

***Digital
Components
in Smart Cities
projects***

Municipal Digital Strategy

*Shift from non-digital infrastructure
projects to Smart Cities digital projects*

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Key focus areas to be discussed

- *Main technical components*
- *Relative available technologies in the market*

Main technical components



Relative available technologies in the market

- *Key benefits*
- *Main Functionalities*

Key benefits



Main Functionalities

- *Reference Technical/ business Architecture*

Reference Technical/ business Architecture



Digital Components Mapped to the Projects types

Roads Initiatives

- IoT sensor based guard rails or dividers
- Digital Signages
- Digital City Map locator Kiosks (Multi-lingual 2D-3D maps for city whereabouts, stores, shopping etc.) integrated with city map app by GIS.
- Smart Poles (surveillance CCTV Cameras, street light, environmental monitoring sensors, Wi-Fi hotspots, Digital boards).
- Sensors integrated with GIS to report congestion in traffic
- e-CMP (Comprehensive mobility plan)
- Pedestrian generating electricity from footsteps (applicable to crowded places)
- Grade Separated Pedestrian Digital Crossings (especially for disabled)
- SOS for emergency response system

Humanization Initiatives

- Digital Advertisement Boards (Billboards)
- Social Media integration
- Open air gym with sustainable practices for Youths, Children and senior citizens.
- Solar Umbrellas and flowers to produce energy for lights and other utilities of Parks.
- Laser light beams musical green concerts along with Parks aesthetics (at identified larger parks only).
- Digital lighting and sounds for musical fountains & rain dance.
- Digital 3D art designs on wall
- 7D animation based entertainment (at identified larger parks only).
- GIS (Geographic Information System)
- SCADA (Supervisory Control and Data Acquisition)
- Automatic ON/OFF for deep & trickle irrigation (sensor based)
- Integration of city entrances and islands of traffic centres with LED & laser lighting
- Billboards for advertisements integrated with PIS(Public Information System).

Building & Public Utilities

- BIM (Building Information Modeling)
- HVAC (Heating, ventilation, and air conditioning)
- e-Natural Disaster Management platform based responses
- SCADA (Supervisory Control and Data Acquisition)
- Solar based public toilets integrated with sensors for real time monitoring for cleanliness.
- QR coding enhanced by RFID tagging.

Flood Initiatives

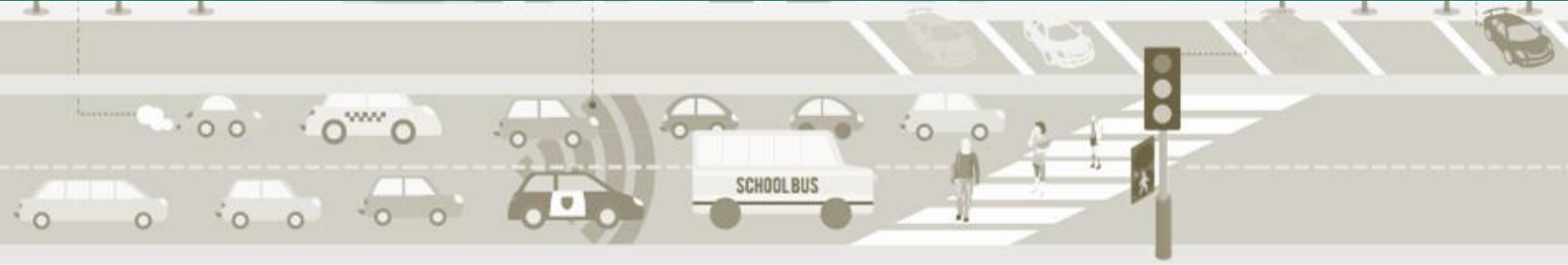
- HIS (Hydrological Information System)
- Drainage Monitoring Sensors for automatic reporting for cleanliness
- SWMM(Storm Water Management Models) Awareness Program
- Barrage & Check dam structure health monitoring
- 3D Mapping of shorelines to avoid and prepare for flood situations.

Waste Management Initiatives

- Real-time container tracking through wireless sensor networks.
- Smart Bins with sensors & RFID tagging.
- Vehicle Tracking system (VTS), GPS enabled to track the collection vehicles for garbage.
- Geo-fencing of area and marking important points & routes, Geocoding and Geo-fencing of Stoppages and parking yard
- Integration of Waste reporting to Unified City Apps

Digital Components Mapped to the Projects types

Roads Initiatives



Roads Initiatives: IoT sensor based guard rails or dividers

Main technical components

- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- Bosch road signature as a crowdsourced localization service with radar service.
- <https://www.bosch-mobility-solutions.com/en/products-and-services/passenger-cars-and-light-commercial-vehicles/automated-driving/bosch-road-signature/>

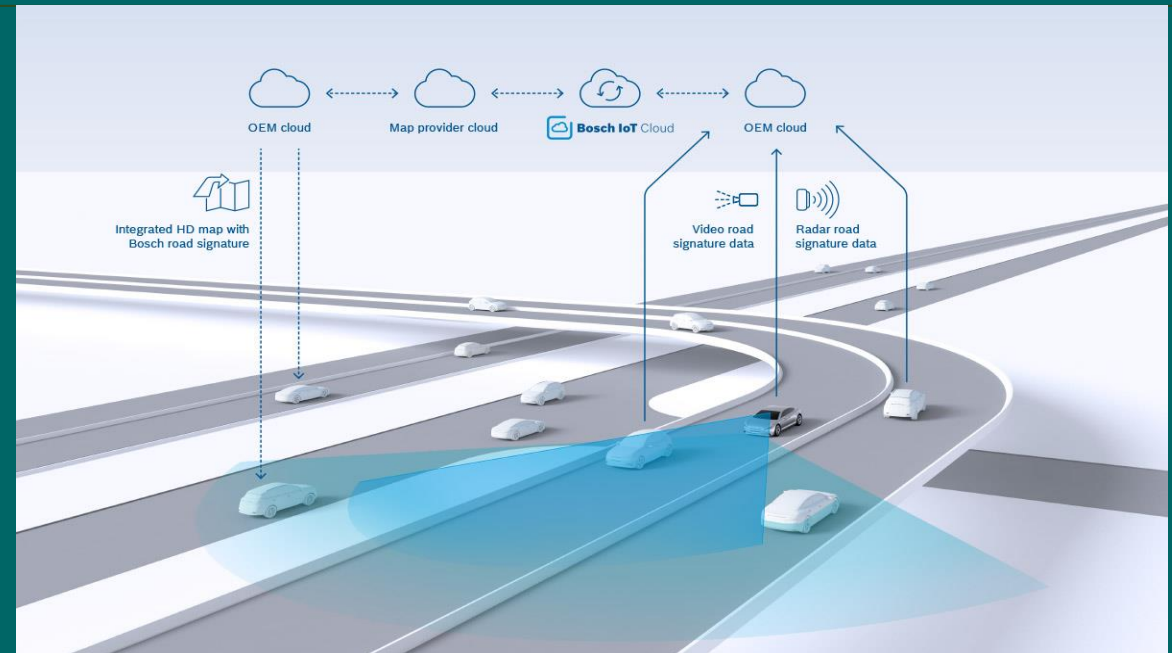
Key benefits

- Building IoT based Safety Management system.
- One of the key technologies for vehicle localization.
- Makes use of radar and video sensors installed in the vehicles.
- Extends the functionality and benefits of radar and camera systems by integrating Bosch road signature software.
- Compatible with all conventional map formats.

Main Functionalities

- An IoT-based system for collision detection on guardrails-Sensor based guard rails are provided along the roads to prevent the bumps or any accidental causes to the moving vehicles.
- One of the applications is in the road safety and highways, in a wide range of scenarios.

Reference Technical/ business Architecture



IoT-based guard rails business architecture

Roads Initiatives: Digital Signages

Main technical components

- Digital Signages.
- IoT Sensors.
- Wireless sensor network (WSN).

Relative available technologies in the market

- Cisco's Graphical user interface, wizards Cisco® IOS® Software command line interface.
- https://www.cisco.com/c/dam/global/dk/assets/docs/Expo_Teknisk_MariusHolmsen.pdf

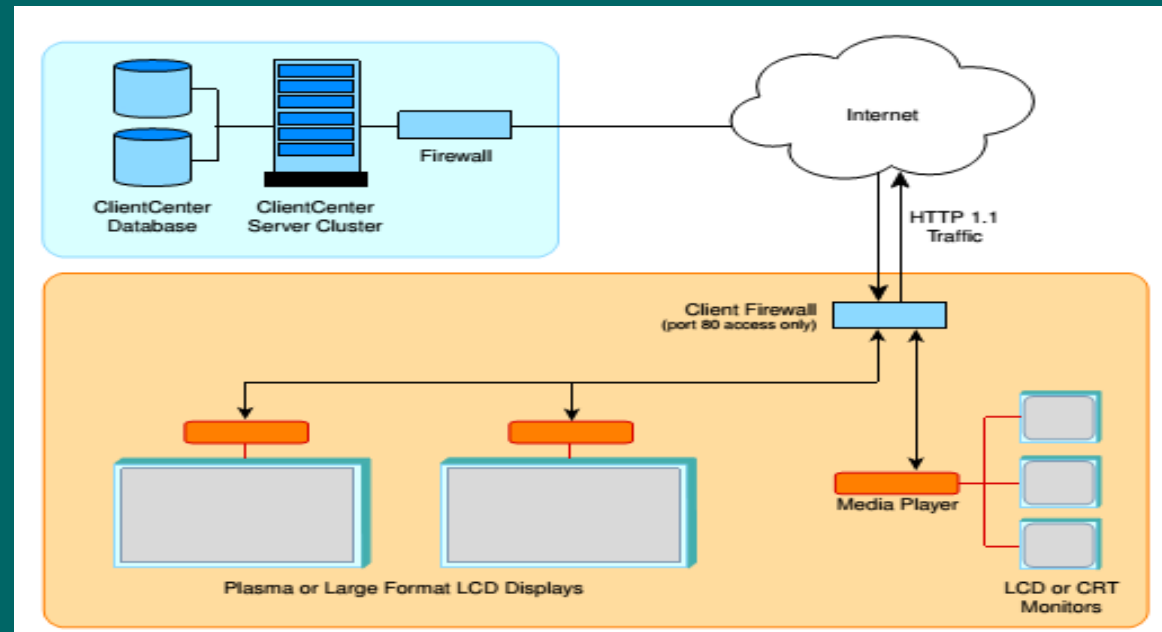
Key benefits

- Comprehensive: system that includes management and publishing and display of content .
- Simple: Ease of use: simple interface, little training, standards-based.
- Flexible: easily update signage content, control content uniquely on-screen, in location or time of day.
- Reliable: robust equipment and network reliability
- Scalable: ability to deploy thousands of signs across a distributed network.
- Content Authoring and Capture—high-quality content development, ability to repurpose existing content.
- Cost: Low cost and affordable TCO: clear up-front costs and low operational costs.

Main Functionalities

- A Comprehensive Solution for management, publishing and playback of digital media on networked digital displays.
- Compelling digital media content delivered to networked digital signage displays for targeted communications.
- Content typically includes video, graphics, animations, streaming web or TV content, and text.

Reference Technical/ business Architecture



Digital Signage technical architecture

Roads Initiatives: Digital City Map Locator Kiosks

Main technical components

- Digital City Map Locator Kiosks integrated solution with charging solutions.

Relative available technologies in the market

- Cisco Vision Dynamic Signage solution & The Cisco® Interactive Experience Platform (IEP).
- https://www.cisco.com/c/dam/m/en_in/innovation/smartcities/assets/smart-cities-ebook_v7.pdf

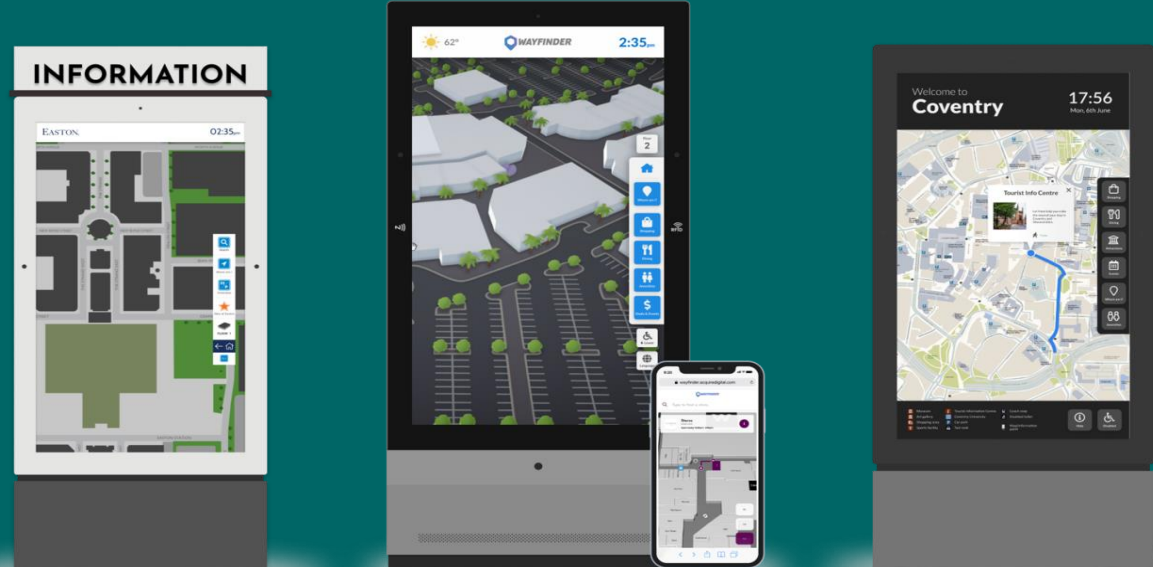
Key benefits

- Navigation system with interactive maps, always ready to be consulted.
- Different research options, with an intuitive user interface
- Animated paths that show how to reach one's destination, both on the same or more than one floor, even including elevator.
- All of the maps and the path are facing user.
- It is time saving for the user and "staff saving" for the company.
- Possibility to make changes and to manage the kiosk remotely wherever an internet connection is available.
- Modular system that gives the chance to expand locations or the floor of the mapping.

Main Functionalities

- Digital City Map Locator Kiosk is a digital and interactive mapping system that gives users information and intuitive paths to reach their destinations.
- Shopping malls, directional centers, hospitals, office and meeting centers, universities, graveyards, airports, public authority buildings, museum and art galleries and multiple location companies. Kiosk Way finder shows visitors an animated path to reach their destination.

Reference Technical/ business Architecture



Digital City Map locator Kiosks Business architecture

Roads Initiatives: Smart Poles

Main technical components

- Smart Poles.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Huawei's Intelligent Smart Poles using use interconnection technologies such as power line communication (PLC), ZigBee, SigFox, and LoRa along with smart Pole Management Platform .
- <https://www.huawei.com/minisite/iot/en/smart-lighting.html>

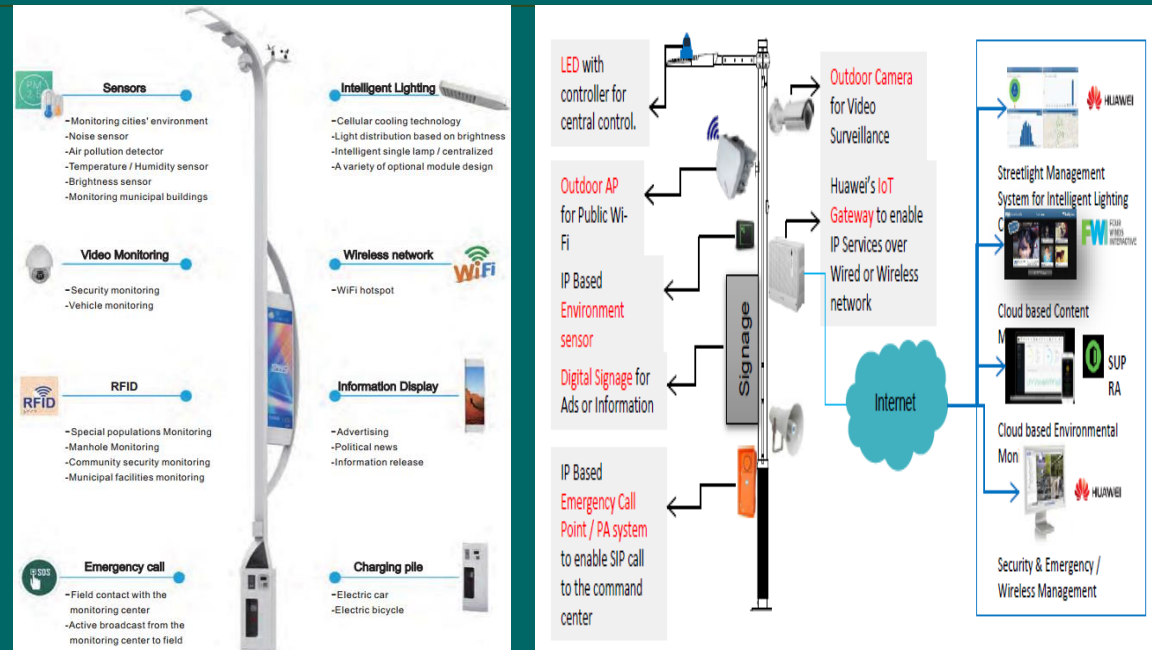
Key benefits

- Huge reduction of energy and maintenance cost
- Increased public safety from improved lighting.
- Safer traffic due to increased visibility of hazards.
- Measurable environmental impact due to reduced energy consumption.

Main Functionalities

- An IoT-based system for collision detection on guardrails-Sensor based guard rails are provided along the roads to prevent the bumps or any accidental causes to the moving vehicles.
- The smart Pole Management Platform consists of several modules for different IoT services enabled by the IoT gateway on the Smart Pole for various users of MUNICIPALITY to manage the services independently. The applications enabled on the platform includes but not limited to the Smart Streetlight Management, Environmental sensing, Public addressing & Emergency Call point integration with the IP telephony system and the Digital Signage Management.

Reference Technical/ business Architecture



Smart Poles business architecture

Roads Initiatives: Sensors integrated with GIS to report congestion in traffic

Main technical components

- Sensors integrated with GIS to report congestion in traffic.

Relative available technologies in the market

- Libellium & Siemen's (In Wimag and SLD4) Vehicle Traffic Monitoring Platform with Bluetooth Sensors over ZigBee.
- <http://www.libellium.com/vehicle-traffic-monitoring-bluetooth-sensors-over-zigbee/>
- <https://www.siemens.com/global/en/home/products/mobility/road-solutions/traffic-management/on-the-road/smart-detection/ground-sensors.html>

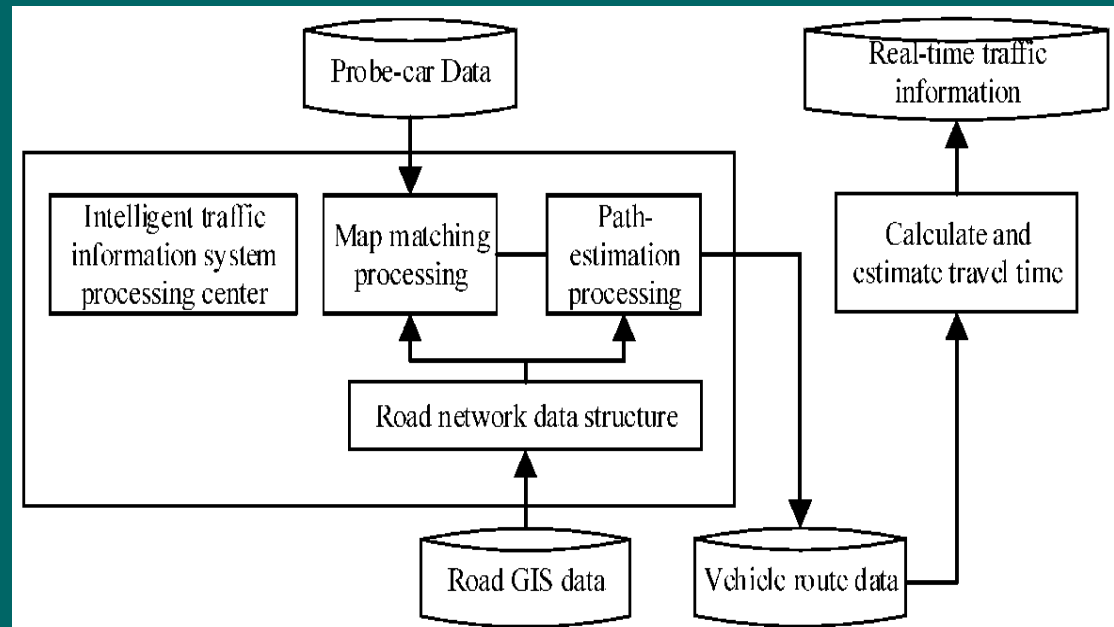
Key benefits

- Configuration Management
- Incident Management
- Disaster Recovery
- Data analysis & reporting
- IT security
- Data integrity checking
- Fault management
- Call centre.
- Reduce carbon emissions.
- Adhere to air quality regulations.
- Discourage air pollution through driving.
- Encourage the Use of public transport.
- Decreasing travel time.

Main Functionalities

- Sensors & other related ICT solutions are deployed for the traffic congestions along the city roads. The data is integrated with GIS for reporting.
- The Vehicle Traffic Monitoring Platform allows system integrators to create real time systems for monitoring vehicular and pedestrian traffic in cities by using the new Bluetooth – ZigBee double radio feature available in the Waspote sensor board.

Reference Technical/ business Architecture



Sensors integrated with GIS to report congestion in traffic technical architecture

Roads Initiatives: e-CMP (Comprehensive mobility plan)

Main technical components

- e-CMP (Comprehensive mobility plan).

Relative available technologies in the market

- Modern, interconnected and IT-based mobility is the core competency of Siemens Mobility.
- <https://www.siemens.com/global/en/home/company/about/businesses/mobility.html>

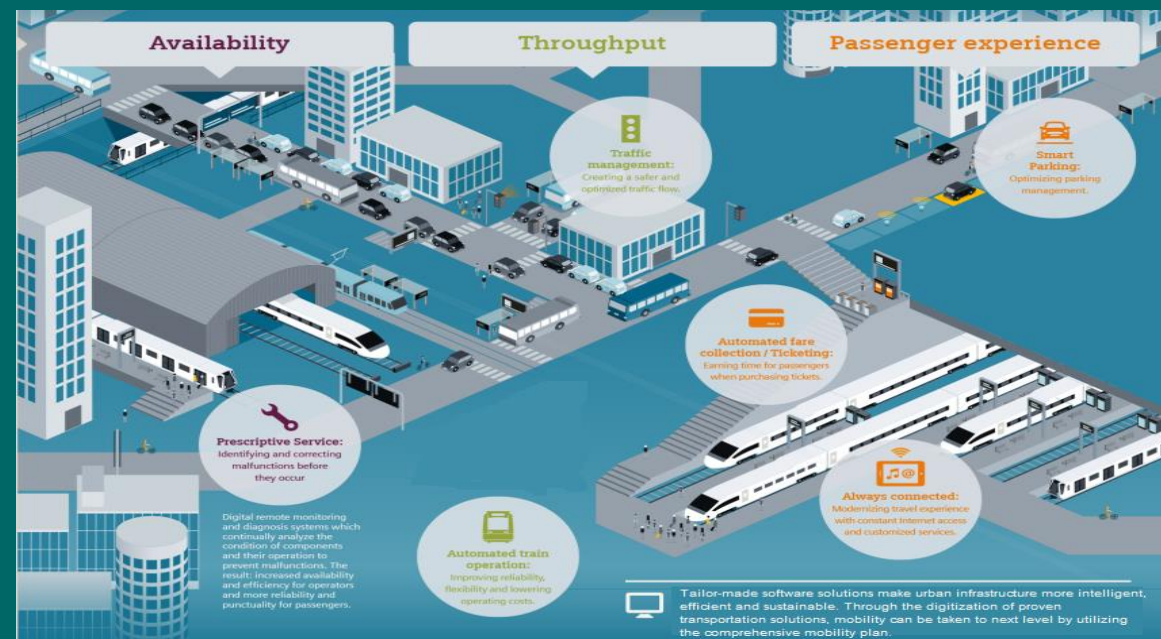
Key benefits

- Signal and control technology for traffic.
- Electrification solutions for road traffic.
- Maintenance and service of vehicles and infrastructure.
- Road traffic control and information systems, parking space management as well as electronic payment and toll systems for urban and interurban traffic.
- Integrated mobility solutions for intermodal networking of different traffic systems.

Main Functionalities

- An IoT-based system Modern, interconnected and IT-based Comprehensive mobility plan integrated with GIS data layers provides the alternative routes for the traffic and other movements of the vehicles.

Reference Technical/ business Architecture



e-CMP (Comprehensive mobility plan) Business architecture

Roads Initiatives: Pedestrian generating electricity from footsteps

Main technical components

- Pedestrian generating electricity from footsteps.

Relative available technologies in the market

- Pavegen's smart-flooring solution.
- <http://www.pavegen.com/what-we-do/>

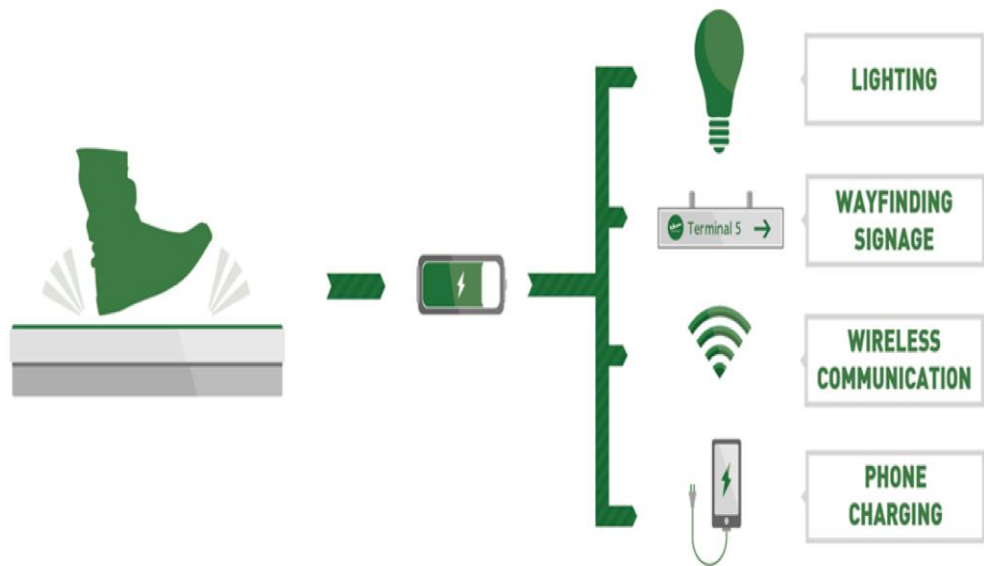
Key benefits

- **NO FOOTSTEP WASTED:** A design is both visually impressive and technologically advanced. The triangular composition maximizes energy output and data capture, by triggering multiple generators per footstep.
- **LIGHT THE WAY:** As a smart on-demand lighting solution that illuminates your path whilst you walk.
- **SEAMLESS INTEGRATION** utilizes commercial vinyl as a top surface for our flooring system. The resilient flooring exceeds international safety standards with high slip resistance for its entire life cycle.

Main Functionalities

- Some of the very crowded pedestrians or walkways around the city is integrated with ICT or digital footsteps based energy generation mechanism.
- The technology has evolved from a singular tile, which generates electricity from footsteps, to an entire array with three multi-functional component parts. These functionalities are called: data, floor and energy.

Reference Technical/ business Architecture



Pedestrian generating electricity from footsteps Business architecture

Roads Initiatives: Grade Separated Pedestrian Digital Crossings (especially for disabled)

Main technical components

- Grade Separated Pedestrian Digital Crossings.

Relative available technologies in the market

- Modern, interconnected and IT-based mobility is the core competency of Siemens Mobility.
- <https://www.itdp.in/wp-content/uploads/2016/07/Urban-street-design-guidelines.pdf>

Key benefits

- This compilation of currently in-place warning devices will enhance the general understanding of how various safety devices are being employed to enhance pedestrian safety at grade crossings especially for disabled.
- Traffic safety and regulations.

Main Functionalities

- For disabled locomotary functions, special grades based categorized pedestrian are accompanied with Digital crossings along the roads.
- The probable pedestrian safety at grade cm of crossings is made more difficult to address by the lack of knowledge about the type of devices in use that are directed at pedestrians at grade crossings.
- At grade crossing should always be preferred as it is most convenient for all pedestrians.

Reference Technical/ business Architecture



Grade Separated Pedestrian Digital Crossings business architecture

Roads Initiatives: SOS for emergency response system

Main technical components

- SOS (Save Our Souls) as emergency response system.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Cisco's Graphical user interface integrated with SOS emergency response system, wizards Cisco® IOS® Software command line interface.
- https://www.cisco.com/c/dam/global/dam_assets/docs/Expo_Teknisk_MariusHolmsen.pdf

Key benefits

- SOS is Comprehensive threat response, Rapid and pervasive reach, Reduces response time, Web-based system.
- Reducing Confusion: Collaboration literally brings everyone to the same page when sharing incident information, updates, strategies. As a result, greater understanding is achieved.
- Dramatic Time Savings: Real-time collaboration compresses the time needed for meetings because major points can be listed and agreed upon quickly, without the back and forth of briefing everyone as they arrive to an incident.
- Awareness to Situation Change: all of your current information – you are alerted as developments unfold so you can address issues promptly.

Main Functionalities

- SOS popularly known as 'Save Our Souls' are integrated with awareness program for emergency response mechanism when there is crisis call from any helpline medium.
- For emergency response to any of the casualties or road accidents the street poles along the pedestrian are integrated with SOS emergency mechanism may be with helpline contact or panic buttons.

Reference Technical/ business Architecture



SOS for emergency business architecture

Digital Components Mapped to the Projects types

Humanization Initiatives



Humanization Initiatives: Digital Advertisement Boards (Billboards)

Main technical components

- Digital Advertisement Boards (Billboards).
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Cisco® Interactive Experience Platform (IEP) for Digital Advertisement boards.
- https://www.cisco.com/c/dam/global/dam/assets/docs/Expo_Teknisk_MariusHolmsen.pdf

Key benefits

- Digital Outdoor Advertising becomes affordable, less waiting, flexible, have time slots, changeable displays, movie magic.
- Simplifies remotely managing and provisioning content distribution to digital displays.
- Quicker and efficient addition of new applications over time because it supports for third-party media players and content management systems.
- Reduces the time and cost to deploy new content and applications.

Main Functionalities

- Digital advertisement boards or billboards play significant role in information dissemination, brand value promotion and also act as PIS (Public Information Display).
- The platform allows to combine applications built on web technologies for customer information, marketing, and branding promotions.

Reference Technical/ business Architecture

DIGITAL BILLBOARDS SOLUTIONS FOR PUBLIC INFORMATION

HARDWARE+ SOFTWARE+CMS= DIGITAL BILLBOARD SOLUTIONS



Digital Advertisement boards business architecture

Humanization Initiatives: Social Media integration

Main technical components

- Social Media integration

Relative available technologies in the market

- Cisco Kinetic for Cities.
- <https://www.cisco.com/c/en/us/products/collateral/se/internet-of-things/datasheet-c78-737127.html>

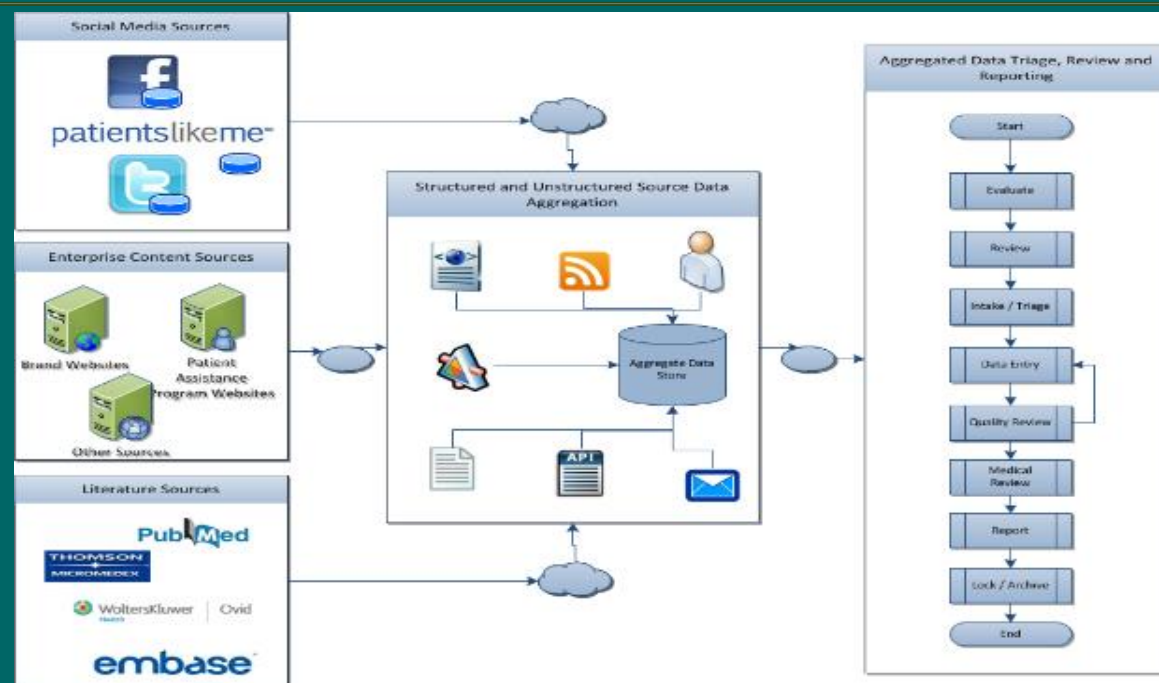
Key benefits

- Social Media integration have Coverage across the world, Very inexpensive, Fast and speedy revert , Advertisement, web traffic, Sales point for the business, Less time consuming, Instant socialization Quick spread of any update, New notion for customer support.
- The exploration of SMC brings particular advantages, under virtually no cost, such as real-time data and content authenticity due to its human generated nature.

Main Functionalities

- Social Media Information along with sentiment analysis acts as powerful tool to spread awareness about any cause or the initiatives.
- Social Media Analytics (SMA) as a type of digital analytics which focus is the study of interactions between, their opinions/thoughts, their own life, companies as so its products or services through the social media data. Such study provides important information to "analysts, brands, agencies or vendors" facilitating the generation of economic value to municipality/government.

Reference Technical/ business Architecture



Social Media Integration Technical architecture

Humanization Initiatives: Open air gym with sustainable practices for Youths, Children and senior citizens

Main technical components

- Open air gym with sustainable practices for Youths, Children and senior citizens.
- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- Cisco CMX Dashboard, Kinetic for Cities, Flow Monitoring with Cisco Access Points (APs).
- https://www.cisco.com/c/dam/global/dam/assets/docs/Expo_Teknisk_MariusHolmsen.pdf

Key benefits

- Healthcare initiative for public fitness.
- Increasing the social-well beingness by using sustainable practices of ICT & Digital components for gym equipment.
- Attract New Users to Outdoor Environments.
- IoT based Safety Management system.

Main Functionalities

- Integration of existing infrastructure with sustainable practices of ICT & Digital components can only make citizen or park goers & environment a fit.
- Make Exercise Fun by the addition of nature and fresh air helps make exercising fun and therefore more effective.

Reference Technical/ business Architecture



Open air gym business architecture

Humanization Initiatives: Solar Umbrellas and flowers to produce energy for lights and other utilities of Parks

Main technical components

- *Solar Umbrellas and flowers to produce energy for lights and other utilities of Parks.*

Relative available technologies in the market

- *Huawei Power Cube 500 for Smart Power (Solar) Solution.*
- *<https://e.huawei.com/ae/products/telecom-energy/hybrid-power/powercube-500>*

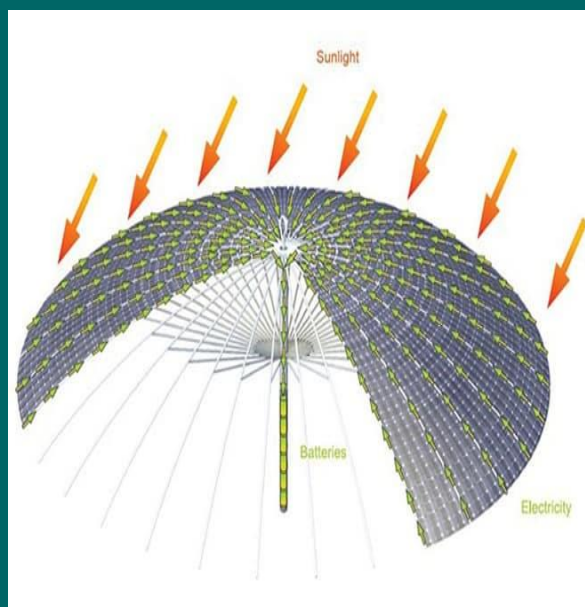
Key benefits

- *Save the Environment*
- *Energy efficient.*
- *Lower utility bills.*
- *Time-of-Use rates (TOU)*
- *If it's available - Net Metering*
- *Solar reduces dangerous greenhouse gases from cars*

Main Functionalities

- *Utilizing ICT based solar panels integration for ON-OFF GRID management of renewable energy can be a great initiative for parks atmosphere.*

Reference Technical/ business Architecture



Solar Umbrellas and flowers business architecture

Humanization Initiatives: Laser light beams musical green concerts along with Parks aesthetics

Main technical components

- Laser light beams.

Relative available technologies in the market

- LaserNet is one of the world's leading laser companies: ILDA Accredited Professional Laser show Companies.
- <https://lasernet.com/>

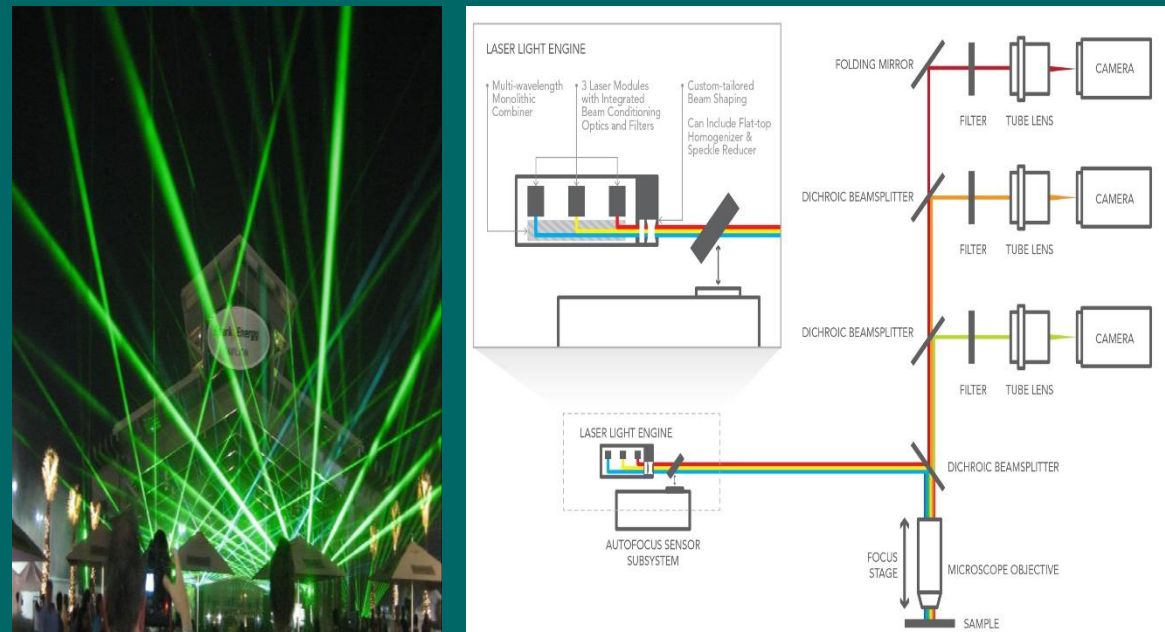
Key benefits

- Aesthetics management
- Entertainment.
- Social well-beingness.
- Park regeneration.

Main Functionalities

- In some of the parks, laser lights can be encouraged to organize green concerts with Parks aesthetics as well as awareness programs becoming the prime source of attraction aiming to make Saudi Cities lively in quality of life standards.

Reference Technical/ business Architecture



Laser light beams musical business & technical architecture

Humanization Initiatives: Digital lighting and sounds for musical fountains & rain dance

Main technical components

- Digital lighting and sounds
- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- LED lighting of Philips
- <http://www.lighting.philips.com/main/systems/system-areas/parks-plazas>

Key benefits

- Aesthetics development.
- Social well-beingness.
- Urban landscape regeneration.

Main Functionalities

- For aesthetics and livability of parks environment, digital features like lighting, sounds for musical fountains and rain dance themes can be encouraged.

Reference Technical/ business Architecture



Digital lighting and sounds for musical fountains & rain dance business architecture

Humanization Initiatives: Digital 3D art designs on wall

Main technical components

- Digital 3D art designs LED lighting.
- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- Digital 3D art design by Huawei, Philips, Planar etc.
- <http://www.planar.com/products/>
- <https://consumer.huawei.com/en/press/news/2018/huawei-preserves-cultural-heritage-by-bringing-art-to-a-wider-audience/>

Key benefits

- Aesthetics management.
- Entertainment.
- Social well-beingness.
- Park regeneration.
- Livability.

Main Functionalities

- For aesthetics improvement of green infrastructure, digital 3D art designs on walls should be inscribed or displayed to make it holistic visit in park.

Reference Technical/ business Architecture



Digital 3D art designs on wall architecture

Humanization Initiatives: 7D animation based entertainment (at identified larger parks only)

Main technical components

- 7D animation based entertainment
- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- One step VR theme park by Alibaba.
- <https://gzlongze.en.alibaba.com/>
- <https://www.alibaba.com/showroom/7d-cinema-for-sale.html>

Key benefits

- Aesthetics management
- Entertainment.
- Social well-beingness.
- Park regeneration.
- Livability.

Main Functionalities

- For entertainments purpose, at the larger identified parks, 7D based animations can be prime source of attraction aiming to make Saudi Cities lively in quality of life standards.

Reference Technical/ business Architecture



7D animation based entertainment business architecture

Humanization Initiatives: GIS (Geographic Information System)

Main technical components

- GIS (Geographic Information System)
- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- GIS for Agriculture by ESRI.
- <https://www.esri.com/library/bestpractices/gis-for-agriculture.pdf>

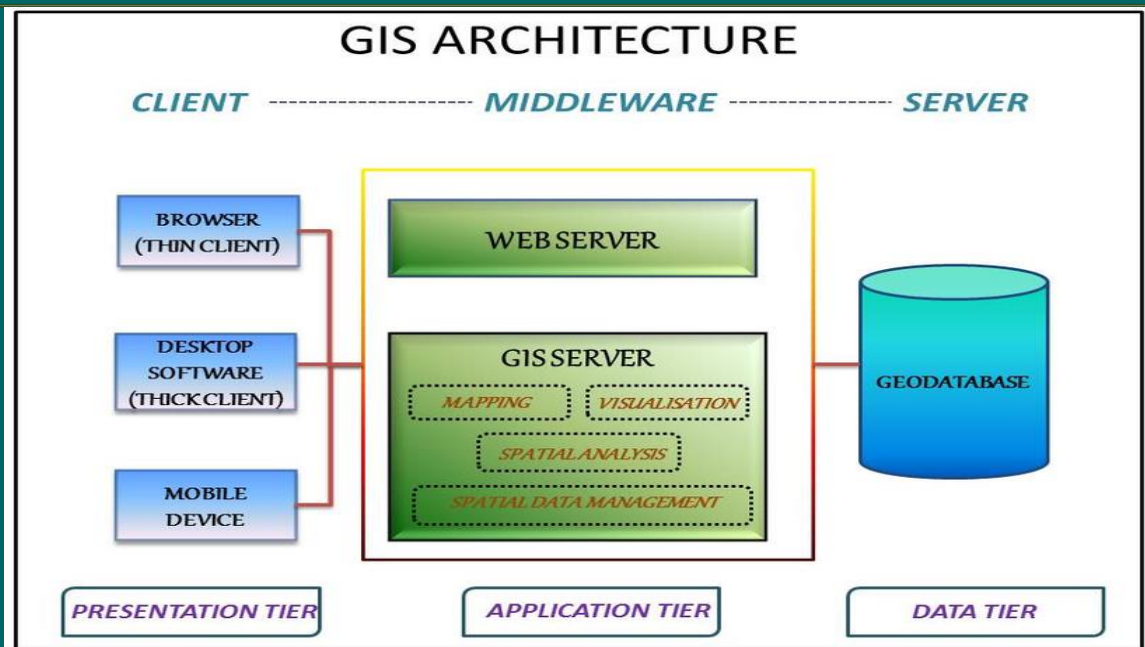
Key benefits

- Early identification of crop health and stress.
- Ability to use this information to do remediation work on the problem.
- Improve crop yield.
- Crop yield predictions.
- Reduce costs.
- Reduce environmental impact.
- Crop management to maximize returns through the season.
- Crop management to maximize returns during harvest time.

Main Functionalities

- GIS data layers about rain-fed areas, rain-shadow areas, water proficient or water scarce areas will accordingly help to inculcate the better practices of irrigation.
- While natural inputs in farming cannot be controlled, they can be better understood and managed with GIS applications such as crop yield estimates, soil amendment analyses, and erosion identification and remediation.

Reference Technical/ business Architecture



GIS technical architecture

Humanization Initiatives: SCADA (Supervisory control and data acquisition)

Main technical components

- SCADA (Supervisory control and data acquisition).

Relative available technologies in the market

- Schneider-electric SCADA solutions.
- http://www2.schneider-electric.com/documents/solutions/sustainable_solutions/Smart_Cities_Success_Stories.pdf

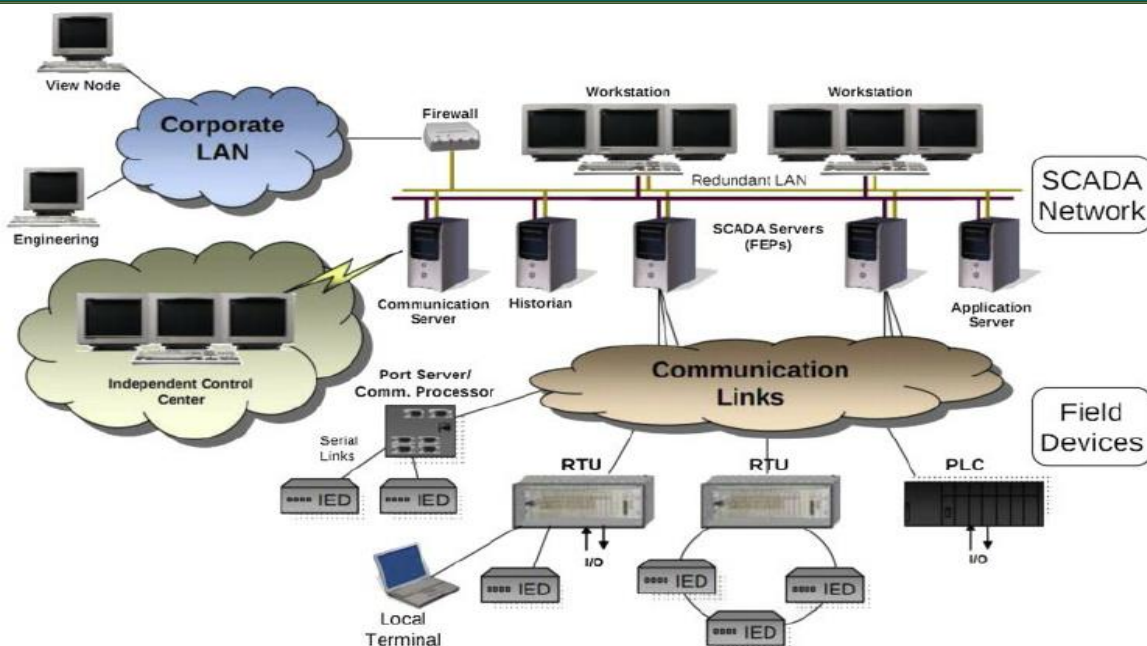
Key benefits

- Optimize the time spent.
- Delegate work efficiently.
- Maximize ROI.
- Smooth operation & monitoring.
- Remote Control.
- Data collection, storage and retrieval.

Main Functionalities

- Supervisory Control And Data Acquisition (SCADA) is a control system architecture that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management, the real-time control logic or controller calculations are performed by networked modules which connect to the field sensors and actuators, this digital component can help in controlled water supply & utilization in quantitative as well as qualitative improved approach.

Reference Technical/ business Architecture



SCADA technical architecture

Humanization Initiatives: Automatic ON/OFF for drip & trickle irrigation (sensor based)

Main technical components

- Automatic ON/OFF for drip & trickle irrigation
- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- Bosch & Jasper smart solution for farming.
- <https://www.jasper.com/customers/agriculture>
- <https://www.bosch-si.com/iot-platform/iot-projects/agriculture/iot-food-production.html>

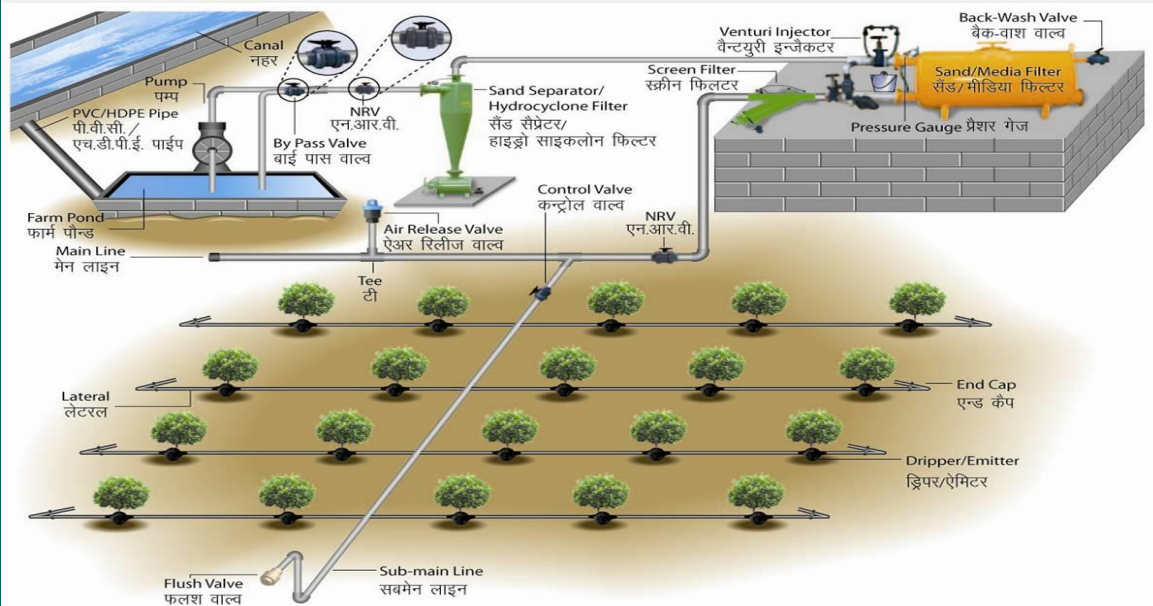
Key benefits

- Saves cost by effectively using inputs
- Better monitoring of crops and avoiding crop losses through disease or adverse weather
- Help in optimizing water use
- Better planning of farm activities
- Early identification of crop health and stress
- Ability to use this information to do remediation work on the problem
- Improve crop yield
- Crop yield predictions
- Reduce environmental impact
- Crop management to maximize returns through the season
- Crop management to maximize returns during harvest time.

Main Functionalities

- Integration of normal drip and trickle method of irrigation with automatic sensor based ON/OFF can save water and make irrigation process more efficient.

Reference Technical/ business Architecture



Layout of Drip Irrigation System (ड्रिप सिंचाई पद्धति का रेखाचित्र)

Automatic ON/OFF for drip & trickle irrigation technical architecture

Humanization Initiatives: Integration of city entrances and islands of traffic centres with LED & laser lighting

Main technical components

- Integration of city entrances and islands of traffic centres with LED & laser lighting.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Philips Color Kinetics_
- <http://www.colorkinetics.com/Learn/docs/PCK-Controlling-LED-Lighting.pdf>

Key benefits

- Aesthetics.
- Safety & Security
- Urban landscape.
- Energy Efficiency - LED Lighting Features A Much Better Energy Efficiency.
- Ecologically Friendly - LED Lighting Is Much More Eco-Friendly.

Main Functionalities

- To make city entrances lively in aesthetics and promoting the brand value of the city, at the entrances of each city or islands of the traffic centre with sculptures can be reinforced with beautiful LED/Laser lightings.

Reference Technical/ business Architecture



Integration of city entrances and islands of traffic centres with LED & laser lighting business architecture

Humanization Initiatives: Billboards for advertisements integrated with PIS (Public Information System)

Main technical components

- Billboards for advertisements integrated with PIS (Public Information System)
- IoT sensors.
- Wireless Sensor Networks (WSNs)

Relative available technologies in the market

- Intelligent Billboard by Intel-Dentsu-Cloudian.
- <https://cloudian.com/resource/case-studies/cloudian-intel-dentsu-targeted-advertising/>

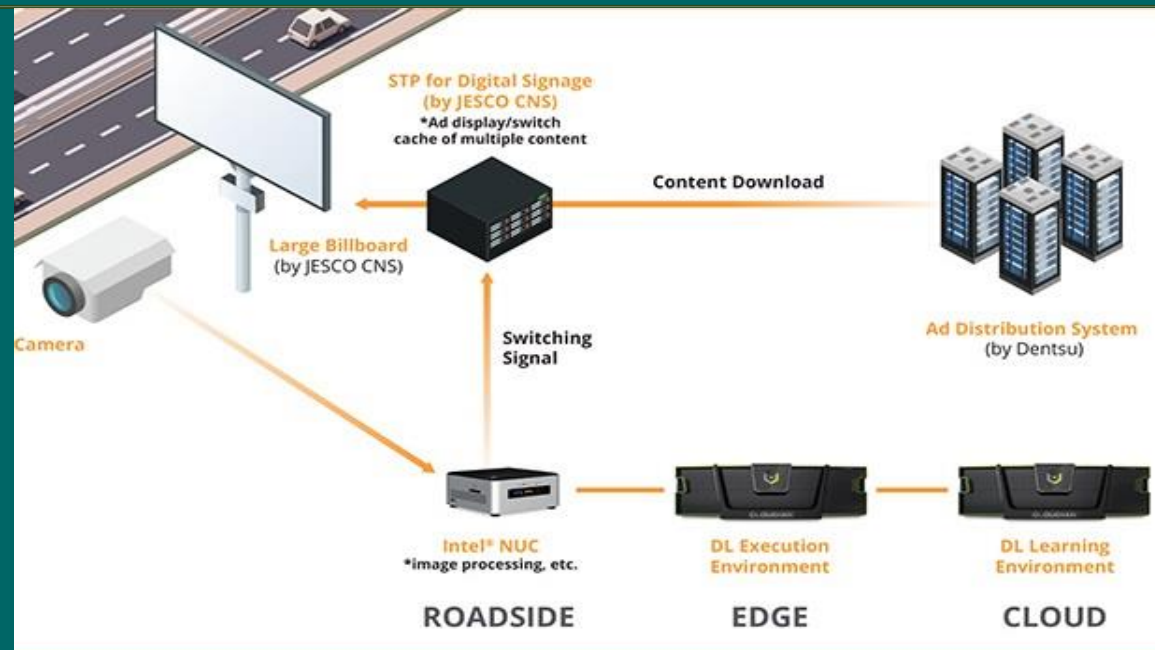
Key benefits

- Real time benefits for advertising.
- Real-time measurements of traffic flow using AI-based counting; no need of manual counting.
- Roadway load monitoring by measuring large vehicles and regular cars on inbound and outbound lanes.
- Searching and tracking of license plates, such as for Amber Alerts.
- Safety monitoring to trigger roadway and parking lot warnings, such as water covered roads, falling objects, broken-down cars, illegal parking, etc.

Main Functionalities

- Cities should be designed with multiple digital billboards for advertisement purposes integrated with Public Information Display.

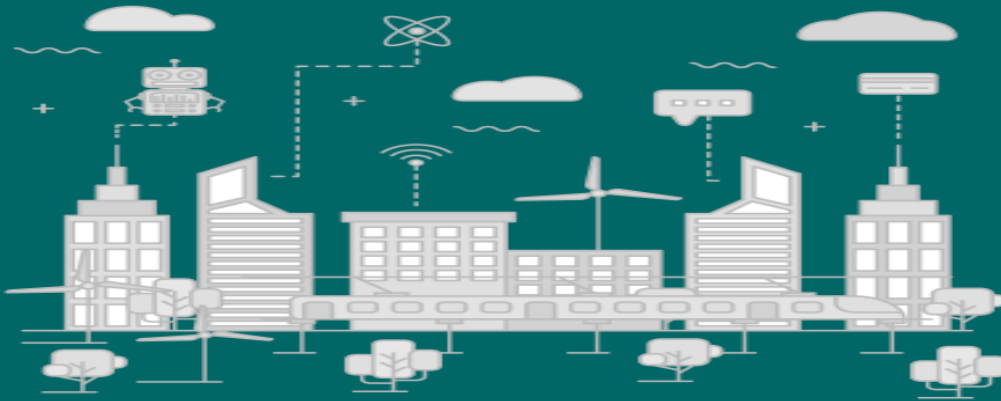
Reference Technical/ business Architecture



Billboards for advertisements integrated with PIS business architecture

Digital Components Mapped to the Projects types

Building & Public Utilities



Building & Public Utilities: BIM (BIM Building Information Modeling)

Main technical components

- Integration with BIM (Building Information Modeling).
- 3D Modeling.
- Augmented Reality (AR).

Relative available technologies in the market

- Autodesk BIM Solution.
- <https://www.autodesk.co.nz/solutions/smart-city>

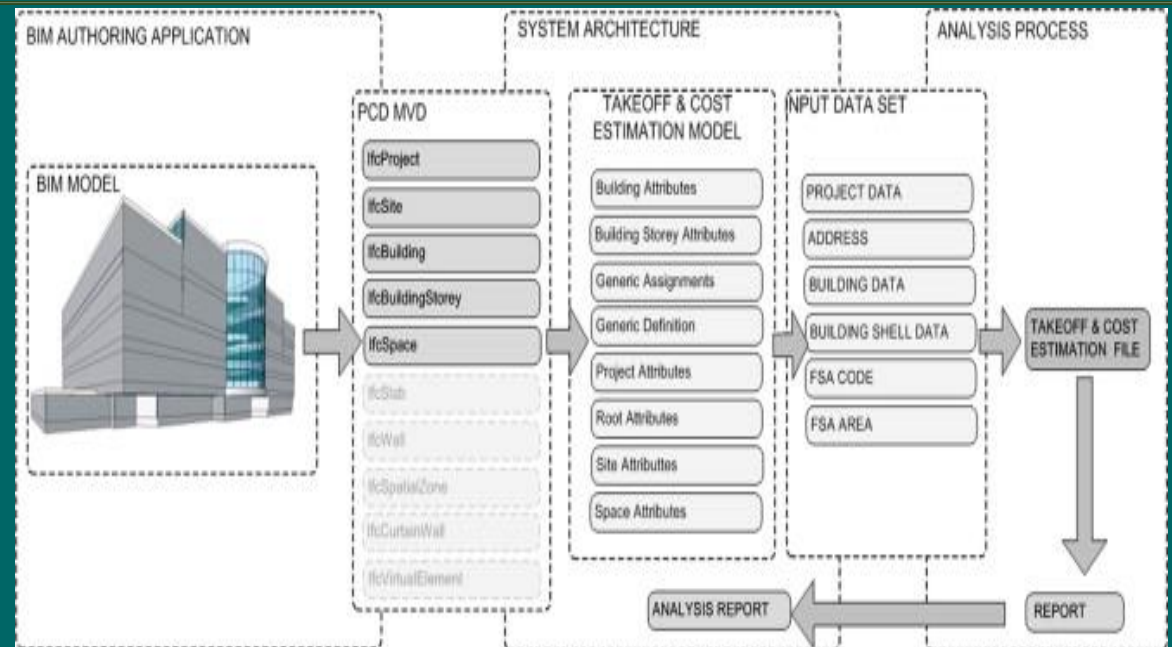
Key benefits

- BIM facilitates single-source projects as information brings the model to life.
- BIM improves construction productivity by building as a process.
- BIM reduces rework model for maintenance.

Main Functionalities

- BIM (Building Information Modeling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.

Reference Technical/ business Architecture



BIM business architecture

Building & Public Utilities: HVAC (Heating, ventilation, and air conditioning)

Main technical components

- Integration with HVAC (Heating, ventilation, and air conditioning) system.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Huawei's EC-IoT Smart Building Solution.
- <https://www.huawei.com/minisite/iot/en/smart-buildings.html>

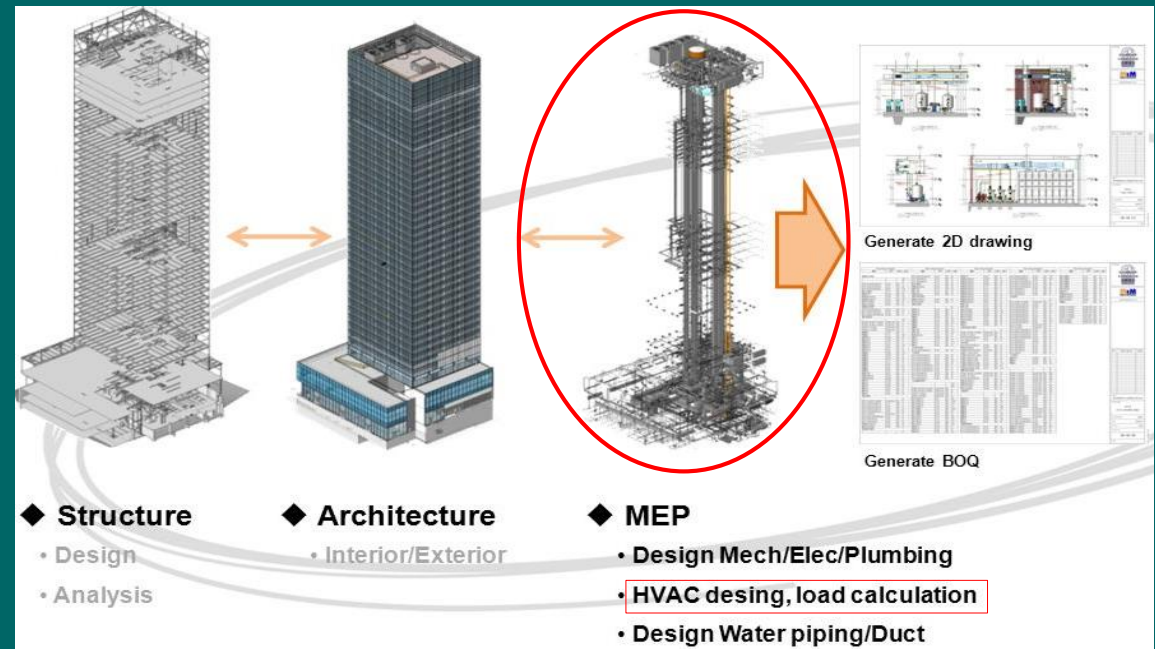
Key benefits

- HVAC lowers the electricity bills, provides better temperature variability, provides cleaner air & enables remote access.

Main Functionalities

- HVAC (Heating, ventilation, and air conditioning) is the technology of indoor and vehicular environmental comfort. Its goal is to provide thermal comfort and acceptable indoor air quality.

Reference Technical/ business Architecture



Building & Public Utilities: e-Natural Disaster Management platform based responses

Main technical components

- e-Natural Disaster Management platform based responses system.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Libellium's e-Natural Disaster Management Solutions.
- <http://www.libelium.com/early-warning-system-to-prevent-floods-and-allow-disaster-management-in-colombian-rivers/>

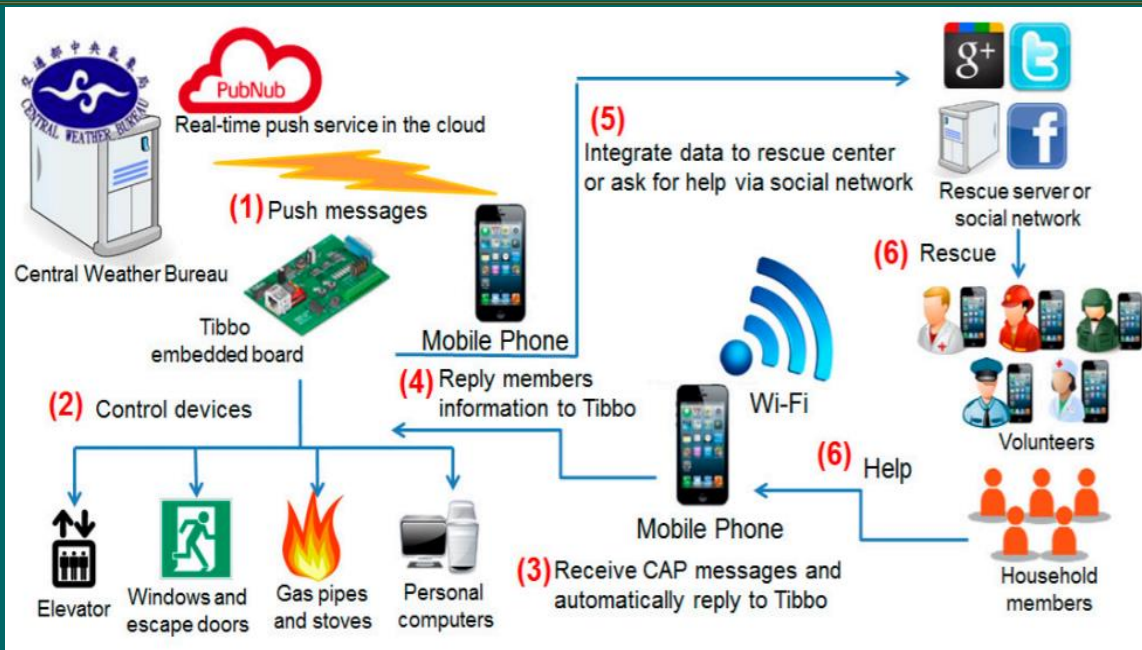
Key benefits

- Monitoring natural disaster recovery online.
- Real-time information for emergency response operations.
- Monitoring for response readiness.
- Saving life & properties.

Main Functionalities

- To activate the **Early Warning System** data is also stored in the cloud for those people who are not directly related to the decision making process for response management for natural disaster platform.
- Due to the difficulties on the communications deployment, a Raspberry Pi 3B was used to store data locally and to process the information gathered.
- This Raspberry Pi 3B also has access to the cloud platform **sends SMS alerts to the decision-makers when an event occurs for risk prevention.**

Reference Technical/ business Architecture



e-Natural Disaster Management platform based responses business architecture

Building & Public Utilities: SCADA (Supervisory Control and Data Acquisition)

Main technical components

- SCADA (Supervisory Control and Data Acquisition).

Relative available technologies in the market

- Schneider-electric SCADA solutions.
- http://www2.schneider-electric.com/documents/solutions/sustainable_solutions/Smart_Cities_Success_Stories.pdf

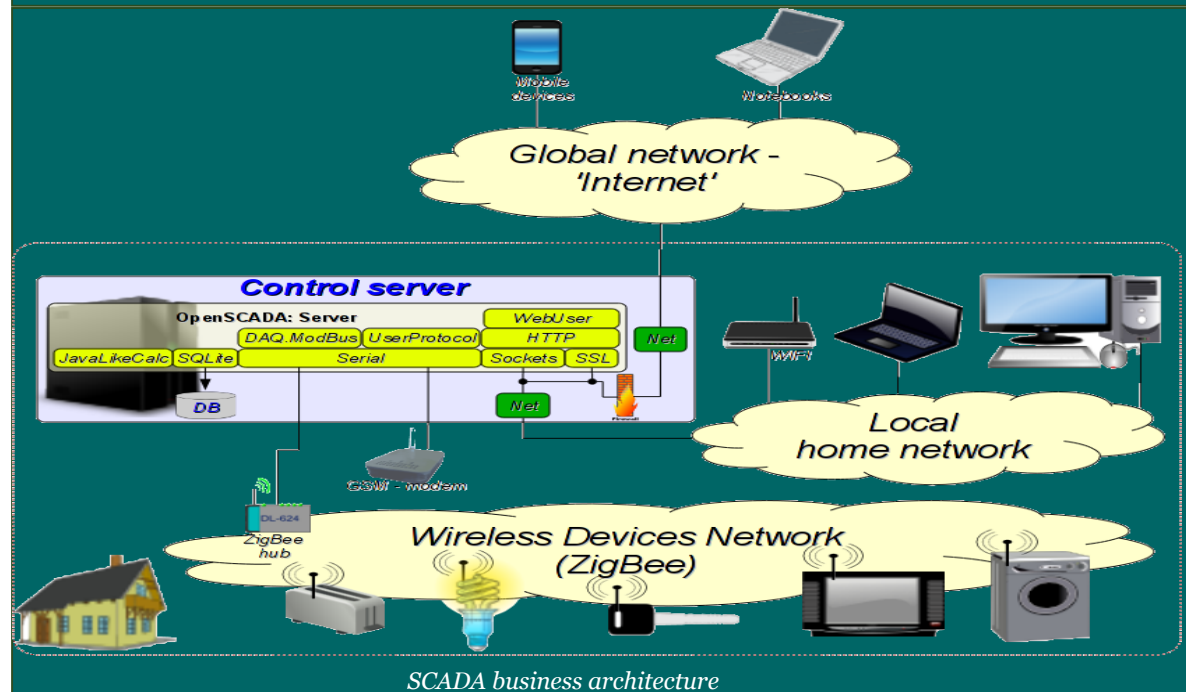
Key benefits

- Optimize the time spent.
- Delegate work efficiently.
- Maximize ROI.
- Smooth operation & monitoring.
- Remote Control.
- Data collection, storage and retrieval

Main Functionalities

- Supervisory Control And Data Acquisition (SCADA) is a control system architecture that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management, the real-time control logic or controller calculations are performed by networked modules which connect to the field sensors and actuators, this digital component can help in controlled water supply in buildings and for energy efficiency utilization in quantitative as well as qualitative improved approach.

Reference Technical/ business Architecture



SCADA business architecture



Building & Public Utilities: QR coding enhanced by RFID tagging

Ministry of Municipal & Rural Affairs

Main technical components

- QR coding enhanced by RFID Tagging.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- SQRcode's QR coding solution enhanced by RFID tagging.
- <https://sqrcode.com/>

Key benefits

- Can be scanned using a smartphone or any other phone with scanning capability.
- QR codes are versatile, they can encode almost all types of data e.g. numeric, alphabets, special and binary.
- Extremely fast scanning.
- Like other 2-d barcodes, QR code has good fault tolerance. Even if some part of the code is damaged, information can still be decoded from the code.
- Stores large amount of information unlike 1-d barcodes.

Main Functionalities

- Digital RFID tagging or QR coding of buildings help municipality to monitor the structure health as well as the other services provided to the particular building, just by one scan every data related to specific building is available to the municipality.
- The QR (quick response) code is a two-dimensional bar code, which can be read by any smartphone using a free reader program. It establishes a link with the product or service in question and the information available online.

Reference Technical/ business Architecture



QR coding enhanced by RFID tagging architecture

Building & Public Utilities: Solar based public toilets integrated with sensors

Main technical components

- Solar based public toilets integrated with sensors.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- JCDecaux wins World's second largest Automatic Public Toilet
- <https://www.jcdecaux.com/press-releases/jcdecaux-wins-worlds-second-largest-automatic-public-toilet-contract-berlin>
- <https://www.jcdecaux.com/tags/smart-city>

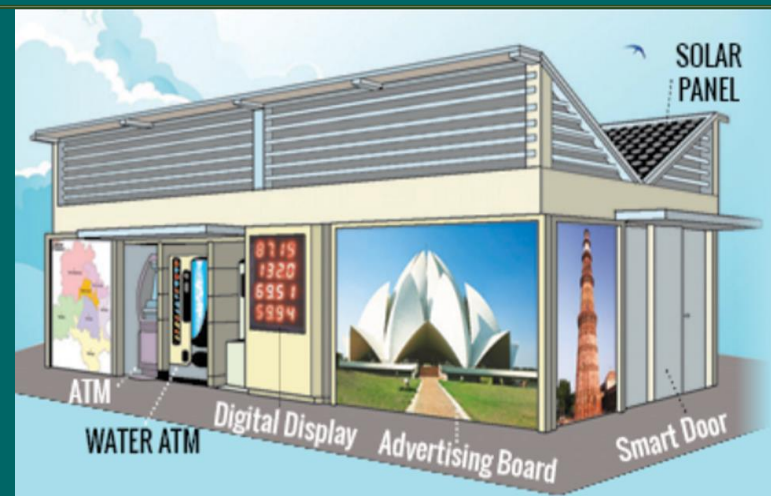
Key benefits

- Automatic monitoring & cleaning.
- Environment friendly and ease of access.
- Reduced Plumbing Issues.
- Automatic Flushing.
- Water Savings.
- Health Tracking.

Main Functionalities

- For real-time monitoring of cleanliness of public facilities like toilets, the infrastructure is developed along with sensors installed to detect when the waste is full, it reports directly to the web-servers attached.
- Each toilet is dependent on solar panels installed over its roof for generation of electricity for operation of sensors.

Reference Technical/ business Architecture

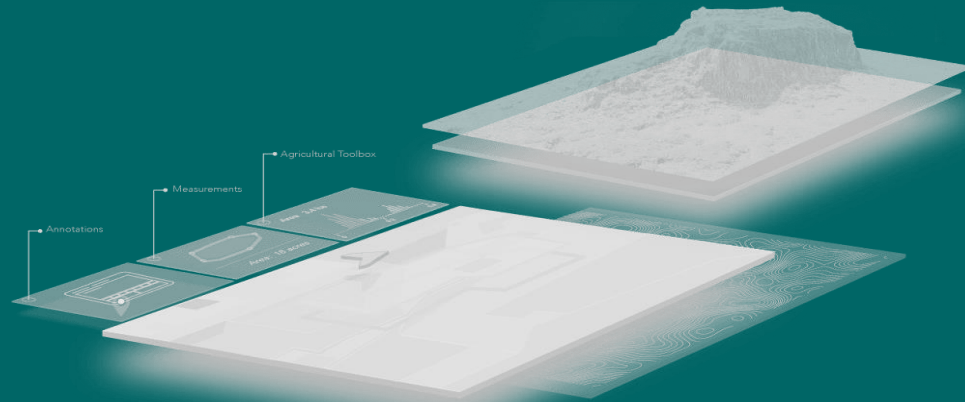


ACCESSIBLE SANITATION

- Sensor-based door to open only after payment
- LED powered by solar cells
- Auto air purifier
- 0.5L water for every flush (conventional: 6-gL)
- Sensor-based water taps
- Solar panels on roof
- Rain water harvesting
- Grey water recycling to reuse water
- Advertisement panels powered by solar batteries

Solar based public toilets integrated with sensors business diagram

Flood Initiatives



Flood Initiatives : HIS (Hydrological Information System)

Main technical components

- HIS (Hydrological Information System).
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Libellium's e-Natural Disaster Management Solutions.
- <http://www.libelium.com/early-warning-system-to-prevent-floods-and-allow-disaster-management-in-colombian-rivers/>

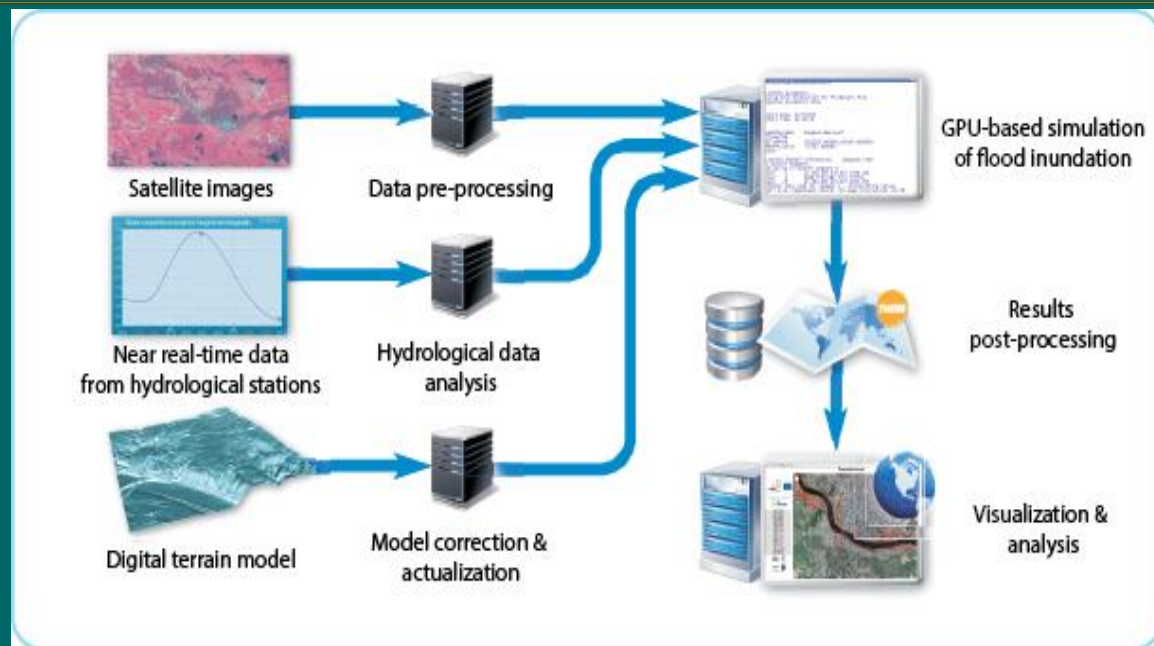
Key benefits

- Assessing the user needs.
- Establishing an observational network and operating it.
- Data collection, validation, processing, and reporting.
- Management of historical data.
- Data transmission, storage, and dissemination.
- Institutional and human resource development.

Main Functionalities

- HIS is integrated with GIS to provide extensive information regarding the water bodies giving real-time forecasting and operations requires adequate information on the hydro-meteorological regime.
- In simpler words, HIS will monitor the water level in the river bodies and other alarming systems are integrated to the web servers for alert mechanism.

Reference Technical/ business Architecture



Hydrological Information System business architecture

Flood Initiatives : Drainage Monitoring Sensors for automatic reporting for cleanliness

Main technical components

- Drainage Monitoring Sensors for automatic reporting for cleanliness.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- JCDecaux wins World's second largest Automatic Public Toilet
- <https://www.jcdecaux.com/press-releases/jcdecaux-wins-worlds-second-largest-automatic-public-toilet-contract-berlin>
- <https://www.jcdecaux.com/tags/smart-city>

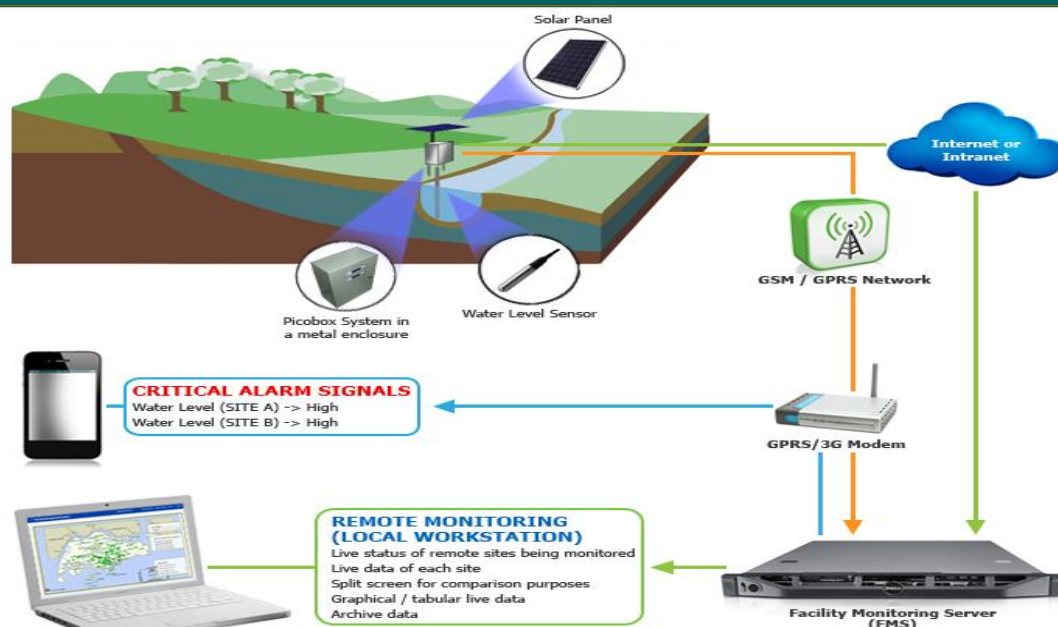
Key benefits

- Automatic monitoring & cleaning.
- Environment friendly and ease of access.
- Reduced Plumbing Issues.
- Automatic Flushing.
- Water Savings.
- Health Tracking.

Main Functionalities

- Drainage all along the cities and river side areas to be integrated with sensors reporting to the web servers for cleanliness once it is full.

Reference Technical/ business Architecture



Drainage Monitoring Sensors for automatic reporting for cleanliness technical architecture

Flood Initiatives : SWMM (Storm Water Management Models) Awareness Program

Main technical components

- SWMM (Storm Water Management Models) Awareness Program.

Relative available technologies in the market

- EPA's Storm water Management Model (SWMM).
- <https://www.epa.gov/water-research/storm-water-management-model-swmm>

Key benefits

- Protecting environment.
- Reducing flooding to protect people & property.
- Reducing demand on public storm water management systems.
- Supporting healthy streams and rivers.
- Creating healthier and more sustainable communities.

Main Functionalities

- Storm Water Management Methods (including Rain water harvesting), several practices for water utilization need to be informed to the citizens through several awareness programs via digital platforms.
- Used for single event or long-term simulations of water runoff quantity and quality in primarily urban areas—although there are also many applications that can be used for drainage systems in non-urban areas. It is used throughout the world for planning, analysis, and design related to storm water runoff, combined and sanitary sewers, and other drainage systems.

Reference Technical/ business Architecture



Storm Water Management Models awareness diagram

Flood Initiatives : Barrage & Check dam structure health monitoring

Main technical components

- Barrage & Check dam structure health monitoring.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Smartec's Dam and Dike Structural Health Monitoring Systems.
- <https://smartec.ch/en/application/dam-and-dike/>

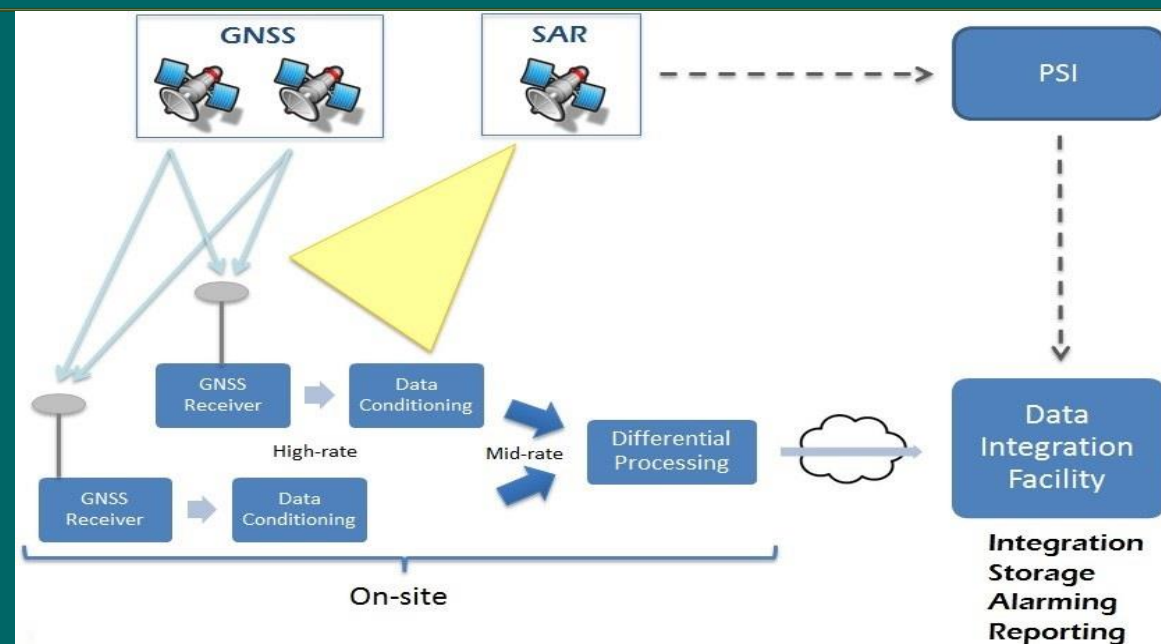
Key benefits

- **Integrated solutions:** Provide structural health monitoring solutions for dams and dikes using advanced fiber-optic technologies and vibrating wire.
- **Optimized operations and maintenance:** Provide important data on the structural behavior of a reservoir, a dam's body or foundation in order to ensure.
- **Preservation of water, safety of people and nature:** Run real-time or continuous.
- **Impact assessment of extraordinary natural event s:** Provide details on the impact of events such as earthquakes or excessive rainfall in an effort to minimize.
- **Regulation compliance:** Develop technologies that meet current and future standards for dams and dikes.

Main Functionalities

- ICT or digital components including sensors installed in the barrages and check dams to keep on monitoring the health of the structures to avoid any causalities or disasters.

Reference Technical/ business Architecture



Barrage & Check dam structure health monitoring technical architecture

Flood Initiatives : 3D Mapping of shorelines to avoid and prepare for flood situations

Main technical components

- 3D Mapping of shorelines to avoid and prepare for flood situations.
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Spar3D's Mapping Coastal Change Using LiDAR and Multispectral Imagery.
- https://www.spar3d.com/wp-content/uploads/woocommerce_uploads/2015/01/Mapping-Coastal-Change-Using-LiDAR-and-Multispectral-Imagery.pdf

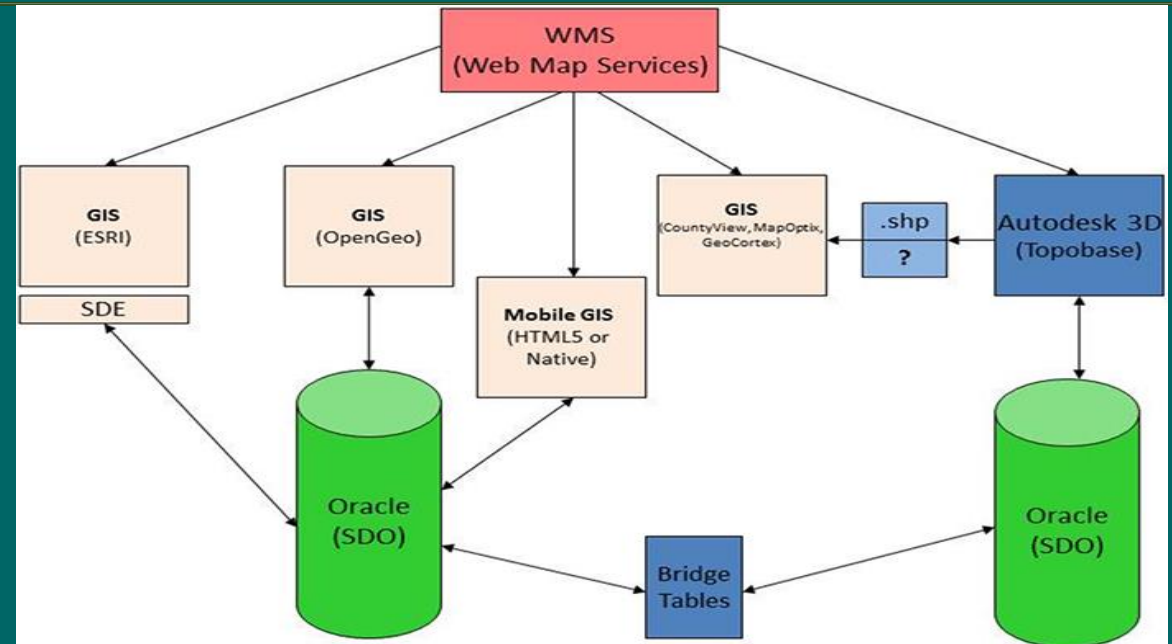
Key benefits

- BIM facilitates single-source projects as information brings the model to life.
- BIM improves construction productivity by building as a process.
- BIM reduces rework model for maintenance.
- HVAC lowers the electricity bills, provides better temperature variability, provides cleaner air & enables remote access.

Main Functionalities

- Innovative solution includes 3D mapping of the shorelines integrated with GIS to avoid the flood and alert for the preparedness can be helpful in preparedness as well as early maintenance of the shorelines to avoid water entering into main lands.

Reference Technical/ business Architecture



3D Mapping of shorelines to avoid and prepare for flood situations technical architecture

Waste Management Initiatives



Waste Management Initiatives : Real-time container tracking through wireless sensor networks

Main technical components

- Real-time container tracking through wireless sensor networks.
- IoT Sensors.
- Wireless sensor networks (WSNs)

Relative available technologies in the market

- Cisco® Kinetic for Cities Waste Management
- <https://www.cisco.com/c/en/us/solutions/industries/smart-connected-communities/kinetic-for-cities-waste-management.html>

Key benefits

- Improve management by utilizing real-time visualization of waste bin status that provides information to operators and agencies.
- Reduce response time to incidents with real-time alerts on incidents such as bin overflow, fire within bins, or accidental or intentional displacement of bins from designated places.
- Reduce operational expenditures with an optimized route feature for operators and collection managers, enabling them to collect and service bins based on the bin fill level and current traffic conditions
- Gain informative insights with historical and trends reporting.
- Reduce operational complexity with a secured, vendor-agnostic, event-centric platform that integrates multivendor systems horizontally.

Main Functionalities

- Optimizes routes by providing real-time status of waste bins, with fill level and overflow alerts, as well as fleet status on a single platform.
- Is vendor agnostic, with data aggregated from myriad sensors .
- Provides distributed and event-centric information .
- Normalizes and externalizes nonstandard technologies as model-driven APIs .
- Enables visualization engines and applications .
- Plays a vital role in breaking through silos and implementing truly connected departments that give a cohesive services to cities, agencies, operators, and citizens .

Reference Technical/ business Architecture



Real-time container tracking through wireless sensor networks architecture

Waste Management Initiatives : Smart Bins with sensors & RFID tagging

Main technical components

- Smart Bins with sensors & RFID tagging
- IoT Sensors.
- Wireless sensor network (WSN)

Relative available technologies in the market

- Cisco® Kinetic for Cities Waste Management.
- <https://www.cisco.com/c/en/us/solutions/industries/smart-connected-communities/kinetic-for-cities-waste-management.html>

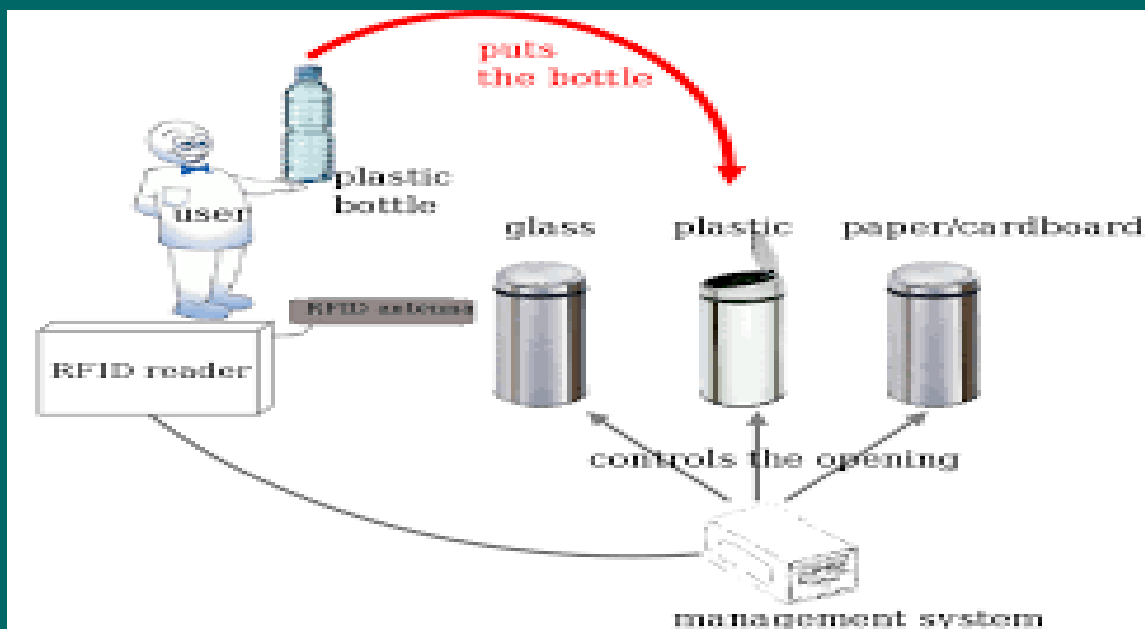
Key benefits

- Improve management by utilizing real-time visualization of waste bin status that provides information to operators and agencies.
- Reduce response time to incidents with real-time alerts on incidents such as bin overflow, fire within bins, or accidental or intentional displacement of bins from designated places.
- Reduce operational expenditures with an optimized route feature for operators and collection managers, enabling them to collect and service bins based on the bin fill level and current traffic conditions.
- Gain informative insights with historical and trends reporting.
- Reduce operational complexity with a secured, vendor-agnostic, event-centric platform that integrates multivendor systems horizontally.

Main Functionalities

- Request for collection of waste can be put up through unified city app.
- Real-time fire alarms reduce response times. Waste management sensors are capable of measuring temperature within the bins and alerts operators when the temperature exceeds the threshold.
- An Overflow alert informs operators that the bin needs to be emptied immediately to avoid an overflow of waste
- The Tilt alert gets triggered when the waste bins get moved and/or tilted abruptly. There would be an accelerometer within these sensors and any axial aberration triggers the alert.

Reference Technical/ business Architecture



Smart Bins with sensors & RFID tagging business architecture

Waste Management Initiatives : Vehicle Tracking system (VTS), GPS enabled to track the collection vehicles for garbage

Main technical components

- Vehicle Tracking system (VTS), GPS enabled to track the collection vehicles for garbage.

Relative available technologies in the market

- KPIT's Vehicle Tracking System (VTS).
- <https://www.kpit.com/resources/downloads/brochures/kpit-vehicle-tracking-system.pdf>

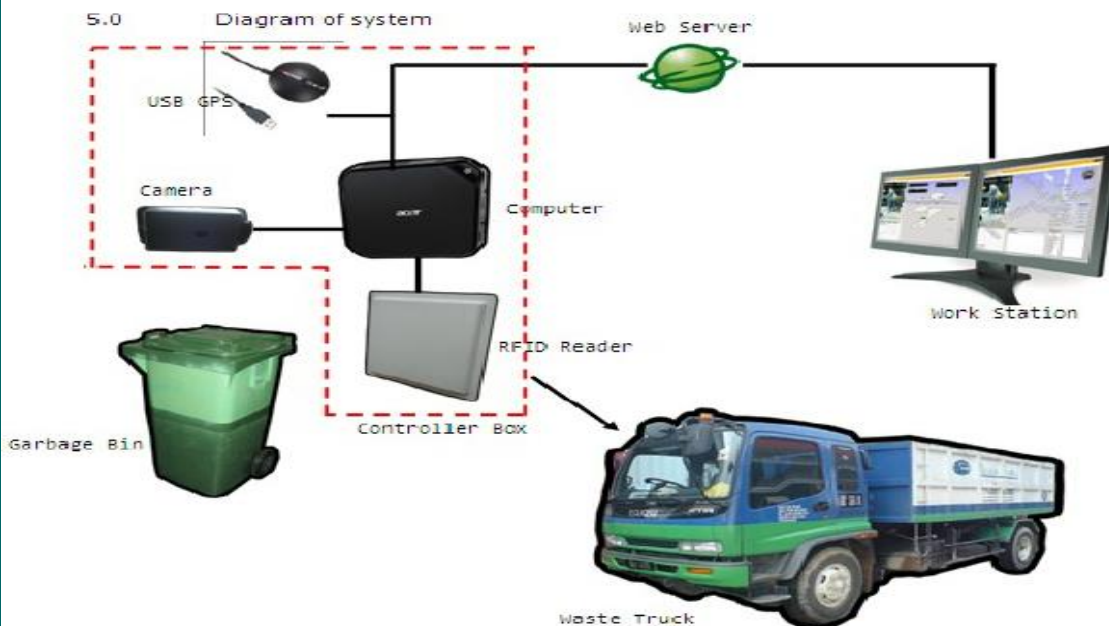
Key benefits

- Reduce response time to incidents with real-time alerts on incidents such as bin overflow, fire within bins, or accidental or intentional displacement of bins from designated places.
- Reduce operational expenditures with an optimized route feature for operators and collection managers, enabling them to collect and service bins based on the bin fill level and current traffic conditions.

Main Functionalities

- Reduction of trip time, fuel saving and serving more locations through route optimization as well as tracing the movement of waste in the city.

Reference Technical/ business Architecture



Vehicle Tracking system (VTS), GPS enabled to track the collection vehicles for garbage technical architecture

Waste Management Initiatives : Geo-fencing of area and marking important points & routes, etc.

Main technical components

- Geo-fencing of area and marking important points & routes, etc.

Relative available technologies in the market

- Sweco's solution Geo-fencing of area and marking important points & routes.
- <https://www.sweco.se/en/our-offer/in-focus/smarter-cities/>

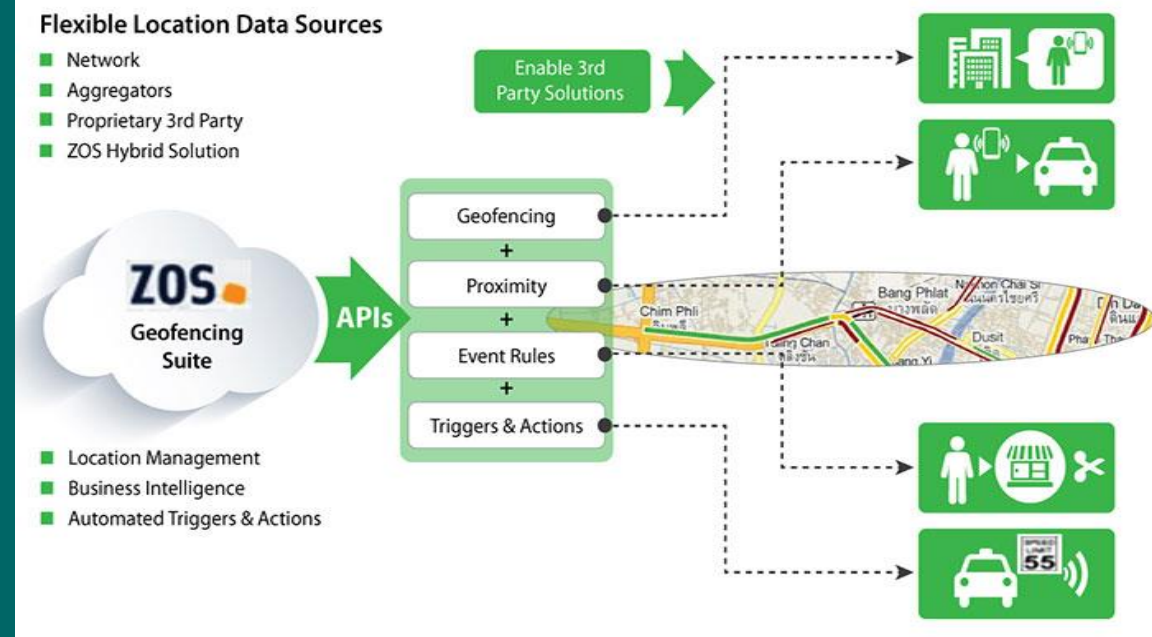
Key benefits

- Reduce operational complexity with a secured, vendor-agnostic, event-centric platform that integrates multivendor systems horizontally.
- Improve management by utilizing real-time visualization of waste bin status that provides information to operators and agencies.
- Geo-fencing leads to represent the dustbins on maps which help for monitoring.

Main Functionalities

- Reduction of trip time, fuel saving and serving more locations through route optimization as well as tracing the movement of waste in the city.
- Geo-fencing means using GIS based tools preparing data layers for collection of wastes, Geo-coding demarcates the tagging of bins with QR codes. Geo-fencing also comprises of stoppages, routes & parking yards for the collection vehicles.

Reference Technical/ business Architecture



Geo-fencing of area and marking important points & routes business architecture

Waste Management Initiatives : Integration of Waste reporting to Unified City Apps

Main technical components

- Integration of Waste reporting to Unified City Apps.

Relative available technologies in the market

- Cisco Kinetic for Cities.
- <https://www.cisco.com/c/en/us/solutions/industries/smart-connected-communities/kinetic-for-cities-waste-management.html>

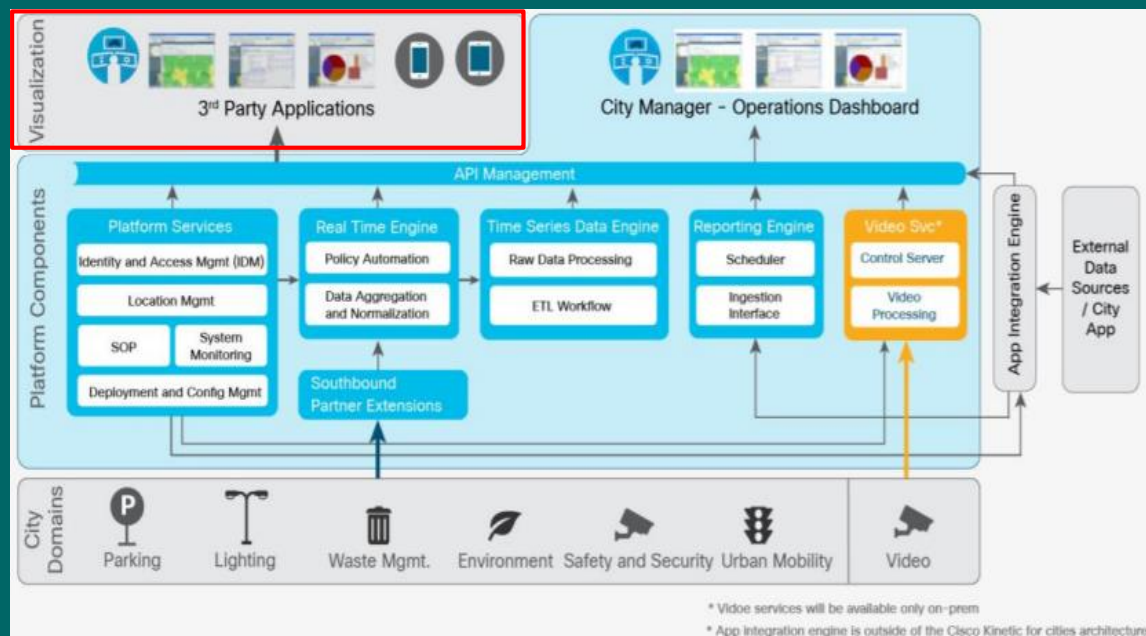
Key benefits

- Applications are important platforms for the information dissemination and services involved.
- Gain informative insights with historical and trends reporting.

Main Functionalities

- Prevention & control of the misuse of manual system of attendance and Induction of transparency and accountability in operations.

Reference Technical/ business Architecture



Integration of Waste reporting to Unified City Apps technical architecture

References

- **Bosch road signature as a crowdsourced localization service with radar service** (<https://www.bosch-mobility-solutions.com/en/products-and-services/passenger-cars-and-light-commercial-vehicles/automated-driving/bosch-road-signature/>)
- **Cisco's Graphical user interface, wizards Cisco® IOS® Software command line interface** (https://www.cisco.com/c/dam/global/da_dk/assets/docs/Expo_Teknisk_MariusHolmsen.pdf)
- **Huawei's Intelligent Smart Poles** (<https://www.huawei.com/minisite/iot/en/smart-lighting.html>)
- **Libelium** (http://www.libelium.com/vehicle_traffic_monitoring_bluetooth_sensors_over_zigbee/)
- **Modern, interconnected and IT-based mobility is the core competency of Siemens Mobility** (<https://www.siemens.com/global/en/home/company/about/businesses/mobility.html>)
- **KPIT's Vehicle Tracking System (VTS)** (<https://www.kpit.com/resources/downloads/brochures/kpit-vehicle-tracking-system.pdf>)
- **Huawei Power Cube 500 for Smart Power (Solar) Solution** (<https://e.huawei.com/ae/products/telecom-energy/hybrid-power/powercube-500>)
- **LaserNet is one of the world's leading laser companies: ILDA Accredited Professional Laser show** (<https://lasernet.com/>)
- **Sweco's solution Geo-fencing of area and marking important points & routes.** (<https://www.sweco.se/en/our-offer/in-focus/smarter-cities/>)

Ministry of Municipal & Rural Affairs (MoMRA), Kingdom of Saudi Arabia

Thanks