Internet Of Things

UNIT-II

Faculty:A.K.Rout Semester-7th

M2M:

Machine-to-Machine (M2M) refers to networking of machines(or devices) for the purpose of remote monitoring and control and dataexchange.

 Term which is often synonymous with IoT is Machine-to-Machine (M2M).

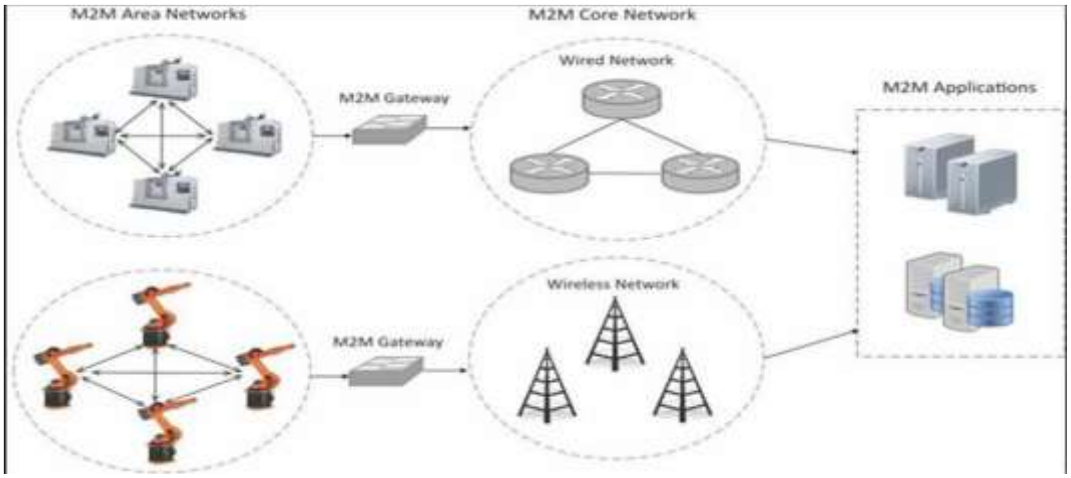
 IoT and M2M are often usedinterchangeably.

Fig. Shows the end-to-end architecture of M2M systems comprises of M2M area networks, communication networks and application fomain.

An M2M area network comprises of machines(or M2M nodes) whiach have embedded network modules for sensing, actuation and communicating various communiction protocols can be used for M2M LAN such as ZigBee, Bluetooth, M-bus, Wireless M-Bus etc., These protocols provide connectivity between M2M nodes within an M2M area network.

 The communication network provides connectivity to remote M2M area networks. The communication network provides connectivity to remote M2M area network. The communication networkcan use either wired or wireless network(IP based). While the M2M are networks use either properietorary or non-IP baed communication protocols, the communication network uses IP-based network. Since non-IP based protocols are used within M2M area network, the M2M nodes within one network cannot communicate with nodes in an externalnetwork.

 To enable the communication between remote M2M are network, M2M gateways are used.



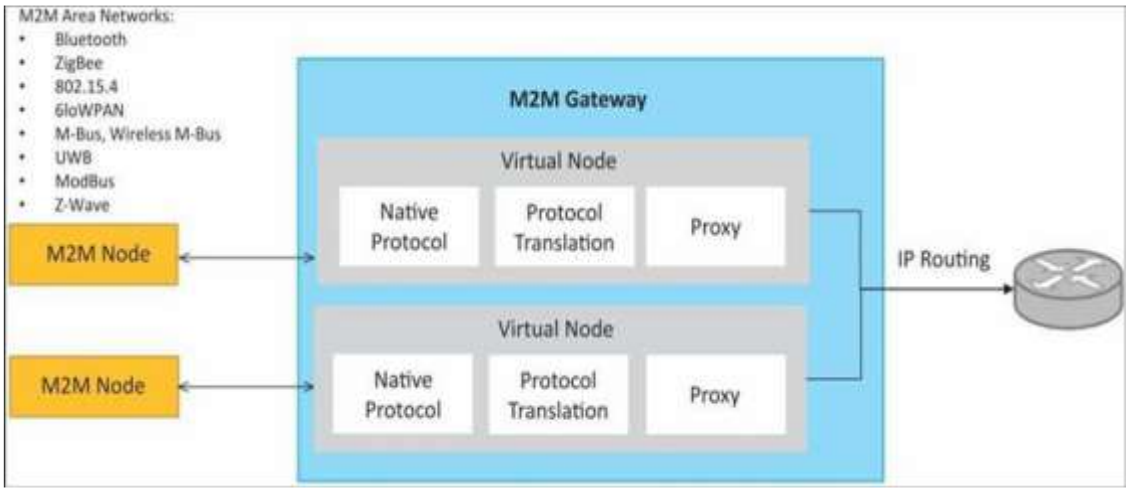


Fig. Shows a block diagram of an M2M gateway. The communication between M2M nodes and the M2M gateway is based on the communication protocols which are naive to the M2M are network. M2M gateway performs protocol translations to enable Ip-connectivity for M2M are networks. M2M gateway acts as a proxy performing translations from/to native protocols to/from Internet Protocol(IP). With an M2M gateway, each mode in an M2M area network appears as a virtualized node for external M2M area networks.

Differences between IoT and M2M

1) Communication Protocols:

 Commonly uses M2M protocols include ZigBee, Bluetooth, ModBus, M-Bus, WirelessM-Bustec.,

 In IoT uses HTTP, CoAP, WebSocket, MQTT,XMPP,DDS,AMQPetc.,

2) Machines in M2M Vs Things inIoT:

 Machines in M2M will be homogenous whereas Things in IoT will be heterogeneous.

3) Hardware Vs SoftwareEmphasis:

 the emphasis of M2M is more on hardware with embedded modules, the emphasis of IoT is more onsoftware.

4) Data Collection &Analysis

 M2M data is collected in point solutions and often in on-premises storage infrastructure.

 The data in IoT is collected in the cloud (can be public, private or hybrid cloud).

5) Applications

 M2M data is collected in point solutions and can be accessed by on-premises applications such as diagnosis applications, service management applications, and on- premisis enterpriseapplications.

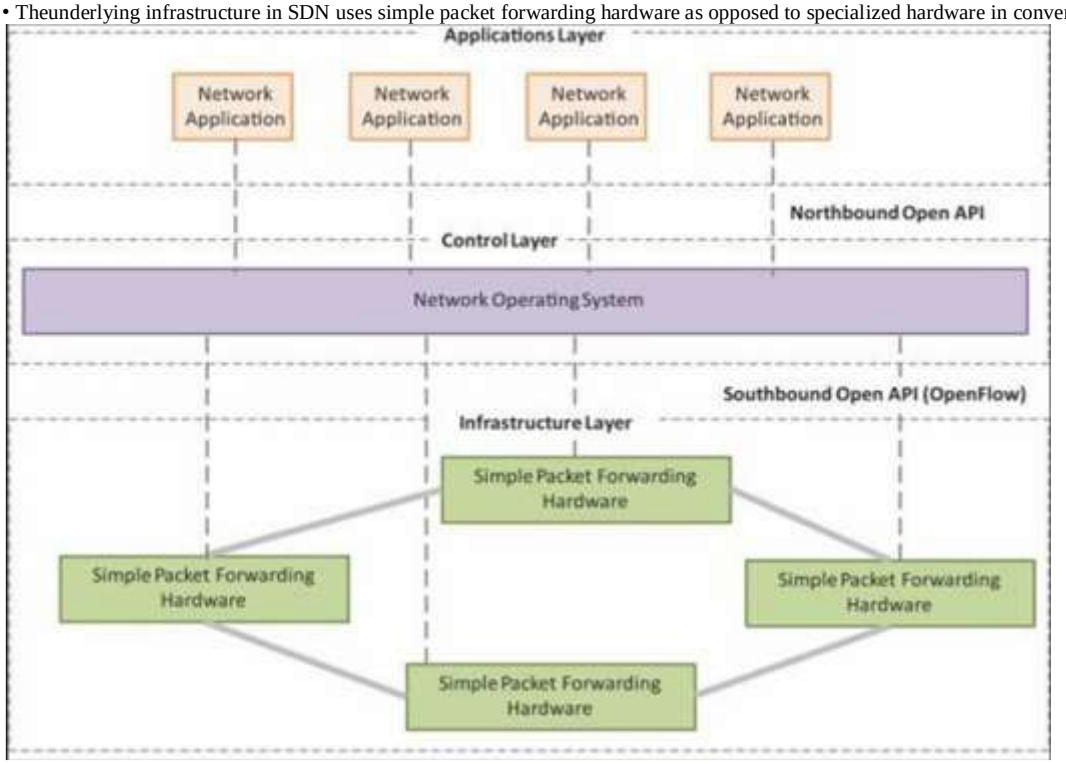
 IoT data is collected in the cloud and can be accessed by cloud applications such as analytics applications, enterprise applications, remote diagnosis and management applications,etc.

SDN and NVF for IoT
Software Defined Networking(SDN):

• Software-DefinedNetworking (SDN) isanetworking architecture that separates the control plane from the data plane and centralizes the networkcontroller.

• Software-based SDN controllers maintain a unified view of thenetwork

• Theunderlying infrastructure in SDN uses simple packet forwarding hardware as opposed to specialized hardware in conventional networks.



SDN Architecture

Key elements of SDN:

1) Centralized NetworkController

With decoupled control and data planes and centralized network controller, the network administrators can rapidly configure the network.

2) Programmable OpenAPIs

SDN architecture supports programmable open APIs for interface between the SDN application and control layers (Northbound interface).

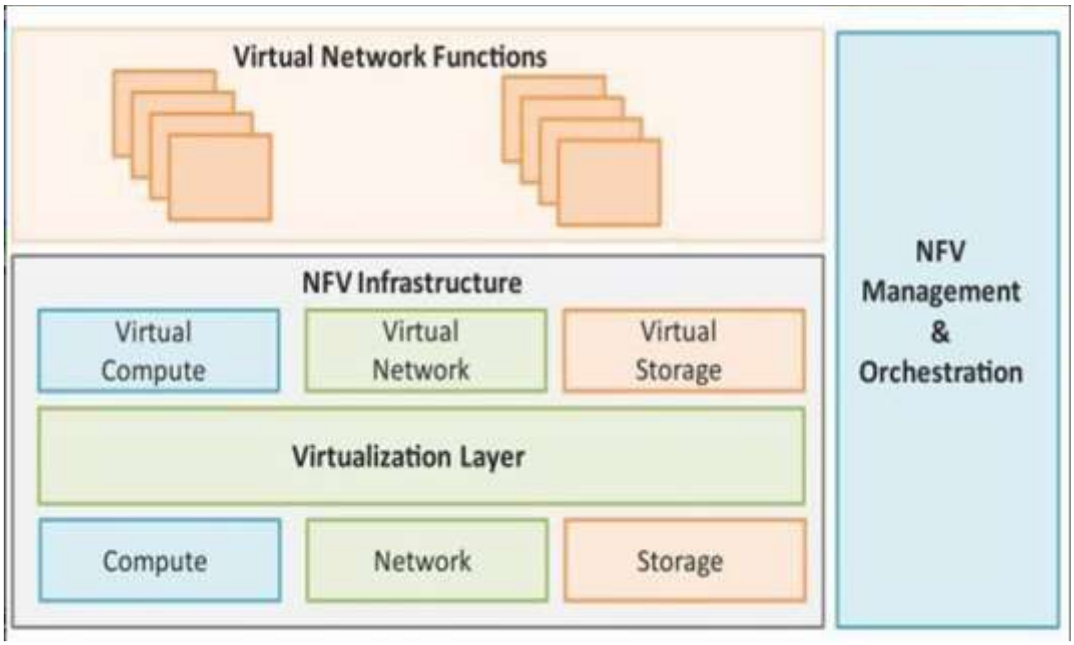
3) Standard Communication Interface(OpenFlow)

SDN architecture uses a standard communication interface between the control and infrastructure layers (Southbound interface). OpenFlow, which is defined by the Open Networking Foundation (ONF) is the broadly accepted SDN protocol for the Southboundinterface.

Network Function Virtualization(NFV)

• Network Function Virtualization (NFV) is a technology that leverages virtualization to consolidate the heterogeneous network devices onto industry standard high volume servers, switches andstorage.

• NFV is complementary to SDN as NFV can provide the infrastructure on which SDN canrun.



Key elements of NFV:

NFV Architecture

1) Virtualized Network Function(VNF):

VNF is a software implementation of a network function which is capable of running over the NFV Infrastructure (NFVI).

2) NFV Infrastructure(NFVI):

NFVI includes compute, network and storage resources that are virtualized.

3) NFV Management andOrchestration:

NFV Management and Orchestration focuses on all virtualization-specific management tasks and covers the orchestration and life-cycle management of physical and/or software resources that support the infrastructure virtualization, and the life-cycle management of VNFs.

Need for IoT Systems Management

Managing multiple devices within a single system requires advanced management capabilities.

1) **Automating Configuration :** IoT system management capabilities can helpin automating the systemconfiguration.

2) **Monitoring Operational & Statistical Data :** Management systems can help in monitoring opeartional and statistical data of a system. This data can be used for fault diagnosis orprognosis.

3) **Improved Reliability:** A management system that allows validating the system configurations before they are put into effect can help in improving the systemreliability.

4) **System Wide Configurations :** For IoT systems that consists of multiple devices or nodes, ensuring system wide configuration can be critical for the correct functioning of thesystem.

5) **Multiple System Configurations :** For some systems it may be desirable to have multiple valid configurations which are applied at different times or in certainconditions.

6) **Retrieving & Reusing Configurations :** Management systems which have the capability of retrieving configurations from devices can help in reusing the configurations for other devices of the sametype.

IoT Systems Management with NETCONF-YANG

YANG is a data modeling language used to model configuration and state data manupulated by the NETCONF protocol.
The generic approach of IoT device management weith NETCONF-YANG. Roles of various componentsare:

1) ManagementSystem

2) ManagementAPI

3) TransactionManager

4) RollbackManager

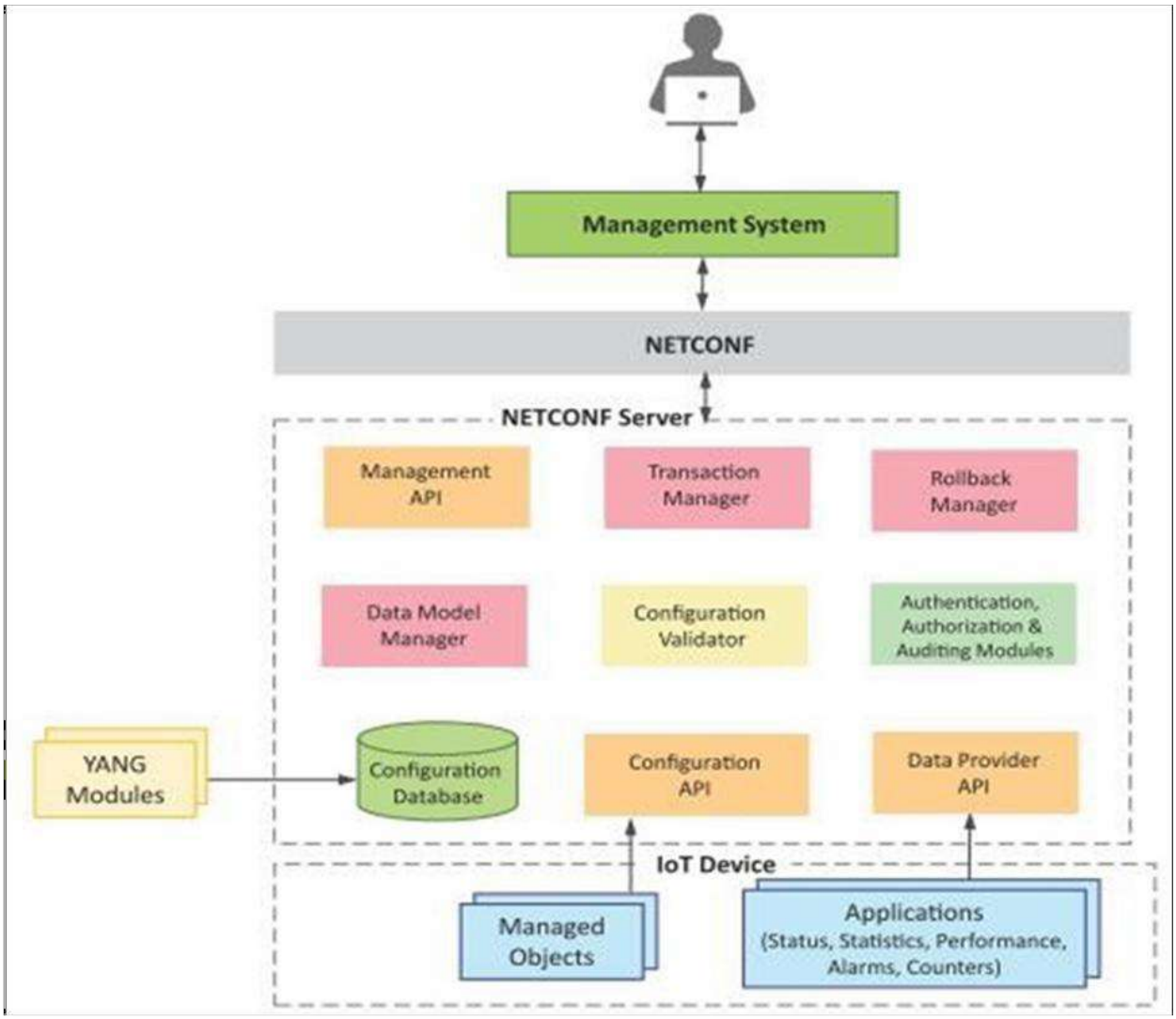
5) Data ModelManager

6) ConfigurationValidator

7) ConfigurationDatabase

8) ConfigurationAPI

9) Data ProviderAPI



1) **Management System :** The operator uses a management system to send NETCONF messages to configure the IoT device and receives state information and notifications from the device as NETCONFmessages.

2) **Management API :** allows management application to start NETCONFsessions.

3) **Transaction Manager:** executes all the NETCONF transactions and ensures that ACID properties hold true for thetrasactions.

4) **Rollback Manager :** is responsible for generating all the transactions necessary to rollback a current configuration to its original state.

5) **Data Model Manager :** Keeps track of all the YANG data models and the corresponding managed objects. Also keeps track of the applications which provide data for each part of a datam,odel.

6) **Configuration Validator :** checks if the resulting configuration after applying a transaction would be a validconfiguration.

7) **Configuration Database :** contains both configuration and operastionaldata.

8) **Configuration API :** Using the configuration API the application on the IoT device can be read configuration data from the configuration datastore and write opeartional data to the opearationaldatastore.

9) **Data Provider API:** Applications on the IoT device can register for callbacks for various events using the Data Provider API. Through the Data Provider API, the applications can report statistics and opeartionaldata.

Steps for IoT device Management with NETCONF-YANG

1) Create a YANG model of the system that defines the configuration and state data of the system.

2) Complete the YANG model with the _Inctool' which comes withLibnetconf.

3) Fill in the IoT device mangement code in the TransAPImodule.

4) Build the callbacks C file to generate the libraryfile.

5) Load the YANG module and the TransAPImodule into the Netopeer server using Netopeer managertool.

6) The operator can now connect from the management system to the Netopeer server using the NetopeerCLI.

7) Operator can issue NETCONF commands from the Netopeer CLI. Command can be issued to changew the configuration dsta, get operational dat or execute an RPC on the IoTdevice.