



## **Utilizing Service Oriented Architecture (SOA) in IoT Smart Applications**

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### **Abstract**

The Service Oriented Architecture (SOA) are used to integrate and manage the city services through a standard framework that has the capacity to develop, deploy and managed the functions that support the components of the city infrastructure. The objective of SOA implementation is to employ sophisticated IT processes that produce continuous, rapid business change outcomes. The aim of this paper is to present current research of the emergence of SOAs considering the trends in urbanization along with the evolution of technology and ubiquitous computing. This paper will explore current trends in development and utilization of Service Oriented Architectures (SOAs) in Smart Cities and propose an SOA framework that will address the challenges of urban planning and development. Advantages of the SOA if we used it for a Smart City Application can be described as the following: Integrate the physical infrastructures of the city such as the transportation sector, utilities, land, and city services, Flexibility, Scalability and Business agility, Easier Testing and Debugging, Reusability, Platform independence, Increased Productivity, SOA enables business decisions to be translated rapidly into technology. Internet of things (IoT) brings unprecedented changes to all contexts of our lives, as they can be informed by smart devices and real-time data. Among the various IoT application settings, e-government seems to be one that can be greatly benefited using IoT, transforming and augmenting public services.

**Keywords:** Service Oriented Architecture (SOA), Infinet, Smart City, Sustainability, Urbanization, Urban Planning, Spatial Data, Ubiquitous, City Services, City Infrastructure, Internet of things (IoT)

## 1. Introduction

A considerable percentage of the global population has migrated to urban centers, which has changed the dynamics of city development and governance. This rapidly increasing, global urbanization of cities creates a demand for advancement in the socioeconomic development of city infrastructures that reflects the increased complexity of the city resident's quality of life [8]. Modern day challenges to the development of Smart Cities include rapid population growth, polarized economic growth, decreasing fiscal budgets, greenhouse gas emissions [3]. Prandi et al (2014) asserted that the rapid evolution of technology is the basis for all disciplines that are associated with smart city concepts. Therefore, to promote and to maintain the organization, attractiveness, sustainability and prosperity of the city, the Service Oriented Architecture (SOA) of Smart Cities must be utilized to integrate and to organize the city's resources. This paper will explore current trends in development and utilization of Service Oriented Architectures (SOAs) in Smart Cities and propose an SOA framework that will address the challenges of urban planning and development.

With the growth and evolution of information technology (IT) in the last century, the term of information communication technology (ICT) has been dominating over the 21st century in all aspect of our lives worldwide. The transition from traditional social structure towards a digital and smart society has begun already, particularly in the smart city project sector, where a variety of pilot projects and agendas have been implemented both in developed and developing countries.

Internet of Things (IoT) is ubiquitous in society. IoT-enabled dynamic capabilities in real-time sensing and responding can spur digital transformation in unlocking the potential of digital government into data-driven smart government capable of delivering policies and services of public interest and public value. However, the literature indicates challenges in IoT cyber security and systemic use across the government. There is the urgent need for IoT research on policy and use. This paper developed a framework for IoT-enabled smart government performance. We applied this framework to conduct case study analyses of digital technology policy, IoT cyber security policy, and IoT use in major application domains at the U.S. federal government level. The results show that some agencies were strategic and forward-thinking in funding and partnering with sub-national governments in promoting the IoT use. However, there remains a critical need for national IoT policies to promote systemic IoT use across the application domains.

The “Internet of Things” (IoT) encompasses billions of “smart” objects and devices, from sensors, industrial and utility components to cars, trucks, machines, and other ordinary objects using wireless technology to connect to the Internet, that transform the way we work, connect, communicate and consume products and services. In recent years the ubiquity of the IoT objects has exponentially grown from 2 billion in 2006 to a projected 200 billion by 2020. This means approximately 26 smart objects for every person on earth (Intel, 2016). While there are many different technical and strategic definitions of the IoT, we adopt in this paper a definition of the IoT as “the set of Internet Protocol-addressable devices that interact with the physical environment and typically contain elements for sensing, communicating, processing, and actuating” (GAO, 2017a, p. 1, *Italics added*). This definition was presented by United States Government Accountability Office (GAO) to the U.S. Congressional Committees on cyber security risks of the IoT in 2017. Accordingly, we underscore the criticality of new capabilities afforded by the IoT in real-time operating systems in government and in society. Namely, IoT technologies embedded in complex systems, such as autonomous vehicles, possess inherent capabilities in not only sensing, communicating, and processing, but also moving or controlling a component or system autonomously, potentially without human input (GAO, 2017c).

The inspiration for dealing with this thesis is to take care of these issues, utilizing the emergence of SOAs considering the trends in urbanization along with the evolution of technology and ubiquitous computing. Through exploring current trends in development and utilization of Service Oriented Architectures (SOAs) in Smart Cities and propose an SOA framework that will address the challenges of urban planning and development. A service-oriented architecture is

basically a gathering of services. These services communicate with each other. The correspondence can include either basic information passing, or it could include two or more services coordinating some activity. A few methods for interfacing services to each other is required [11].

SOA has turned into a noteworthy purpose of enthusiasm for some fields, with its potential for giving improved administration situations alongside the benefits of adaptability, openness, dependability, and exclusive while diminishing IT-related working expenses. SOA was utilized, to some degree, in more than half of substantial, new applications and business forms planned in 2007, The Majority of SOA ventures succeed, and most organizations that have begun utilizing SOA have proceeded with it. In any case, a few organizations have been baffled by the low level of administration sharing ("reuse") that they have accomplished, and some SOA ventures have fizzled for an assortment of reasons.

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The International Conference on Smart Learning Environment (ICSLE 2017) expects to unite specialists, experts, and approach creators to talk about issues identified with the improvement of learning conditions to upgrade learning [13]. The smart teaching method structure fuses class-based isolated heading, accumulate based communitarian learning, individual-based modified learning and mass based generative learning. Learning Partition frameworks can investigate and part trainees' information to derive fitness, meta-ability, and certainty part.

The key qualities of smart learning and the fundamental challenges to be conquered when outlining smart learning conditions to aid personalization [12].

## **2. The Emergence between Smart Cities and SOA**

Smart Cities provide the opportunity to integrate the physical infrastructures of the city such as the transportation sector, utilities, land, and city services. The smart city model typically integrates the economic, social, and environmental components of the city in a way that sustainably maximizes the efficiency of the city's primary systems. Rolimetal (2015) defined the Smart City as an urban system that utilizes ICTs to develop infrastructures and public services that are in a more accessible, interactive, and efficient context. Fundamentally, Information and Communication Technologies (ICTs) and geographic information technologies (GIS) have revolutionized the communications and interaction capabilities across urban settings in the form of high-level decision-making tools [1]. The features that are specific or unique to the smart city address the services that are available to the residents, government policy and sustainable management. The e-city is constructed based upon the potential of the modern city [4] as shown in figure 1.

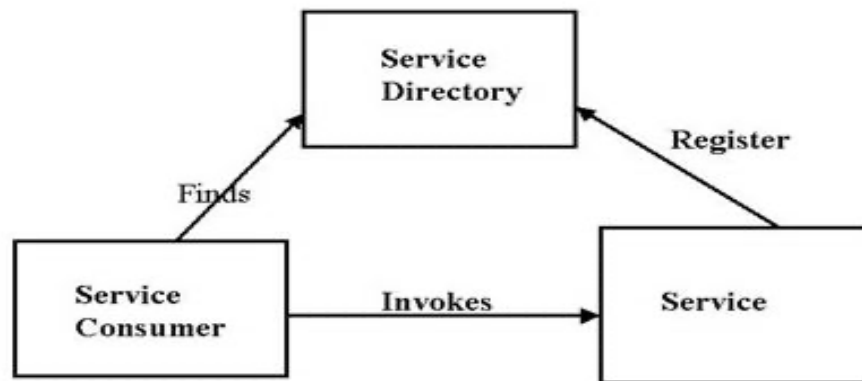


Fig. 1. A service-oriented architecture

### 3. Smart City System

The principal question is what is implied by a smart city. The answer is, there is no inside and out recognized importance of smart city. It infers unmistakable things to different people. The conceptualization of smart city, along these lines, contrasts from city to city and country to country, dependent upon the level of progression, energy to change and change, resources and objectives of the city tenants. smart city would have a substitute significance in India than, say, Europe. For sure, even in India, there is no one technique for describing smart city. The expression "smart city" was authored towards the finish of the twentieth century. It is established in the execution of easy-to-use data and correspondence innovations created by real ventures for urban spaces. Its significance has since been extended to identify with the fate of urban communities and their advancement. Smart urban communities are forward-looking, dynamic and asset proficient while giving in the meantime a high caliber of life. They advance social and mechanical developments and connection existing frameworks. They consolidate new vitality, movement and transport ideas that go simple on the earth. Their center is around new types of administration and open cooperation.

Insightful choices should be taken at the vital level if urban communities need to wind up smart. It takes more than singular activities yet watchful choices on long haul usage. Considering urban communities as whole frameworks can enable them to accomplish their definitive objective of getting to be smart. Smart urban communities commandingly handle the current worldwide difficulties, for example, environmental change and shortage of assets. Their claim is likewise to secure their monetary intensity and personal satisfaction for urban populaces constantly on the ascent. The idea smart city flies up regularly with regards to urban advancement. The idea unquestionably has a positive flavor, yet what does it really mean? There is no special definition for a smart city. The translations and definitions utilized by various intrigue gatherings, partners and locales fluctuate. The impression is regularly that a smart city is the same as a computerized city, and some of the time its significance is near that of a supportable city.

It is a testing term since who needs his commitment to the advancement not to be called smart. While most human exercises happen in urban areas, nearly anything can be incorporated inside the smart city idea. Things being what they are, the reason would it be a good idea for us to utilize a unique term on the off chance that it incorporates everything in a city? The premise of creating frameworks has dependably been to move towards an ideal characterized by numerous criteria. Financial viewpoints are regularly among the center criteria. Generally, an ideal has been come to with brought together arrangements. Economy of scale has been accomplished by frameworks with an unmistakable purpose of control. For instance, control networks have been worked around substantial power plants. Open transport frameworks have been founded on some person choosing the timetables

and courses for the benefit of others. Retail shopping has moved to vast malls. Indeed, even administration in the public eye has implied a capable focal organization settling on choices on benefit of the nationals as shown in table 1.

Table .1 Smart city Components

<b>1-Smart Mobility</b>	<b>2-Smart Economy</b>	<b>3-Smart Living</b>
<ul style="list-style-type: none"> <li>•Improved Accessibility</li> <li>•Safe Transportation</li> <li>• More effective and smart transportation systems</li> <li>•Leveraging networks for efficient movement of vehicles, people, and goods, to reduce gridlock</li> <li>•New 'social' states of mind such as car sharing, car pooling, and car-bike combinations</li> </ul>	<ul style="list-style-type: none"> <li>•Regional/global competitiveness</li> <li>•Entrepreneurship &amp; Innovation Momentum</li> <li>•High Levels of Productivity</li> <li>•Broadband access for all citizens and businesses for business opportunities</li> <li>•Independent of location, helping maintain population in rural areas,</li> <li>•Electronic business processes (e.g., e-banking, e-shopping, education).</li> </ul>	<ul style="list-style-type: none"> <li>•Better Quality of Life</li> <li>• Social Aspects - Education, healthcare, Public Safety, Housing</li> <li>•Access to high-quality healthcare services (including e-health or remote healthcare monitoring), electronic health records management</li> <li>•Home automation, smart home and smart building services</li> <li>•Access to social services of all Kinds</li> </ul>
<b>4-Smart Governance</b>	<b>5-Smart People</b>	<b>6-Smart Environment</b>
<ul style="list-style-type: none"> <li>•Participatory Decision Making</li> <li>•Public &amp; Social Services</li> <li>•Transparency</li> <li>•Democratic processes and inclusion</li> <li>•Interconnecting governmental organizations and administrations</li> <li>•Improving community access to services.</li> </ul>	<ul style="list-style-type: none"> <li>•Social &amp; Human Capital</li> <li>•Qualified, Creative and Educated Citizenry</li> <li>•Able to utilize the ICT based smart services</li> <li>•Delivering a more consistent educational experience in both urban and rural areas</li> <li>•e-education solutions (remote learning and collaboration) to have citizens better informed.</li> </ul>	<ul style="list-style-type: none"> <li>•Pollution Monitoring</li> <li>•Use of Sustainable Technologies</li> <li>•Environmental/sustainable /Energy consumption</li> <li>•Reducing energy consumption through novel technology innovations while promoting energy conservation and material re-use.</li> </ul>

The project to "2020 education development program" refers to to build a modern educational innovation system, to cultivate innovative talents traction, integration of modern educational philosophy, through the development of virtual experiments related of the standards and norms, breakthrough in the construction of virtual experimental teaching environment key technology, research and development with independent intellectual property rights, set in kind imitation true, innovative design, intelligent guidance and teaching management in one, with good autonomy, interactivity, scalability and security of virtual reality Experimental teaching platform. Through a number of subjects of virtual experimental teaching resources design and application demonstration, the project will achieve the original creation in virtual experiment new breakthroughs in innovation in key technologies, so

that our country in the collar domain research results into the international leading ranks, and formed in the virtual reality.

Modern service industry supporting system of sustainable development in the field of laboratory teaching to resolve the contradiction between the scale and quality of education, to overcome the real unbalanced resources, lack of innovation and other issues, to effectively improve people only to cultivate the quality of the establishment of a high academic level, innovation ability of the research team for our country in the development of related fields to provide nuclear heart technology support.

#### **4. New markets created by Internet of Things (IOT) and Smart Cities**

The Internet of Things as systems administration innovation and smart data as estimate innovation will recognize the eventual fate of smart urban areas. For instance, they will empower more exact coordination of age and utilization than any other time in recent memory previously; control of the expanding decentralization; converging of the warming and power markets; incorporation of modern plants, structures and transportation frameworks as vitality specialist organizations.

Subsequently, this makes totally new markets for innovations and administrations. For example, Siemens is as of now taking an interest in a roughly 100-million-pound venture went for discernibly assuaging the heap on London's fast travel framework starting at 2018. As the assignment of the century, the Crossrail Tunnel is the by and by greatest framework venture in Europe and will increment the limit of the London worker rail organize by around 10 percent.

The Internet of Things (IoT) creates an emerging new era of the Internet, in which machines and objects get connected and equipped with sensors, surpassing their traditional role to constitute dynamic actors of networked environments with novel services. The ubiquitous nature of IoT brings dramatic changes to the way we work and live, with an increasing adoption in various domains of personal and organizational activity. According to industry reports, IoT is a very promising technology and is predicted to flourish within the next years, as 127 new devices connect to the Internet every second (McKinsey, 2018). It is expected that more than 24 billion IoT devices will exist by 2020, which will be four times the world population, while by 2018 IoT penetration will cover half of the world population. Investments on IoT are predicted to reach \$5-6 trillion (Newman, 2017). More than half of major new business processes and systems will incorporate some elements of IoT (Gartner, 2017). As IoT advances it is applied in government and the public sector allowing for services that improve the lives of the citizens (IBM Industries, 2017). IoT can bring unprecedented benefits in government systems and services, making a shift from e-government to smart government, transforming G2C, G2B and G2G transactions and processes.

Security and safety are of critical importance to the society and can become even more significant if they are related to areas such as public health or the environment. IoT can allow for the effective treatment of security and safety needs of the public sector through the sensing, processing, and communication capabilities of autonomous devices. Critical areas, in aerial, maritime and ground contexts, can be greatly benefited by being monitored with the use of IoT technology to facilitate appropriate and timely action. In particular, the use of mobile IoT devices can enable a wide range of activities related to security and safety, such as the surveillance and monitoring of areas, the detection of threats, the effective management of events, the fast response to emergency situations, the notification about security/safety alerts and the communication of status to people. Such IoT empowered activities can be applied to several contexts such as border surveillance and control for trespassing, weather monitoring and forecasting for intense or dangerous phenomena, air pollution detection, fire detection in forests and rural areas, monitoring of water level in rivers, lakes, and the sea for avoiding floods or quality control of water for drinking and agriculture. IoT enables advanced e government services that can be sustainable and efficient, and which could not be previously affordable or even possible. In all these cases, IoT systems and applications enable the provision of advanced services to people and the society in general, that can enhance their security and safety against several threats and in diverse contexts. These electronic services are offered to the public by the government, allowing for a better quality of life by protecting citizens and the environment. In addition, thanks to the use of IoT, these electronic government-to-citizen and government-to-society services eliminate the risk of putting people that are responsible for dealing with such incidents in danger. We believe that these critical public services are where IoT can bring most value to e-government.

## **5. Challenges of IoT in E-government**

The adoption of IoT in e-government can be very promising as well as challenging at the same time. In this section, we focus on the challenges of the use of IoT in e-government which can be divided into technical and non-technical.

### **5.1.1 Technical Challenges**

The central concept of the IoT era is that “things interact with each other”. Such interactions refer to peer to peer communication and data exchange as well as communication with back-end systems usually found in the Cloud. The autonomous nature of IoT devices allows us to gain from the automation of various functionalities, the integration of data and services and the analysis of the behavior of autonomous entities and the collected data. It should be noted that IoT devices are characterized by two parameters, i.e., the type of the hardware they use and the type of the software they adopt. In the following paragraphs we provide our view on the technical challenges in the adoption of the IoT vision in E-government services.

### **5.1.2 Non-Technical Challenges**

IoT in e-government goes beyond technical challenges and comprises non-technical ones which can include organizational, political, financial, and legal issues. Such issues can affect the decisions that need to be made and the actions that will follow them at strategic, tactical, and operational level regarding the utilization of IoT technology for e-government purposes. Decisions can concern the extension of current e-government systems and services or the development of new ones for utilizing IoT. Such decisions about plans and actions for pursuing e-government projects with IoT need not necessarily be driven by top government but they can rather start at local authority level. In any case IoT-based information systems and services should be designed so as to be aligned with government or local administration strategy and objectives.

## **6. The Infinet**

In the early 1980s, the Integrated Factory Information Network (INFINET) emerged as a solution to define architectures that could permit monolithic automation islands that could be broken down into smaller, discrete, remotely accessible functions [10]. A very basic architecture that consisted of an application layer, support layer and a service layer evolved and was entitled the INFINET Distributed Application System Architecture. The software and hardware components made up the infrastructure within the service layer. Figure 1 shows a modern INFINET platform infrastructure:

the modern INFINET platform is very similar to the modern-day SOA framework. The terminal access layer evolved from ubiquitous computing in which concepts of high-level connectivity between hardware and applications were reflected. The concepts of SOA continued to grow and were eventually adopted by public agencies as an IT management solution.

## **7. Related Work**

Several recent studies have emerged regarding SOAs, urban sensing and the development of dynamic, sustainable Smart City infrastructures. Typical approaches to SOA models that promote interconnectivity of city systems address issues of organization and efficiency. Hashemi & Hashemi (2012) defined the SOA as a standard framework in which city services are developed, implemented, and managed to increase the agility of the IT processes for rapid business change outcomes.

An increased understanding of geospatial technologies and the value of geospatial engineering applications may be to urban planning has also been a major contributor to the growth of SOA models for Smart Cities. Daniel & Doran (2013) concluded that the integration of geomatics and ICTs are indispensable tools in the smart city development and implementation strategies; but that beyond ICTs, considerations of the modification of paradigms that directly impact city development and governance models are equally as important.

Daniel & Doran (2013) supported that the key significance of the deployment of ICTs in Smart Cities is the geographic information technologies, in that the technologies provide quick access to the layers of information that can be integrated to facilitate situational analyses and subsequent decision-making processes. The service provider, the service consumer and the service repository are the basic components of a SOA [6]. Falconer & Mitchell (2012) proposed a basic smart city framework that was based upon a systematic process to enable connectivity between smart communities (S+CCs).

The city objectives that address the social, environmental, and economic needs of the city are used as the determinants for other developmental initiatives to improve functioning. The city indicators use methodologies such as the Green City Index, the Mercer Quality of Living Survey, and the Global City Indicators Facility (GCIF) to assess and benchmark the city. The city components detail the city's assets which are measured according to the physical components, which are further divided into subsections of logistics, air, road, and rail. The city content dictates how the solutions to the city's urban planning challenges are implemented. Rolim et al (2015) presented the UrboSenti as a seminal approach to ubiquitous SOA urban sensing, which consisted of data collection services and assistance in sensing application development. The UrboSenti is regarded as different from other urban sensing models in that UrboSenti may use data from a diversity of sources and combines social and traditional sensing. Prandi et al (2014) developed a SOA platform based upon a visualization of a 3D city model. This approach took advantage of the increasingly significant role of 3D models in urban Spatial Data infrastructures. Figure 3. shows SOA Smart City Platform (Prandi et al 2014)

The Raw Data and 3D City D8 components store the geographical data for the city that will be processed within the platform, to include the input for generation in the cityGML that is in the Smart City services component. The cityGML is used in PostgreSQL and Oracle databases and the database schema for the model is 3DcityDB open-source database. The Web Map Service (WMS), Web Processing Service (WPS), and Web Feature Service (WFS) manage the geodata inside the map server and grant access to the data. The Java servlet enables the visualization of the objects in the city model and the consummation of the OGC web services.

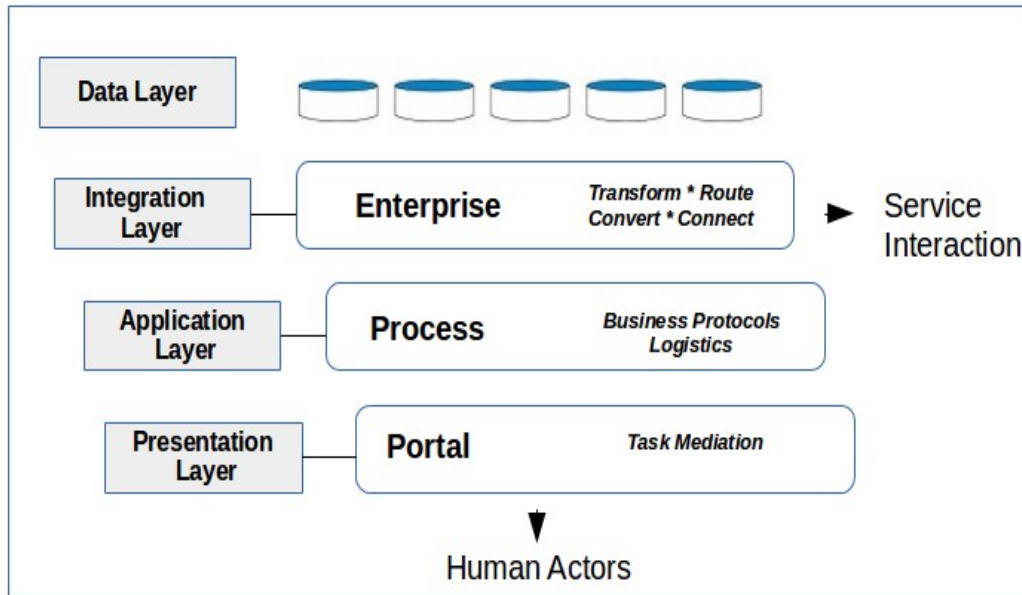
Prandi et al (2014) concluded that their proposed SOA model was scalable, interoperable, and provisional for several service-oriented functionalities. However, the disadvantages of the model included limited accessibility regarding the semantics of the city model and the magnitude of the interactive capacities of the city management functions. Otherwise, the platform produced improvement outcomes and was considered easily modifiable considering future changes.

## **8. Proposed Framework**

The ideal SOA framework should support the capabilities that are needed to integrate and to effectively manage the city's resources and is easily modifiable considering the changing urban landscapes along with the rapid evolution of technology. The framework will also provide IT flexibility in order to respond to the city's business challenges and continuous changes and will consist of the following structure:

1. User-oriented services layer
2. Application-oriented layer
3. Security service layer
4. Data services layer
5. Information infrastructure layer for urban systems

Therefore, the proposed framework in figure 2 will serve as a basis for the management of city infrastructure components by maximizing the systems interoperability through an operational GIS platform. The SOA framework will enable continuous monitoring of the city systems to include the utility, irrigation, communications, and sewage networks. The value of the proposed framework is that it will provide urban planners with an appropriate geographical representation of the city that may be used as a tool for decision making that will produce outcomes of long-term efficiency and cost reduction. Figure 2 shows the proposed SOA framework:



**Fig. 2. Proposed SOA Framework for Smart City**

The data is stored in the data layer and is distributed to several communication channels that are used by the human actors. The data layer addresses issues of data storage and management, data quality and the data movement and allows for the creation of reusable data services that can be used in the orchestration of business processes. The M2M communication takes place in the integration layer, which designed as an Enterprise Service Bus. Although the services are assigned to different areas of the infrastructure, the services are interrelated and therefore must be integrated to reflect the degree of interrelatedness [6] , The application layer of the SOA framework hosts the business processes, protocols and programming logic as a business process registry. The presentation layer hosts the human task mediations as a business service registry, where the interactions between services are defined. The architecture is codependent upon a strong governance system.

## 9. Service Oriented Based Education Systems

As the appropriation of SOA builds, numerous scholastic organizations are bringing SOA advances into their instruction frameworks, promising, and conveying more versatile and dependable training administrations. Numerous colleges have recognized the potential advantages of utilizing SOA for financial reasons, and for more propelled educating and information sharing various studies were directed to examine the advantages of utilizing SOA for smart learning frameworks as shown in figure.3.

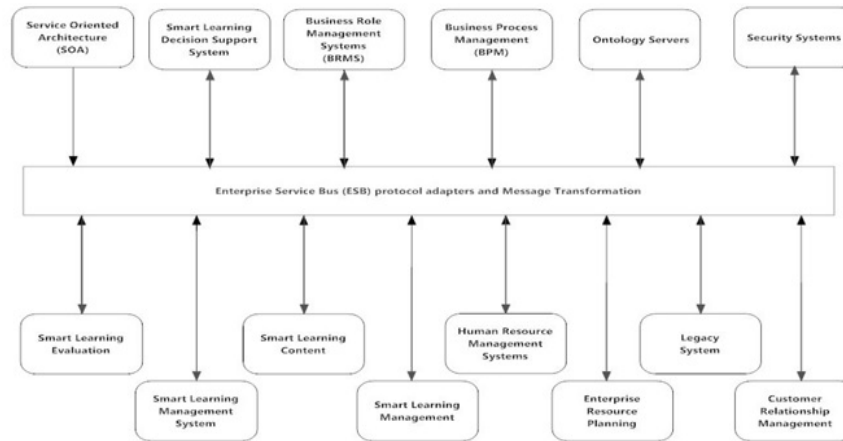


Fig. 3. Service Oriented Based Education Systems

### 9.1. Modeling and Implement of Smart Education System

A brief exhibit of the model in this segment represents how a segment engineering model of smart learning education could conceivably be executed. We are currently attempting to fabricate a complete model of our engineering and part demonstrate utilizing UML. The item is a smart learning education that gives history administration of put away information and benefit administration for every student as shown at figure 4.

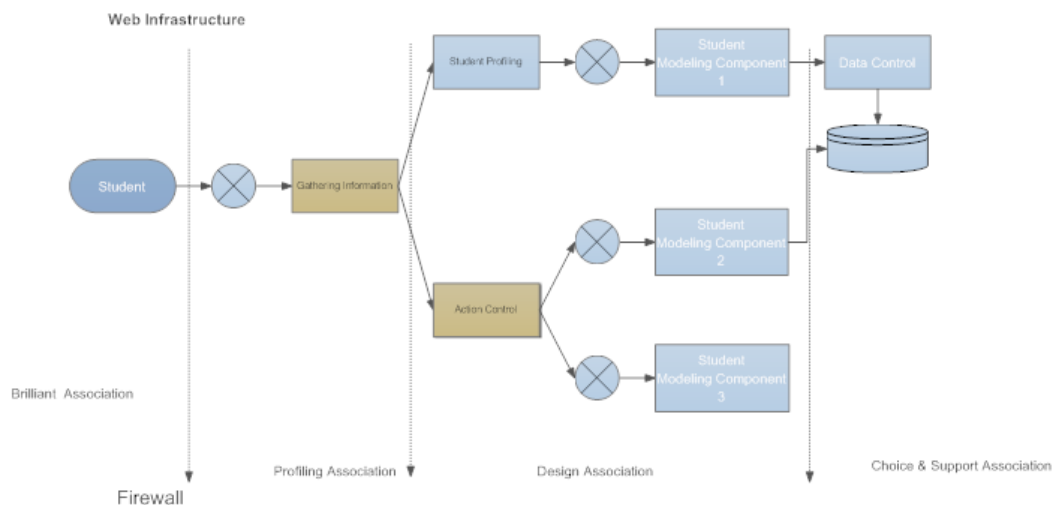


Fig.4. Component Architecture Model of Smart Education System

We presented the component architecture model of Smart Education System through the case of a user of Smart Education System. There are Smart Education Systems between student and server. Figures 4.5 illustrates how student in our Architecture Model of Smart Education System deals with obtaining information and sources through using web services, also student modeling assistant and retrieving, storing, manipulating data by Data Base Management System (DBMS).

### 10. Implementation of Proposed Framework

The approach to the construction of a SOA requires significant collaboration between the IT and the designated deployment to support the appropriate services and to avoid duplications by business silos [9]. The implementation of the proposed framework will focus upon development of the appropriate size for the Smart City project using a bottom-up approach. Figure 5 shows the proposed smart city framework from a bottom-up approach:

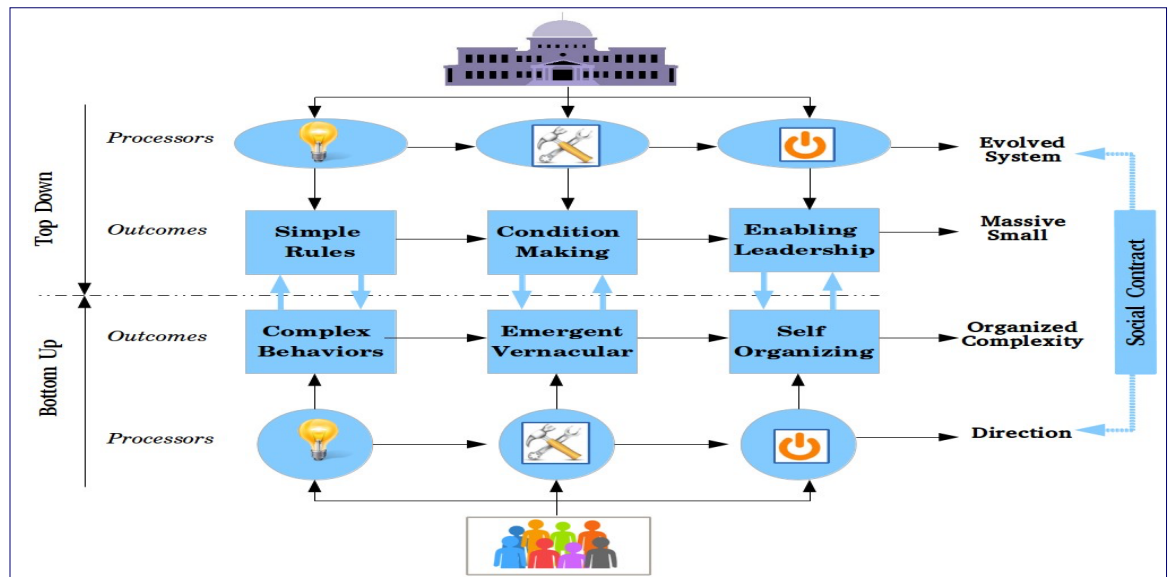


Fig. 5. Smart City Framework: Bottom Up

The system has a massive, small operating system with generative, simple rules, responsive condition making and permissive leadership functions. The bottoms up outcomes are spontaneous, adaptive, and cooperative, respectively. This approach is ideal for small urban projects and assesses the existing services and builds the business processes and services based upon the support needs of each service. Nahdan (2004) listed the following concerns as a guide to the steps to SOA deployment:

1. Identification of the service and primary functionalities.
2. Identification and assessment of service location.
3. Definition of the service domain.
4. Assessment of service orchestration and routing.

- 5. Determination of service governance.
- 6. Adoption of service messaging standards.

The generation of events during the subsystem operations needs to be stored within a database that provides for offline assessments. Falconer & Mitchell (2012) asserted that the primary objectives of SOA implementation for Smart Cities should produce outcomes of easily accessible catalog systems of the city content, specific definitions for the roles of the city stakeholders, and a taxonomy that enables benchmarking of content that is based upon the hierarchy of city components. Therefore, the implementation of the SOA will focus upon the deliverables and take an incremental approach to the development of each component of the system.

**10.1 Execution and Experimental Results**

The execution for PPSO way is calculated through the accompanying three variables:

(i) Cluster-To-Cluster (C2C) Distance – It speaks to divergence among clusters. It is figured given distinction among the cluster sentries greater C2C attitude speak to a greater level of cluster grouping. Figure 6 speaks to how the C2C qualities were computed in the PPSO.

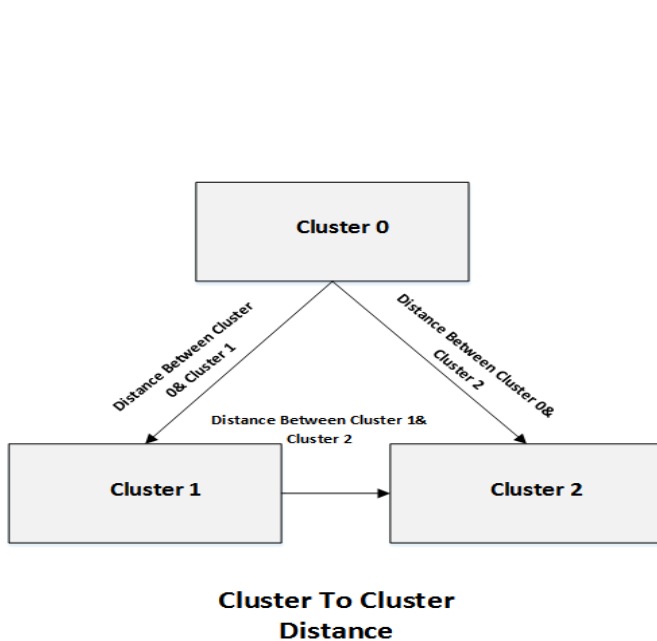


Fig.6. (C2C)Distance

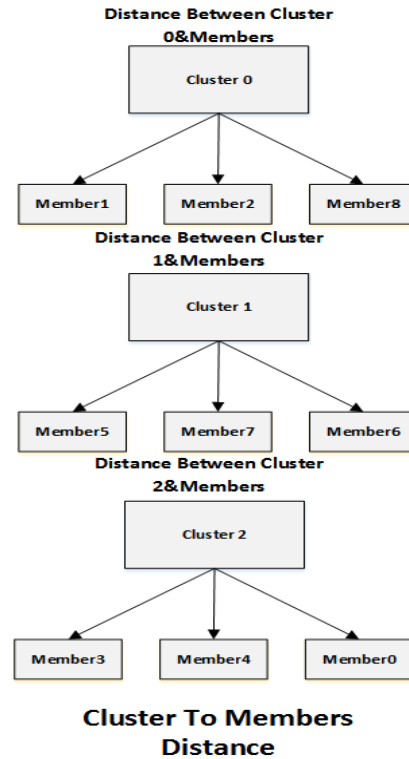


Fig.7.(C2M) Distance

(ii) Cluster-To-Member (C2M) Distance – It speaks to the total of separations among every one of the individuals having a place with the group which speaks to the smallness of the group. Little C2M values demonstrate a higher level of the smallness of groups. Figure.7 addresses a descriptive portrayal of (C2M) expel estimation between the cluster centroid also the people in any gathering.

(iii) Member-To-Member (M2M) Distance – It addresses contrast among the people in a cluster and over the gatherings. Figure.8 speaks to the descriptive depiction of (M2M) distance calculations.

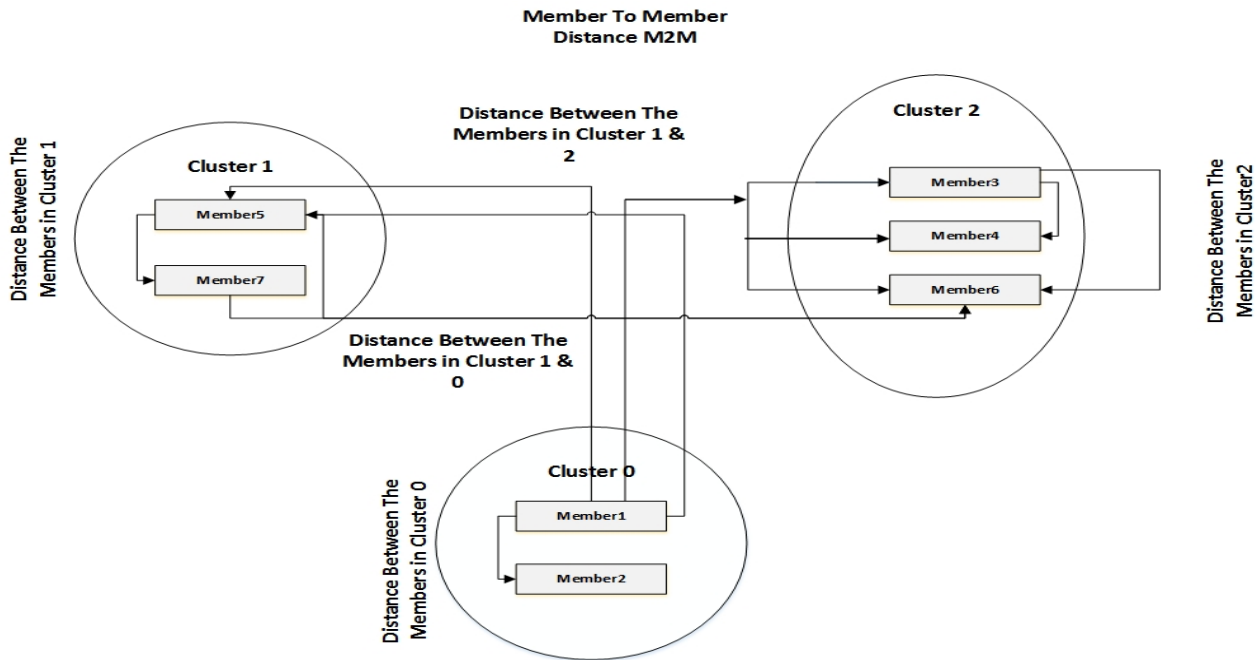


Fig.8. (M2M) Distance

Genuine information to trainees’ summarizes encounters was gathered and appraises on ability, meta-skill, and certainty [criterion](#) were figured. Is the framework gotten to by “N” number of trainees touching base at a standard interim of? considering the Poisson distributions. The reenactment investigation was led for an aggregate of 50–100 issues for every trainee

**11. Discussion**

Synchronization is the objective and the key to Smart City integration through SOA deployments. Densely populated, large urban centers can be extremely complex with compounded issues in regard to services such as transportation logistics and waste management. The Smart City capitalizes upon the existing engineering capabilities to develop a common IT space for the modernization of the city [2]. The SOA may be used to interconnect the city subsystems to achieve holistic analyses and the bridging of a diversity of services in a typical Smart City initiative. Overloads, resource consumption and the cost of resource consumption of just some of the monitoring functions that can be derived from the SOA in regard to municipal objects and services that are provided to the residents. The technical barriers to Smart City initiative implementations include that the scaling of more current technologies is unproven, modern technology challenge the status quo in municipal management strategies, and an overall deficiency in full understanding of technology between city sectors [3].

The smart city model integrates the city's economic, social, and environmental components in order to maximize resource management efficiency. Service oriented approaches enable agility within the scope of business and technical capabilities through the adoption of Web protocols in system deployments and sound tenets of system design. The framework that has been proposed in this paper can be used as a foundation to promote the organization of city resources, maximize the potential of e-services, and support municipal efforts for environmental sustainability.

Smart cities provide the citizens with interoperable E-services that improve the quality of life while fulfilling the environmental sustainability responsibilities of preservation and energy efficiency. A properly designed SOA will underpin the objectives that are reflected in the service governance for the smart city and will prove to be ideal in size and capabilities. Further, it is critical that the services and associated service providers are identified at the beginning of the project along with geographic issues that are unique to the targeted region. We pointed out that to fully develop the concept of a Smart City across a wide geographical target, the infrastructure must allow for sensor networks and heterogeneous geographic information to be integrated into a common ground. The challenges of SOAs for Smart Cities exist inside of the architecture design, implementation, and in the management.

The utilization of Smart Learning furthermore, (STL) is on the ascent among computerized locals close by our development towards smart social orders. In any case, the STL frameworks today do not have the important refinement due to a few difficulties including information investigation and administration, student framework intuitiveness, framework discernment, asset arranging, readiness, and scalability. We likewise examined the improvements around smart cities and smart social orders and featured the basic need of creating learning, and human and social capital for their enablement. It was examined that smart cities advancements would expand the part of gaining from standard "education for business" degree to the thought of social and collective administration where the general public will team up to prepare each other in keeping up its information, moral, great practice, flexibility, intensity, and for bringing development, and turning into a learning-based economy. We felt persuaded by the difficulties and openings encompassing the instruction business and computerized learners, as well as the advancements in urbanization, and proposed, in this thesis, (STL) Structure. Learning utilized IoT, Big Data, supercomputing, profound learning, versatile processing, and distributed computing to give upgraded advancement, administration, and conveyance of educating and learning in future city and smart society settings.

The advancement of new innovations empowers learners to take in more viably, proficiently, adaptably, and serenely. Smart learning, an idea that portrays learning in advanced age, has increased expanded consideration. This thesis examines the meaning of Smart learning and shows an applied structure. The smart learning method structure incorporates class-based separated direction, gather based communitarian learning, individual-based customized learning, and mass-based generative learning. Learning Analytics frameworks can investigate and measure learners' information to derive fitness, meta-ability, and certainty measures. While considering the necessities of understudies, the Learning Analytics framework additionally measures viability and effectiveness of the learning condition. These measures empower the Learning Analytics framework to auto-arrange and auto-redo itself to offer customized guideline and ideal learning pathways to understudies. We expect that the smart learning environments could decrease learners' cognitive load and enable learners to focus on sense making and facilitate ontology construction. In addition, more flexibility in the learning environment will be available for the learners. This flexibility will advance the development of personal and collective intelligence of learners. Furthermore, the SOA based smart learning will gain more attention in the smart cities projects.

## **12. Applying IOT-Based E-government: Example Case**

Having discussed the challenges associated with the adoption of IoT in e-government, we return to the application scenarios of IoT-based e-government systems to examine them through a specific example. The following paragraphs describe the application of IoT in providing alerts for weather phenomena. We assume several smart devices placed on a set of road vehicles. Such devices exhibit various functionalities, e.g., routing. End users may adopt these devices to calculate the shortest or the simplest path to perform their activities. In the central, cloud infrastructure, there is a service

available, delivered by the Civil Protection department of the Ministry of Internal affairs, which is capable of processing meteorological data and derive decisions in relation to intense meteorological events. IoT devices are subscribed in the service and are ready to receive data related to alerts for emergency or intense meteorological situations. As IoT devices are mobile, they should update their location in the central service. This is automatically performed through the exchange of light weight messages; thus, the central system is capable of knowing the location of the end users. Suppose the discussed service identifies intense meteorological events in a specific area. This area is continuously updated as the events are realized. The central system can perform a simple reasoning process and group the end users in a set of clusters according to the risk of being affected by the phenomenon. The groups are continuously updated to 'follow' the realization (e.g., change of location) of the phenomenon. Specific warning messages are delivered to users belonging to groups that are affected or will be affected by the phenomenon. IoT nodes after the reception of the messages can easily update their operation, e.g., update the routing results and follow a different route.

Based on the above example, one can easily identify the two core dimensions of the mobile IoT - e-government synergy: the IoT nodes and the e-government services. Usually e-government services are placed at the Cloud to increase efficiency and be beneficial from the increased computational capabilities while IoT nodes are close to citizens and, usually, change their location. The most important issue in this setting is to model the interaction between the two parts and define schemes that allow for high quality services to end users.

E-government services can easily be combined with systems that monitor the activity of end users as they are moving around and utilize it not only to update their location but also to update the IoT node operation. The principles of offering location-based services can be easily incorporated in the IoT e-government systems. However, location-based models should be enhanced by techniques for handling the heterogeneity of the devices and the functions they perform. IoT nodes can also be grouped to be monitored by the e-government services for offering 'personalized' services and avoid network flooding. Spatio-temporal clustering can be adopted to continuously generate clusters of IoT nodes. In this way, e-government services can target specific groups of users and support multiple roles. The modular approach and a role-based infrastructure can increase the efficiency in the delivery of data creating the basis for personalized e-government services.

### **13. Conclusion**

Smart cities provide the citizens with interoperable e-services that improve the quality of life while fulfilling the environmental sustainability responsibilities of preservation and energy efficiency [8]. A properly designed SOA will underpin the objectives that are reflected in the service governance for the Smart City and will prove to be ideal in size and capabilities. Further, it is critical that the services and associated service providers are identified at the beginning of the project along with geographic issues that are unique to the targeted region. Prandi et al (2014) pointed out that to fully develop the concept of a Smart City across a wide geographical target, the infrastructure must allow for sensor networks and heterogeneous geographic information to be integrated into a common ground.

The challenges of SOAs for Smart Cities exist inside of the architecture design, implementation, and in the management. Hashemi & Hashemi (2012) pointed to deficiencies in the integration and interaction of organizational systems and deficiencies in the adaption process for business changes as major challenges to the success of SOA deployments. Prandi's et al (2014) proposed SOA model reflected disadvantages of limited accessibility regarding the semantics of the city model and the magnitude of the interactive capacities of the city management functions.

Overall, the improvements that have been marked because of the successful implementation of an SOA have been tremendous considering the constant changes in the business and municipal landscapes. Duravkin (2010) concluded that SOAs potentially improve the manageability of the city resources in the contexts of reliability, speed and safety that translate to improvement to the quality of life of the residents. IoT adoption in e-government encompasses several challenges of technical as well as organizational, political, and legal nature, which should be addressed for developing efficient applications. With the application of IoT in e-government being at an early stage, it is imperative to investigate these challenges and the ways they could be tackled. The chapter provides an overview of IoT in e-government across several application domains and explores the aspects that should be considered and managed before it can reach its full potential.

## References

- [1] Daniel, S. Doran, M. 2013. geoSmart City: geomatics contribution to the smart city. In Proceedings of the 14th Annual International Conference on Digital Government Research. ACM. New York, NY. 65-71.
- [2] Duravkin, E. Using SOA for Development in Information System “Smart City”. TCSET. 2010.
- [3] Falconer, G. Mitchell, S. 2012. Smart City Framework. Cisco. Retrieved from <https://www.cisco.com/web/about/ac79/docs/ps/motm/Smart-City-Framework.pdf>
- [4] Hashemi, S. Hashemi, S. A Novel Service Oriented Architecture for the Integration of Information Systems in Electronic City. International Journal of Scientific & Technology Research. Vol. 1. No. 11. 2012.
- [5] KonzeptUSA. 2007. INFINET Platform. Retrieved from standard framework in which city services are developed, implemented and managed in order to increase the agility of the IT processes for rapid business change outcomes.
- [6] Nadhan, E. 2004. Service-Oriented Architecture: Implementation Challenges. Microsoft Developer Network. Retrieved from <https://msdn.microsoft.com/en-us/library/aa480029.aspx>
- [7] Prandi, F. Soave, M. Devigili, F. Andreolli, M. De Amicis, R. Services Oriented Smart City Platform Based on 3D City Model Visualization. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. 2. No. 4. 2014.
- [8] Rolim, C. Rosseto, A. Leithardt, V. Borges, G. dos Santos, T. Souza, A. Geyer, C. An Ubiquitous Service-Oriented Architecture for Urban Sensing. Agent Technology for Intelligent Mobile Services and Societies. Vol. 498. pp. 1-10. 2015.
- [9] Search CIO. 2009. Best practices for a SOA implementation and application integration. Techtarget. Retrieved from <http://searchcio.techtarget.com/Best-practices-for-a-SOA-implementation-and-application-integration>
- [10] Townsend, E. 2008. The 25 year History of Service Oriented Architecture. Retrieved from [http://www.eriktownsend.com/look/cat\\_view/9-library/5-white-papers/4-white-papers-technology](http://www.eriktownsend.com/look/cat_view/9-library/5-white-papers/4-white-papers-technology)
- [11] M. Al-Hader, A. Rodzi, A. R. Sharif, and N. Ahmad. Smart city components architecture. In Computational Intelligence, Modelling and Simulation, 2009. CSSim '09. International Conference on, pages 93-97, 2009.

- [12] Metawa, N., Elhoseny, M., Hassanien, A.: An automated information system to ensure quality in higher education institutions. In: 12th International Computer Engineering Conference (ICENCO), IEEE (2016), doi:10.1109/ICENCO.2016.7856468
- [13] Elhoseny, H., Elhoseny, M., Abdelrazek, S., Bakry, H., Riad, A.: Utilizing service oriented architecture (SOA) in smart cities. *Int. J. Advancements Comput. Technol. (IJACT)* 8(3), 77– 84 (2016)