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| Remote acess of IoT devices via VoIP:How to improve functionality and productivity of IoT devices with VoIP | AbstractInternet of things (IoT) are any devices that can communicate over a network and provide a means to collect/process data and respond to input. These devices can bring increased productivity and increased profit to a business. Voice over IP (VoIP) is the transmission of voice data over an IP network. VoIP can be used to expand the benefits of IoT devices by allowing remote access to their features. This can include syncing calendars to machines or automation of maintenance requests when a machine needs service. To implement, an IoT gateway is a secure method to integrate VoIP with IoT.setupDawn M. BissellITEC495-Q1WWProfessor Wayne SmithJuly 7, 2017  |

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# Introduction

 Internet of Things (IoT) devices are an ever-present reality that will continue to grow in the future. They offer beneficial features for a business that can be utilized remotely with a Voice over Internet Protocol (VoIP) system. This paper provides a brief overview of IoT and VoIP. An explanation of why the two should be integrated is provided along with a sample scenario. A method of integration (IoT gateway) is presented and why it should be used. Lastly, IoT gateways will be compared with a solution selected.

According to Aljabari, IoT devices are “a global network infrastructure of objects with identification, sensing and communication capabilities" (2015). They use different communication technologies such as RFID, Bluetooth, and Wi-Fi. IoT includes sensors, actuators, and other devices that are connected to a network. The network can be wired or wireless. All IoT devices usually collect data and process the data and are capable of responding to input and transfer data over a network. (Aljabari, 2015).

VoIP is the transmission of voice data over an IP-based network. This is usually the Internet. The voice becomes digitized and encoded into packets that are sent over the network. Using VoIP allows the convergence of voice and data networks. A VoIP gateway is needed to complete the phone calls through the IP network. (Aljabari, 2015).

# Analysis

Using VoIP technology as the core for IoT provides greater functionality, cost-savings, and increased productivity for a business. VoIP allows for a business to cut costs while adding additional features that provide flexibility and increased productivity, especially when connected to IoT applications. (Mae, 2016).

The widespread use of the internet has allowed for devices to become an interconnected chain instead of a single device. Emails, faxes, texting, and applications shares the same network and can communicate. VoIP can be imbedded into the IoT devices; thus, increasing the power of the VoIP devices. (Callari, 2016).The power is increased by allowing remote access to the IoT devices.

 According to Mae, an example of what is possible when integrating VoIP with IoT is providing an alert to a manager when an IoT machine needs repaired or needs maintenance (2016). VoIP integration can also provide a means to control lighting and facility temperature from a mobile phone; furthermore, an IP based calendar can be synced with a machine to prepare the machine for high volume times or meetings. (Mae, 2016). This is because VoIP extends the reach of an IoT system to the telephone and mobile networks; thus, remote access to the IoT system is possible with VoIP. (Aljabari, 2015).

# Sample Scenario

An example scenario is for a small manufacturing company that has upgraded their analog phone system to VoIP. Once the upgrade is complete, the next step for future progression would be an upgrade of existing manufacturing equipment. The current machinery is not network capable. An upgrade to IoT compatible devices would allow for the integration of the manufacturing equipment with the new VoIP phone system. Once the upgrade to IoT devices is complete, hardware would be required to most efficiently integrate the VoIP system with the IoT machinery.

# Discussion of potential solutions

An IoT gateway can be used to integrate VoIP systems and IoT systems since they share the common protocol, IP. When a smart VoIP system is developed, it allows you to control IoT devices via any VoIP phone, web browser, or smartphone application by accessing the IoT gateway with the devices listed. (Aljabari, 2015). Basically, VoIP allows remotes access to any IoT devices that is connected to a smart phone line.

According to Treadway, "an IoT gateway aggregates sensor data, translates between sensor protocols, processes sensor data before sending it onward and more" (2016). An IoT gateway acts like a connection point between devices and the cloud. It can be an actual hardware device or a virtual machine. The gateway works by communication with the IoT sensors then relaying the data to the cloud. The gateway also acts as an extra layer of security for data stored in the cloud. If an IoT device because compromised, the gateway can prevent the device from accessing the data stored in the cloud. The is done with edge analytics on smart IoT gateways. (Rouse, n.d.). A smart VoIP system (see below image) allows the IoT gateway to communicate with the VoIP Gateway with IP PBX (Aljabari, 2015).

(Aljabari, 2015).

Another possible solution for this example would be to not use the IoT gateway. However, this would cause a security risk to the network. The security risks for IoT devices include becoming a part of a botnet or simply gaining access to the network through the vulnerable device. The main reason IoT devices are so vulnerable is because often have older software that is not secure. The devices are produced in a cost-efficient manner; thus, security is often neglected. (Foxhoven, 2016).

As mentioned by Rouse, the IoT gateway protects the stored data from an affected IoT device (n.d.). Furthermore, the gateway acts like a communication tool between the cloud and the devices. This prevents a storm of packets from flooding the cloud in an unorganized manner. (Rouse, n.d.). The gateway can act as a filter of unwanted traffic that is harmful to the network.

# Criteria for evaluation potential solution

 As mentioned above, the use of an IoT gateway would be the best and most secure solution for implementing IoT devices with VoIP. The criteria for selecting the gateway is as follows:

* Cost efficient
* Includes IP PBX
* Customer Support
* Wireless capability

# Selection and Defense of solution

To implement an IoT gateway for this example, a Dell gateway can be used. The Dell Edge Gateway 5000 Series aims to appeal to users for either industrial automation, building automation, and transportation (Treadway, 2016). This gateway is $899 which would fit the budget of the small manufacturing company. The Dell Edge Gateway 5000 can use an Ubuntu Core 15 with an Intel Atom E3825 1.33GHz + 2GB DDR3L-1067MHz core processor and a 32GB Solid State Hard Drive. This price includes 1 year of ProSupport and a Wireless 8-2.11n LAN Card. (Dell, 2017).

Other potential options are the Eurotech IoT Gateway or the HPE Edgeline gateway. Both of these options are enterprise grade gateways. (Postscapes, n.d.). For the sample scenario listed above, the Dell gateway will be the best option for the small manufacturing plan. This is because it is cost efficient, well-known, and has the customer support the small company requires. Furthermore, it has wireless capabilities.

# Conclusion

In conclusion, it is recommended to use an IoT gateway for the integration of VoIP and IoT devices. This gateway will add an extra layer of security to the network and protect data that is stored. Furthermore, the gateway can be purchased for a reasonable price from a reputable company. VoIP integration of IoT devices expands the features of IoT to remote devices. This can increase productivity and profits for a business. Furthermore, the solution can be implemented with an IoT gateway to protect the organization’s data in a simple, cost-efficient manner.

# References

Aljabari, G. (2015). *Integrating VoIP systems with the Internet of things*. Retrieved from Palestine Polytechnic University: http://staff.ppu.edu/galjabari/files/21

Callari, R. (2016, January 21). *IoT and VoIP are talking to each other.* Retrieved on June 24, 2016 from https://telzio.com/blog/iot-voip-are-talking-to-each-other/

Dell. (2017). *Dell edge gateway 5000*. Retrieved on June 25, 2015 from http://www.dell.com/en-us/work/shop/productdetails/dell-edge-gateway-5000/xctoi5000us

Foxhoven, P. (2016, November 8). *Security risks from the internet of things.* Retrieved on July 9, 2017 from http://internetofthingsagenda.techtarget.com/blog/IoT-Agenda/Security-risks-from-the-internet-of-things

Mae, I. (2016, September 12). *VoIP and the internet of things: can they transform your business?* Retrieved on June 20, 2016 from https://www.voipreview.org/blog/voip-and-internet-things-can-they-transform-your-business

Postscapes. (n.d.). *IoT Gateways.* Retrieved on July 9, 2017 from https://www.postscapes.com/iot-gateways/

 Rouse, M. (n.d.). *IoT gateway.* Retrieved on June 24, 2017 from http://whatis.techtarget.com/definition/IoT-gateway

Treadway, J. (2016, April*). Using an IoT gateway to connect the "things" to the cloud.* Retrieved on June 22, 2017 from http://internetofthingsagenda.techtarget.com/feature/Using-an-IoT-gateway-to-connect-the-Things-to-the-cloud

# Feedback from Peer Reviews

Overall, I received rather good feedback. It was precise on what I needed to address. Below are the key items that was brought to my attention from the peer review process:

* More explanation of how VoIP and IoT work together
* Add criteria for evaluating potential solutions
* Combine last 2 paragraphs
* Add section headers
* Add table of contents
* Adjust title of paper
* Ensure an is used instead of a
* Ensure verbs agree (share vs. shares)
* Explain why I chose the Dell edge Gateway.
* Showcase 2 other gateways
* Be specific on security risks involved and how to secure
* Explain why an IoT gateway is more secure
* Do not focus heavily on the research; need to add more of my own writings
* Limit the number of times "that" is used