ONBOARDING RASPBERRY PI 3B+ ON VMWARE PULSE 2.0

Version 1.0
Table of Contents

Executive Summary .......................................................................................................................... 3
  Business Case ............................................................................................................................... 3
  Solution Overview ....................................................................................................................... 3

Introduction ..................................................................................................................................... 4
  Purpose ......................................................................................................................................... 4
  Audience ....................................................................................................................................... 4

Solution Configuration ..................................................................................................................... 5
  Solution Architecture .................................................................................................................. 5
  Assumptions ................................................................................................................................. 6
  Pre-Requisites ............................................................................................................................. 6
    Software Requirements ............................................................................................................... 6
    Network Requirements ............................................................................................................... 6

Solution Validation ......................................................................................................................... 7
  Onboard ......................................................................................................................................... 7
    Creating a Device Template ....................................................................................................... 7
    Download and Install Pulse Agent ............................................................................................ 10
    Onboarding the Raspberry Pi ..................................................................................................... 10
Executive Summary

Business Case
The Internet of Things (IoT) is rapidly transforming traditional business models and operational processes to boost innovation and growth. An IoT-ready infrastructure has unique requirements with onboarding, configuring, managing, and securing connected devices, and as a tidal wave of IoT use cases reaches your organization, your IT and Operational Technology (OT) departments may struggle to keep up. VMware can help organizations achieve IoT infrastructure excellence and deliver successful business outcomes that meet the needs of both your IT and OT organizations.

VMware Pulse™ IoT Center™ is a secure, enterprise-grade, end-to-end IoT infrastructure management solution that allows OT and IT to have complete control over their IoT use cases, from the edge all the way to the cloud. It helps companies to onboard, manage, monitor, and secure all things and infrastructure for IoT.

Raspberry Pi 3 B+ is a small and affordable computer that you can use to put the power of computing and digital making into the hands of people all over the world. It enables more people to harness the power of computing and digital technologies for work, to solve problems that matter to them, and to express themselves creatively. Raspberry Pi is commonly used in a wide variety of Internet of Things projects and applications.

This Solution Paper is intended to validate that VMware Pulse™ IoT Center™ can be used to onboard, manage, monitor and secure one or a fleet of Raspberry Pi devices.

Solution Overview
This reference architecture is a showcase of using VMware Pulse™ IoT Center™ to effectively and efficiently onboard a Raspberry Pi.

- We demonstrate the architecture of the deployment.
- We successfully onboard a Raspberry Pi as a managed Edge System.
Introduction

Purpose
This reference architecture verifies the supportability of a Raspberry Pi as a managed Edge System on VMware Pulse™ IoT Center™.

Audience
This reference architecture is intended for IT and OT administrators and IoT Architects involved in planning and managing Internet of Things Infrastructure, Applications and Services.
Solution Configuration

Solution Architecture
For this solution, we have a Raspberry Pi 3B+ connected to your either your internal network or to the internet through WiFi or Ethernet wherever Pulse is hosted. In our case, we will be onboarding a Raspberry Pi 3B+ as a Managed Edge System/Gateway.
Assumptions

- You have access to a Raspberry Pi 3B+ running Raspbian Stretch.
- You have access to a VMware Pulse™ IoT Center™ version 2.0 environment on the cloud or set-up in an On-Prem environment.
- The Raspberry Pi has a WiFi or LAN connection and the ability to reach out to internet.
- You have a basic understanding of navigating through Linux Command Line Interface.
- You have access to the Raspberry Pi via SSH or SCP.
- You have a User created on the VMware Pulse console.

Pre-Requisites

Software Requirements

<table>
<thead>
<tr>
<th>Software/Applications/Frameworks</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS Distro</td>
<td>Raspbian Stretch</td>
</tr>
<tr>
<td>Root Access</td>
<td>Yes</td>
</tr>
<tr>
<td>Complete File Structure Access to Root/Sudo</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Network Requirements

<table>
<thead>
<tr>
<th>Source</th>
<th>Destination</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPi 3B+</td>
<td>VMware Pulse 2.0 Instance</td>
<td>443 (Outbound)</td>
</tr>
</tbody>
</table>
Solution Validation

Onboard

Creating a Device Template

1. Log-in to the Pulse Console.

2. To onboard a device, we first have to create a device template. Navigate to Inventory > Device Templates and Click Create.

3. Provide a template name, type of the device (Gateway or Thing) and add an image (optional). As we are looking at onboarding a gateway, select the Type of Device is Gateway.

4. In the next step, add System Properties (properties originating on the device) and Custom properties (properties defined on the console for asset management).
5. Next, whitelist the Metrics (Time Series Data) that you want. For ease of use, CPU Utilization, Memory Usage and Disk Usage (available in IA) are already added. You can choose to add more metrics depending on your use case.

<table>
<thead>
<tr>
<th>Edit Device Template</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Details</td>
<td></td>
</tr>
<tr>
<td>2 Properties</td>
<td></td>
</tr>
<tr>
<td>3 Metrics</td>
<td></td>
</tr>
<tr>
<td>4 Connected Device Templates</td>
<td>Allowed Metrics</td>
</tr>
<tr>
<td>5 Commands</td>
<td></td>
</tr>
<tr>
<td>6 Enrollment Provider</td>
<td></td>
</tr>
<tr>
<td>7 Review</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Display Name</th>
<th>Value Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU-Usage</td>
<td>Double</td>
</tr>
<tr>
<td>Memory-Usage</td>
<td>Double</td>
</tr>
</tbody>
</table>

6. Next, whitelist the Templates that can be added as Connected Devices to this Template.

<table>
<thead>
<tr>
<th>Edit Device Template</th>
<th>Connected Device Templates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Details</td>
<td></td>
</tr>
<tr>
<td>2 Properties</td>
<td></td>
</tr>
<tr>
<td>3 Metrics</td>
<td></td>
</tr>
<tr>
<td>4 Connected Device Templates</td>
<td>Allowed Device Templates</td>
</tr>
<tr>
<td>5 Commands</td>
<td></td>
</tr>
<tr>
<td>6 Enrollment Provider</td>
<td></td>
</tr>
<tr>
<td>7 Review</td>
<td></td>
</tr>
</tbody>
</table>

7. Then, whitelist and configure the commands that you want allowed to be executed on the gateway.

<table>
<thead>
<tr>
<th>Edit Device Template</th>
<th>Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Details</td>
<td></td>
</tr>
<tr>
<td>2 Properties</td>
<td></td>
</tr>
<tr>
<td>3 Metrics</td>
<td></td>
</tr>
<tr>
<td>4 Connected Device Templates</td>
<td></td>
</tr>
<tr>
<td>5 Commands</td>
<td></td>
</tr>
<tr>
<td>6 Enrollment Provider</td>
<td></td>
</tr>
<tr>
<td>7 Review</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Name</th>
<th>Type</th>
<th>Executable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enable SSH</td>
<td>SSH</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Disable SSH</td>
<td>SSH</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Get Log File</td>
<td>FILE_UPLOAD</td>
<td>-</td>
</tr>
</tbody>
</table>

8. As for the Enrollment Provider Step, select Token-based under Provider Type and provide expiry time. Or select Property Based and provide a string value to Identity Key (example, “mac_addr”). Know that by default, Basic Authentication is enabled.
9. Finally, review the template and save it.

10. You should be able to see the device template card now.
Download and Install Pulse Agent

**There are three ways to get the Agent on a device:**

1. Download the Agent on your local system using the browser to login to the Pulse Console and downloading the agent from the Downloads section by clicking on the gear icon on the top left. Use FTP/SFTP applications like WinSCP or FileZilla and copy the agent to the device (in this case the VM).

   ![Downloads](image_url)

   **Agent Packages**

<table>
<thead>
<tr>
<th>Name</th>
<th>Processor</th>
<th>Version</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse Agent (arm)</td>
<td>ARM Processor</td>
<td>2.0.0.501</td>
<td>Download</td>
</tr>
<tr>
<td>Pulse Agent (aarch64)</td>
<td>aarch64 Processor</td>
<td>2.0.0.501</td>
<td>Download</td>
</tr>
<tr>
<td>Pulse Agent (x86_64)</td>
<td>x86_64 Processor</td>
<td>2.0.0.501</td>
<td>Download</td>
</tr>
</tbody>
</table>

2. If the device has a GUI, open a browser and use the same instructions in the above step.

3. Alternatively, you can copy the URL of the Agent. Create a folder for Pulse by using the command `mkdir pulse` and change the permission `sudo chmod 777 pulse`. Then, use CURL or WGET commands and download the agent using Command Line. Please note that to specify output file name, wget uses upper-case 'O' while curl uses lower-case 'o'.

   ```
   wget -O pulseagent.tar.gz https://iotc001-pulse.vmware.com/api/iotc-agent/iotc-agent-x86_64-2.0.0.501.tar.gz
   curl -o pulseagent.tar.gz https://iotc001-pulse.vmware.com/api/iotc-agent/iotc-agent-x86_64-2.0.0.501.tar.gz
   ```

**To install the Agent:**

1. First, we change the permissions of the tarball `sudo chmod +x pulseagent.tar.gz`

2. Then, we un-tar the Agent tarball:

   ```
   tar -xvf pulseagent.tar.gz
   ```

3. Now, navigate within the iotc-agent folder that is created and run install.sh as sudo.

   ```
   sudo ./install.sh
   ```

4. Confirm that the iotc daemon and iotc-agent services are running. You can check the logs by either tailing syslog or using the `journalctl -f` command. Please note that GRPC errors are currently common and expected.

**Onboarding the Raspberry Pi**

**Onboard using Basic Authentication**

1. On the gateway, change the directory to `/opt/vmware/iotc-agent/bin`.

2. Make sure you are running the commands below as sudo.

3. Run the command to onboard using Basic Authentication:
Raspberry Pi 3B+ on VMware Pulse IoT Center 2.0

```
./iotc-agent-cli enroll --auth-type=BASIC --template=<templatename> --name=<gatewayname> --username=<pulseusername>

OR

./DefaultClient enroll --auth-type=BASIC --template=<templatename> --name=<gatewayname> --username=<pulseusername>
```

4. The response should be ‘0’ for successful enrollment.

**Onboard using Token-based Authentication**

1. Log-in to the Pulse Console.
2. Navigate to **Inventory > Devices** and select **Register**.

![Register Gateway](image)

3. Then, enter a Device Name and select the Device Template which has Token based Authentication enabled and the one the device will be coupled to.

4. Once you click register, you will be able to see a device entry in the Devices list view.

![Devices - All Devices](image)
5. Select the device, click Actions and select “Create Gateway Credentials”

6. Click on Create and then copy the Token created. Please note that from this point onward, you have until the Expiry Time to onboard a gateway with that token.

7. On the gateway, change the directory to /opt/vmware/iotc-agent/bin.

8. Run the command to onboard using Token-Based Authentication:

   ```
   ./iotc-agent-cli enroll --auth-type=REGISTERED --token=<authenticationtoken>
   OR
   ./DefaultClient enroll --auth-type=REGISTERED --token=<authenticationtoken>
   ```

9. The response should be ‘0’ for successful enrollment.

**Onboard using Property-based Authentication**

1. Log-in to the Pulse Console.

2. Navigate to **Inventory > Devices** and select **Register**.
3. Then, enter a Device Name and select the Device Template which has Property based Authentication enabled that the device will be coupled to.

![Register Gateway]

4. Once you click register, you will be able to see a device entry in the Devices list view.

![Devices - All Devices]

5. Select the device, click Actions and select “Create Gateway Credentials”

![Select Device and Actions]
6. Enter the corresponding value to the key that the gateway should report to be able to onboard.

   ![Credential for UbuntuVM_0001]
   
   **Value**
   00:0c:29:5d:da:93

   **Credential**
   This is a one-time credential that will be used for gateway enrollment

7. On the gateway, change the directory to `/opt/vmware/iotc-agent/bin`.

8. Run the command to onboard using Token-Based Authentication:
   
   `./iotc-agent-cli enroll --auth-type=PROPERTY --key=<identitykey> --value=<correspodingvalue>`
   OR
   
   `./DefaultClient enroll --auth-type=PROPERTY --key=<identitykey> --value=<correspodingvalue>`

9. The response should be ‘0’ for successful enrollment.