CoAP Simple Management Protocol Developer Tutorial

May 24, 2023 0v11

1 Overview

CoAP Simple Management Protocol (CSMP) is designed to efficiently manage large scale deployments of compute, memory, and bandwidth constrained IoT devices.

This tutorial provides an introduction and demonstration of the capabilities of CSMP. By the end of this tutorial, the reader will understand how to:

1. Acquire, build, and deploy the Cisco CSMP Agent Reference Stack for a readily available development platform. Namely … the Raspberry Pi 4.
2. Acquire and launch an instance of the Cisco Field Network Director (FND) CSMP controller.
3. Demonstrate device registration with FND.
4. Demonstrate device configuration by FND.
5. Demonstrate device metrics reporting to FND.

This tutorial assumes the CSMP Agent RPi and FND instance both are connected to the same local LAN segment (allowing usage of link-local IPv6 addresses, no routing required). This tutorial may be modified to operate over any IPv6 enabled network using Global or Unique Local IPv6 addressing, but these details are beyond the scope of this tutorial.

2 Prerequisites

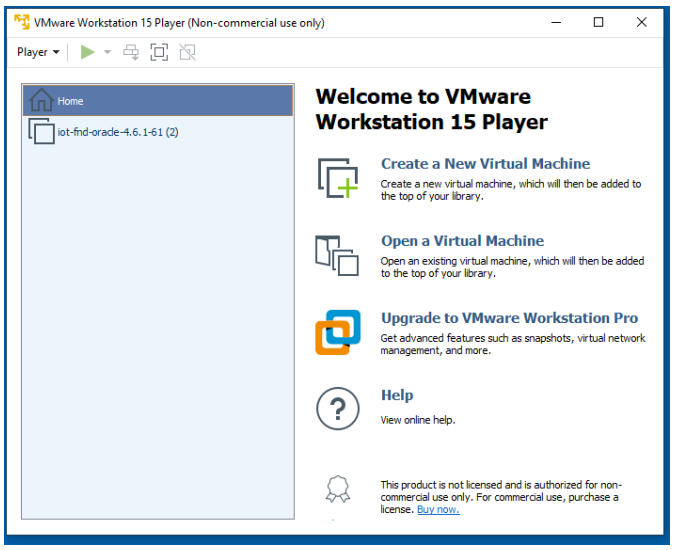
1. Request access to the FND OVA virtual machine by sending a request to csmp-developer-request@cisco.com

3 Cisco Field Network Director Setup

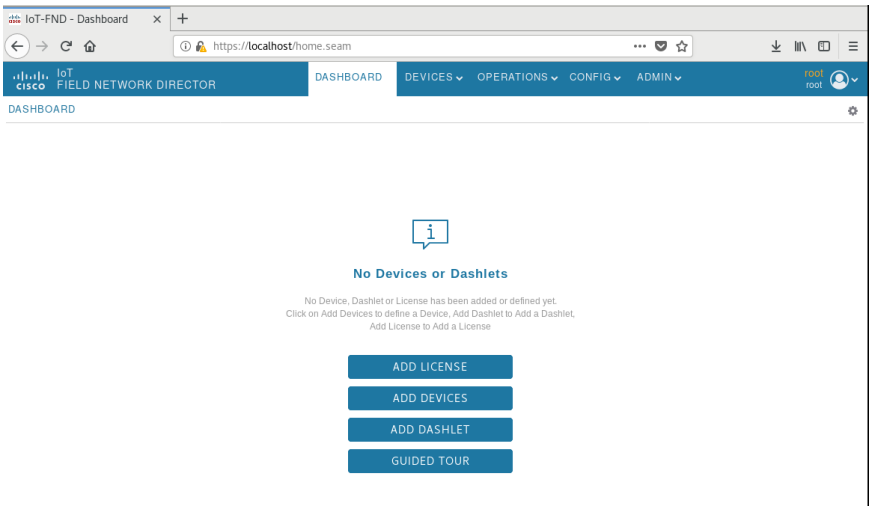
3.1 Installation for Windows 10

The following describes the workflow to acquire and deploy an instance of the Cisco Field Network Director within a Redhat Linux virtual machine running on a Windows 10 host.

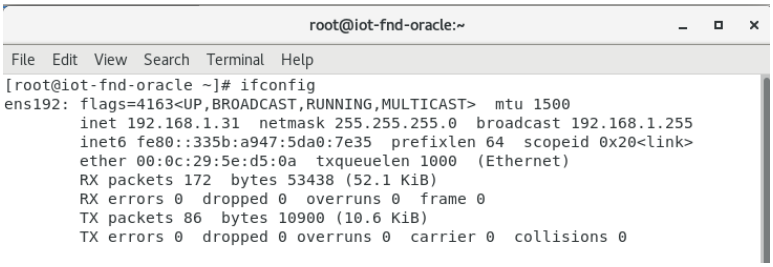
1. Acquire and install VMware Workstation 15 Player from here.
2. Cisco FND OVA access instructions will be provided in response to csmp-developer-request@cisco.com request described in Section 2.
3. Start VMware Workstation 15 Player.
4. Open Virtual Machine and select the FND OVA image.



   a. This may take a few minutes.
5. Play the FND Image
   a. You may have to reduce the memory and processor settings:
      i. 8 GB / 2 processors is known to work for 16 GB Windows 10 quad CPU laptop.
6. (First login) Log into Redhat Linux
   a. User: root
   b. Password: cisco123
   c. You will be asked to immediately set a new root password.
7. Launch FND by opening a terminal and issue the command “service cgms start”.
   a. This may take a few minutes on first launch.
   b. Progress can be followed by observing server.log
      i. tail -F /opt/cgms/server/cgms/log/server.log
      ii. Within a few minutes you should see … JBoss EAP 6.2.0.GA (AS 7.3.0.Final-redhat-14) started in ….
8. Launch Firefox browser to page https://localhost
   a. Add Exception/Confirm Security Exception if you encounter “Your Connection is Not Secure”.
9. (First login) Log into FND
   a. Username: root
   b. Password: root123
   c. You will be asked to change the default password.
   d. When logged in, you should see the following screen:



10. Determine FND link local address (to be used by CSMP Agent RPi)
    a. Open a terminal, execute “ifconfig” , record IPv6 link local address.

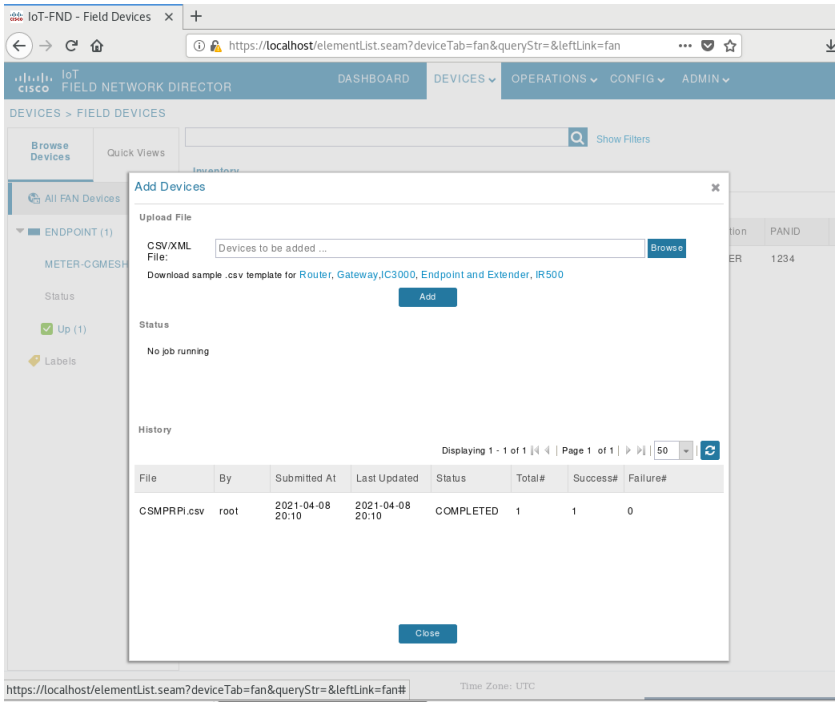


3.2 Pre-Provision CSMP Agent Within FND

The CSMP Agent must be populated within FND Inventory before FND will allow the CSMP Agent to register.

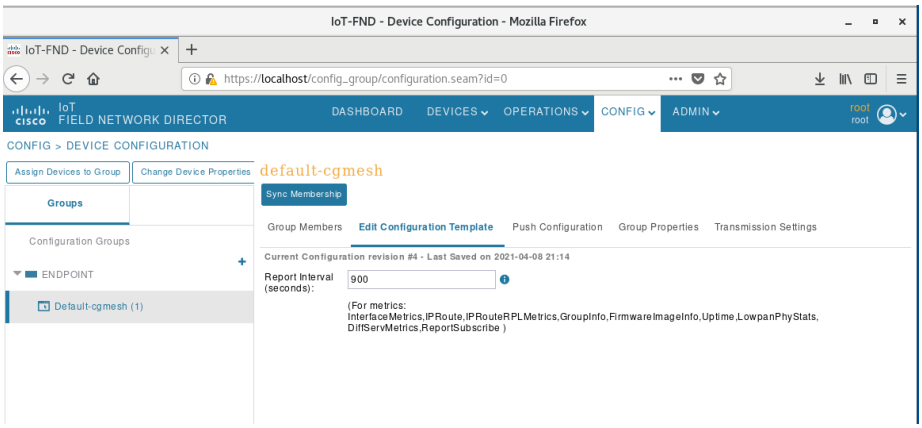
Within FND UI…

1. Disable map (convenience)
    a. Click user icon at upper right and select Preferences.
    b. Disable map, click Apply.
2. Add CSMP RPi device
    a. Select Devices/Field Devices.
    b. Select Add Devices Tab from Inventory.
    c. Click Endpoint and Extender from Download sample list, open file in text editor.



d. Edit this file to provide the EID desired for the CSMP Agent.
    i. NOTE: the EID MUST contain 16 hex digits (the example does not).
        1. This is required to satisfy CSMP Agent command line.
    ii. Leave deviceType, function fields as is.
    iii. Save the file to folder of your choosing.
e. Browse to this file, click Add. CSMP Agent details will load from the file.
f. Observe Status: Add Device Completed!, click Close.
g. Inventory tab will now list the CSMP Agent device with status Last Heard: never

3. For the purpose of this tutorial, we want to configure the CSMP Agent with the shortest metrics reporting interval allowed.
    a. Access the Config/Device Configuration tab
    b. Select Default-cgmesh at the left (Configuration Groups).
    c. Click Edit Configuration Template
    d. Set Report Interval to 900 seconds. Click Save icon at bottom.



4 CSMP Agent Setup

4.1 Ubuntu/RPi4

4.1.1 Build / Install

The following steps describe the workflow to acquire, build, and deploy the CSMP Agent upon a Raspberry Pi 4 running the Ubuntu operating system.

1. Acquire and assemble RPi4 development kit here.
2. Flash RPi SD Card with Ubuntu Desktop. Instructions are here.
3. Log into Ubuntu Desktop.
4. Download CSMP Agent ZIP file from here.
5. Proceed with instructions in the README file from the root folder of the CSMP Agent download.

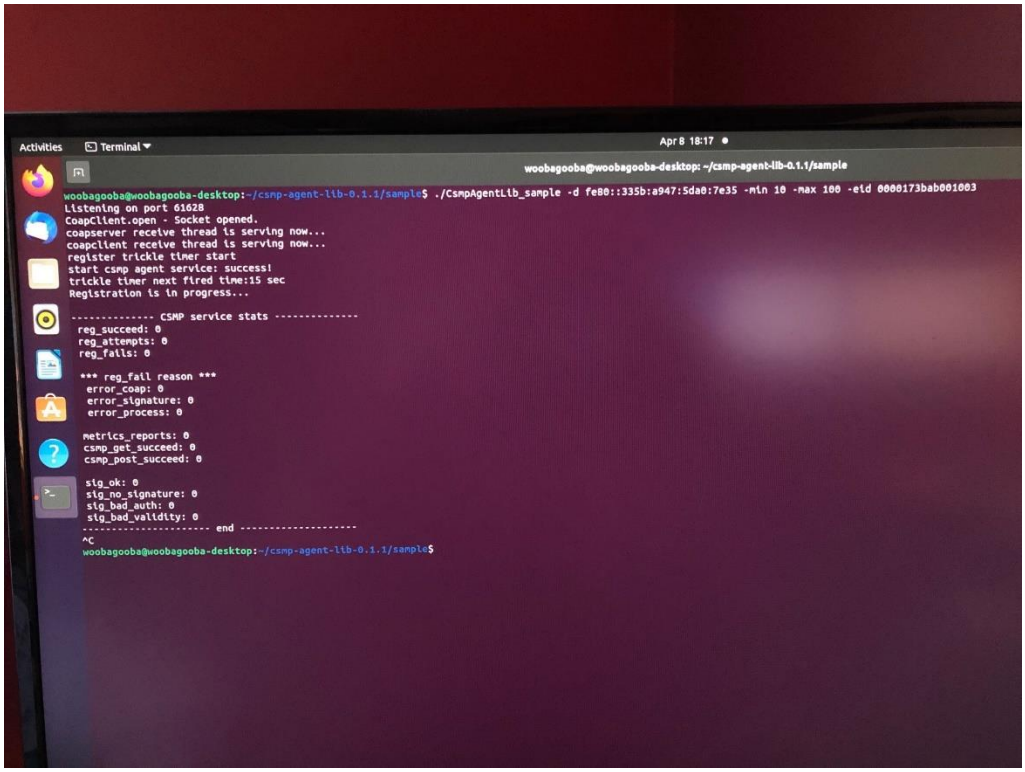
4.1.2 Start CSMP Agent

Open a terminal on the CSMP Agent RPi.

1. cd into the csmp-agent-lib-x.x.x/sample folder
2. Run the agent as described in csmp-agent-lib-x.x.x/README using the full command line
    a. ./CsmpAgentLib_sample -d <FND IPv6 address> -min 10 -max 100 -eid <RPi EID>.
    b. NOTE WELL: EID MUST EXACTLY match that populated in FND.

c. Multiple simultaneous executions of the agent on a single host are not currently supported.

3. Once launched you should see the following output (or similar) from the RPi:



4.2 Additional CSMP Agent Platforms

The CSMP Agent library can be integrating into any IPv6 enabled IoT device platform (such as Wi-SUN Field Area Network devices, etc.). Inquire with your platform vendor for availability and configuration and setup details.

5 CSMP Agent and FND Communication

The CSMP Agent and FND should now be successfully communicating using the CSMP protocol.

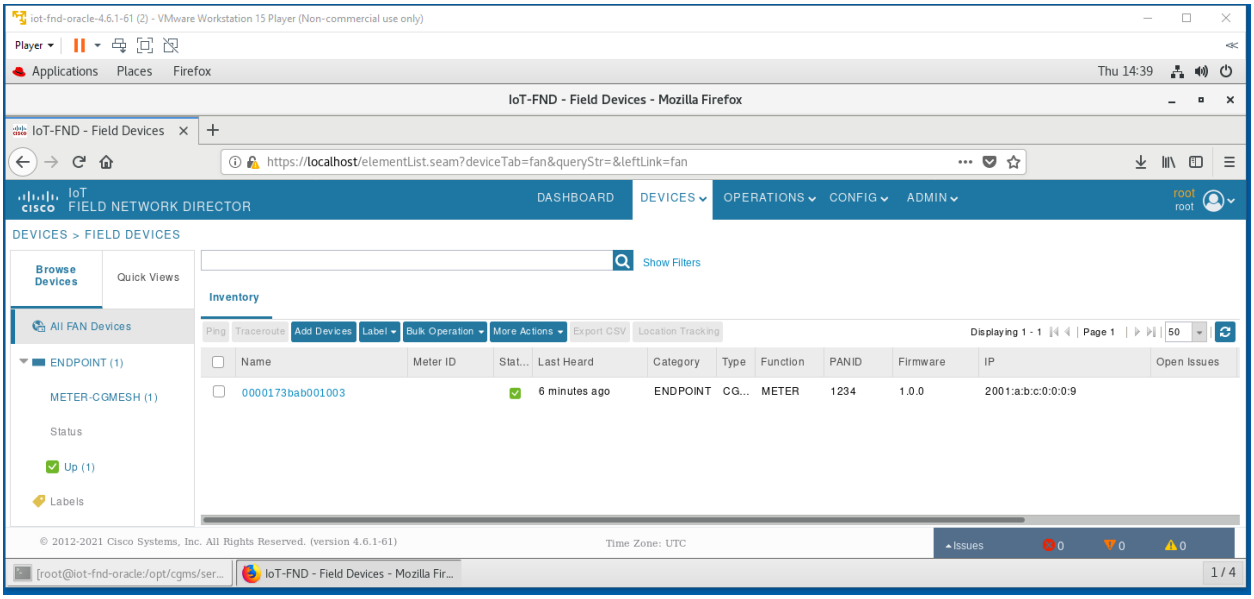
The CSMP Agent will register with FND, receive configuration from FND, and commence periodic metric reporting to FND. This can be confirmed in several ways.

5.1 CSMP Agent

CSMP Agent output will report “Regist to the NMS successfully” with “CSMP service stats” indicating reg_succeed counter has incremented. Metrics counter will increment with transmission of each metrics report (Report Interval configures in FND … here every 15 minutes).

5.2 FND UI

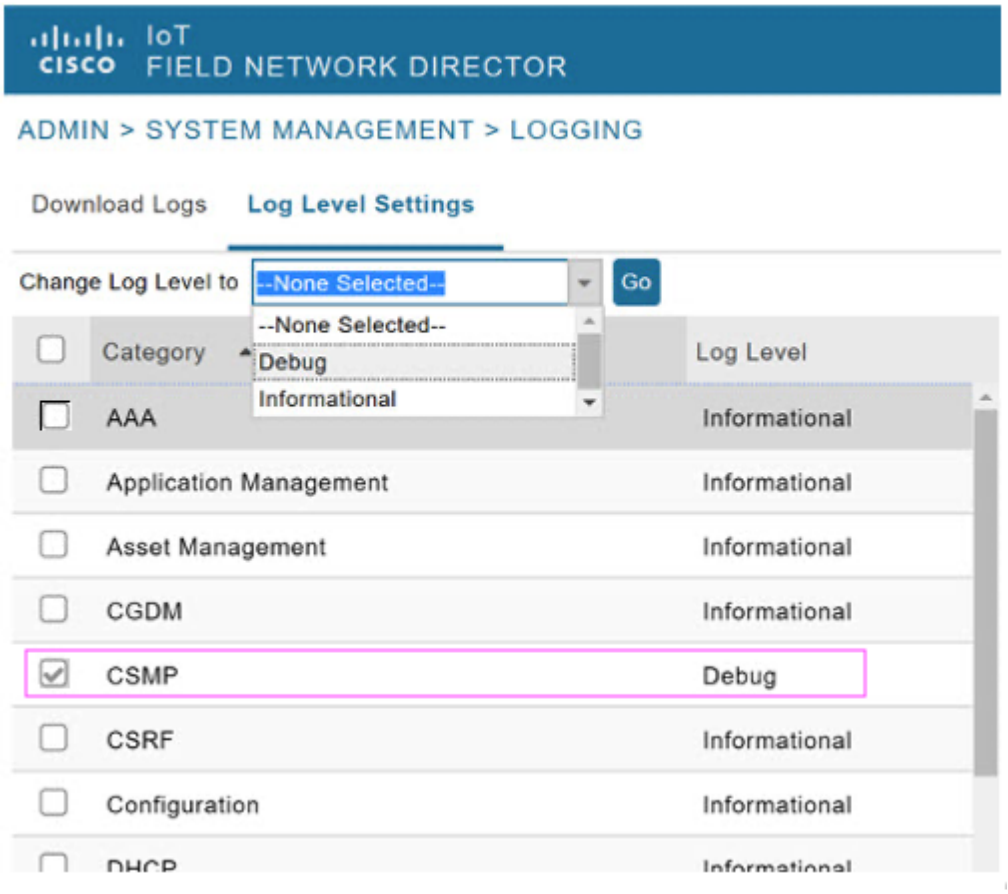
FND Device Inventory page will report the device is Up and will report last heard time.



5.3 FND Logs

CSMP TLV exchanges between FND and the agent can be recorded within FND's logs. To enable this capability, within FND:

1. Select Admin > System Management > Logging.
2. In the Logging page, select Log Level Settings tab, select CSMP, Change Log Level to Debug in the drop-down menu as show in the below screenshot.
3. Save settings. This enables CSMP Debug logging for all devices/EID's.



To access the TLV log information:

1. In the Logging page, select Download Logs tab to download the FND debug logs.
2. Or access the main FND log file from `/opt/cgms/server/cgms/log/server.log`.

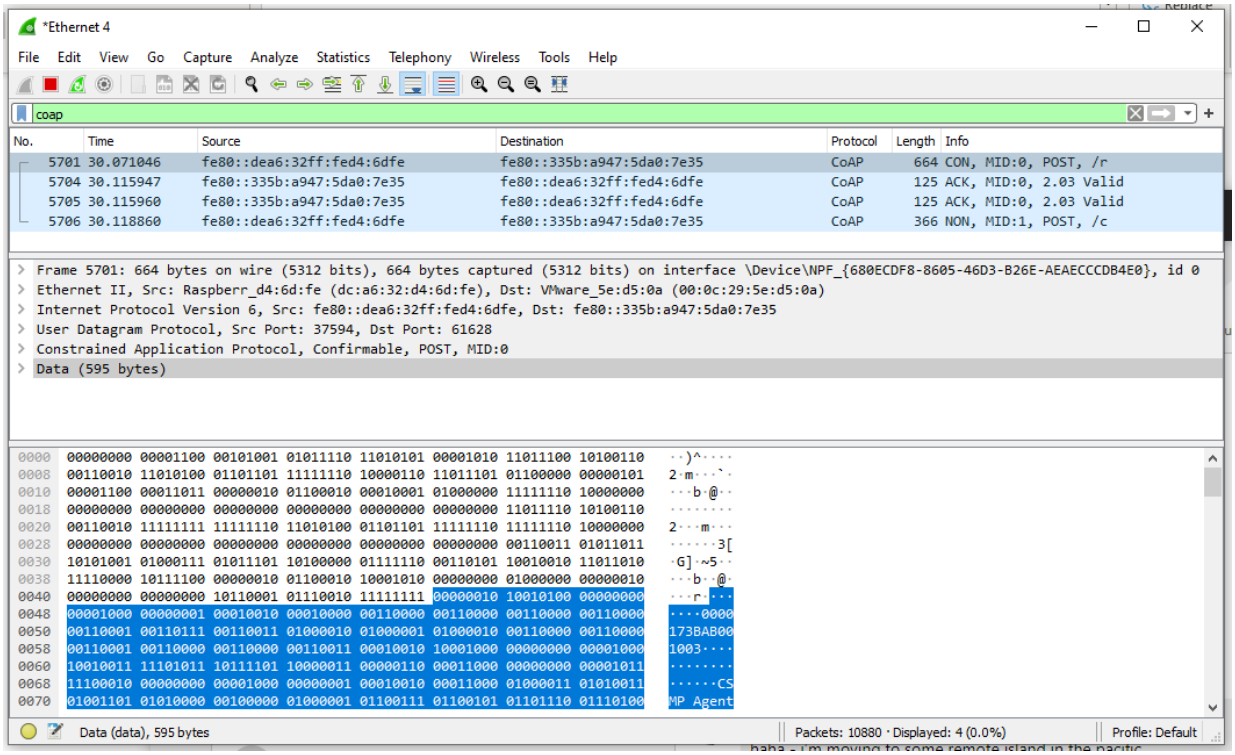
Sample CSMP-TLV11 (HARDWARE_DESCRIPTION) from the `server.log`.

```
csmpTlv( n=HardwareDesc t=11 vt=(0,0)
v=0801121D4952353330202D2053696E676C6520616E74656E6E6120772F2042425528
093A066C6F7770616E4203312E304A0A362E3628362E362E35295A0B46435732313330
303032456213436973636F2053797374656D732C20496E632E6A12495235333053422D
4F46442D4643432F4B39880102 m=entPhysicalIndex: 1
entPhysicalDescr: "IR530 - Single antenna w/ BBU"
entPhysicalClass: 9
entPhysicalName: "lowpan"
entPhysicalHardwareRev: "1.0"
```

```
entPhysicalFirmwareRev: "6.6(6.6.5)"
entPhysicalSerialNum: "FCW2130002E"
entPhysicalMfgName: "Cisco Systems, Inc."
entPhysicalModelName: "IR530SB-OFD-FCC/K9"
entPhysicalFunction: 2
)
```

5.4 Wireshark

Wireshark can be used to monitor the CSMP messaging between the CSMP Agent and FND. Note: decoding of payload TLVs is not yet supported. The display (filtered for protocol CoAP) should look something like this…



The capture above includes:

1. The registration message from the CSMP Agent to FND
2. The registration response, from FND to the CSMP Agent, containing configuration for the Agent.
3. The first periodic metrics report from the CSMP Agent.

6 Troubleshooting FAQ

6.1 FND virtual machine overloads host CPU

Adjust guest operating system ram/CPU downward.

6.2 FND not starting.

1. Increase virtual machine ram/CPU.
2. Check output from command – cgms service status
3. CGMS database password may expire after 7 days and needs to be refreshed as follows:

```
service cgms stop
su oracle
cd /home/oracle/app/oracle/cgms/scripts
./change-password.sh
For cgms user password is    'cgms123'
For cgmsDba 'cgmsDba123'
Exit
service cgms start
```

6.3 CSMP agent registration not completing.

1. Check routing configuration.
2. Confirm both RPi and FND host are able to ping each other.
    a. Inbound port 61628 needs to be open on FND host firewall.
3. Confirm RPi is on the same network as FND.

6.4 FND virtual machine not connecting to network

The VM network connection is configured for Bridge mode. Network activation will fail if there is contention for the interface (ex. Virtual Box is also installed and using the interface). Disable unused network connections to resolve VM network activation failures.

7 Additional Platform Support

Feedback to Cisco indicates this tutorial will also install and execute on the following platforms:

1. FND running on Ubuntu 20.04 host with vmware 16, with csmp agent running on same host or a remote ubuntu desktop. FND required 16 GB/2 processors on host. FND will warn about processors needs, less than clear warnings for RAM requirements.