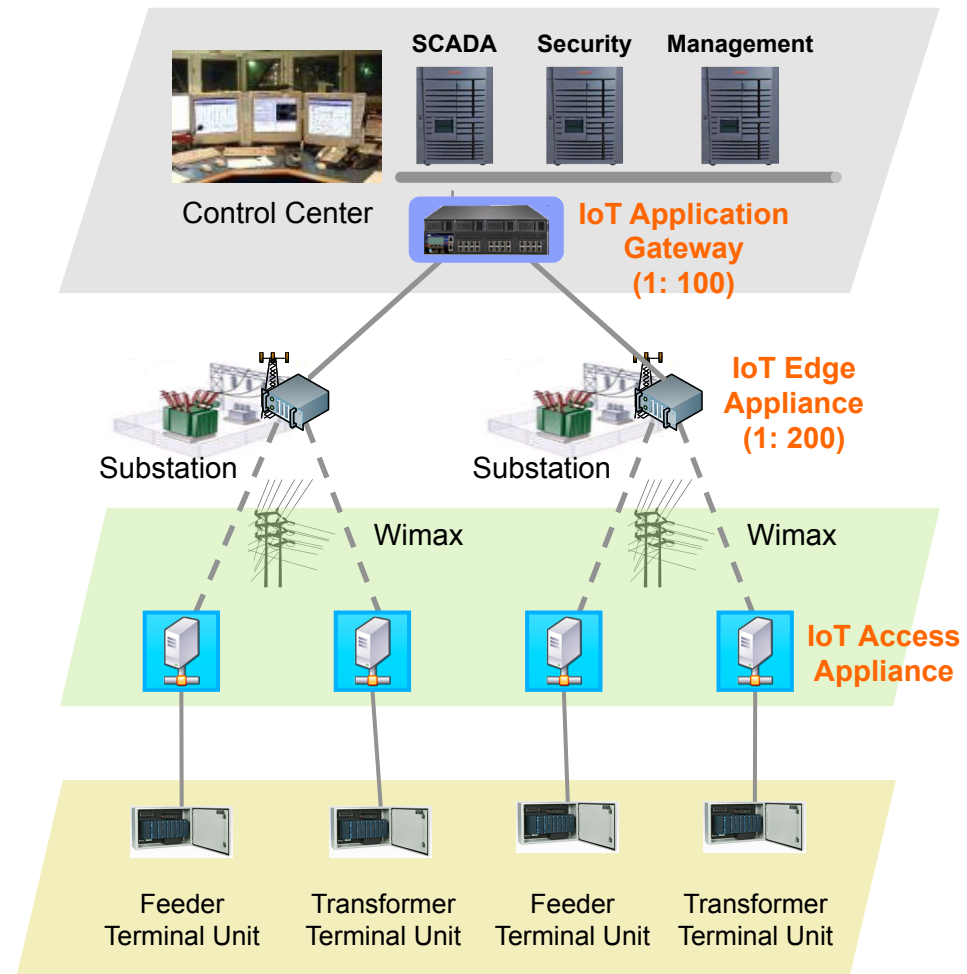
Smarter Cities

Potential Use Cases/Solutions

Public Safety

Secure Locations:- Video, Swipe Cards, Parking, Asset Tracking, Utility Mgt
City/Town Centers:- Crime monitoring, Weather, Crowd Mgt, Traffic Mgt
Broader Protection:- Access, Facial Recognition, Events, Surge

Transport

Congestion Mgt:- Traffic Attributes, Events (visit / maintenance Weather,
Stations / On Board:- Crowd mgt, Timetables mgt, Safety,
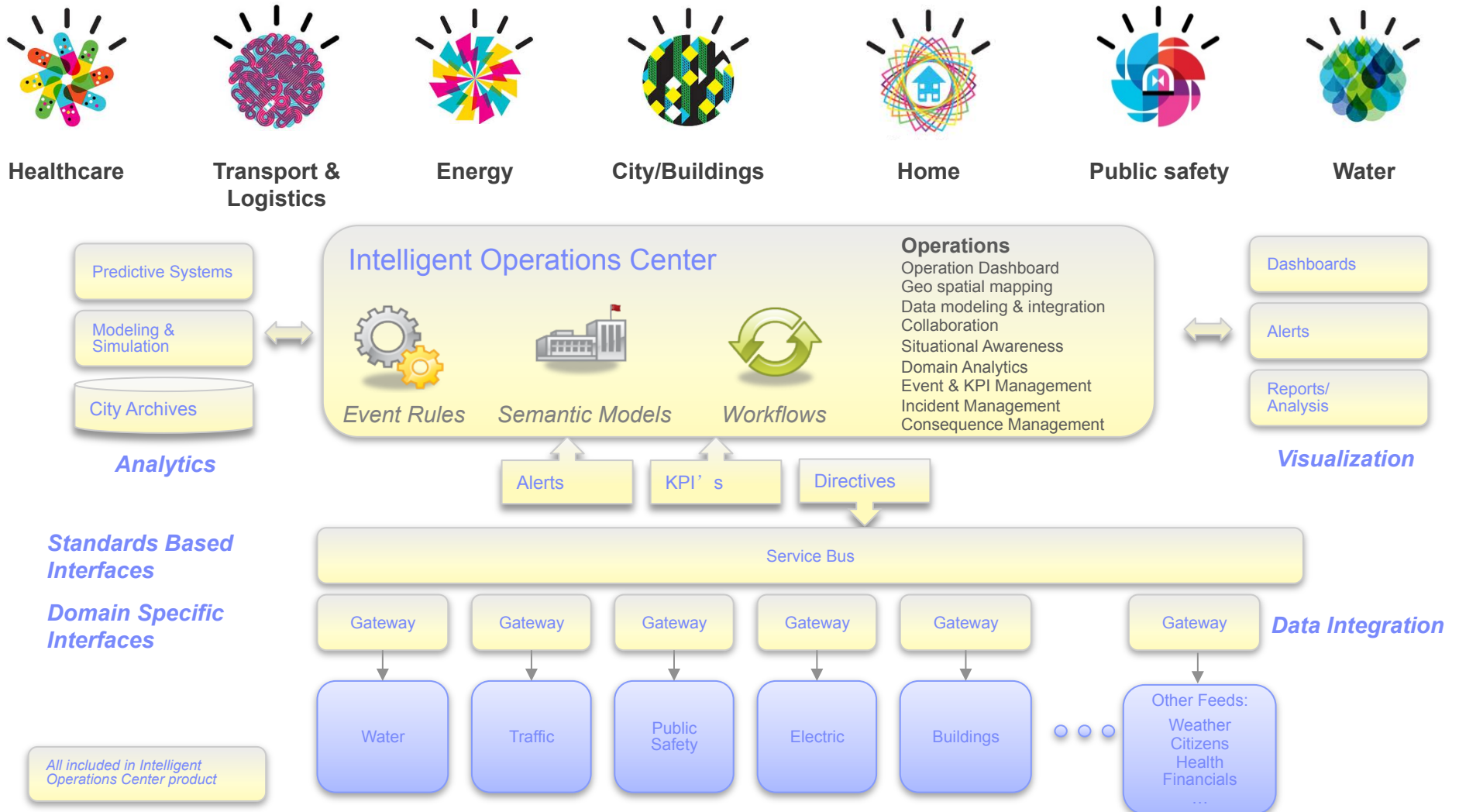Tunnel/ Motorway mgt:- Flow mgt, Emergency mgt, Asset mgt, Maintenance

Water

Coastal Monitoring:- Object tracking, Sea Defenses, Quality mgt, weather
Tourism Mgt:- Crowd mgt, Mass notification, transportation optimization, events
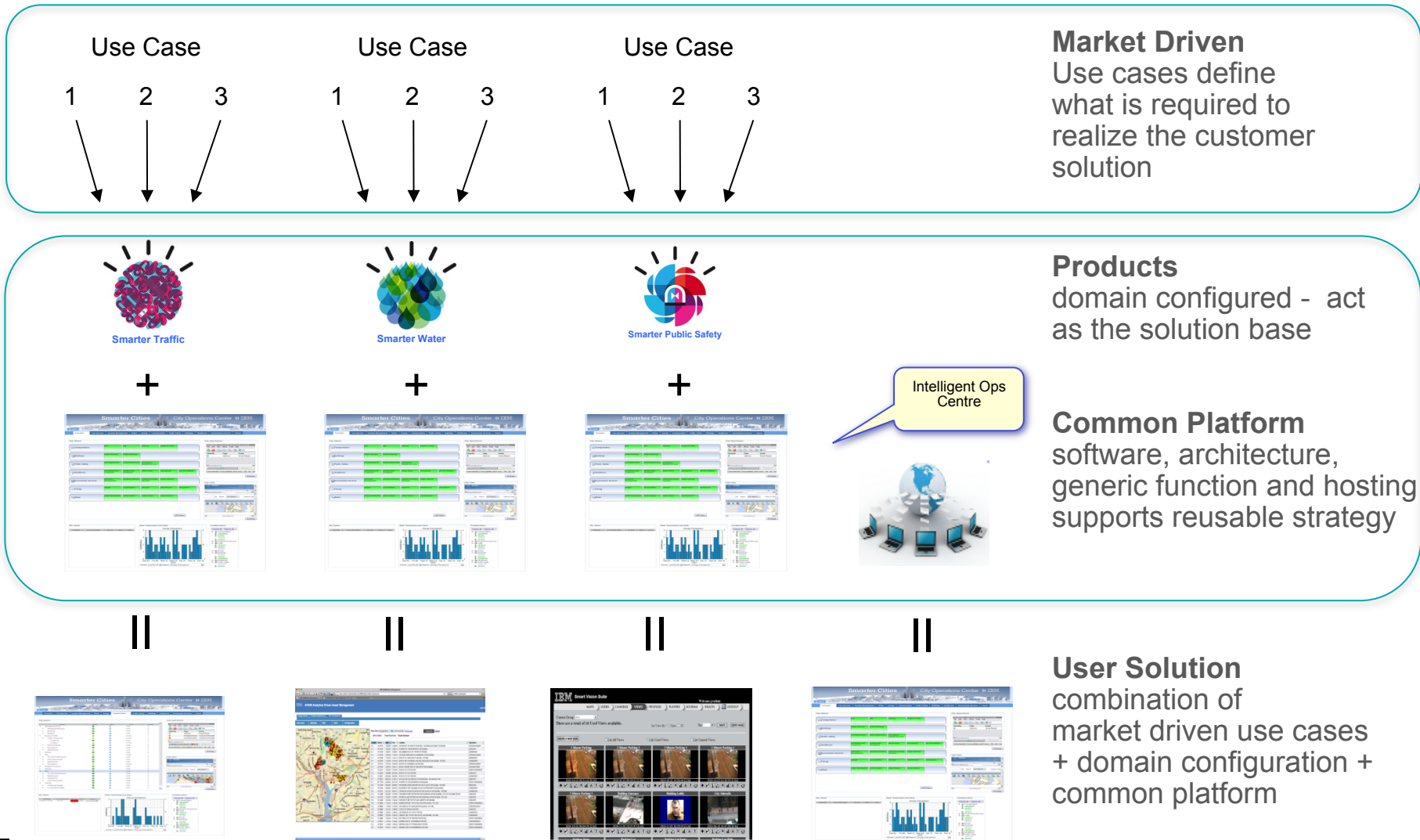Sea Port Mgt:- Traffic mgt (land /sea), Asset mgt, weather.

Building

Airports:- Facial Recognition, Crowd flow, Door Access, Parking, Retail, Asset Mgt
Sport Stadiums:- Crowd Flow, Utility mgt, Transportation corridors, Asset Mgt
Leisure & Retail:- Utility mgt, Footfall profiling, Facial Recognition, Parking

IBM

# Helicopter View on the Smarter Cities architecture :

Healthcare   **Transport & Logistics**   **Energy**   **City/Buildings**   **Home**   **Public safety**   **Water**

Intelligent Operations Center

Operations
Operation Dashboard
Geo spatial mapping
Data modeling & integration
Collaboration
Situational Awareness
Domain Analytics
Event & KPI Management
Incident Management
Consequence Management

Predictive Systems

Modeling & Simulation

City Archives

Event Rules   *Semantic Models*   *Workflows*

Dashboards

Alerts

Reports/ Analysis

Analytics

Visualization

Alerts   KPI's   Directives

Standards Based Interfaces

Service Bus

Domain Specific Interfaces

Gateway   Gateway   Gateway   Gateway   Gateway   Gateway   *Data Integration*

Water   Traffic   Public Safety   Electric   Buildings   Other Feeds: Weather Citizens Health Financials …

All included in Intelligent Operations Center product

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© 2012 IBM Corporation

Each domain offering solution is based on market driven use cases and built on a common platform

Use Case
1   2   3

Use Case
1   2   3

Use Case
1   2   3

Market Driven
Use cases define what is required to realize the customer solution

Smarter Traffic

Smarter Water

Smarter Public Safety

+

+

+

Intelligent Ops Centre

Products
domain configured - act as the solution base

Common Platform
software, architecture, generic function and hosting supports reusable strategy

User Solution
combination of market driven use cases + domain configuration + common platform

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Intelligent City Operation Centre is a multi domain system

City at a glance

Key Performance Indicators
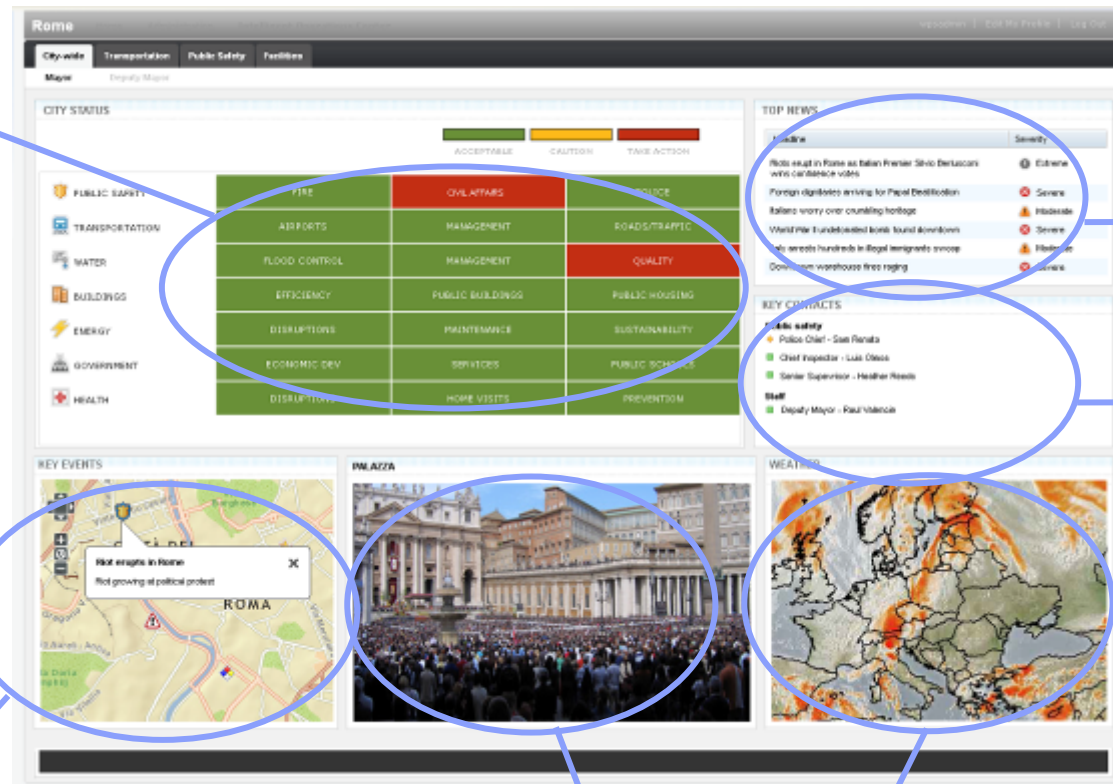
Incident & Event Management

Cross Agency Collaboration

Geo spatial mapping

Data Collection and Integration

Programming model encourages partner innovation through well defined points of extensibility

Add Users, Groups, Roles:

Security roles and groups can be defined and extended, controlling the user interface context.

Add/Customize Work Flows:

Write Service Run Books that open and track incidents and work orders based on policy definitions.

Add Video, Maps, etc:

Special visual integration, such as map layers or video feeds.

Define Event Rules:

The event policies can be customized in Impact for special processing, and to generate additional KPI metrics.

Create New Reports:

Leverage the Cognos model to create ad-hoc reports. Can leverage Framework Manager to extend model.

Use Analytics Tools:

ILOG and SPSS can be leveraged for Analytics on domain data

Add New KPI Metrics:

Domain Data Provider can send KPI metric data into the message bus using our standard message format and JMS. These can come from any source.

Customize the User Interface:

Write a compliant portlet that can be configured into the main IOC portal. Invocation through main menu or launch in context points in other portlets.

Send Events:

Domain Data Provider can send Common Alerting Protocol (CAP) events into the message bus using our standard message format and JMS. These can come from any source.

Extend the Data Model:

Data Model definitions, tools for data cleansing, value standardization, and data integration.

Connect Data Sources:

Domain Data Provider can provide solution based data, such as: TMDD standards based traffic data, water usage, account data, and so on.

Display KPI Widgets:

The new KPI metrics can be aggregated into a dashboard visual widget for display in the Operation centre portal.

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IBM Intelligent Transportation product

Provides citywide traffic visibility to alleviate congestion
and rapidly respond to incident response

- **Increase situational awareness** across entire transportation network and city services (e.g. emergency management response)

- **Analyze traffic performance** to improve travel experience

- **Centralize monitoring** and **transit arrival prediction**


Samp
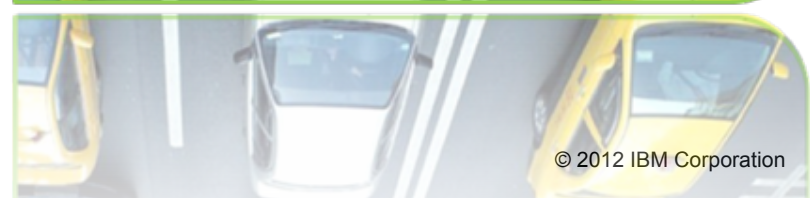
IBM Intelligent Water Solution

·An interactive portal based solution that comprises two components:

▪Work Optimization

➢ enables utilities to optimize maintenance and repair schedules based on type of work order, location, crew and equipment needed

➢ allows the utility to address "work on the way" and "work in the neighbourhood" while responding to high priority work

▪Usage & Revenue Analysis

➢ allows utilities to better understand and predict water usage

➢ optimize revenue based on better customer segmentation

➢ detect usage anomalies

31
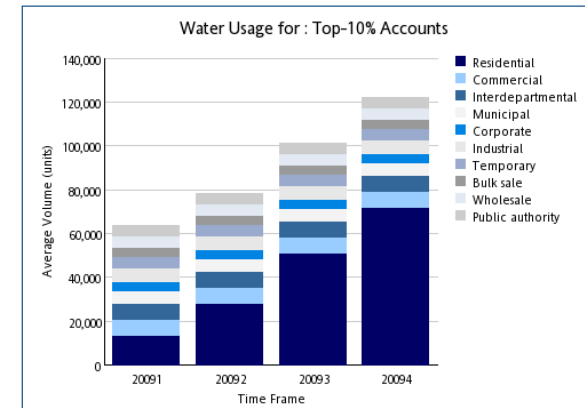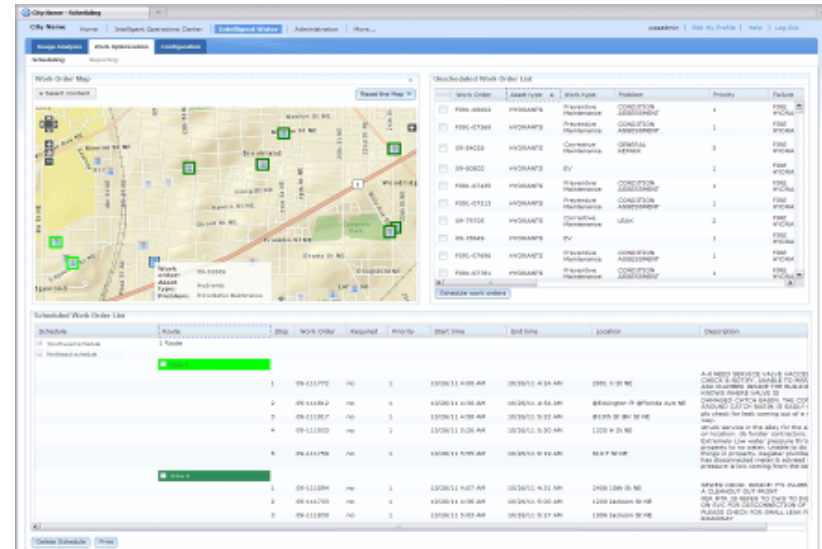
Organizations need to find ways to get more value from their physical security / monitoring systems

- **Limited Effectiveness**
  - Inherent inefficiency in 'Human eye'
  - Security systems are reactive, not proactive
  - Large amounts of surveillance video data hardly ever used
  - No consolidated view of activity and security threats
  - Limited data-sharing and integration between stakeholders
  - Poor compliance and audit of approved security processes

- **High Costs**
  - High cost of staff to monitor CCTV feeds, retrieving, managing and storing video content with limited value
  - High cost of proprietary hardware, maintenance and support

- **Low Value for Investment**
  - Labour costs are increasing without impact on security
  - No ability to mine data for patterns and vulnerabilities

Human's Ability to an Detect event

Drops by 95%

22 mins
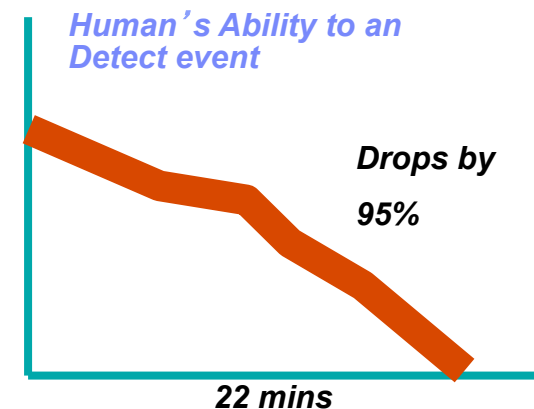
Intelligent Operations Centre + Video Correlation & Analytics
Video & Video Analytics combine to provide incident management through IOC

Event Captured, video analytics / image stored locally

Video Analytics
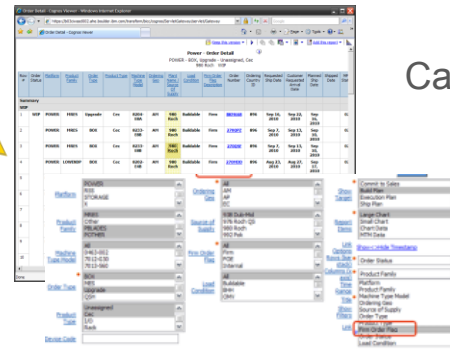
Captured data converted to events for IOC

Events stored , and processed

Data Processing
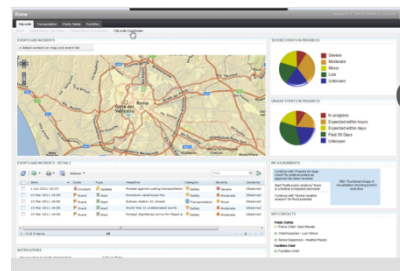
Charting, Geo Spatial

Data Analytics
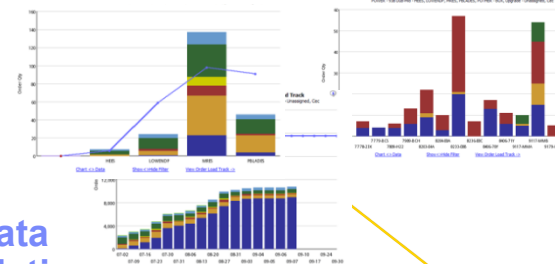
"It can cut 12 man hours down to 20 minutes with one person as opposed to 3 people sitting there at their computer screens"

Nick Beaton, Chicago OEMC, Operations Center Commander

"I can call up in real time all instances where a camera caught someone wearing a red shirt ... Video canvases that used to take days and weeks to do you'll now be able to do with the snap of a finger "

33

Jessica Tisch, NYPD Director Policy and Planning for Counterterrorism

Insight

Asset Location & Management, Work Management

Problem

- Inability to locate assets
- Higher than necessary asset levels
- Lost productivity & operational down time
- Uncertainty about asset maintenance / calibration
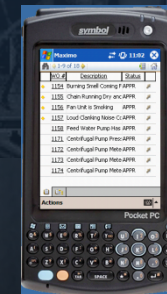
Solution

- Automated real-time location tracking
- Condition monitoring & automated status updates
- Integration with EAM
- Work force management

Business Value

- Increased productivity
- Reduced asset levels
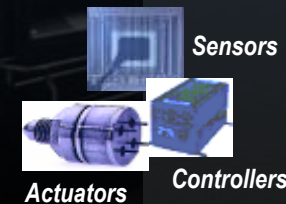- Increased auditability
- Reduced asset loss

Industry specific applications:
- Asset Tracking & Optimization
- Personnel Safety

Maximo Asset Management

Maximo Mobile Work Management

Real-Time Location Services

Sensors

Sensor Events

Actuators   Controllers

Example: Container Management

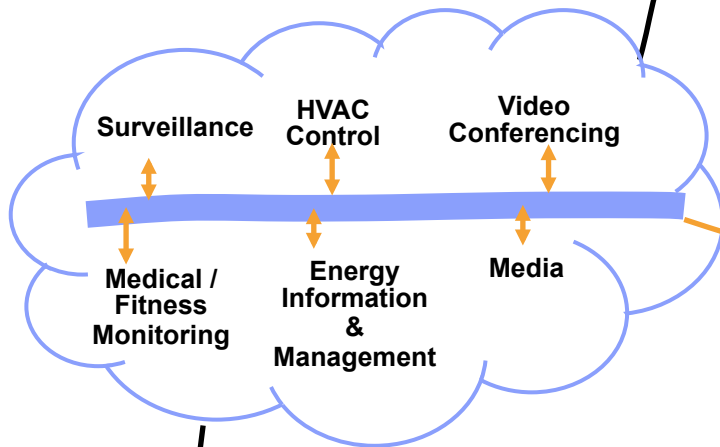| Client Requirement	Solution
▪ **Enhance asset management with end-to-end visibility (e.g. reducing container empty ratio)** ▪ **Improve operation efficiency with advanced planning and dynamic decision making**	▪ **IoT infrastructure with access appliances and application gateways, with access appliances installed across wide geo regions** ▪ **Integrated service management capability**

IBM
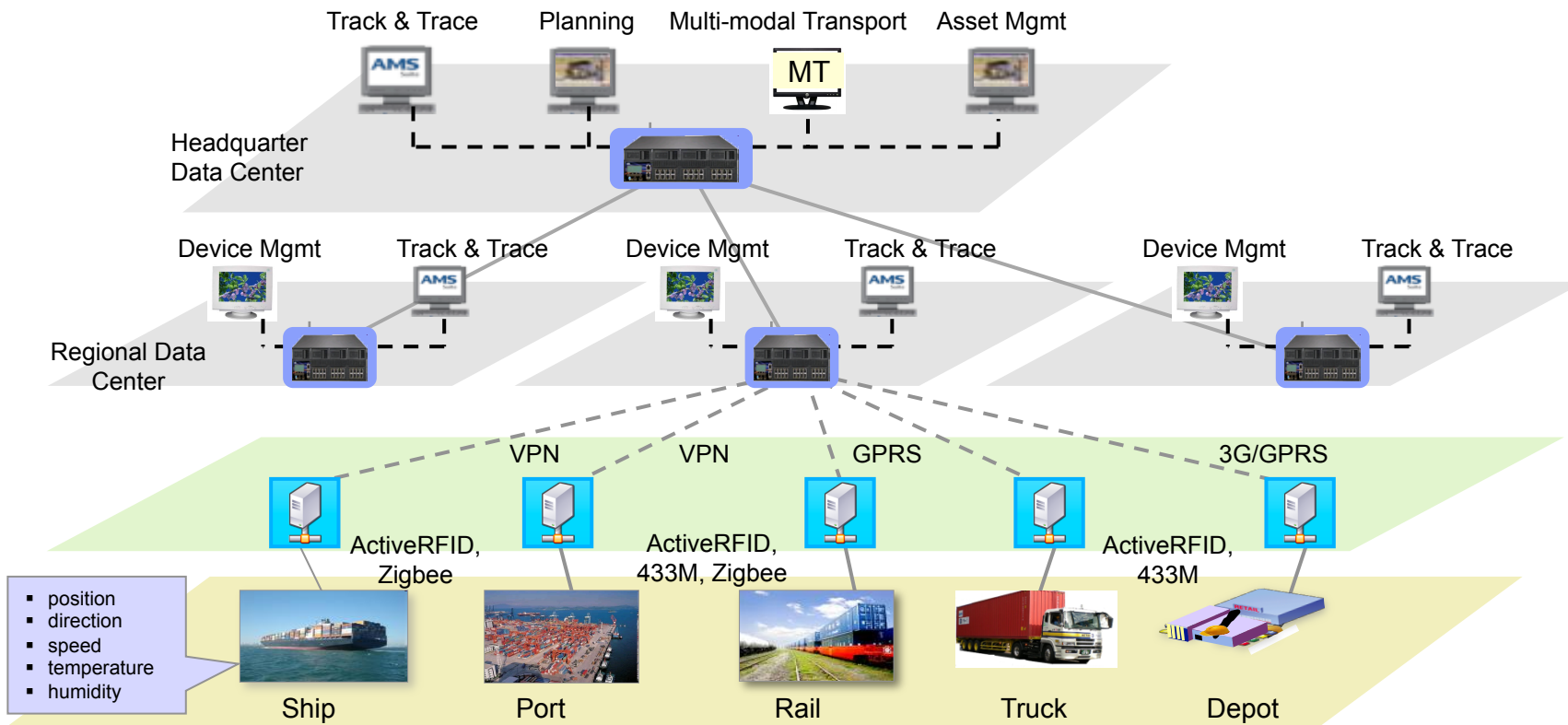
IBM's Smarter Home and Connected Services in the Cloud
Fully enabled Smarter Home, Boeblingen, Germany

Mobile Access

Connected Services in the Cloud

Surveillance

HVAC Control

Video Conferencing

Medical / Fitness Monitoring

Energy Information & Management

Media

Broadband Connection

Home Access

3rd Party Service Providers
- Energy management
- Health & wellbeing
- Safety & security
- Entertainment

Home Gateway
- JVM, Eclipse, OSGI
- WiFi, Zigbee, powerline
- Applications

Home Area Network

Entertainment and convenience

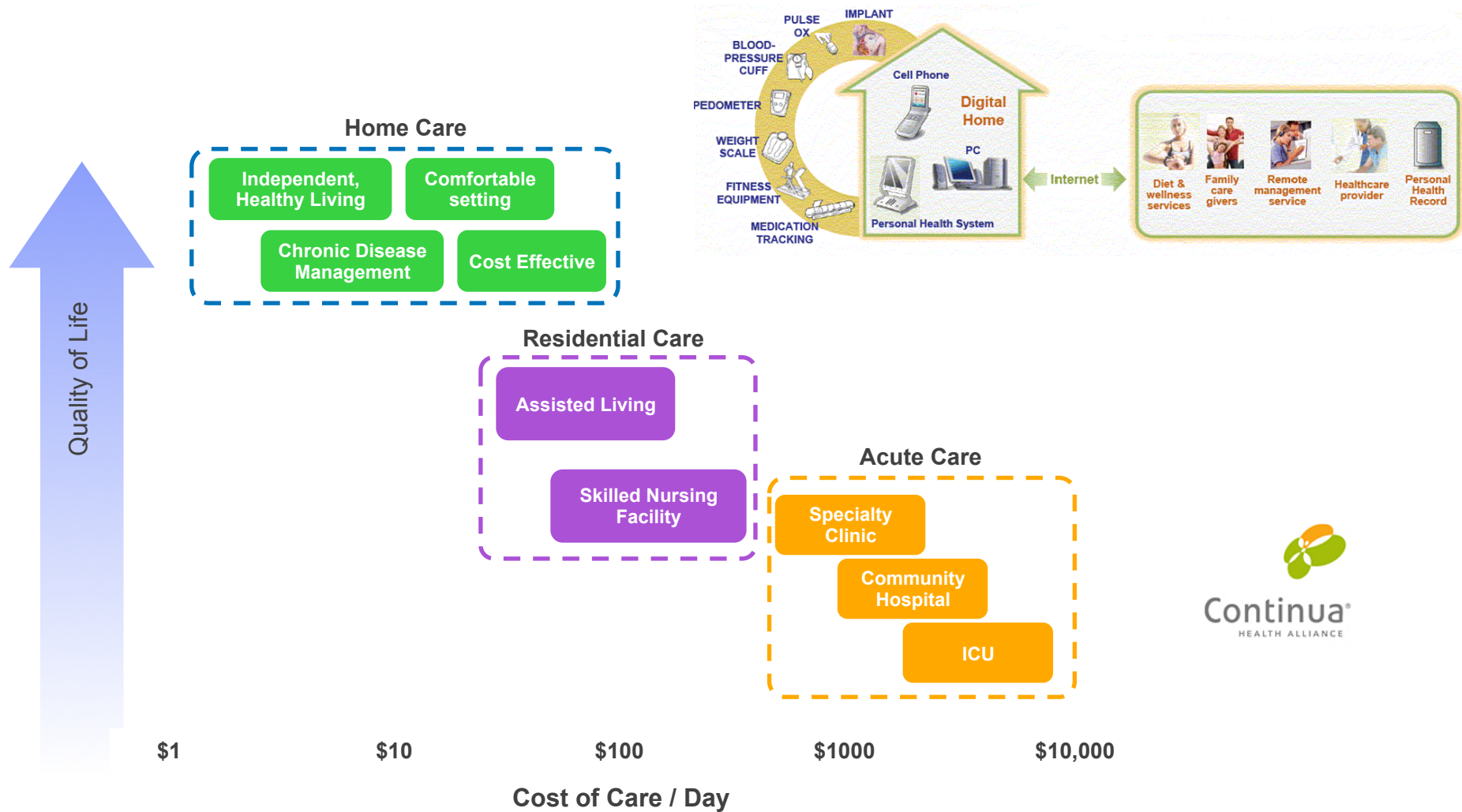**Energy management**

Safety and security

Health and wellness

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Smarter Healthcare - Connected Home Health
Home = Higher Quality of Life & Lower Costs

Home Care
- Independent, Healthy Living
- Comfortable setting
- Chronic Disease Management
- Cost Effective

Residential Care
- Assisted Living
- Skilled Nursing Facility

Acute Care
- Specialty Clinic
- Community Hospital
- ICU

Quality of Life

$1 $10 $100 $1000 $10,000

Cost of Care / Day

Continua® HEALTH ALLIANCE

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Example: Chronic Disease Management

Client Requirement

- **Scalable, resilient and secure infrastructure for chronic disease management**
- **Support of applications with personalized guidelines for various chronic diseases**
- **Continuous remote monitoring and real-time intervention**
- **Health kiosks at communities and homes**

Solution

- **IoT infrastructure with access appliances and application gateways**
- **Integrated service management capability**
- **Evidence based clinical decision support**
- **Reliable and secure backend for storing health records and performing analytics**