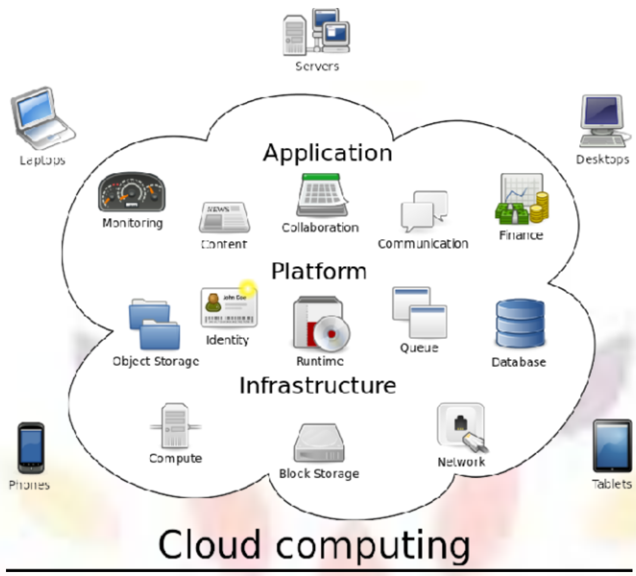
UNIT– 5

The Internet of Things (IoT) involves the internet-connected devices we use to perform the processes and services that support our way of life. Another component set to help IoT succeed is cloud computing, which actsasasortoffrontend.Cloudcomputingisanincreasinglypopularservicethatoffersseveraladvantagesto. Memory and space constraints can be minimized if an application is instead hosted on the internet. The worker can use a cloud computing service to finish their work because the data is managed remotely by a server. Another example: you have a problem with your mobile device and you need to reformat it or reinstall the operating system. You can use Google Photos to upload your photos to internet-based storage. After the reformat or reinstall, you can then either move the photos back to you device or you can view the photos on your device

In truth, cloud computing and IoT are tightly coupled. The growth of IoT and the rapid development of associated technologies create a widespread connection of "things." This has lead to the production of large amounts of data, which needs to be stored, processed and accessed. Cloud computing as a paradigm for big data storage and analytics. While IoT is exciting on its own, the real innovation will come from combining it with cloud computing. The combination of cloud computing and IoT will enable new monitoring services and powerfulprocessingofsensorydatastreams.Forexample,sensorydatacanbeuploadedandstoredwithcloud computing, later to be used intelligently for smart monitoring and actuation with other smart devices. Ultimately, the goal is to be able to transform data to insight and drive productive, cost-effective action from thoseinsights. Thecloud effectively serves as thebrain to improved decision-making and optimized internet-based interactions.However, when IoT meets cloud, new challenges arise. There is an urgent need for novel network architectures that seamlessly integrate them. The critical concerns during integration are quality of service (QoS) and quality of experience (QoE), as well as data security, privacy and reliability. The virtual infrastructureforpracticalmobilecomputingandinterfacingincludesintegratingapplications,storagedevices, monitoring devices, visualization platforms, analytics tools and client delivery. Cloud computing offers a practical utility-based model that will enable businesses and users to access applications on demand anytime and from anywhere.



Service models

Service delivery in cloud computing comprises three different service models: software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

Softwareas a service(SaaS) provides applications to the cloud's end user that are mainly accessed via a web portal or service-oriented architecture-based web service technology. These services can be seen as ASP (applicationserviceprovider)ontheapplicationlayer.Usually,aspecificcompanythatusestheservicewould run, maintain and give support so that it can be reliably used over a long period of time.
Platform as a service (PaaS) consists of the actual environment for developing and provisioning cloud applications. A proprietary language was supported and provided by the platform (a set of important basicservices)to ease communication,monitoring,billingandotheraspectssuchasstartupaswellastoensure an application's scalability and flexibility..

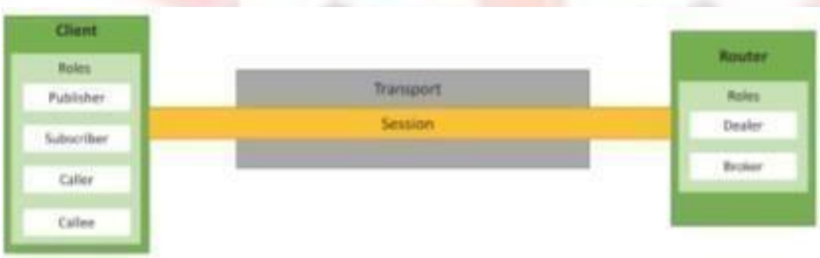
Infrastructure as a service (IaaS) provides the necessary hardware and software upon which a customer can build a customized computing environment. Computing resources, data storage resources and the communications channel are linked together with these essential IT resources to ensure the stability of applications being used on the cloud. Those stack models can be referred to as the medium for IoT, being used and conveyed by the users in different methods for the greatest chance of interoperability. This includes connectingcars,wearables,TVs,smartphones,fitnessequipment,robots,ATMs,andvendingmachinesaswell as the vertical applications, security and professional services, and analytics platforms that come with them.

CLOUD STORAGE API'S

A cloud storage API is an application program interface that connects a locally-based application to a cloud-based storage system, so that a user can send data to it and ccess and work with data stored in it. To the application, the cloud storage system is just another target device, like tape or disk-based storage. An applicationprograminterface(API)iscodethatallowstwosoftwareprogramstocommunicatewitheachother. The API defines the correct way for a developer to write a program that requests services from an operating system(OS) or other application. APIs are implementedby functioncalls composed of verbs andnouns. The required syntax is described inthe documentation of the application beingcalled.

WAMPFOR IOT

Web Application Messaging Protocol(WAMP) is a sub-protocol of Websocket which provides publish-subscribe and remote procedure call (RPC) messaging patterns.



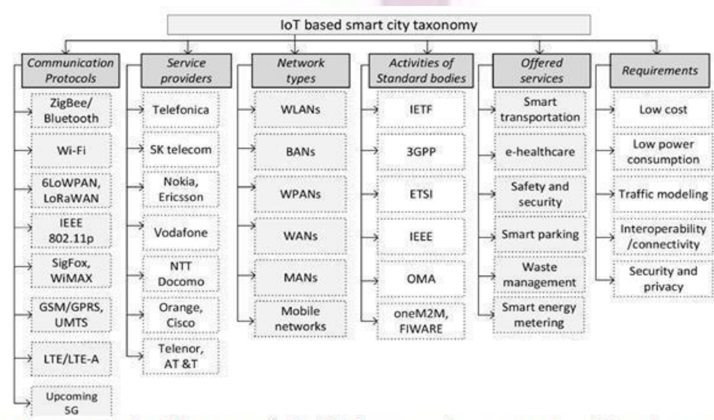
WAMP

Transport: Transportischannelthat connectstwopeers.
Session: Session isaconversationbetweentwopeersthat runsoveratransport.

The model acts as a definition of some stored dataand handles the interactions withthe database. In a web application, the data can be stored in a relational database, non-relational database, an XML file, etc. A Django model is a Python class that outlines the variables and methods for a particular type of data.
Template

TheInternet-of-Things(IoT)isthenovelcutting-edgetechnologywhichprofferstoconnectplethoraofdigital devices endowed with several sensing, actuation and computing capabilities with the Internet, thus offers manifold new services in the context of a smart city. The appealing IoT services and big data analytics are enabling smart city initiatives all over the world. These services are transforming cities by improving infrastructure,transportationsystems,reducedtrafficcongestion,wastemanagementandthequalityofhuman life.Inthispaper,wedeviseataxonomytobestbringforthagenericoverviewofIoTparadigmforsmartcities, integrated information and communication technologies (ICT), network types, possible opportunities and major requirements. Moreover,anoverviewoftheup-to-dateeffortsfromstandardbodies ispresented.Later, we give an overview of existing open source IoT platforms for realizing smart city applications followed by severalexemplarycasestudies. Inaddition, wesummarizethelatestsynergiesandinitiativesworldwidetaken to promote IoT in the context of smart cities. Finally, we highlight several challenges in order to give future researchdirections.

An illustration of IoT based smart city



A representation of IoT-based smart city taxonomy

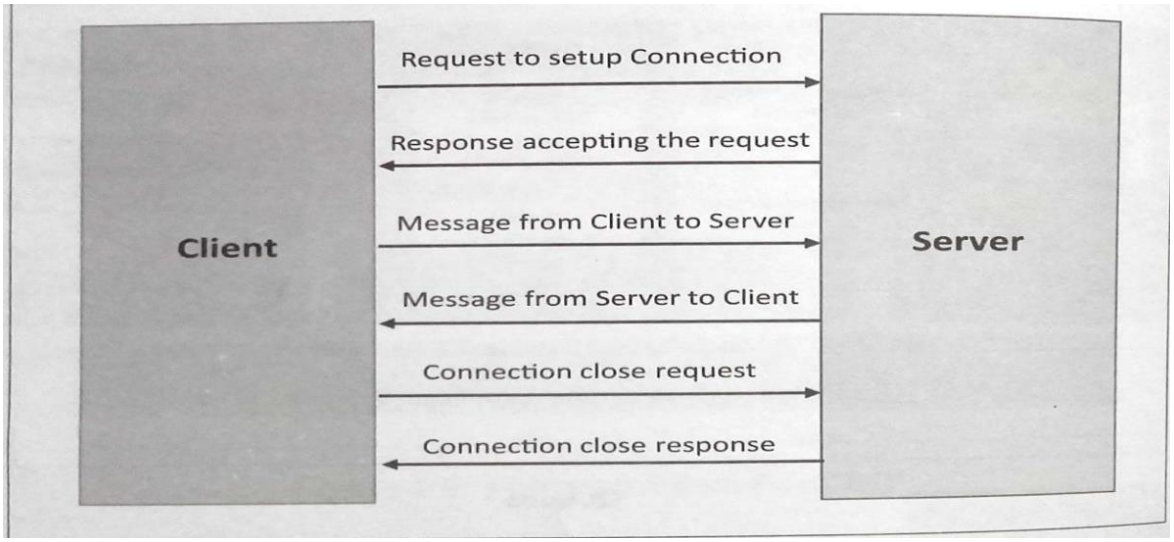
This section presents a taxonomy of IoT based smart cities which categorizes the literature on the basis of existing communication protocols, major service providers, network types, standardization efforts, offered services, and crucial requirements.

Communication Protocols

IoT based smart city realization significantly relies on numerous short and wide range communication protocols to transport data between devices and backend servers. Most prominent short range wireless technologies include Zig-Bee, Bluetooth, Wi-Fi, Wireless Metropolitan Area Network (WiMAX) and IEEE 802.11p which are primarily used in smart metering, e-healthcare and vehicular communication. Wide range technologies such as Global System for Mobile communication (GSM) and GPRS, Long-Term Evolution (LTE), LTE- Advanced are commonly utilized in ITS such as vehicle-to infrastructure (V2I), mobile e-healthcare,smartgridandinfotainmentservices.Additionally,LTE-Misconsideredasanevolutionforcellular IoT (C-IoT). In Release 13, 3GPP plans to further improve coverage, battery lifetime as well as device complexity[7]. Besideswell-knownexistingprotocols,LoRaalliancestandardizestheLoRaWANprotocolto support smart city applications to primarily ensure interoperability between several operators. Moreover, SIGFOX is an ultra narrowband radio technology with full star-based infrastructure offers a high scalable global network for realizing smart city applications with extremely low power consumption. A comparative summary2 of the major communication protocols.

Network Types

IoT based smart city applications rely on numerous network topologies to accomplish a fully autonomous environment. The capillary IoT networks offer services over a short range. Examples include wireless local area networks(WLANs), BANs and wireless personal area networks(WPANs).The application are as include indoor e-healthcare services, home automation, street lighting. On the other hand, applications such as ITS, mobile e-healthcare and waste management use wide area networks (WANs), metropolitan area networks (MANs), and mobile communication networks. The above networks pose distinct features in terms of data, size, coverage, latency requirements, and capacity.


Client
Server
Request to setup Connection
Response accepting the request
Message from Client to Server
Message from Server to Client
Connection close request
Connection close response