UNIT V
IoT Systems Management with NETCONF-YANG

Need for IoT Systems Management
• Automating Configuration
• Monitoring Operational & Statistical Data
• Improved Reliability
• System Wide Configurations
• Multiple System Configurations
• Retrieving & Reusing Configurations

Simple Network Management Protocol (SNMP)
• SNMP is a well-known and widely used network management protocol that allows monitoring and configuring network devices such as routers, switches, servers, printers, etc.
• SNMP component include
• Network Management Station (NMS)
• Managed Device
• Management Information Base (MIB)
• SNMP Agent that runs on the device

Limitations of SNMP
• SNMP is stateless in nature and each SNMP request contains all theinformation to process the request. The application needs tobeintelligentto manage the device.
• SNMP is a connectionless protocol which uses UDP as the transportprotocol,making it unreliable as there was no support for acknowledgementofrequests.
• MIBs often lack writable objects without which device configurationisnotpossible using SNMP.
• It is difficult to differentiate between configuration and statedatainMIBs.
• Retrieving the current configuration from a device can be difficult withSNMP.
• Earlier versions of SNMP did not have strong security features.

Network Operator Requirements
• Ease of use
• Distinction between configuration and state data
• Fetch configuration and state data separately
• Configuration of the network as a whole
• Configuration transactions across devices
• Configuration deltas
• Dump and restore configurations
• Configuration validation
• Configuration database schemas
• Comparing configurations
• Role-based access control
• Consistency of access control lists:
• Multiple configuration sets
• Support for both data-orientedandtask-oriented access control

NETCONF
• Network Configuration Protocol (NETCONF) is a session-based network management protocol.

NETCONF allows retrieving state or configuration data and manipulating configurationdataonnetwork devices
• NETCONF works on SSH transport protocol.
• Transport layer provides end-to-end connectivity and ensure reliable deliveryof messages.
• NETCONF uses XML-encoded Remote Procedure Calls (RPCs) for framing request andresponse messages.
• The RPC layer provides mechanism for encoding of RPC calls and notifications.
• NETCONF provides various operations to retrieve and edit configuration datafromnetwork devices. • The Content Layer consists of configuration and state data which is XML-encoded.
• The schema of the configuration and state data is defined in a data modelinglanguagecalled YANG. • NETCONF provides a clear separation of the configuration and state data.
• The configuration data resides within a NETCONF configuration datastore ontheserver.

YANG
• YANG is a data modeling language used to model configuration and state datamanipulated by the NETCONF protocol
• YANG modules contain the definitions of the configuration data, state data, RPCcallsthatcan be issued and the format of the notifications.
• YANG modules defines the data exchanged between the NETCONF client andserver.
• A module comprises of a number of 'leaf' nodes which are organized intoahierarchicaltree structure.
• The 'leaf' nodes are specified using the 'leaf' or 'leaf-list' constructs.
• Leaf nodes are organized using 'container' or 'list' constructs.
• A YANG module can import definitions from other modules.
• Constraints can be defined on the data nodes, e.g. allowed values.
• YANG can model both configuration data and state data using the 'config' statement

• This YANG module is a YANG version of the toaster MIB
• The toaster YANG module begins with the header information followed by identity declarations which define various bread types.
• The leaf nodes ('toasterManufacturer' , 'toasterModelNumber' and oasterStatus') are defined in the 'toaster' container.
• Each leaf node definition has a type and optionally a description and default value.
• The module has two RPC definitions ('make-toast' and 'cancel-toast').

IoT Systems Management with NETCONF-YANG
• Management API
• Transaction Manager
• Rollback Manager
• Data Model Manager
• Configuration Validator
• Configuration Database
• Configuration API
• Data Provider API