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# Improving Solution Architecture of Internet of Things to Support a Successful Implementation of Digital Transformation in the Context of 2030 vision of Saudi Arabia

[1]Alanoud Alsudairy, [2]Dr.Ahmed Alsanad, [3]Dr.Ahmed Emam
[1] King Saud University ,[2] King Saud University , [3]King Saud University

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***Abstract:***
Internet of Things (IoT) is an information exchange system between computing devices and people over a network. Because IoT is new to Saudi Arabia (SA), no business model in the public sector provides it, making it difficult to adopt. The results of 55 studies show that one challenge for adopting IoT in SA is a lack of a consistency in designing a dynamic solutions architecture to coordinate the required support to integrate IoT into the SA digital transformation plan. Another challenge is a lack of government standards. This study summarizes the problems that researchers and developers face in managing IoT activities for a dynamic solutions architecture for Saudi Vision 2030. It explores how to define a dynamic solutions architecture for any IT platform, based on design, implementation, experimental validation, and evaluation of the effects on system quality. To begin, this study provides an overview of IoT and details to enable IoT technologies for public and private sectors to help achieve Saudi Vision 2030.

***Keywords**: Computer-based model, digital transformation, Internet of Things (IoT), platform, Saudi Vision 2030, solutions architecture.*

## INTRODUCTION

Although a wide range of individuals characterize the term, its underlying use has been ascribed to a specialist on computerized advancement named Kevin Ashton [50]. A common thread in all of the proposed definitions is that the Internet was originally a repository of information created by humans, while the subsequent form will include information created by 'things') i.e., devices (, which is why it is called the Internet of things. Additionally, the IoT is commonly characterized as a dynamic worldwide system foundation with self-designing capacities dependent on principles and interoperable correspondence conventions; physical and virtual 'things' in an IoT have Personalities and traits and are equipped for utilizing astute interfaces and being incorporated as a data arrange. [50]The motivation behind the IoT is to expand the elements of the Web and make it progressively more helpful. With the IoT, clients can share data generated by people and contained in databases, as well as by devices in the physical world [52]. The basic concept of the IoT is that personal computers (PCs), sensors, and objects or devices cooperate with one another and produce information; thus, the IoT can be considered an innovation framework enhanced by various data advancements. The Web of things (WoT) consolidates various advances into a semi-self-sufficient system. It provides an interface that connects singular gadgets to the system and to one another. There are also controller frameworks in the WoT system (i.e., programming and architectures) that provide a framework for handling information by investigating and utilizing the information gathered by associated gadgets to make decisions and facilitate activities initiated by gadgets [8].

The main objective of this research study is to determine the impact of IoT on digital transformation for Saudi Vision 2030. The following questions can help to determine the impact of IoT:

Question 1: What is the current status of the IoT as it relates to SA's Vision 2030 digital transformation objective?

Question 2: Which dynamic solutions architecture is best suited for designing IoT applications?

The goal of this research is to examine the impact of IoT on digital transformation within Saudi Vision 2030. This investigation will result in the design of a dynamic solutions architecture that suits public and private IT platforms. To achieve this goal, we define the following objectives:

- Conduct a literature review to assess the current status of the IoT as it applies to digital transformation within SA's Vision 2030.
- Explore the current status of ensuring privacy as it relates to digital transformation within SA's Vision 2030.
- Investigate dynamic solutions architectures and identify which type is most suitable for designing IoT applications.
- Develop a dynamic solutions architecture suitable for designing IoT applications.

This paper focuses on designing a dynamic solutions architecture for SA to develop a practical decision framework that addresses business, functional, technical, and implementation perspectives.

The rest of this paper is organized in the following sections: Section II investigates related work and presents the IoT technology that has been applied and the challenges it created. Section III explores IoT reference architecture requirements. Section IV highlights an analysis of IoT reference architecture projects. Section V describes the proposed design of the dynamic solutions architecture. Section VI summarizes the paper and mentions future works and improvements for the research.

## RELATED WORK

New issues that emerge from the development of innovation, areas, and interfaces in PC gadgets lead to an expanding number of clients with various profiles that are influenced by such factors as culture, age, exceptional needs, and level of involvement in innovation. The accompanying areas speak to a diagram of these kinds of issues. To comprehend the fundamentals of the IoT idea, we consider the five primary pieces of IoT: sensors, an entryway, the cloud, the perceptive city, and Social IoT, as appeared in Fig. 1.

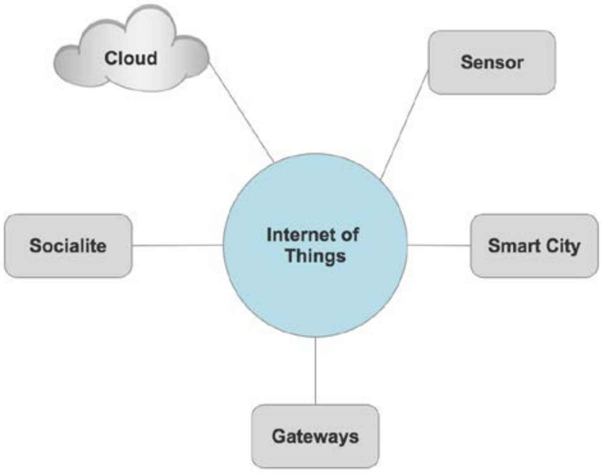


***Fig. 1** The IoT concept.*

### *A. IOT and Digital Transformation*

The IoT depends on common media transmission systems and other data transporters and is an expansion of the original Web. The Web terminal is a PC or server, which runs a wide range of programs [8]. No other terminals (i.e., equipment) are associated with the Web. Although the fundamental idea behind the IoT is the Web, it is different in that PC and servers, as well as inserted PC frameworks and their supporting sensors, can be treated as terminals. It can interface many types of autonomous items and structure them to work together and build a useful, interconnected network [52]. This is the unavoidable outcome of continued software engineering and innovation improvements. PCs needs to serve humans in a wide range of functions, such as in ecological observation gear and computer-generated reality hardware.

Regardless of the length of time or type of equipment or items interface with the Web or the event triggering the exchange of information, it is called the IoT [50].

Digital transformation is changing the way we live, work, learn. The IoT will change everything, including ourselves [23] [11]. Although the IoT offers new opportunities, it also bring new challenges, including interactions between devices/objects, levels of implementation, and security concerns [55]. However, many studies (e.g., [3], [4], [8], [11], and [14]) have discussed the future of the IoT as expecting to bind together everything in our reality under framework. IoT deployment is a relatively new field of study and is considered the leading technology in digital transformation. The IoT is one of the most important components of digital transformation and can connect many devices that are present in its ecosystem [37], [36]. The creation of a dynamic solutions architecture will motivate further development in the IoT domain. Furthermore, the IoT is considered one of the major factors involved in digital transformation that will help achieving SA’s Vision 2030 [1]. For SA to reinforce its situation in computerized administrations and the Improvement of brilliant urban communities, endeavors ought to be increasingly cantered around framework, guideline, instruction, business enterprise, and guidelines on information protection and security to guarantee a sheltered information sharing condition [26].

Digital transformation otherwise called digitalization implies a game plan driven by 'the progressions related with the utilization of computerized innovation in all parts of human culture' [30]. In contemporary writing, digitalization is a 'worldwide megatrend that is in a general sense changing existing worth chains crosswise over ventures and open segments' [28] and the terms 'versatile applications, 'huge information', machine-to-machine, IoT, the modern Internet, and Industry 4.0' are utilized to portray this marvel [28].

The information services division (ISD) has investigated advanced change through five interrelated points of view and key patterns (i.e., vital, social and moral, authoritative, innovative, and administrative). Vital patterns remember problematic changes for the business atmosphere that have definitely prompted the arrangement of new systems and networks, just as money related markets. In view of the current cultural and moral patterns, relations inside social orders will vary as they are advancing and adjusting to the proceeded with improvement of IT, which is moving the standards of lead. Hierarchical patterns incorporate how the conventional structures of liquid types of association. Current mechanical patterns show as educational ancient rarities include become typical inside the advanced and physical circle, fast improvement inside IT and development innovation have become pivotal components. Finally, there are administrative patterns; as new measures and guidelines rise, significant arrangement is expected to guarantee that the change towards new administrative structures are set up [28].

### A. *Technologies of IoT*

IoT consists of a lot of new technologies. The key technologies are sensors and actuators, network communication, smart city, and cloud computing technologies.

#### 1) *Sensors and actuators*

An actuator is a kind of gadget worked by a wellspring of vitality that can control or move a framework or a system wherein the control structure can be essential (i.e., a basic mechanical or electronic system), programming- based (e.g., a printer driver or a robot control structure), a human, or some other wellspring of data [44]. Sensors are fundamental parts of shrewd items; one of the most significant parts of the IoT is setting mindfulness, which is unimaginable without sensor innovation. These sensors are generally little in size, are ease and expend negligible power [26].Radio recurrence recognizable proof (RFID) is a framework that transmits the personality of an item or individual as sequential number RFID remotely utilizing radio waves. This innovation assumes a significant job in the IoT in illuminating recognizable proof issues, as it is dependable, effective, verified, reasonable, and exact. The primary parts of RFID are a tag, per user, and reception apparatus; get to controller, handset, transponder, programming, and server [2]. RFID labels are more profitable than scanner tags since they are decipherable from a long separation, rewritable, effective, and blocked [14]. RFID innovation is ordered into three classifications: aloof, dynamic, and semi-uninvolved [2]. To guarantee the privileges of people are regarded when RFID labels are utilized, all IoT partners must be made mindful of their privileges and obligations in the securing, ownership, arrangement, and the executives of IoT gadgets/objects [12].A remote sensor organize (WSN) comprises of spatially conveyed, autonomous gadgets that utilization sensors to helpfully screen a physical circumstance or the earth. Remote components of the IoT model have gotten significant consideration in numerous areas, for example, in space investigation, the military, country security, human services, exactness horticulture observing, fabricating, environment checking, and backwoods fire and flood identification [2]. The sensor hub has four fundamental segments: a radio, a processor, sensors, and a battery. WSNs can incorporate countless hubs, self-association, autonomous activity, and consistent area interoperability. Two highlights recognize WSNs from machine-to-machine Technology (M2M): different sensors are the main comprehensive equipment structure in WSNs, and correspondence is only remote [6], [16]. Incorporating WSNs into IoT innovation will supply smart vitality the executives in structures, yielding clear monetary and ecological advantages. Web correspondence encourages getting to a structure's Vitality data and control frameworks from a workstation or a cell phone worked from anywhere on the planet [11].

### 2) *Gateway and network*

Gateways simplify IoT networks by supporting the association of various associated devices and unifying the great diversity and variety of data generated by different network devices. There are two common approaches to implementing an IoT gateway: simple or embedded control [45]. Communication is not limited to person-to-person; it can be person-to- things and things-to-things. M2M communication shares M2M communication involves broadcasting messages over a short range via wired or wireless networks after receiving data sent by devices over a short range via wired or wireless networks by capturing events from devices. It is classified under three domains [18]:

- The application domain, which specifies the functions of the services provided by the provider to end users.
- The network domain: The domain specifies the connection between M2M gateways and M2M applications.
- The M2M device domain: The domain specifies the connection between M2M gateways and the M2M device.

Different conventions and benchmarks are engaged with IoT interchanges: Internet convention rendition 6 (IPv6), Internet convention form 4 (IPv4), IPv6 over a low power remote individual region organize (6LoWPAN),Compelled application convention (CoAP), transmission control convention (TCP), and client datagram convention (UDP), which takes need over TCP moves [8].

### 3) *Cloud computing*

Cloud computing (CC) involves a set of server and network technologies that outsource IT actions to one or more third parties that have many resources to meet organizational needs easily and efficiently [25]. IoT cloud services will be more scalable than the current Internet cloud services to ensure more connections between devices and applications in its calculations and storage, which will facilitate handling massive volumes of requests from users. CC is the most good and practical answer for managing information delivered by the IoT, and it makes another relationship for information accumulation, combination, and offering to outsiders [9], [11]. CC server booking calculations show that the proposed planning calculation builds the presentation of homogeneous and heterogeneous frameworks by up to 40% [7], [11].

#### 4) *Smart city*

A smart city is defined as a city that capacities cleverly by coordinating the entirety of its framework and administrations and utilizing wise gadgets for observing and control. To guarantee manageability and effectiveness, a shrewd city (see Figure 5) needs interoperability between IoT arrangements [40].

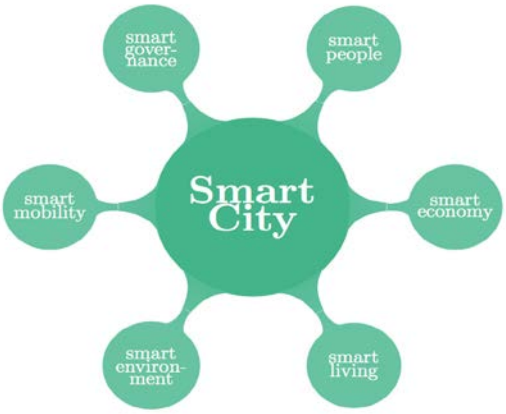


***Fig. 4.*** *The smart city concept* [40].

### B. ***IoT solution architecture***

A solution architecture is a theoretical system used to understanding huge connections among substances in a domain [59]. IoT arrangement engineering gives the most noteworthy deliberation level to the meaning of an IoT design reference model. A reference model builds up shared belief for IoT designs and frameworks [56], and a couple of norms boards of trustees have endeavoured to set up such a model. Among them, the International Telecommunication Union (ITU) proposed a far reaching reference model for IoT situations [56] that is made out of four layers and Incorporates the executives and security abilities, which are related with

The four layers (i.e., application, administration and application backing, system, and gadget layers) [60].The application layer contains IoT applications, while the administration and application bolster layer comprises of basic abilities that can be utilized by various IoT applications and different nitty gritty ability groupings to give unmistakable assistance abilities to different IoT applications. Significant control elements of system availability and IoT administrations and application are given by the system layer, and in the gadget layer, direct/circuitous gadget connection with the entryway and correspondence organize is performed. The executives capacities incorporate overseeing gadgets and information traffic, while security abilities include, for instance, authorization, confirmation, application information classification and uprightness assurance, protection insurance, security reviews, hostile to infection administrations. A reference engineering maps onto programming components that actualize the usefulness characterized in the reference model [59]. Delegates of the gigantic number of IoT innovation and item associations must fortify endeavors to coordinate IoT structures [4], [23]. The design of the IoT ought to be fabricated uniquely in contrast to the present Internet and has three levels: observation, arrange, system, and application layers. The principle capacity of the observation layer is to acquire data by means of RFID, sensors, and two-dimensional codes. The system layer is forms the two-path transmission of observation information and control data.

### *C. The IoT Supports SA's Vision 2030 Digital Transformation Objective*

Saudi Arabia "Vision 2030" comprises 96 strategic objectives, governed by a number of Key Performance Indicators (KPIs) that will be achieved through a number of initiatives developed and executed by different governmental entities alongside private and nonprofit organizations within the respective ecosystems. The Council of Economic and Development Affairs has set up an effective and integrated governance model with the aim of translating “Vision 2030” into multiple Vision Realization Programs (VRPs) working in parallel to accomplish the vital goals & realize the vision.

To assemble the limit and capacities required to accomplish the driven objectives of "Vision 2030," the National Transformation Program was propelled as a VRP including 24 government organizations. It intends to create administrative work and build up the required foundation to accomplish "Vision 2030" aspiration and prerequisites.

The National Transformation Program consists of eight main themes. Improve Living Standards and Safety is one of these themes, which seeks to elevate Saudi cities to become smart cities with high-quality services and infrastructure. Adopting IoT technology can add a massive value in the urban planning and development of cities for instance, in order to achieve the targeted strategic objectives, such as Improve the Quality of Services Provided in Saudi Cities, and Enhance Traffic Safety.SA has included a digital transformation objective in its Vision 2030 goals. The Kingdom’s digital transformation program can be considered as supporting economic transformation by moving toward decreasing SA’s dependence on oil and developing its other industries, including the technology sector [61]. SA is investing a great deal of support and funding in its IT sector, including encouraging creative and innovative thinking

Among Saudi youth to prepare them for their future role in this sector [58]. With the support of leading global and local companies and by combining their expertise, knowledge, and resources, as well as oversight by the Ministry of Communication and Information Technology, the Saudi government will realize its Vision 2030 goals and establishing partnerships to support this transformation [61]. The IoT is emerging, and SA is taking the lead in the region by building and reinforcing its IT infrastructure [58].

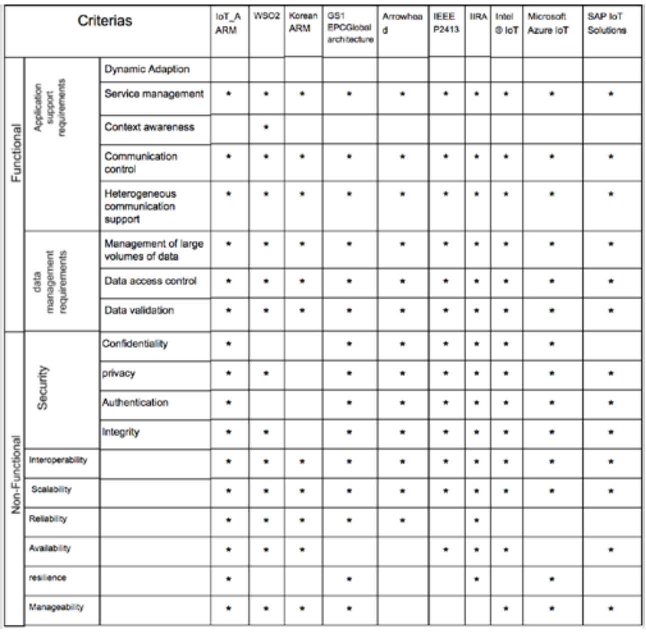
## ANALYSIS OF IoT REFERENCE ARCHITECTURE PROJECTS

The reference architectures described previously are comparable in specialized ideas and standards, yet they contrast in their innovation methodologies and usage. To achieve better platform and systems in IoT, a reference architecture must fulfill most of the requirements.

This section summarizes the 48 reference architecture projects based on the recorded requirements. Fig. 8 through Fig. 11 show a comparison of the results. However, 38 of the reference architectures gave good results in regard to the criteria evaluation, and 10 of them produced weak results in the evaluation. Heterogeneous communication support, management of large volumes of data, and data validation are important issues in data mining and IoT systems. The IoT platform as a service (iPaaS), ELAA, VITAL, PTC IoT, Purdue Enterprise, Freescale, CALIPSO, Mobility First-based, and ekoNET architectures did not reference this capability. However, the ekoNET and symbIoTe architectures missed the security issue considerations, but all reference architectures missed to be dynamic architectures and save the timeline.

As appeared in Fig (8,9,10 and 11) , the entirety of the non-functional requirements are included by the four IoT reference engineering ventures. A portion of the useful prerequisites is not tended to by these undertakings. Among them, dynamic adaption ought to be considered in the IoT reference design, because of the high dynamicity of IoT situations.

The reference engineering of IoT frameworks should bolster setting mindfulness. Just WSO2 underpins setting mindfulness not at all like different tasks. It underpins the usage that include capacities for a protected human body. Appropriately, it asserts that it is adaptable and altered and has autonomic administrations dependent on the related setting of IoT segments.

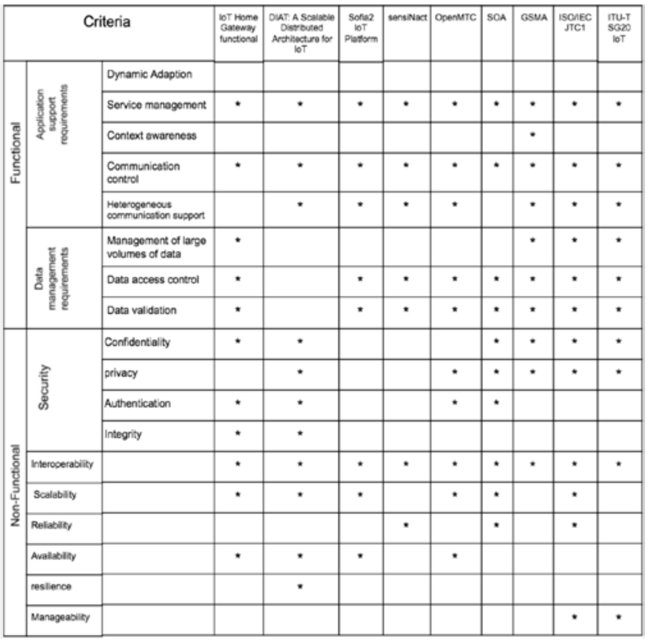


| Criterias | | | IoT_A ARM | WSO2 | Korean ARM | GS1 EPCGlobal architecture | Arrowhead | IEEE P2413 | IIRA | Intel ® IoT | Microsoft Azure IoT | SAP IoT Solutions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Functional | Application support requirements | Dynamic Adaption | | | | | | | | | | |
| | | Service management | * | * | * | * | * | * | * | * | * | * |
| | | Context awareness | | * | | | | | | | | |
| | | Communication control | * | * | * | * | * | * | * | * | * | * |
| | | Heterogeneous communication support | * | * | * | * | * | * | * | * | * | * |
| | data management requirements | Management of large volumes of data | * | * | * | * | * | * | * | * | * | * |
| | | Data access control | * | * | * | * | * | * | * | * | * | * |
| | | Data validation | * | * | * | * | * | * | * | * | * | * |
| Non-Functional | Security | Confidentiality | * | | | * | * | * | * | * | * | |
| | | privacy | * | * | | * | * | * | * | * | * | * |
| | | Authentication | * | | | * | * | * | * | * | * | * |
| | | Integrity | * | * | | * | * | * | * | * | * | * |
| | Interoperability | | * | * | * | * | * | * | * | * | * | * |
| | Scalability | | * | * | * | * | * | * | * | * | * | * |
| | Reliability | | * | * | * | * | * | | * | | | |
| | Availability | | * | * | * | | | * | * | * | | * |
| | resilience | | * | | | * | | | * | | * | |
| | Manageability | | * | * | * | * | | | | * | * | * |

*Fig. 8.* *Analysis of reference architecture projects (part 1 of 4).*

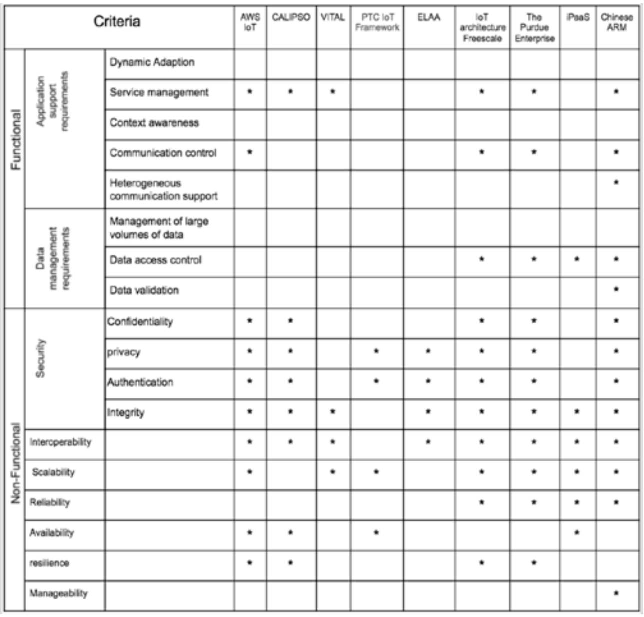
| Criteria | | | SiteWhere | FIWARE | EBBITS | BETaaS | IBM IoT | Oracle's Internet of Things Platform | Google Cloud IoT | Predix:The Industrial Internet Platform | IoT Accelerator Platform | Bosch IoT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Functional | Application support requirements | Dynamic Adaption | | | | | | | | | | |
| | | Service management | * | * | * | * | * | * | | * | * | * |
| | | Context awareness | | | | | | | | | | |
| | | Communication control | * | * | * | * | * | * | * | * | * | * |
| | | Heterogeneous communication support | * | * | * | | * | * | | | | |
| | Data management requirements | Management of large volumes of data | * | * | * | * | * | * | * | * | * | |
| | | Data access control | * | * | * | * | * | * | * | * | * | |
| | | Data validation | * | * | * | * | * | * | * | * | * | |
| Non-Functional | Security | Confidentiality | * | | * | * | * | * | * | * | * | * |
| | | privacy | * | * | | * | * | * | * | * | * | * |
| | | Authentication | * | | * | * | * | * | * | * | * | * |
| | | Integrity | * | * | * | * | * | * | | * | * | * |
| | Interoperability | | * | * | * | | * | | | | | |
| | Scalability | | * | * | * | | * | * | * | * | * | |
| | Reliability | | | | | * | | | | * | | * |
| | Availability | | * | * | * | * | | | * | | | |
| | resilience | | * | | | | * | * | | | * | * |
| | Manageability | | | | | | | * | | | | |

*Fig. 9.* *Analysis of reference architecture projects (part 2 of 4).*



| Criteria | | | IoT Home Gateway functional | DIAT: A Scalable Distributed Architecture for IoT | Sofia2 IoT Platform | sensiNact | OpenMTC | SOA | GSMA | ISO/IEC JTC1 | ITU-T SG20 IoT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Functional | Application support requirements | Dynamic Adaption | | | | | | | | | |
| | | Service management | * | * | * | * | * | * | * | * | * |
| | | Context awareness | | | | | | | * | | |
| | | Communication control | * | * | * | * | * | * | * | * | * |
| | | Heterogeneous communication support | | * | * | * | * | | * | * | * |
| | Data management requirements | Management of large volumes of data | * | | | | | | * | * | * |
| | | Data access control | * | | * | * | * | * | * | * | * |
| | | Data validation | * | | * | * | * | * | * | * | * |
| Non-Functional | Security | Confidentiality | * | * | | | | * | * | * | * |
| | | privacy | | * | | | * | * | * | * | * |
| | | Authentication | * | * | | | * | * | | | |
| | | Integrity | * | * | | | | | | | |
| | Interoperability | | * | * | * | * | * | * | * | * | * |
| | Scalability | | * | * | * | | * | * | | * | |
| | Reliability | | | | | * | | * | | * | |
| | Availability | | * | * | * | | * | | | | |
| | resilience | | | * | | | | | | | |
| | Manageability | | | | | | | | | * | * |

*Fig. 10.* *Analysis of reference architecture projects (part 3 of 4).*



| Criteria | | | AWS IoT | CALIPSO | VITAL | PTC IoT Framework | ELAA | IoT architecture Freescale | The Purdue Enterprise | iPaaS | Chinese ARM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Functional | Application support requirements | Dynamic Adaption | | | | | | | | | |
| | | Service management | * | * | * | | | * | * | | * |
| | | Context awareness | | | | | | | | | |
| | | Communication control | * | | | | | * | * | | * |
| | | Heterogeneous communication support | | | | | | | | | * |
| | Data management requirements | Management of large volumes of data | | | | | | | | | |
| | | Data access control | | | | | | * | * | * | * |
| | | Data validation | | | | | | | | | * |
| Non-Functional | Security | Confidentiality | * | * | | | | * | * | | * |
| | | privacy | * | * | | * | * | * | * | | * |
| | | Authentication | * | * | | * | * | * | * | | * |
| | | Integrity | * | * | * | | * | * | * | * | * |
| | Interoperability | | * | * | * | | * | * | * | * | * |
| | Scalability | | * | | * | * | | * | * | * | * |
| | Reliability | | | | | | | * | * | * | * |
| | Availability | | * | * | | * | | | | * | |
| | resilience | | * | * | | | | * | * | | |
| | Manageability | | | | | | | | | | * |

*Fig. 11.* *Analysis of reference architecture projects (part 4 of 4).*

The graph in Fig. 12 shows a ranking of all criteria for an IoT architecture. The most important criteria in this architecture and number of architecture is service management (44), communication control (44), heterogeneous communication support (28), management of large volumes of data (29), data access control (40), data validation (36), confidentiality (32), privacy (37), authentication (33), integrity (34), interoperability (37), scalability

(36), availability (22), and resilience (18). The least important criteria for an IoT architecture is manageability (11) reliability (16), dynamic adaption (0), context awareness (2), and resilience (18).

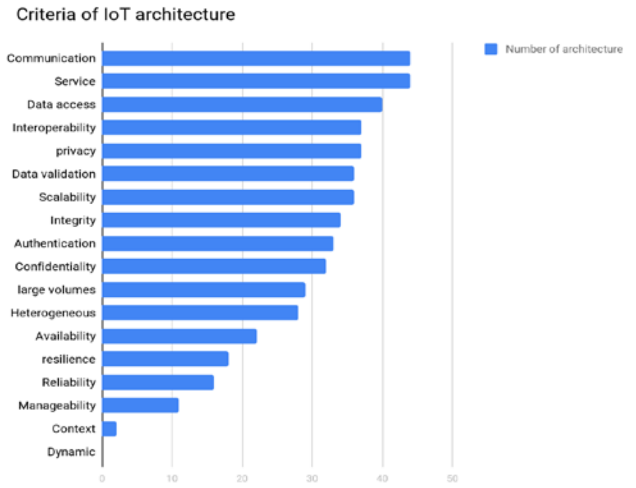


***Fig. 12.*** *Criteria for an IoT architecture.*

The graph in Fig. 13 shows according to survey data collected from 48 reference architecture projects based on the recorded requirements, IoT criteria architecture the highest criteria achieved service management and communication control (8.8%), data access control (8.0%), interoperability and privacy (7.4%), data validation and scalability (7.2%),integrity (6.8%),authentication (6.6%), confidentiality (6.4%), management of large volumes of data (5.8%), heterogeneous communication support (5.6%), availability (4.4%) and resilience (3.6%). The least important criteria for an IoT architecture is manageability (3.2%) reliability (2.2%), dynamic adaption (0%).

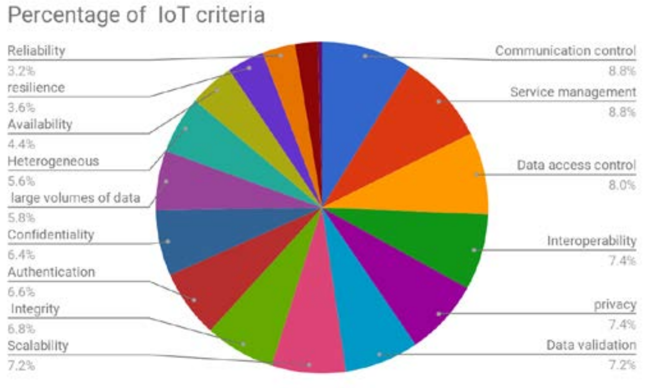


***Fig. 13.*** *Percentage of IoT criteria*

## PROPOSED MODEL ARCHITECTURE AND DESIGN

The proposed model architecture has five main layers:

1. The *Infrastructure of the System layer* consists of the supporting technologies that are needed for the distributed system to function. These technologies might include the database server, the application servers, web servers, and smart city.
2. The *Device layer* consists of the various types of sensors and actuators. However, to be considered as IoT devices, they must have an indirect or direct connection to the Internet sensor. They should also be able to collect data for specific systems.
3. The *Communication layer* provides M2M and nature of administration (QoS) and directs information move needs to recognize and control the quality with which a help can be gotten to by its clients. An entryway empowers gadgets that are not straightforwardly associated with the Internet to arrive at cloud administrations and ensures the availability of the gadgets. There are various potential conventions for correspondence between the gadgets and the cloud. Three potential conventions are HTTP, MQ Telemetry Transport (MQTT), and CoAP. They bolster gadgets that are associated with various kinds of wired and remote advancements. They deal with different interfaces that procedure and break down the data that is sent by sensors and actuators that are associated with the Internet.The *Cloud Platforms layer* helps to abstract data, extract stored information, aggregate it, transfer it, and manage the data flow. Information stream analytics, data analytics, and data management are required to extract the necessary information from data that is collected via devices. Such protocols as CoAP, MQTT, and custom protocols for IoT cloud platform collect, manage, and analyze sensor data for IoT and M2M applications to yield a valuable result from all the data that is collected.
4. The *Application layer* provides simple software, applications, and customer interfaces to end users. Data visualization is important for data representation in a form that users understand and

can interpret. The high-level application-programming interface (API) is a market-leading API management solution that enables automated API creation that are responsible for effective utilization of the data that is collected. The API supports both pushing data to applications and pulling data on demand via applications.

These layers interact with each other to produce a comprehensive and productive design of a dynamic solutions architecture that suits any IT platform in an efficient way.

When building an IoT system, to provide a framework that allows users to create their own IoT applications, it is important to consider security on all layers. Security capacities incorporate approval, verification, application information secrecy, trustworthiness insurance, security assurance, security review, and antivirus. Fig. 14 shows the significant level design of the proposed model.

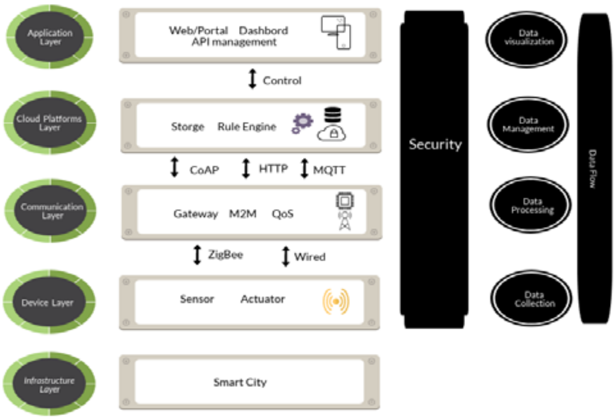


***Fig. 14.*** *Proposed model architecture and design*

## CONCLUSION

IoT is one of the physical worlds that is becoming an information system of sensors and actuators that are embedded in physical objects. It represents a world where just about anything can be connected and communicated in an intelligent fashion. No single unified design for a dynamic solutions architecture can suit both public and private sectors. This study examined the impact of IoT in digital transformation for Saudi Vision 2030, which will result in designing dynamic solutions for architecture that can fit both public and private IT platforms. The challenge that we face is to design a dynamic solutions architecture in SA to develop a practical decision framework that addresses business, functional, technical, and implementation perspectives. We expect to provide more transparency and raise awareness on how the changes that come with IoT affects the digital transformation of SA.

To design a dynamic solutions architecture, we must conduct extensive research to assess the status of IoT with respect to digital transformation for Saudi Vision 2030, the challenges that IoT face, and the appropriateness of the available solutions. We can evaluate the dynamic solutions architecture by applying a wearable computing sensor that is compatible with the standards of our framework. Future studies will provide more transparency and raise awareness on how the changes that come with IoT will affect the digital transformation of SA.

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