Designing Smart Home (IOT) Using Cisco Packet Tracer 7.2 Simulator

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ABSTRACT : The **internet of things**, or **IoT**, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Internet of Things (IoT) is rapidly gaining momentum in the scenario of telecommunications. Conventional networks allow for interactivity and data exchange, but these networks have not been designed for the new features and functions of IoT devices. In this paper, an algorithm is proposed to share common recourse among Things, that is, between different types of smart appliances. . Purpose is to analyze deeper the cases separating the network and IoT layout, giving a deeper explanation of the purpose of the simulations, presenting all the information needed to utilize the exercises but also giving suggestion how to expand the exercises further.

This implementation can be implemented effectively using package tracking software that includes IoT functions to control and simulate a smart home. IoT technology can be applied to many real life issues, such as: homework, treatment, campus, office, etc.

INDEX TERMS Internet of Things, Home Gateway, resources sharing, IoT gateway, collaborative groups, architecture with centralized management,Cisco Packet Tracer.

I. INTRODUCTION

The Internet of Things (IoTs) is a novel paradigm of integration of several technologies that is rapidly gaining momentum in the scenario of telecommunications, especially in wireless network [1]. In traditional communications systems, usually within a house or an office several personal computers and smart devices are seamlessly connected together through a wireless router. In this network, resources can be shared; the most common example is a printer and access to the Internet.

Therefore, the integrated intermediary network devices, such as switches and routers, are used to interconnect the network computers in order to exchange data. These devices

Devices and objects with built in sensors are connected to an Internet of Things platform, which integrates data from the different devices and applies analytics to share the most valuable information with applications built to address specific needs.

These powerful IoT platforms can pinpoint exactly what information is useful and what can safely be ignored. This information can be used to detect patterns, make recommendations, and detect possible problems before they occur.

For example, if I own a car manufacturing business, I might want to know which optional components (leather seats or alloy wheels, for example) are the most popular.

Using Internet of Things technology,This reprogramming can be done by the user directly in a configuration panel or by software from a mobile application.

The issue currently with an IoT gateway, is that not smartly self-managed or allowed to take efficient control of the exchange of resources between heterogeneous things of an IoT network.

Although, there is a variety of research about IoT Gateway for smart devices. A novel Machine-to-Machine (M2M) service is introduced in [3]. They proposed self-configurable gateway and configuration of smart things over the wireless networks. As well, an IoT gateway is designed and implemented through creating a unified connection to the technological layer aided by IoT in [4]. This proposed gateway allows management of devices and identification of new device by creating virtual representations of the physical devices. An auto configuration solution based on interpretable configuration is presented in [5], which focused on some algorithms for computing the IoT gateway configurations. Five algorithms are contributed, while a thorough evaluation reveals which of the algorithms should be used in different operation scenarios in order to achieve high fulfillment of the

operator's target. Therefore, a case study is provided , to better known how to design and implement IoT-gateway for home environment, which is based on suitable self-configuration and scalability.

In this paper, we propose a new algorithm for allocating and sharing the common resources among the heterogeneous devices in the scenarios of IoT such as smart cities, smart grids, industrial automation, smart driving, elderly assistance, or home automation, and others.

The proposal is based on an IoT network with centralized management architecture, controlled by an Artificial Intelligence (AI). The AI controller is an algorithm based on machine learning techniques, collecting information on the network through an information protocol. Every smart thing that connects to the IoT network deployed message through Protocol of Discovery of Functions and Services (DFSP). The information of the available and common resources is shared among the things in the integrated network.

The rest of the paper is structured as follows. Related work with IoT Gateways resources sharing in smart cities, controlled by artificial intelligence, will be explained in section 2. Then, in Section 3, we state the problem and describe the resource allocation proposal method for wireless IoT network. Section 4 presents the performance of the tests and results' discussion. Finally, in Section 5, we highlight our conclusion and future work.

II. RELATED WORK

Internet of things is growing very fast and IoT gateway becomes an important part in its structure. IoT gateway allows supporting a variety of communication protocols and data exchange between various IoT-nodes, The goal of IoT gateway is to bridge various sensing domain networks with public communication networks or Internet, settle with the heterogeneity between these various networks, strengthen the management of both IoT gateway itself and terminal nodes [3]. Generally, García-García *et al.* [1] presented an overview of the premise of the emerging of the Internet of Things (IoT) according to enabling technologies, protocols, and applications. They provided a good foundation to gain an insight into the IoT technologies and protocols to understand the overall architecture and role of the different components and protocols that constitute the IoT.

Zhong *et al.* [7] outlined the disadvantages of the practical application with three-layer architecture of IoT. In order to better interpret the meaning and features of the IOT, and discusses the gateway technology which connecting the sensing network and traditional communication network, layers system architecture is explained. They designed IoT application scheme with using the IoT Gateway as a bridge in order to realize exchanges of the information and communication of different equipment in the industry services. Therefore, the sensors and devices use numerous protocols and communication methods for exchanging the data. In a traditional setup, it is difficult to connect multiple devices with different proprietary applications and monitor. Moreover, it is heavy to control multiple devices and store, analyses all the vitals parameter data together. There is no common platform available to connect the multiple sensors and to monitor the vitals simultaneously. Selvaraj and Kalambettu [8] proposed the comprehensive, scalable, plug and play smart gateway for connecting variety of health sensors and allows the smart devices seamless communication for transmit and control the resources. With IoT-Gateway enabled the framework seamlessly connects with cloud services and stream the data for storage, analysis and prediction. The proposed unified framework is also enable seamless connectivity between gateway and cloud platform and services.

The architecture of the heterogeneous Internet of Things (IoT) gateway and the problems of its integration with the Industrial Internet of Things (IIoT) are investigated in [9] by Viacheslav Et al. the issue of the usage of heterogeneous gateway for conversion of packages raised when various protocols are formed in IoT. Therefore, they proposed Industrial Internet of Things Conversion Format (IICF) for converting various protocols of the Industrial Internet of Things among themselves. The proposal based on the analyzed architecture of the heterogeneous IoT gateway, structure of interaction softwaresystem,structure of the model network for interoperability different protocols. Thus, Rodrigues *et al.* in [10] proposed a novel IoT-based mobile gateway solution for mobile health scenarios. The gateway autonomously collects informationabouttheuser/patientlocation,heartrate,andpossible falldetection.Moreover,itforwardsthecollectedinformation toacaretakerIPA,inrealtimethatmanageasetofactionsand alarms appropriately. The algorithms used for each mobile gateway service, and the scenarios where the mobile gateway acts as a communication channel or a smart objects. Also, Athreya *et al.* [11] took a preliminary look at software, hardware, and network architectures involved in IoT systems. They summarize that the various network components to operate and interoperate effectively the smart devices must be able to coordinate their management capabilities.

They proposed the use of self-management and selfadaptation to cope with countless dynamics. The proposal presents an underlying framework for self-managing devices, comprising measurement based learning and adaptation to changing system context and application demands.

An IoT gateway, which provides device connectivity and protocol translation, is often expensive in case of small-scale academic projects. A method is provided to emulate the functionality of an IoT gateway using a local computer instead of a separate hardware. The proposed EmI gateway is successfully tested to provide communication between sensor nodes in heterogeneous networks such as GPRS, WiFi, Ethernet, RF, and Bluetooth and Amazon's cloud server. The EmI gateway is used in the IoT based application of sewage flow scheduling that involves sensor nodes connected in different communication networks.

Therefore, the studies are presented above on IoT gateways do not offer dynamic resource allocation information protocols for that things can use it. Therefore, it is necessary to explore proposals that allow for different ways of assigning resources and sharing dynamically among the smart devices in the networks. Especially when the current proposals already speak on IoT networks with AI intervention. For this reason, we propose IoT-gateway algorithm based on artificial intelligent to allow dynamicselfmanagement of gateways when the resources needed to be assigned and shared between IoT-nodes in wireless networks.

III. PROPOSAL DESCRIPTION

A. PROBLEM

The current data networks allow to connect ''Things'', but under their policies and protocols. Although protocols such as transmissioncontrol(TCP/IP)areflexibleandallowtransport to other protocols in the network, it is a low level protocol, which does not solve all the problems that appear in an IoT network [13]. Things must be managed differently and the resources that Things need are not the same as a conventional network.

SomeIoTprotocolssuchasMQTTcanexchangemessages on these types of networks, as well as the Constrained Application Protocol (CoAP) and Representative State Transfer (REST) [14]. MQTT and CoAP are M2M protocol and REST uses HTTP to perform operations between client and server.

However, the operation of these protocols is not designed to share, use or allocate resources on the network.

For that, is necessary a protocol or autonomous entity that allow to Things talk between them without human intervention, only machines. In this case, it has been decided to work with MQTT protocol [15], since is open source and allow modifying its operating mechanics. MQTT performs the M2M communication through a central server (MQTT Broker)insideaGatewayordirectlythroughthecloud(Cloud Broker). This is a publication/subscribe protocol and was initially aimed at IoT sensors networks [16], since its main target was to optimize bandwidth and minimize the hardware and the processing [1].

However, is possible that when creating an adaptive algorithm, it is can take advantage of its own messages to send over they the new messages of the DFSP protocol designed for this proposal.

Another problem is that wireless routers in home networks are not flexible and do not allow reprogramming of protocols. Commercially this type of devices are obtained, but with very limited functions. To achieve modifications in the network and that Things operate under another type of architecture, it is necessary to change the traditional router to replace it with a reprogrammable one.

In addition, Things do not have the capacity to process information because their factory functions are limited and they cannot collaborate and interact with other things in a network. It is not enough to have a means of communication to the internet, it is necessary to increase the processing capacity.

From the above, it is evident that the devices that make up a conventional data network, such as the host, the router and the cloud platform, must be reconsidered.

B. PROPOSAL

The next proposal consists of creating three control agents of the same type but in different environments. This control agent is the AI, which will be inside the smart things, in the Gateway with centralized administration and the platform in the cloud. The AI is based on the same principle and has two main functions, managing the algorithms based on Machine Learning techniques and learning the relations Machine to Machine (M2M) as the product of the joint work of a group of Things.

It is necessary to see the problem first since the perspective of the ''Things'', because these just work when its user controls it or if before it had a previous programming. For that, the things carry its own control, it is

necessary to know that resource, function or service is shared between the things.

This paper addresses the study of the problem through the analysis of the exchange of DFSP protocol messages between smarts things, the gateway, and the cloud platform. In this way, it is can see how each Thing that connects announces its functions and services and shares it on the network.

On the other hand, the AI that administers the algorithm that assigns the role to each Thing decides that Thing is a resource or makes available a resource. This is an adaptive algorithm and changes according to the role that each Thing assumes within the group work.

NETWORK IOT ARCHITECTURE WITH CENTRALIZED MANAGEMENT

To understand the architecture that will use in this proposal is fundamental to explain it through of three actors and
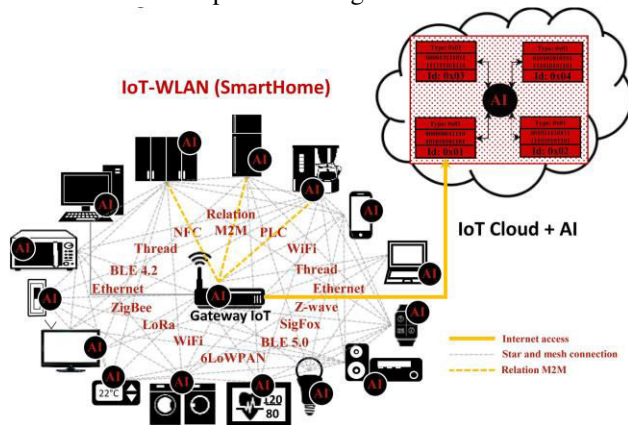

FIGURE 1. Network IoT-WLAN architecture.

its relation: Smart Things, the IoT Gateway and the IoT platform, each contain an AI.

Through the communication of the AI between these three devices, it is possible to achieve a harmony of collective learning in the entire network.

The design of this architecture is thought for a Wireless Local Area Network (WLAN), connecting Things with different interconnection technologies and IoT protocols, depending on their use, bandwidth, processing capacity, and distance [17]. The idea is to modify a network home conventional and become it in a WLAN for IoT. The Figure 1, show an example of network IoT-WLAN, with different topologies and IoT protocols.

The connection of the Gateway to the intelligent platform in the cloud is done through the Internet and constantly monitors what happens in the house. If it is realized queries to the cloud, the platform validates the type of request, classifies it and decides if it is necessary to connect to other platforms else the AI into gateway decides if the problem can be resolved on the local network through the M2M connections [18].

Smart Things + AI: The importance of things acting intelligently, not just improves its internal functions, but it also allows defining functions and services that put to disposition to other things in the network.

Things, in this case study will be appliances inside a house. These require the ability to process and communicate with different communication technologies.

In the architecture of Figure 1, it is can see how everything connects directly to other things or through the Gateway. This connection type will depend on the permissions and relations established by the Gateway.

For example, yellow line of figure 1 depicts the relation M2M established for the gateway where creating a group with something in common.
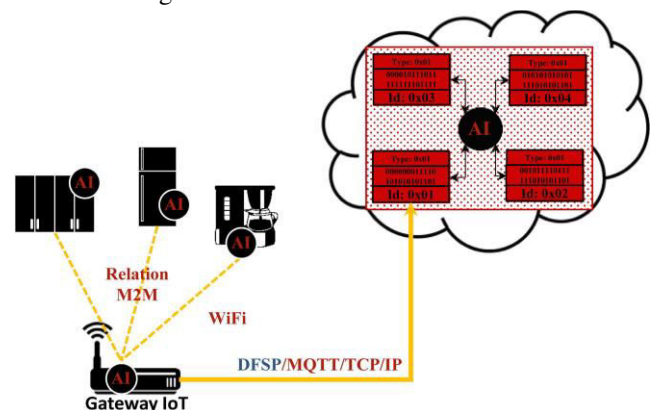

FIGURE 2. Allocation of resources by group of things.

are only made at the gateway level, that is, the central server (MQTT Broker) is not in the cloud.

For this reason, the AI learns about the relation that are commonly established between Things when a group of Things works together. Another indispensable resource is to manage access to the internet. The AI will decide whether the packets are forwarded within the same network or outside the

IoT Platform + IA: Its function is to maintain network monitoring through the gateway and deliver information only when the gateway requests it.

With the information consulted to Internet through of platform in the cloud [17], the Things on the network can complement the local information and make a better decision.

Example: Using the architecture of Figure 1, all things are connectedtoeachotherthroughtheGateway(MQTTBroker) + AI. Only the MQTT protocol will be used to establish M2M relations over WiFi connections.. When it detects that there are continuous requests for common activities between the machines, it creates logical work groups. In Figure 2, these three things highlighted in Figure 1 are isolated to explain their relation in more detail. In this case, it has not yet been established who or what resource is needed. This assignment, is the job that the adaptive algorithm of resource allocation controlled by the AI must perform, see Figure 3.

Figure 2 shows a group of Things doing a joint work. The M2MrelationthattheAIestablishesdependsonthefunctions and the service provided by the Things. For example, it could be assumed that something in common between this group of Things is the preparation of Coffee as a service to the User and each Thing can perform a function that helps with the provision of this service. Coffee is a resource that has the kitchen cupboard and milk is a resource that has the refrigerator. The AI activates the algorithm that is responsible for the allocation of resources and the DFSP protocol collects the information.

FIGURE 3.   IA controlling the algorithms.

In Figure 3, the IoT gateway controls different types of algorithms through the AI and learns from them through the training matrix they provide. Each training matrix is a data file with information about the usage habits and how a machine has been used. This provides information to the system about what kind of operations the user usually performs in front of the machine.

Each petition or service is registered and then analyzed, in order to obtain a statistical history of behavior. After analyzing it with the AI algorithm, things send the resulting matrix to the centralized AI in the gateway. In algorithm 1,

is observe the general steps of the pseudocode of the control algorithm that allows the IA to delegate tasks.

Into the gateway, the AI can handle a number of algorithms and can accommodate as many as necessary and if the capacity of the machine allows it.

The algorithm ''share resources'' works with the information sent from the Things in the network through the MQTT payload. In the payload, another protocol has been specified that determines the type of information depending on the type of message, called DFSP. The other algorithms provide information and perform tasks in parallel to the other tasks of the network depending on the decisions made by the AI. In this case, it will only control two algorithms, the algorithm to establish relation and share resource.

Algorithm 1 Control Into IoT Gateway

1.

1) *Setaneventlistener*(ConnectionrequestfromClients)
2) Initialize MQTT_Broker
3) Received updates on a subscribed topic
4) Update the information of connected Things
5) Activates the algorithms ''establish relation'' and ''share resources''
6) Supplies initial conditions to the **AI**
7) Read training matrix of Things
8) *Set an event listener* (MQTT_Broker)
9) **If** MQTT_Broker is down **then** 10)*Disconnect* from the Clients
11)   **end if**
12)   *End.*

D. OPERATION

 IoT technology roadmap: is it a simple list of product/system components, a description of tools, protocols, and application schemes within the system or already a blueprint designed to make any product or strategy successful within the IoT ecosystem. In addition to the technical aspect of establishing the IoT roadmap, there are others such as the National IoT Strategic Roadmap and then the corporate roadmap that define IoT on some industrial verticals (Energy, Nanotechnology, Automotive, Cognitive Science …).
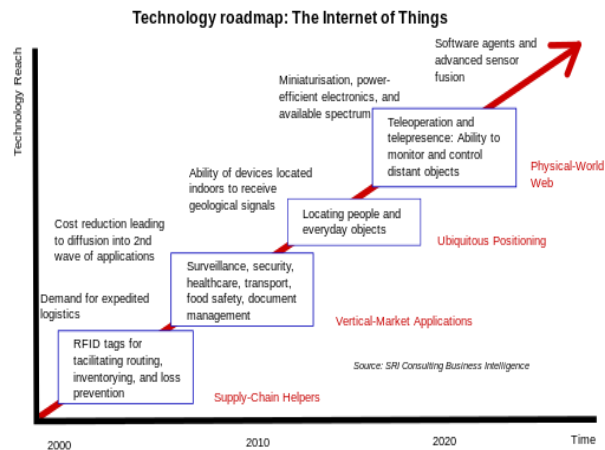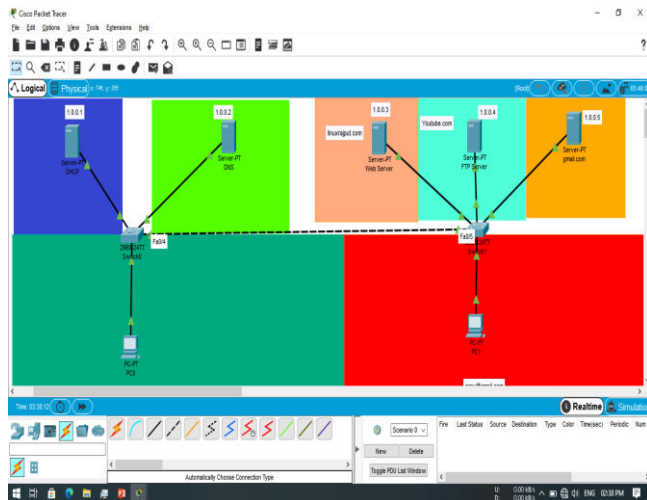
FIGURE 4. Flowchart of the IoT Gateway CAI.

The basic target of an intelligent network is to be able to provide better attention to the user without the need for the latter to control the machines. The idea is that the machines do so autonomously through the AI.

In Figure 4, the AI is observed administering only two algorithms and learning from the user's habits when he is at home. When a problem cannot be resolved internally, the AI decides to search the Internet for possible solutions, learns it and saves it for future problems. The circle that indicates the AI in Figure 4 has the two algorithms that it controls on the sides. Below, the AI analyzes the MQTT payload with the information from the DFSP protocol that comes from Smart Things. Both at the gateway and in smart things AI are present. However, in the flowchart has represented as

only one because both have the same information exchange technique.

The next thing the AI assesses is whether the information that comes through the DFSP is a resource or is a conversation between things. If it is about a conversation that tries to solve a problem, learn it and store it. If it is about a resource then it classifies and stores it. In both cases, the iteration is direct between things, but the information passes through the gateway. Unlike other architectures, the MQTT Broker is present in the Gateway and not in the cloud. This possibly decreases network delays, since for any operation at the local level, it is not necessary to go to a server in the cloud that is far away.

To control internet access, the gateway evaluates whether the requests for things merit it. If the gateway already has, this information previously stored or because you learned it before, then answer the request without having to go to the internet. The cloud platform delivers information requested by the gateway and monitors only what the gateway allows.
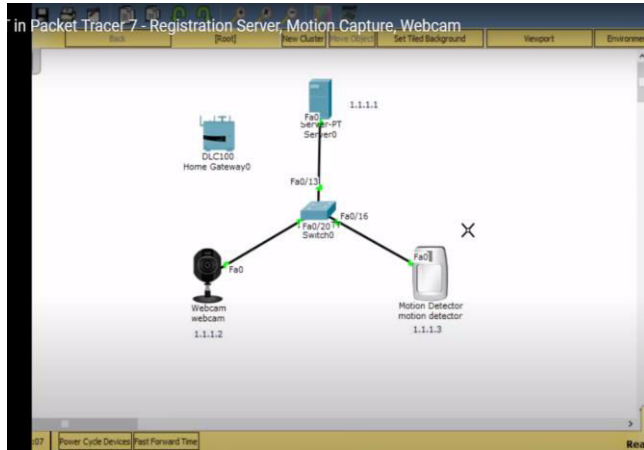
E. ALGORITHM TO SHARE RESOURCES

All the algorithms that the AI manages reside in the IoT Gateway and are based on computational learning techniques (Machine Learning). This algorithm is who allows the Gateway to respond to requests and announcements of resources through the DFSP protocol. The messages of this protocol are encapsulated within the MQTT messages. Its logic is fundamentally based on establishing the role that each Thing plays and the assigning of resources.

The algorithm must know how to differentiate a function or a service from a resource depending on the joint work performed by a group of Things. From this, another algorithm controlled by the AI determines the M2M relation of a group of Things. With this information of the groups created by the AI, the algorithm can be adapted dynamically according to the service required by a User.

Surveillance System

Surveillance systems are an essential part of securing your home or business. These **systems** can range from wireless home **security cameras** to sophisticated alarm **systems** that notify law enforcement at the first sign of trouble. The presence of security cameras can serve as a deterrant to would be thieves, while hidden camera can protect discretely. Whether you want to keep an eye on someone at nearby facilities or documents every person approaching

you Homes first Door,the rightequipment for the job can offer the necessary protection

IMPLEMENTATION OF THE DEVICES

The development of this proposal involves the use of singleboard computers (SBC) such as the Raspberry Pi 3 Model B+ (RPi3) [19]. Each actor in this proposal, it has implemented with an RPi3, except for the cloud platform. It has tested on two different platforms for IoT: ThingsBoard [20] and ThingSpeak [21].

The idea is that each thing is controlled by an RPi3 including the IoT Gateway, under the Android Things operating system . Using the Java programming language and the Android Studio development environment
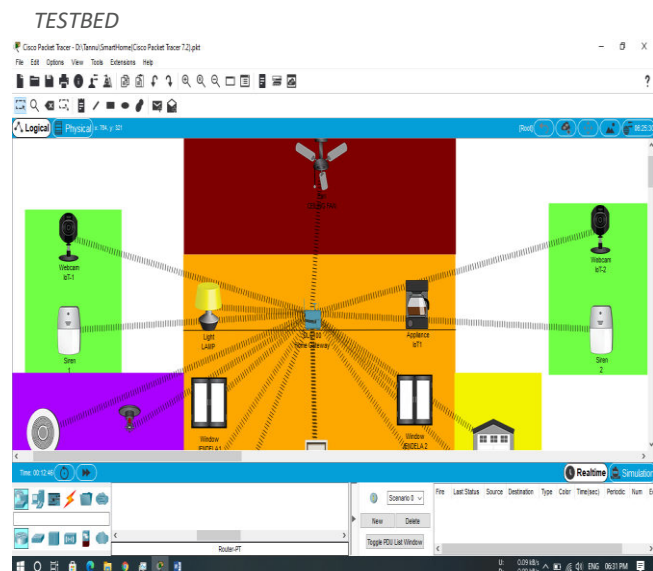
TESTBED

FIGURE 14. Implementation of the proposal.

things automatically and start to send the messages of MQTT protocol to the Gateway.

In Figure 13, the transmission of a message different from the MQTT protocol is observed in a sequential test process performed by the AI. This sequence begins with the CONNECT message and ends with the DISCONNECT message.Thebitrateofeachtransmissionfromthecustomers is on average between 1000 Bps and 2100 Bps. In the disconnection segment, a higher speed is observed, on average, between 2100 Bps and 3600 Bps.

In the simulation seen in Figure 14 has added to each Thing (fridge, cupboard and coffee maker) a training matrix based on statistics of usage and user preferences.

These data are assumed through a text file, in order to observe the operation of the system and thus be able to capture the packages evidencing the transport of information autonomously to other machines.

The simulation also allows us to observe the functioning of Things by controlling other things with basic functions such as on/off (on, red color), selection of type coffee preparation and the ingredients available for its preparation.

In a real implementation within a smart home, everything will be smart [35], [36]. Each of the things in this proposal, including the gateway, is built with an RPi3 and programmed with AI. As shown in Figure 12, it also connects to the cloud where there is also a platform with AI. As in the simulation, this proposal is expected to use other types of connections such as Bluetooth 5.0, WiFi and Ethernet. The idea is that protocols M2M, in this case, MQTT can be transported throughout the network, regardless of the type of the underlying connection.

IV. RESULT

In this , We used the latest cisco packet tracer version to introduce smart home, as this version includes numerous IOE devices. We used the home portal for home automation and record smart devices for monitoring them and Microcontroller (MCU-PT) to connect various sensors as well as IOE devices. MCU moreover offers computing environment for different devices and different language of programming. REFERENCES

V. CONCLUSION

CONCLUSION

In this paper, a smart home system was designed and implemented using Cisco Packet Tacer using Node MCU microcontroller enabkes with Wi-Fi as a method of

monitoring and controlling home appliances i,e user remotely access the system from anywhere around the world.The system is capable of automating the operation of the appliances by analyzing the regular usage patter of the appliances by the user.This not just saves a lot of human effort, but also helps in conserving energy.Also, it can help the differently abled and the elderly in performing basic tasks at home such as switching on/off the light,fan,and so on without havingto dependon others.

FUTURE WORK

IoT involves enhancing network to proficiently collect and analyze the data from various sensors and actuators then send the data to the mobile phone of a personal computers over a wireless connection , building IoT has progressed essentially in the last couple of years since it has created a new era in the world of information‟s and communication technologies . Security is an important issue now days, as the possibilities of intrusion are increasing day by day. Safety from intrusion, theft, fire and leakage gas are most important requirements of home security system for the peoples.

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