42GEARS

WHITEPAPER
Building IoT Solutions with Managed Raspberry Pi

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INTRODUCTION

Internet of Things (IoT) is no longer experimental, it is mainstream. Businesses are embracing it for a competitive edge and innovative offerings. In theory, Internet of Things (IoT) is the concept of providing objects, animals or people with single identifiers and the capability to automatically transfer data to a network without requiring any communication from human or computer. It has evolved from the amalgamation of **Internet**, **wireless technologies** and **micro-electromechanical systems (MEMS)**.

IoT is now allowing companies to make smarter products, enable enhanced operations and help take better business decisions driven by data analysis. It can revolutionize the way companies track and manage business workflow, including their inventory/resource management and delivery processes.

Apart from the operational benefits, IoT can also play a crucial role in saving business costs. In **2015**, **DHL** and **Cisco** had predicted that IoT would save **$1.2 trillion** production costs for businesses. They projected that companies using IoT would be able to reduce lighting bills by **60%** to **70%** and **cut heating and air-conditioning bills by 20%** - **30%**. And as per the recent trend report, currently **15 billion devices** are connected through IoT and cost savings have surpasses the prediction numbers, moreover the estimates are that there will be 50 billion devices connected to the Internet by **2020**.

As per **Gartner**'s report, **IoT will generate $300 billion revenue by 2020**, and the number of connected devices would be approximately more than 200 billion. Products like Amazon's Echo and Google's Home are few examples of bringing IoT seamlessly in our daily lives. Big giants such as **Cisco**, **Bosch**, **Dell**, **HP** are investing heavily on IoT projects.

In this paper we have discussed the benefits of using IoT devices in business scenarios and why Raspberry Pi is a key platform to connect IoT devices.

INTERNET OF THINGS (IOT)

IoT can be defined as the tool to connect Internet with "everyday objects", and enable them to communicate with users as well as with other devices/objects. Google's Nest Learning Thermostat, Philips's Smart Bulbs, Amazon's Dash are some of the best examples of how our daily lives at home or office can be affected with IoT.

Currently, IoT is a collection of various, purpose-built networks, but As IoT evolves, these networks will develop to connect with each other along with additional security, management and analytical capabilities, allow IoT to become more powerful and help businesses achieve more.

Why should businesses go for IoT?

Predictive maintenance, vibration analysis, embedded sensors and reactive technologies are creating interest among business owners. The following possibilities in usage of IoT can prove to be useful in different facets of businesses:

- **Device malfunction prevention:** Sensors can collect data real-time and pass it to connected computers so that enterprises can analyse, predict and take proactive preventive action. For example, companies such as **Rolls Royce** are using sensors in their aircraft engines to monitor their functions. This IoT setup sends alerts of machine performance to cloud for preventive analysis which can help prevent engine malfunction.

- **Tracking and managing Inventory:** Warehousing, manufacturing, storage industries generally track inventory manually using workers or remote scanners. Replacing them with IoT devices can make automated tracking more accurate and efficient at lowering costs.

- **Improved data management:** Business owners and marketers depend on data analysis to make important decisions. With IoT, the task of data gathering, tracking and recording has become fast and easy. Smart IoT devices can keep track on consumer buying behavior, record data and push product recommendations. Qualitative and quantitative demographics can be gathered and effectively used for product designing and advertising.

- **Reduction in labor costs:** IoT devices contain sensors that send real time data to the cloud which could be helpful for businesses to save labor costs on manual troubleshooting of malfunctioned devices or logistics involved in repairing the broken device.

To understand the benefits of IoT in a business scenario, let us take the example of a **logistic** company, where delivery vans are embedded with IoT sensors:

In the above figure, a delivery van has some embedded sensors on wheels, headlights, and engine to capture data like temperature, location, truckload etc. These sensors are connected to an IoT gateway like **Raspberry Pi** (gateways are required to connect the objects carrying sensors data to the cloud as they will not be able to communicate without it). Data from the sensors flows to the gateway, and then to the cloud server via internet before finally reaching admin's dashboard. Admins can provide insight for spare capacity in these vehicles, by monitoring the capacity of truckload and the temperature sensors can help them taking actions on real-time basis to spoil the goods from high temperature.

IOT PLATFORMS

IoT platforms are mediums to establish relationship between device sensors and data network to relay information. These platforms provide assistance to deploy IoT applications. Businesses that want to deploy Internet of Things first need a platform to do so. Raspberry Pi has been emerging as the IoT platform of choice recently. Open Source, cost effective, versatile hardware, huge community support and tons of already ported IoT projects adds to its appeal.

- **Raspberry Pi Evolution**

  Raspberry Pi *was developed by **Raspberry Pi Foundation, UK*** with the intention to teach computing languages in schools. But due to its versatility and business potential, it has emerged as a small budget-friendly computer and has served many IoT projects, though limited to web

applications and Linux based programs. The following list of operating systems are currently supported on Raspberry Pi:

- Raspbian

**- Ubuntu MATE**

- Windows 10 IoT core

1. **A Few IoT projects supported by Raspberry Pi:**
    1. **Pi In The Sky Projects:** It is a great platform for projects that involve monitoring temperature, altitude and landing spot of rockets and flying objects. Pi In The Sky board comes with inbuilt GPS and RF transmitting module which enable project admins to record and track rocket's trajectory.
    2. **Humidity and Temperature Monitoring Projects:** Some projects require monitoring of humidity and temperature extremes to protect the attached hardware. The sensors in these hardware devices can sense extremities, record information and connect to Raspberry web server to transmit the data.
    3. **Digital to Analog Convertors:** Soft Sync is a Raspberry Pi project that combines sensors, switches and digital-to-analog convertors. In IoT applications sometimes there is a need of a digital to analog converter or vice-versa. Ceiling fans which are managed from a laptop or a mobile phone is one of the examples which uses such IoT setup.
    4. **Surveillance Camera:** A surveillance camera can be build based on Pi microcomputer which currently costs only $120, whereas on an average a regular surveillance camera may cost more.
    5. **Pi as a Web Server:** To learn how centralized hub of sensors and devices works, Raspberry Pi web server would be a good IoT project. This Raspberry Pi board can work as a central controlling unit to manage small scale controllers like Arduino. To run this project, a Raspberry Pi board with a Linux OS and a loaded Apache web server is all what is needed.
    6. **Makey Makey IoT:** The Makey Makey IoT can convert any physical objects into touchpads to operate machines such as computers. IoT projects can be built by using alligator clips, USB cable and Makey Makey circuit board.

RASPBERRY PI LINUX SUPPORT WITH MDM CAPABILITY

Raspberry Pi is a viable option for businesses looking to run IoT projects. But, what if they get MDM capabilities too? Like the ability to manage and control the sensor devices and gateway applications? 42Gears offers support to remotely manage Linux platform based devices which means platforms like Raspberry Pi, running Linux flavors can be remotely managed.

While **Figure 1** explains the data flow from sensors to admin's dashboard whereas, **Figure 2** explains (below) that data can possibly flow from admin's dashboard to devices as well.
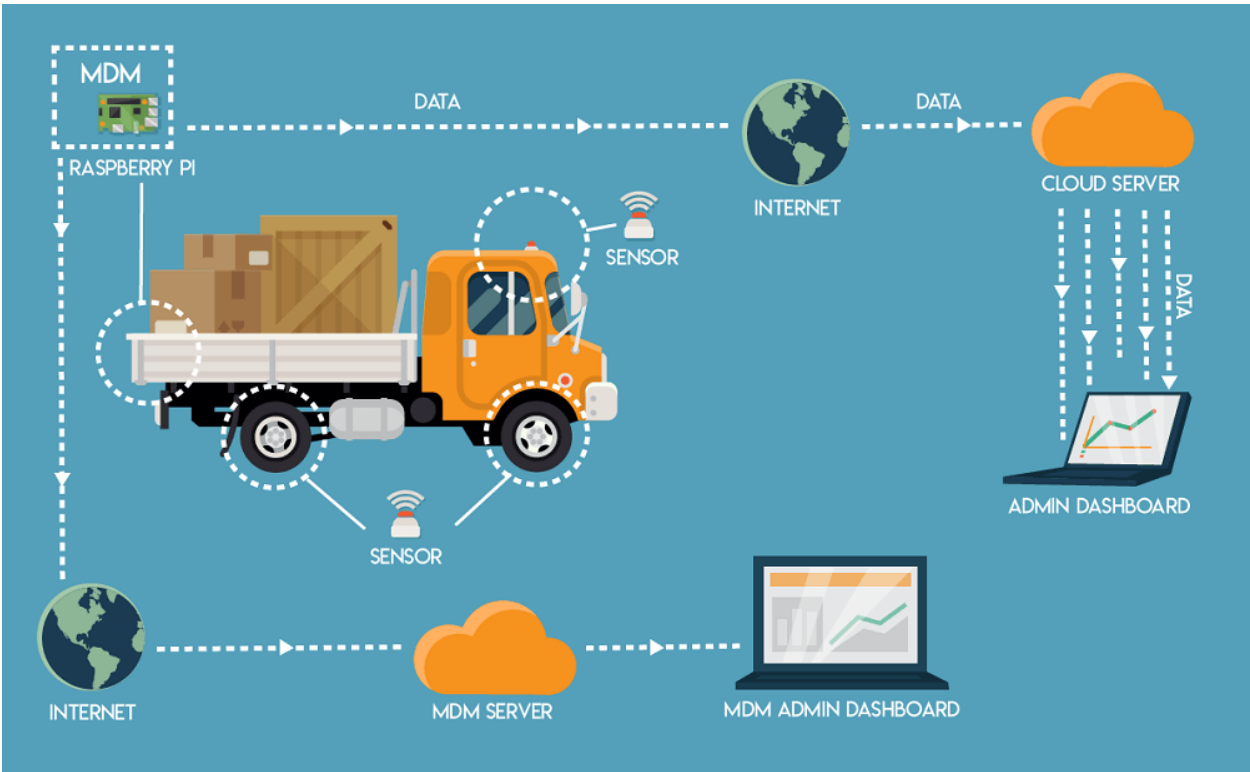
The above figure shows, how an IoT ecosystem can be more manageable and productive with an MDM. Following are few of the benefits of the combination:

- **Software patches** for Pi applications, responsible for collecting sensor data and pushing to cloud, can be rolled remotely.
- Since MDM **communication** is two ways, sensors connected through Pi can be configured and calibrated remotely.

- **Health** of Pi and the sensor devices connected through it can be monitored remotely.
- Since Pi runs Linux flavors, MDM can push and **execute generic Linux scripts**, empowering admins with powerful toolset to manage vast IoT deployments.
- Communication of data exchange between Pi and cloud can be secured by forcing **secure communication** policies from MDM.

CONCLUSION

With growing numbers of smart mobile devices used in business processes, the demand for more controllability from these devices has increased. Also, sensors in objects required tools that can connect and control them efficiently, which led to the emergence of IoT.

IoT projects could do wonders for the businesses if implemented through a proper strategy. Raspberry Pi based IoT projects are very popular due their affordability and ease of implementation. Also, Managing Raspberry Pis though an EMM solution will enhance the IoT projects to offer a complete IoT solution that can help enterprises reduce costs by improving operational efficiencies, and take enterprise mobility to the next level.