Azure Focused IOT

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Problem Statement:

Azure IOT edge devices offer a bunch of useful features like performing logic at the edge rather than in IOT hub reducing network latency, also acts like a IoT edge gateway to exchange telemetry between IoT hub and devices which does not support conventional IoT communication protocols like AMQP, MQTT or HTTP etc and lot of additional offerings.

In order to execute business logic at the IoT edge devices, we need to deploy the IoT edge runtime along with our custom runtime module in the form of containers and it can be deployed to IoT edge devices with the help of either VS code or Azure CLI. We will discuss how to **deploy custom container modules into Azure IoT edge enabled devices using Visual Studio Code and Java** in this tutorial.

Solution/Architecture:



Technical Details and Implementation of solution:

Prerequisites:

- Install Visual Studio Code 2017 or later versions
- Install Docker desktop
- Install JDK8.0 or later versions
- Maven build tool
- Azure subscription
- Docker hub or azure container registry repository

Environment set up:

First, we need to install a docker runtime engine in our local to build container images for IOT edge modules in our local environment and push it to either docker hub or azure container registry. Please download and install docker from below link,

Docker Desktop for Windows

After that, install VS code 2017 or later versions from following link:

Visual Studio Code

Create Azure IOT hub and edge device

Login into <u>https://portal.azure.com/</u> with your Azure subscription and go to **Create a Resource->IoT Hub->Create**

Then, create a IoT edge device, go to IoT Edge->Add IoT Edge Device.

Deploy a Linux VM into edge device

Now, in order to boot up the device as a IoT edge device, we need to install the IoT Edge runtime like IoT Edge agent and IoT Hub in it. We will deploy a Linux VM in the edge device and during boot up it will install the IoT edge runtime. We will use the Azure custom deployment template using the following link which will use ARM template to deploy the resource from a GitHub project.

https://portal.azure.com/#create/Microsoft.Template/uri/https%3A%2F%2Fraw.git hubusercontent.com%2Fazure%2Fiotedge-vm-deploy%2F1.4%2FedgeDeploy.json

and fill up the required details to deploy the resource into Azure as per following screenshots (Give the device connection string as the IoT edge device primary connection string from the portal):

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Once the VM is deployed into Azure, you will see IoT edge agent is running in list of modules in IoT edge devices:

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Create a IoT edge solution template project from VS code, build a container image of it and push to docker container registry

Now, launch docker engine from desktop and start the container and you should see docker container is running at localhost port 80 as per below screenshot:

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Then, Open VS Code and install Azure IoT Edge extension for building a IoT edge solution from a predefined VS code template available from Microsoft.



Go to View menu and open Command Palette, then type Azure IoT edge and select "Azure IoT edge: new IoT edge solution"->Select a path where you will keep the code in your local directory->name the project as EdgeSolution->Select any language as per your choice(in my case it's "Java module use Azure IoT java SDK to build a module")-> name the module as SampleModule->give the path of docker container registry, in my case I have given my docker hub account name in place of docker.io/samplemodule->package name com.edgemodule and press enter and it will create and build a new maven project and you will get a prompt to given your docker hub/ACR credentials in .env file as below:

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Now open Terminal from top Menu and type in "**docker login**". Once you logged in successfully, right click on **deployment.template.json** in the project and click on **Build and push IoT edge solution**

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This will start creating docker images of the project and push it to docker hub.

Now, open the docker and validate if you see the pushed images in docker repository or not as per below screenshot:

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Deploy custom module into IoT edge:

Connect to Azure IoT hub from VS code as per below screenshot by providing IoT hub connection string from IoT Hub-> Shared Access Keys->IoTHubOwner->Primary Connection String

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Now, you are connected to IoT hub, right click on IoT edge device and click on Create deployment for single device as we are deploying to a single edge device for now.



And then select deployment template as per below screenshot:

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It will create a deployment manifest under config folder as below:



After that, right click again on azure IoT edge device and click on Create deployment for single device and then choose the deployment manifest file under Config folder as per below screenshot:



It will deploy the custom **samplemodule** to edge device successfully and then you will be able to see all four modules are running in edge device as per following screenshot:

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Cost Management + *	Aanagement +						

Now, as per the route defined in the deployment manifest, the temperature sensor module will start sending messages into the **samplemodule** and **samplemodule** will start sending sensor data into IoT hub. In order to monitor the telemetry data coming into IoT hub, we should right click on edge device and click on **start monitoring Built-in Event endpoint** as below:



Then, we should give the IoT hub built in Event hub endpoint which can be found **IotHub->Built-in Endpoint** as per below screenshot:

← → C 🔒 portal.azure	.com/#@bhaskarray082021outlook.onmicrosoft.	:om/resource/subscriptions/767f3270-a4e3-4998-8a32-00877bf77174/resourceGroups/iot-rg/providers/Microsoft
Change Backgroun	dtest by Ookla 🚦 Continue 🛭 🚱 One Cognizant	📙 Springboot 📙 iot 📙 Python 📃 Azure AD 📒 Lift&Shift 📒 Azure Blogs
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~	Home > All resources > my-iot-hub-0000	
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📶 Dashboard	🔎 Search 🔍	🖫 Save 🏷 Undo
E All services	CVerview	0
+ FAVORITES	Activity log	Security Security ()
All resources	Access control (IAM)	Consumer Groups ()
回 Resource groups	Tags	Spafault
App Services	Diagnose and solve problems	
🦘 Function App	Events	Create new consumer group
國 SQL databases	Device management	Event Hub compatible endpoint
🥙 Azure Cosmos DB		Only policies that allow service connect permissions can be selected. These permissions are applied to the built-in endpoint.
菒 Virtual machines		Shared access policy ①
🚸 Load balancers	loi Eage	iothubowner Event Hub-compatible endpoint ①
Storage accounts	Configurations + Deployments	Endpoint=sb://ihsuprodblres007dednamespace.servicebus.windows.net/;SharedAccessKeyName=iothubowner;Share
↔ Virtual networks	Updates	
Azure Active Directory	🔎 Queries	Cloud to device messaging
🔭 Monitor	Hub settings	Control message retention time and retry attempts.
🗛 Advisor	e→ Built-in endpoints	Default TTL ①
Ø Microsoft Defender for	🔀 Message routing	0
Cloud	💽 File upload	Feedback retention time ①
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We are all set and will be able to view the sensor data that is consumed by Azure IoT hub now as per below screenshot:

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descentainer	1 1 1 1
> ineventamen	2 "modulesContent"; (
> .vscode	3 "SedgeAgent": (
Contig	4 "properties.desired": {
C) deployment.amd64.json	5 "schemaVersion": "1.1",
> modules	6 "runtime": (
O env	7 "type": "docker",
gitignore	8 "settings": (
() deployment.debug.template.ison	9 "minDockerVersion": "v1.25",
() deployment template ison	10 "loggingOptions": "",
	11 "registryCredentials": {
-40	12 "docker": {
	13 "username": "dockerhub150288",
A	14 "password":
	15 "address": "docker.io"
	PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL AZURE
~	"temperature": 20.567739140739544, "humidity": 25 }, "timeCreated": "2022-12-22T15:46:02.30592" {IOTHubMonitor] [9:16:07 PM] Message received from [my-edge-0001/SampleModule]:
> OUTLINE	{
> TIMELINE	"machine": {
> SERVERS	"temperature": 34.14904927120035,
A 71 IRE IOT MUR	"pressure": 2,497992954946875
2 million have append),
EX my-lot-hub-0001	"ambient": (
✓ Devices	"temperature": 20,582226282489593,
> 😫 my-edge-0001 🔿	"humidity": 24
> Endpoints), "timeCreated": "2022-12-22T15:46:07.31427442"
> MAVEN	L
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Challenges in implementing the solution:

Once we create the Azure IoT edge device in IoT hub, we will need to deploy the IoT edge runtime module inside the device via Linux Virtual machine.

Otherwise, the device will remain in offline state, and we will get error deploying our custom module in the device. So, before the deployment, we have

to boot up the device with IoT edge runtime installed in it either through ARM template custom deployment or Azure CLI etc or if it is a windows VM, we can RDP

to remotely connect to the VM and install the runtime agents through power shell.

Business Benefit:

Using VS code Azure IoT extension, the time to market will be greatly reduced to develop and deploy any custom IoT edge modules that can

written in any language as per our choice in C#, Java, Node.js or python etc. It can be utilized as a low code solution as well.

Code base:

The working code from VS code has been attached below in a zip format:

