Smart Grid – a peek to IBM View

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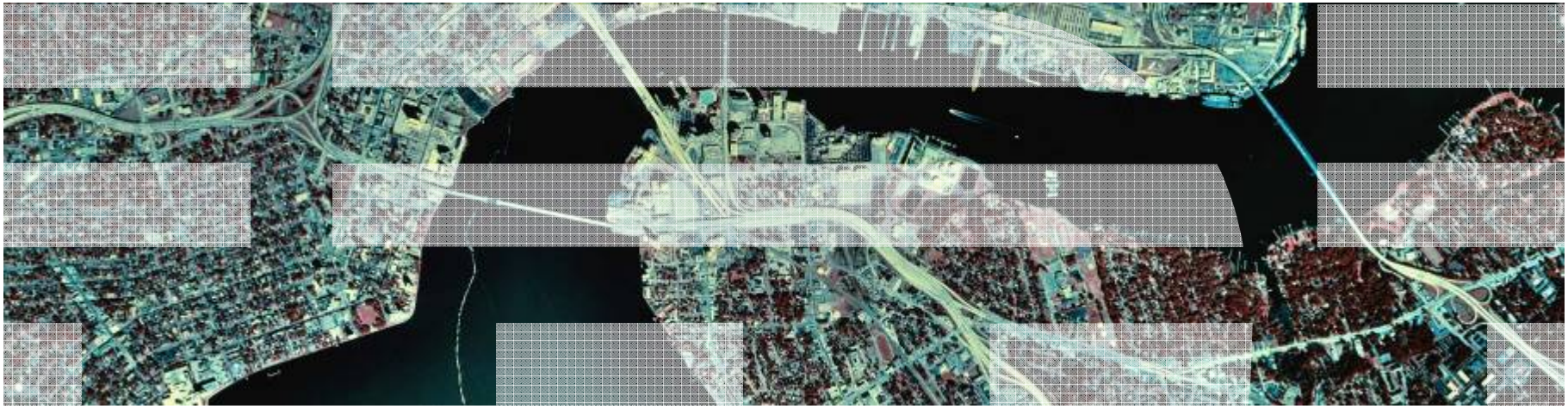
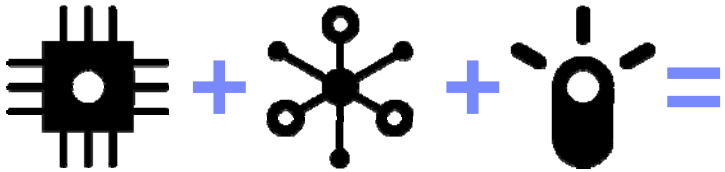
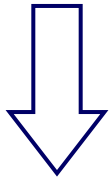
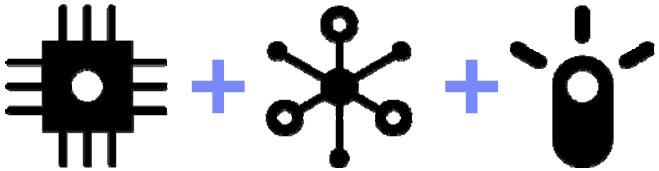


Smarter Plant - Energy

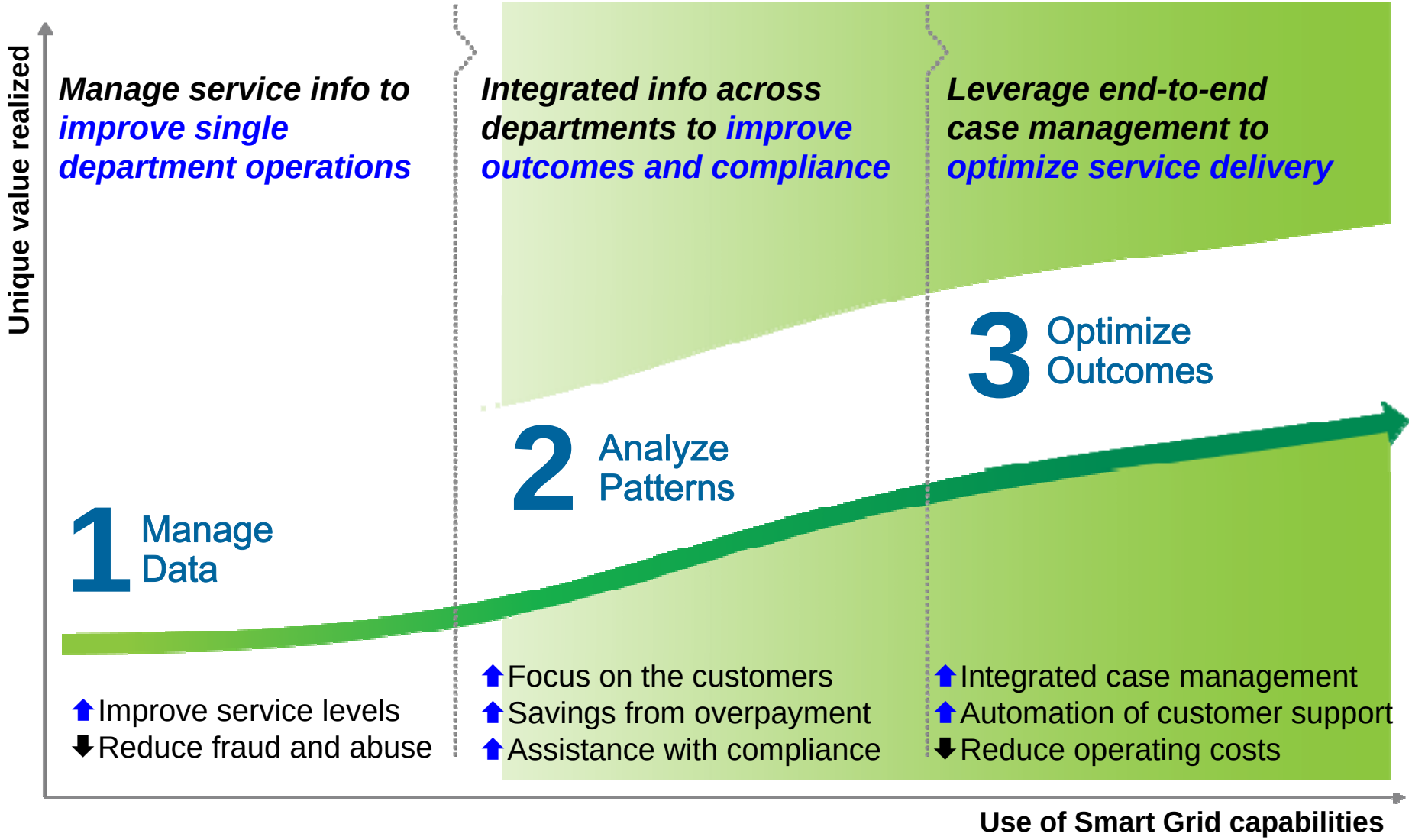
Energy Systems Transformation = An opportunity for energy & utilities organizations to think and act in new ways.

 An opportunity for energy & utilities organizations to think and act in new ways.



Energy Systems Transformation = 

Common solution paths leverage a similar approach

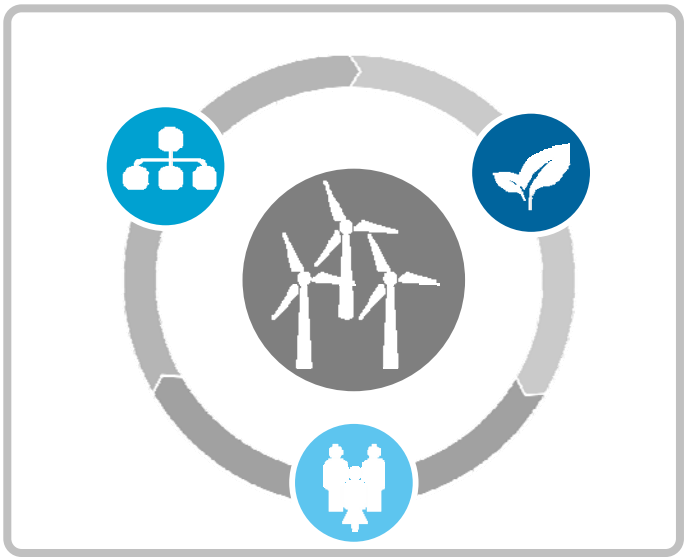


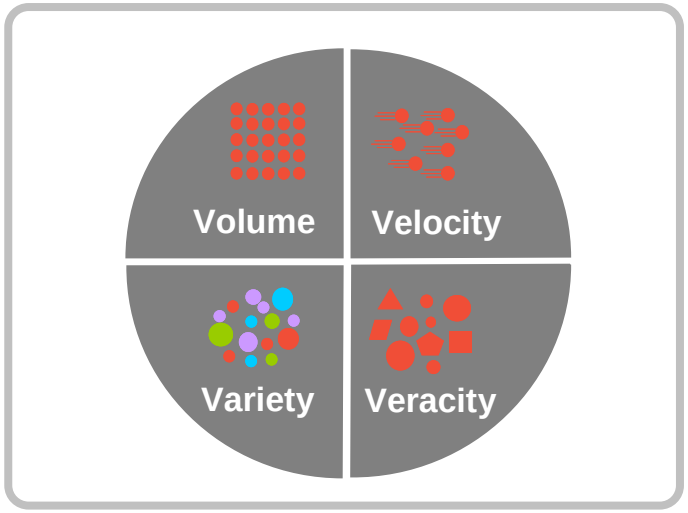
An integrated Framework – a comprehensive management system

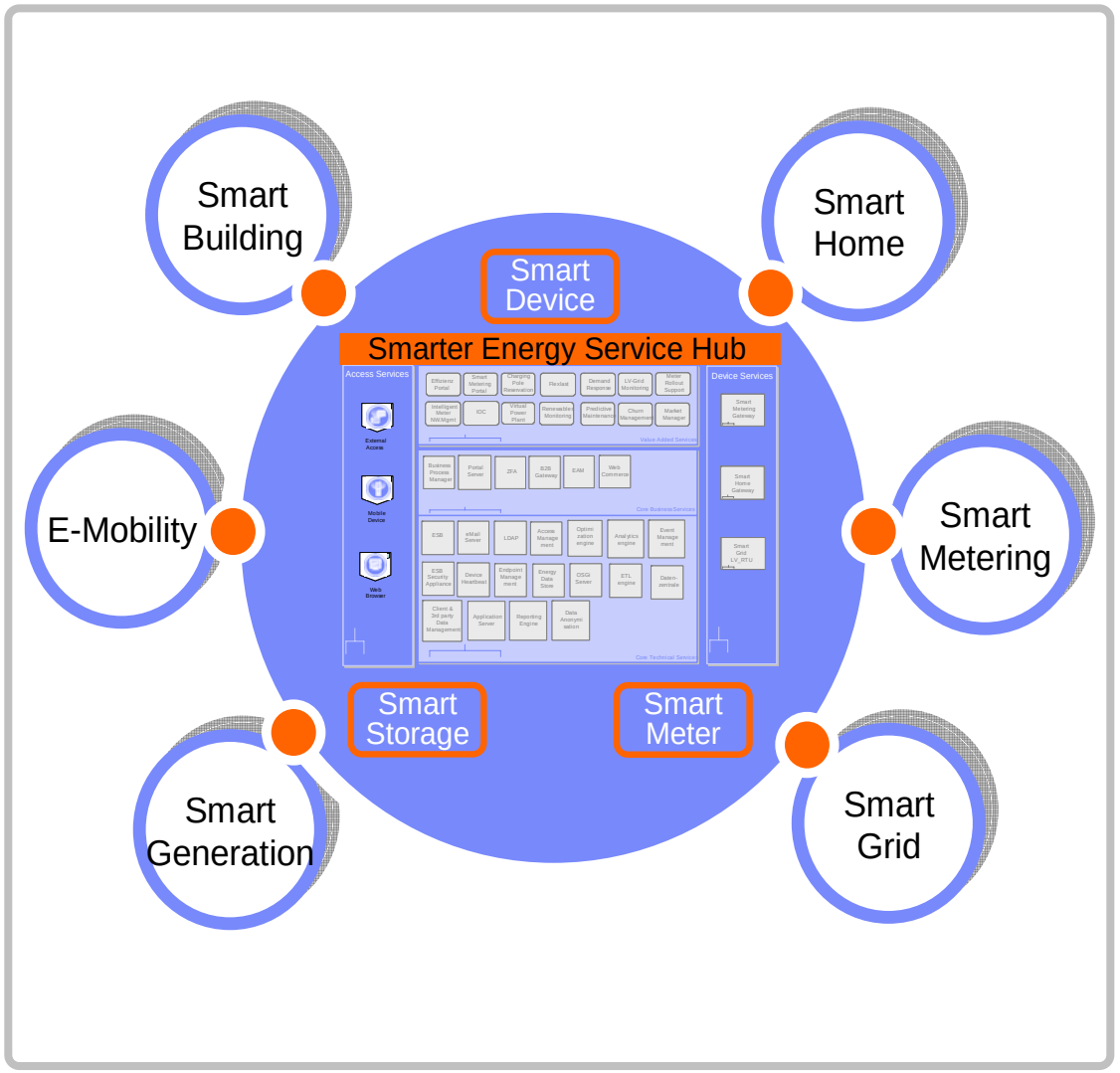
Key functions

- Real-time automated command & control of all the grid services
  - Executive dashboard
  - Emergency response
  - Optimized resource allocation
  - Asset management
  - Energy management
- Integrated Business Intelligence and Predictive trend analysis
- Quick drill down to data
  - role based views
  - security access
- Enables integrated management of all services
  - “Sense” and report facts
  - Monitor & analyze environment
  - Predictive analysis
  - Proactive action

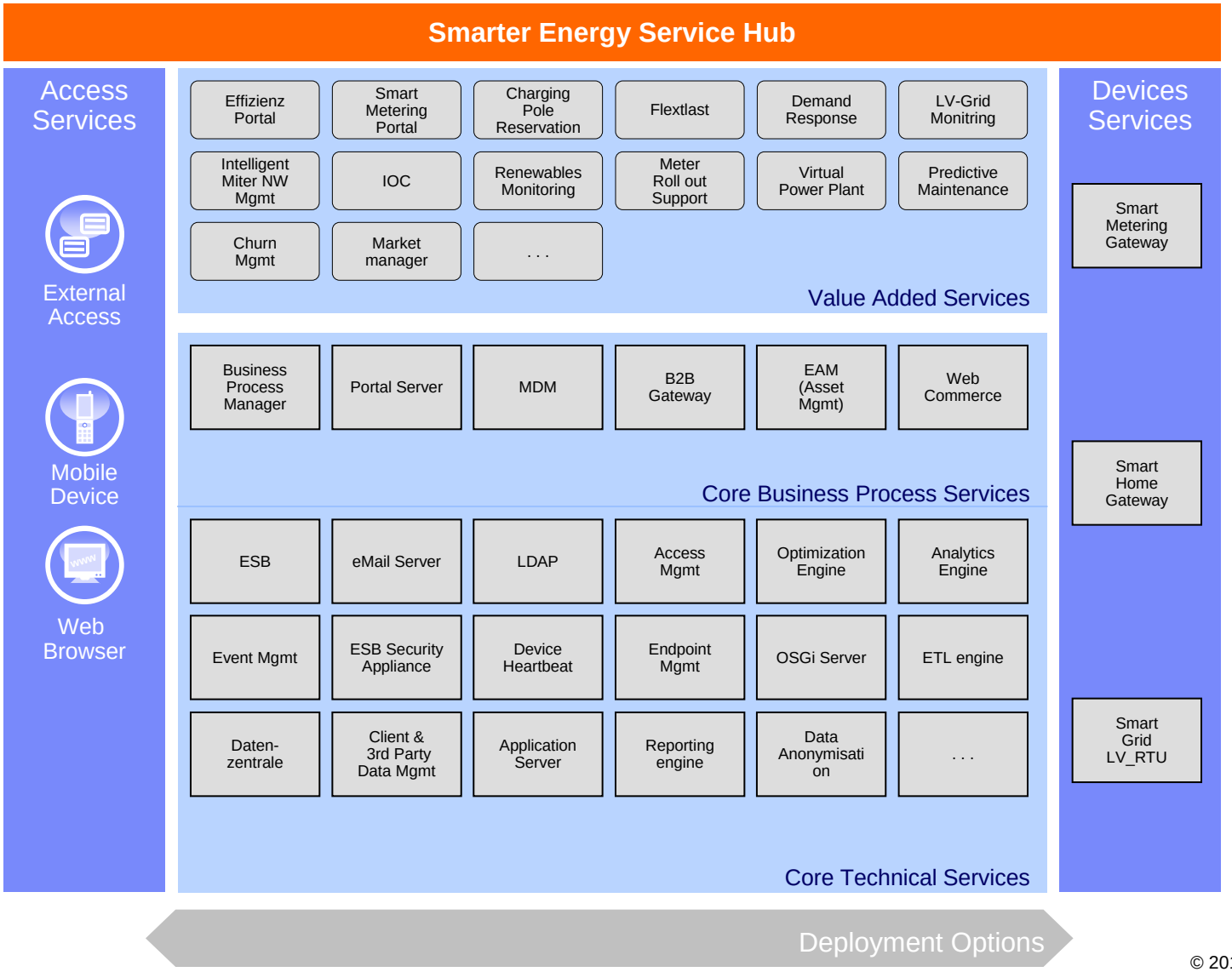
Using Big Data in the Smart Grid



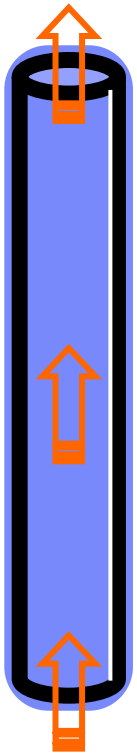




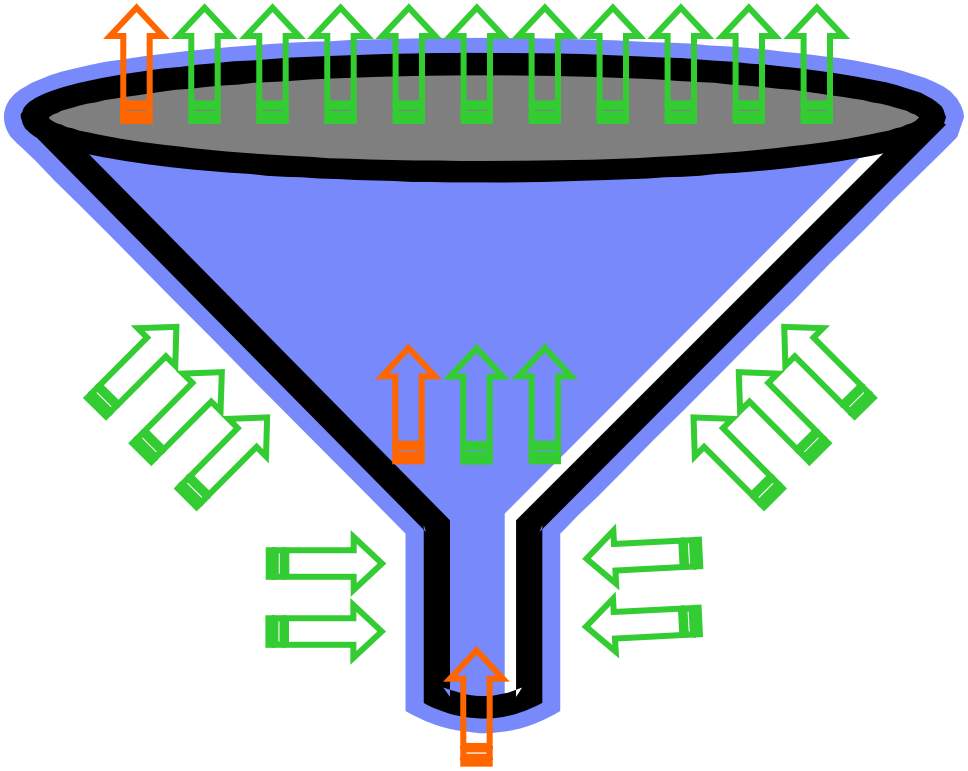
Smarter Energy Services HUB



Reuse of a number of sources (like smart meters) to provide additional business value and solutions.

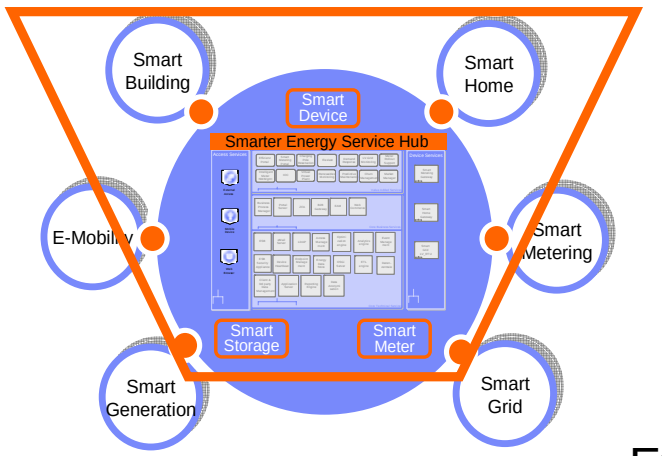


Classical approach
Sample : Meter reading to Cash
Single usage of data and application

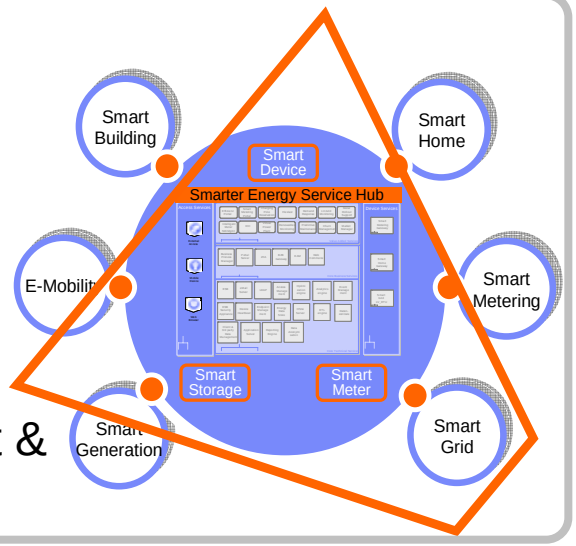


Disruptive or innovative approach
Sample : smarter energy service hub
multiple reuse of same data and core components to generate new business solutions and support agile business development and decision support

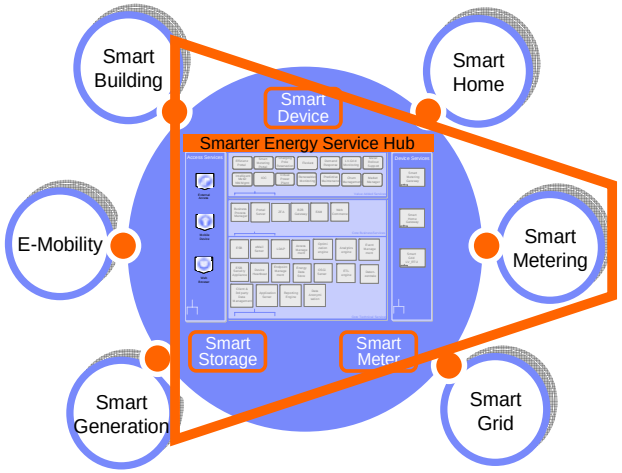
Conceptual model to cover multiple business scenarios



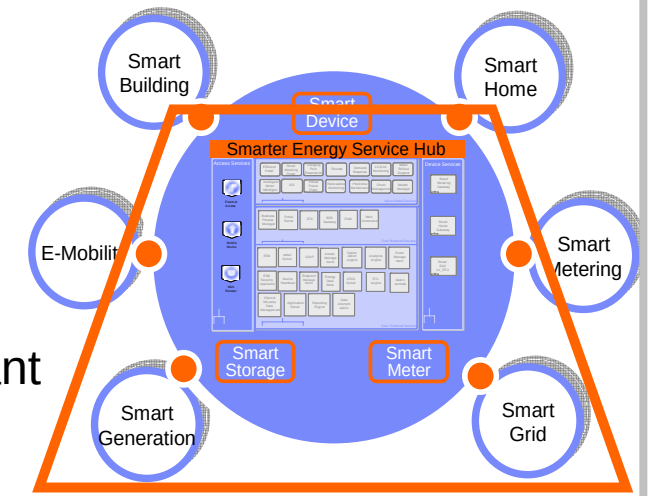
Energy Efficiency



LV-Grid Management & Optimization



Rollout Support

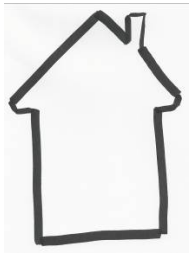


Virtual Powerplant VPP

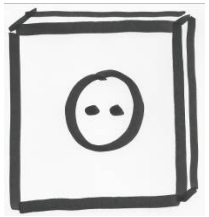
Business Models and Industry Interconnect

Smart Meter

Smart Home

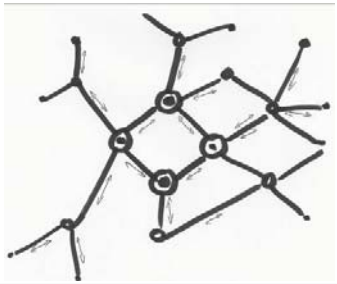


Smart Plug

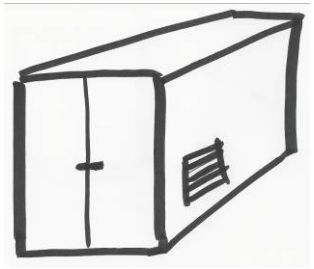


Smart Storage

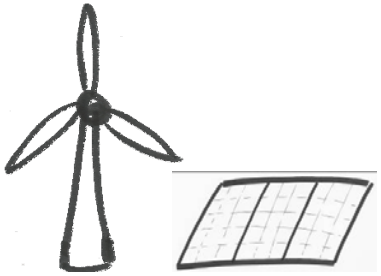
Smart Grid



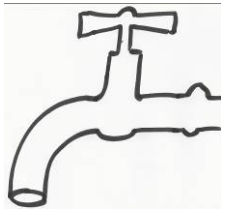
Smart Substation



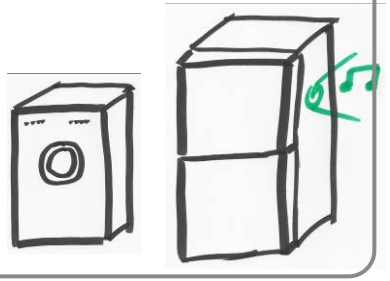
Smart Generation



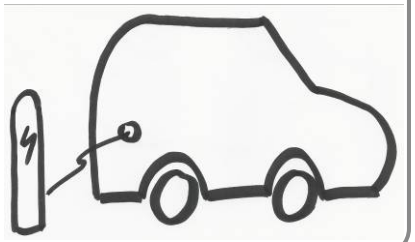
Smart Water



Smart Appliance

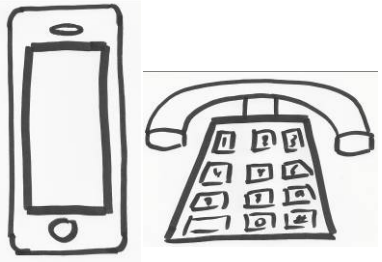


Smart Vehicle

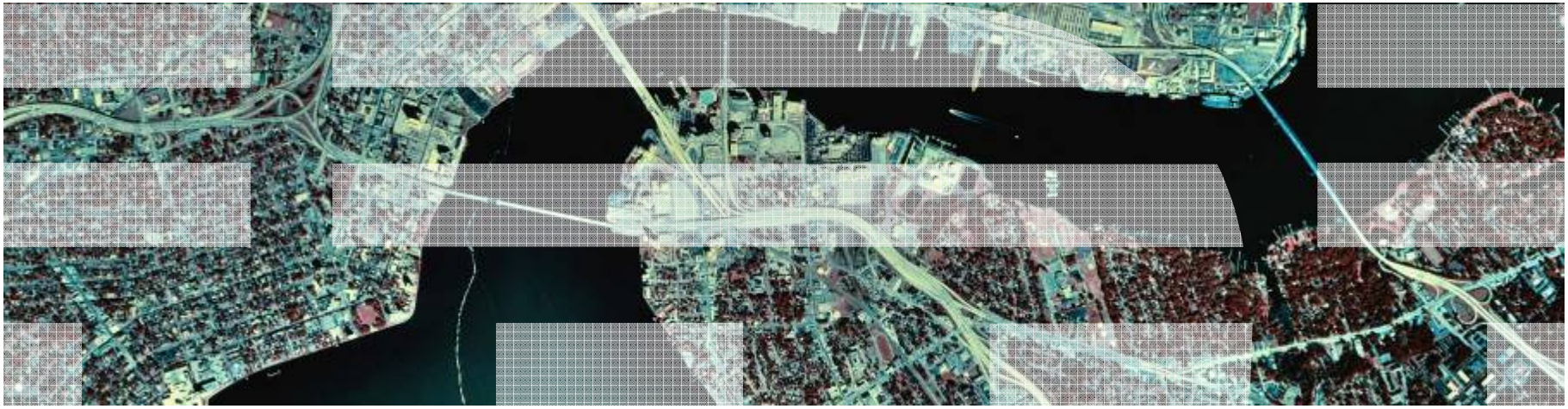


Smart Work

Smart Phone



Activities in IBM Research and Haifa Research Lab



Advancing the Utility of the Future through Big Data & Analytics

SERI Innovation Tracks → Predictive Analytics, Optimization & Adv. Computing for:

Outage Planning Optimization	Asset Management Optimization	Integration of Renewables & DER	Wide-Area Situational Awareness	The Participatory Network

Deep Collaboration

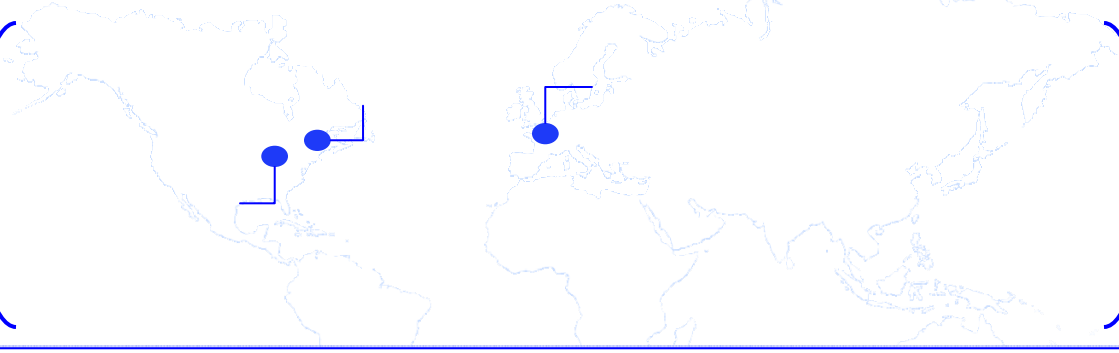
Power Engineering + Mathematicians

Smarter Energy Research Institute

Analytics Platform of the Future

Smarter Energy Lab @ Watson

Founding Members



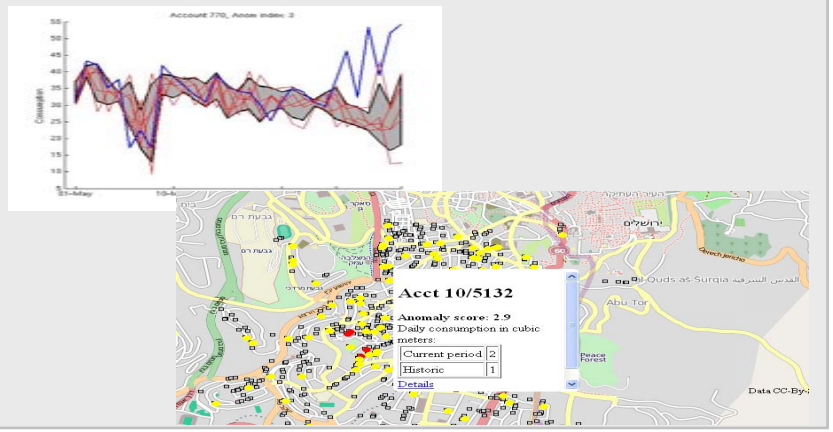
Selecting remaining ~5 global members

Global Membership + Joint Investments + Collaborative Innovation
→ Shared Analytics Assets (algorithms, software, patents)

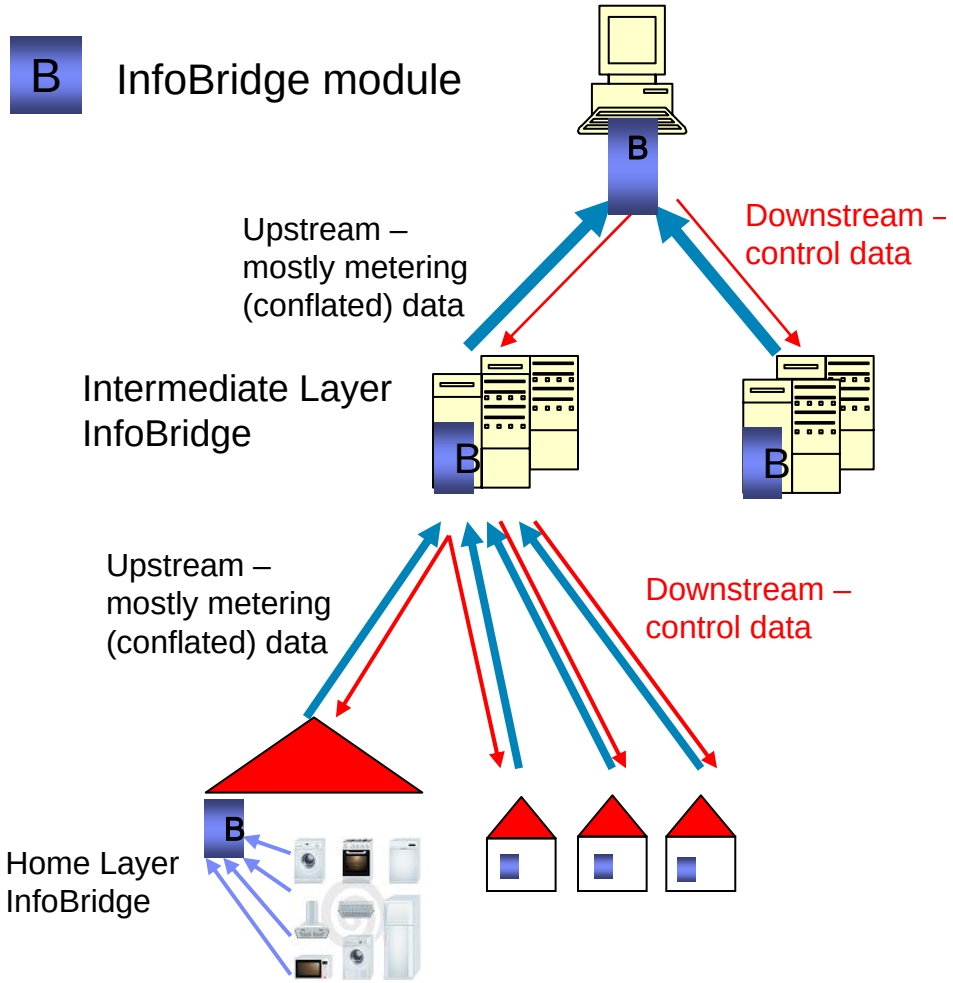
Anomaly Detection for Smart Grid

Solution Definition

Brief Description	▪Very low false-positive rate, scales to many metering points without burdening operational staff. ▪Ability to detect both spikes and dips in consumption. Help detect tampering, theft, meter faults ▪Non-parametric model automatically disregards effects of extreme weather, weekends, holidays and so on.
Business Value	Accurate detection of anomalous consumption. Identification of usage patterns for water and electricity. Understanding of customer usage behavior. Demand prediction and planning.



AMI Networking Topology domestic domain

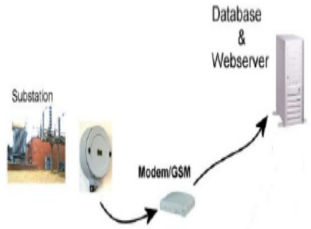


Partial Discharge Forecast

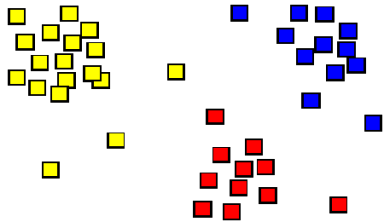
- *Objective*: Partial Discharge Diagnostic.
  - Transform monitoring information of real PD activity into unsupervised machine learning models that aim to predict PD cable criticality.
- *Method:* Unsupervised Cluster Analysis.
  - The clustering problem has been approached under the assumption that same sources generates signals having similar shapes.
- *Data*: Partial Discharge Activity Recorded by UKPN.
  - Digital signals sampled by high frequency CT (HFCT) sensors, which are designed to detect PD on MV cables.
  - The input signals are complex due to multiple sources occurring in practical objects (i.e. substations).
- Feature Extraction
  - Principal Component Analysis (PCA) is shown to be the suitable dimension reduction technique by extracting the majority of the variation in the original data set.

    Implementing PCA is the equivalent of applying Singular Value Decomposition (SVD) on the covariance matrix.

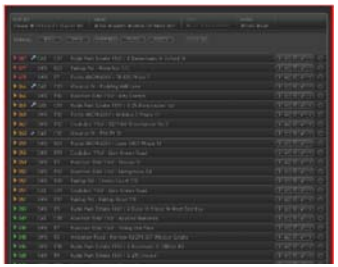
1. Recorded PD Activity



2. Cluster Analysis

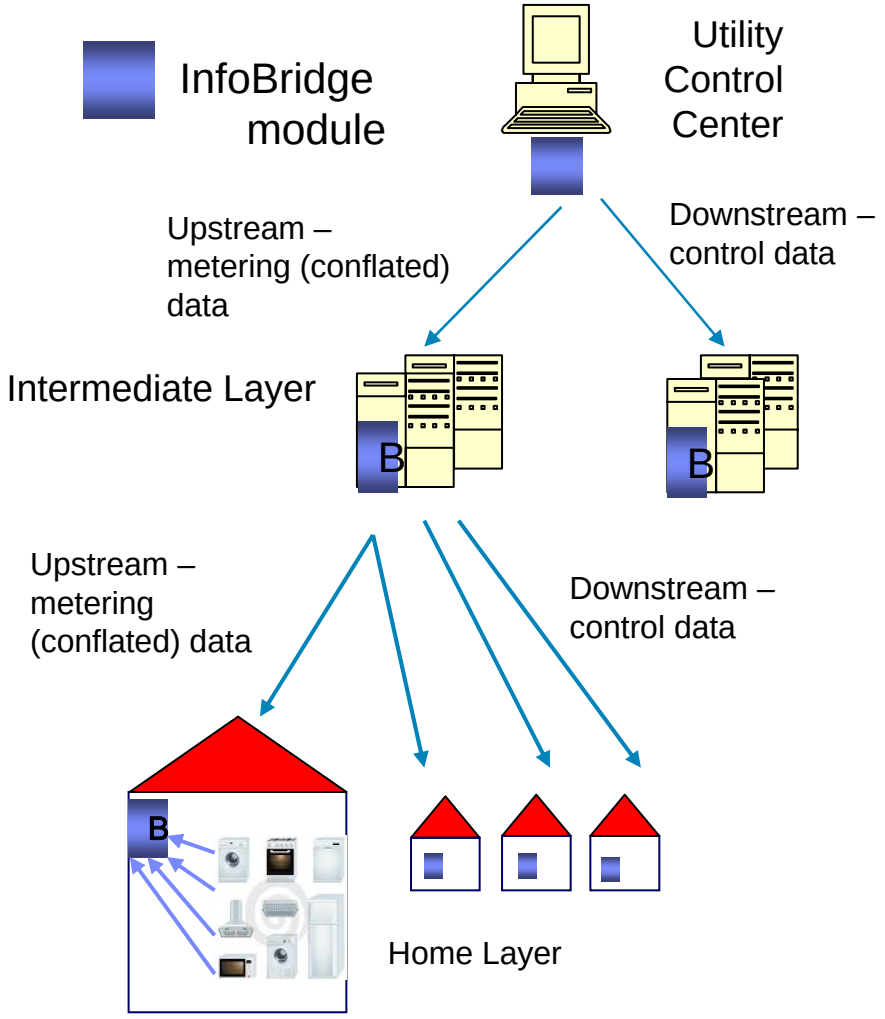


3. Diagnostics



Real time messaging in Smart Grid infrastructure

- InfoBridge: Efficient messaging layer for smart grid data distribution with real-time quality of service
  - **Advanced Metering Infrastructure (AMI):** smart meters in Low Voltage distribution grid (households, businesses, etc)
  - **Distribution Automation (DA):** real-time monitoring of Medium Voltage grid infrastructure (substations, transformers, etc)
- Part in European Union FP7 HiPerDNO Smart Grid project
  - Grid management via real-time HPC with intelligent communication
  - Consortium: EDF France, Brunel U, Oxford U , UK Power Networks, IBM, Fraunhofer, Union Fenosa, Indra, GTD Spain, Korona, Electro Gorenjska



Smart Meters
Indentifying cause of misreading

- Discover the cause of misreading of smart meters
- Color dots represent meters.
  - Size – Problem severity
  - Color: Firmware version (Purple – version 1, Green – version 2)
  - Triangles represent places where outage occurred.
- Finding 1: In area A the meters misreading are due to outage (correlate with the outage, since most of the misreading are inside the triangle)
- Finding 2: In areas B the severest problems (biggest dots) seems to relate to meter with firmware 2 (Green color)