Internet-of-Things
MCA 5036

By,

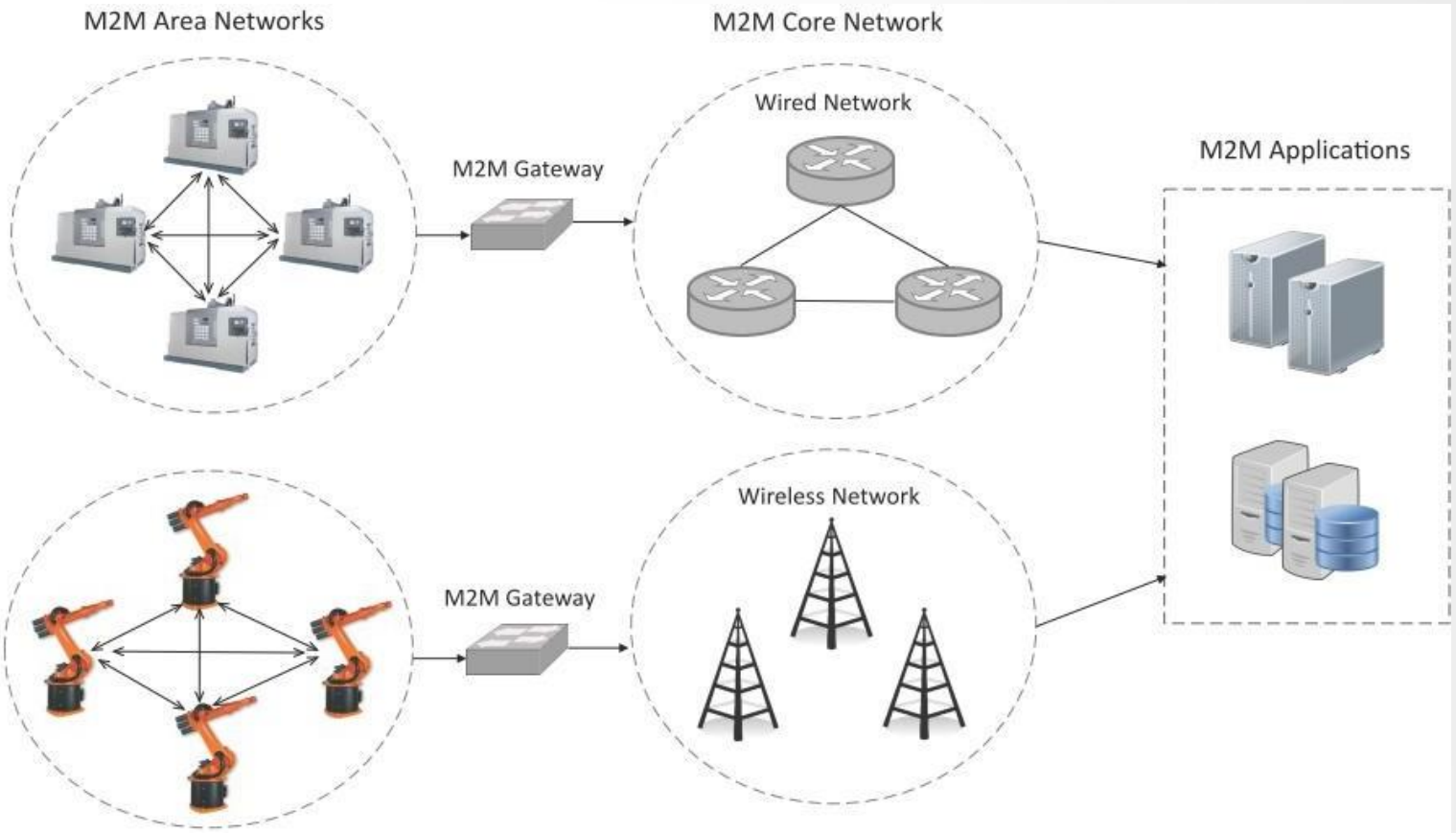
Dr. Vidya Rao
Assistant Professor,
Dept of DSCA, MIT, MAHE

Outline

- M2M
- Differences and Similarities between M2M and IoT
- SDN and NFV for IoT

Machine-to-Machine (M2M)

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

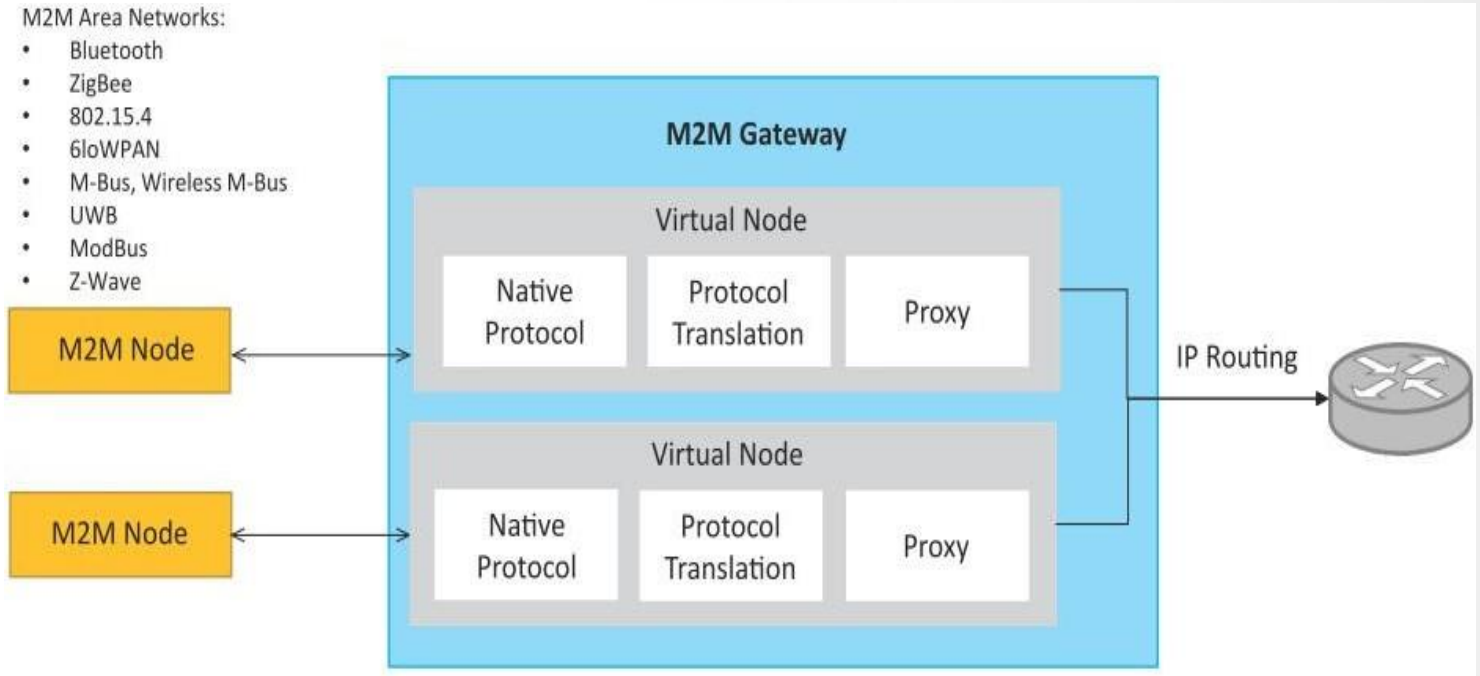


Machine-to-Machine (M2M) contd..

- An M2M area network comprises machines (or M2M nodes) that have embedded hardware modules for sensing, actuation, and communication.
- Various communication protocols can be used for M2M local area networks such as ZigBee, Bluetooth, Modbus, M-Bus, Wireless M-Bus, Power Line Communication (PLC), 6LoWPAN, IEEE 802.15.4, etc.
- The communication network provides connectivity to remote M2M area networks.
- The communication network can use either wired or wireless networks (IP- based).
- While the M2M area networks use either proprietary or non-IP-based communication protocols, the communication network uses IP-based networks.

M2M gateway

- Since non-IP based protocols are used within M2M area networks, the M2M nodes within one network cannot communicate with nodes in an external network.
- To enable the communication between remote M2M area networks, M2M gateways are used.



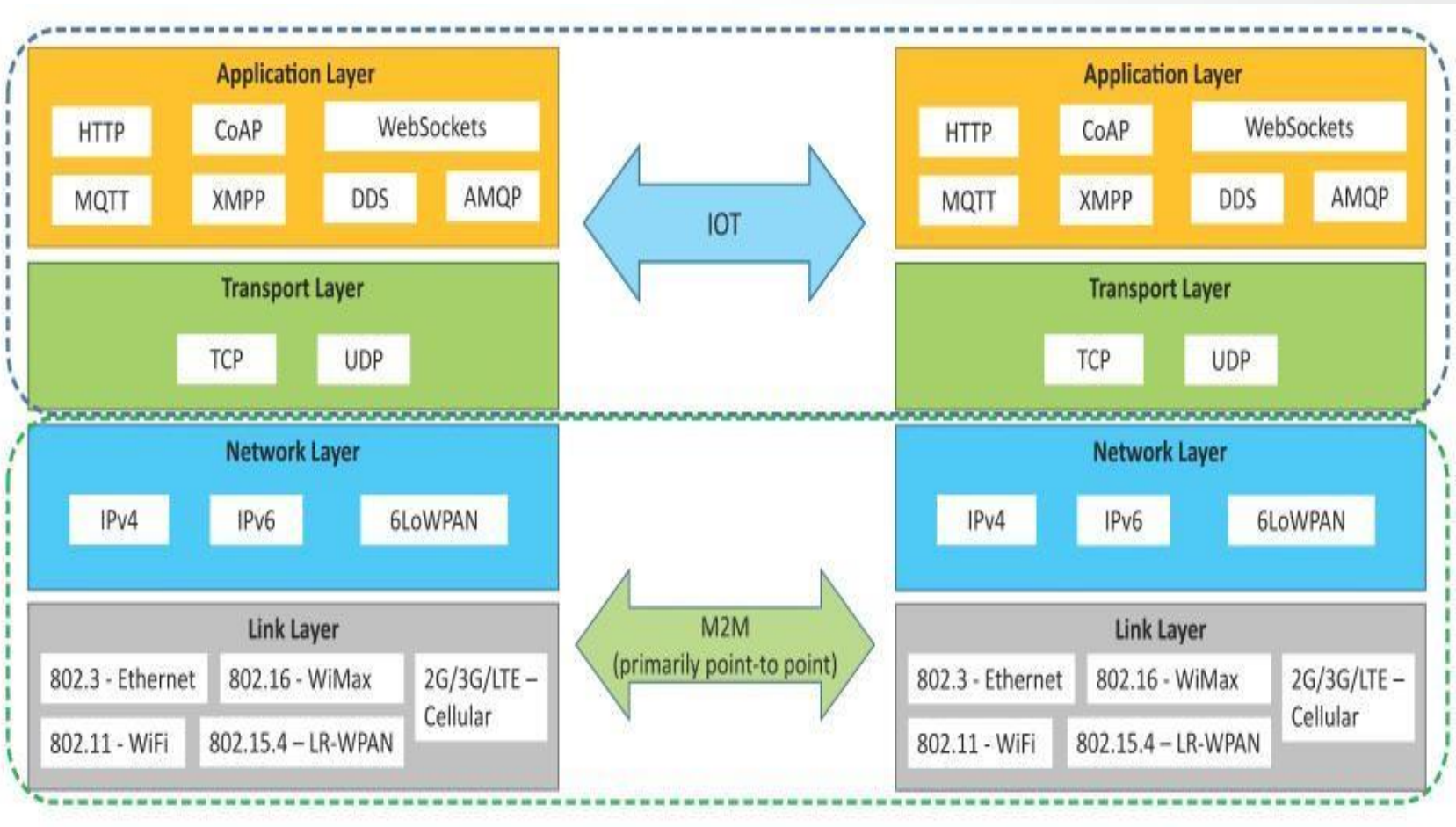
Difference between IoT and M2M

- **Communication Protocols**
  - M2M and IoT can differ in how the communication between the machines or devices happens.
  - M2M uses either proprietary or non-IP-based communication protocols for communication within the M2M area networks.
  - M2M – Zigbee, BT, ModBus, IoT uses protocols above network layers like HTTP, CoAP, WebSocket etc.
- **Machines in M2M vs Things in IoT**
  - The "Things" in IoT refer to physical objects that have unique identifiers and can sense and communicate with their external environment (and user applications) or their internal physical states.
  - M2M systems, in contrast to IoT, typically have homogeneous machine types within an M2M area network.

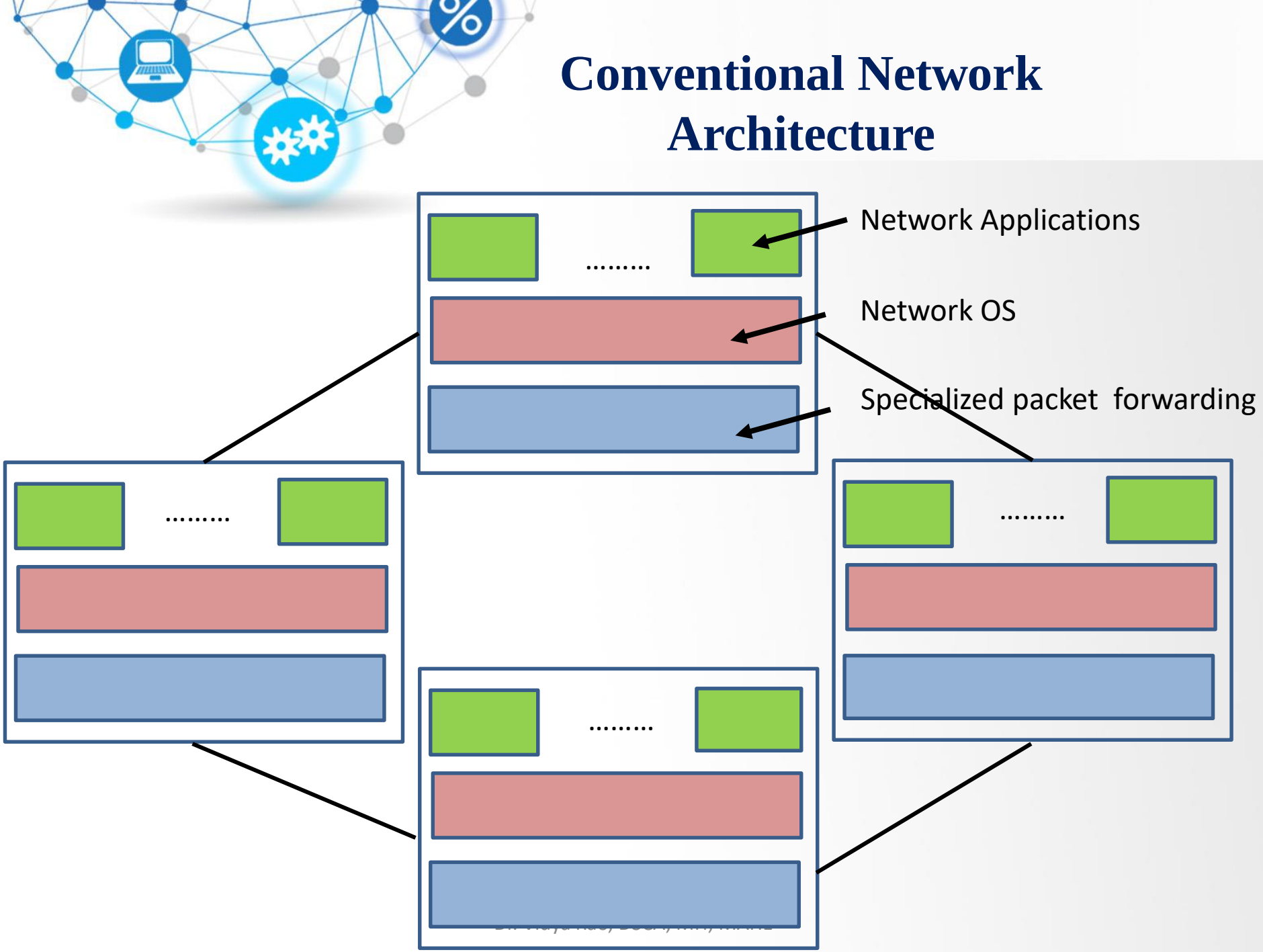
Difference between IoT and M2M

- **Hardware vs Software Emphasis**
  - While the emphasis of M2M is more on hardware with embedded modules, the emphasis of IoT is more on software.
- **Data Collection & Analysis**
  - M2M data is collected in point solutions and often in on-premises storage infrastructure.
  - In contrast to M2M, the data in IoT is collected in the cloud (can be public, private or hybrid cloud).
- **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- premises enterprise applications.
  - 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.

Communication in IoT vs M2M



Conventional Network Architecture

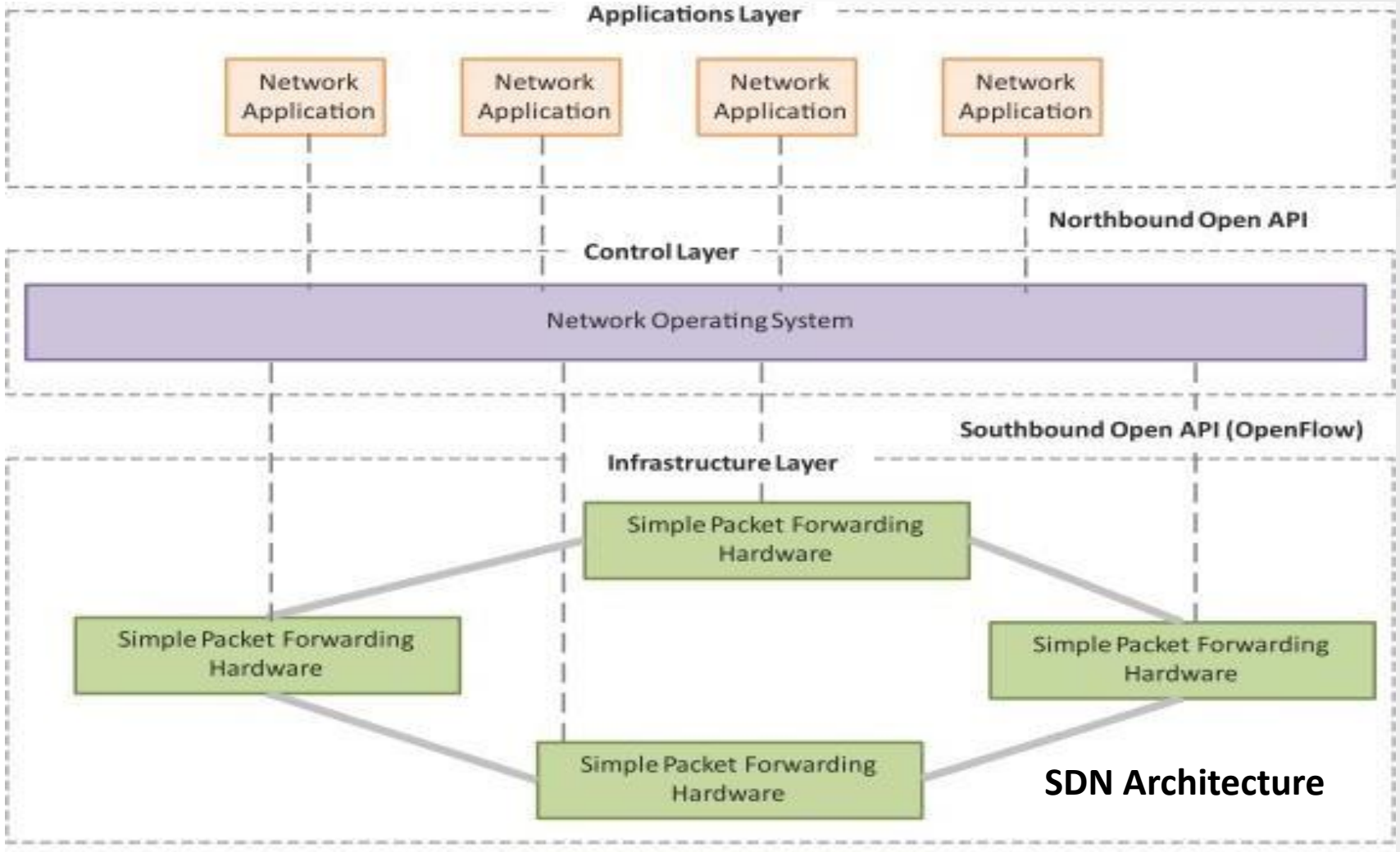


Limitation of Conventional Network Architecture

- Complex Network Devices
- Management Overhead
- Limited Scalability

Software-Defined Network (SDN)

- SDN creates a simpler, inexpensive, scalable, agile and easy to manage

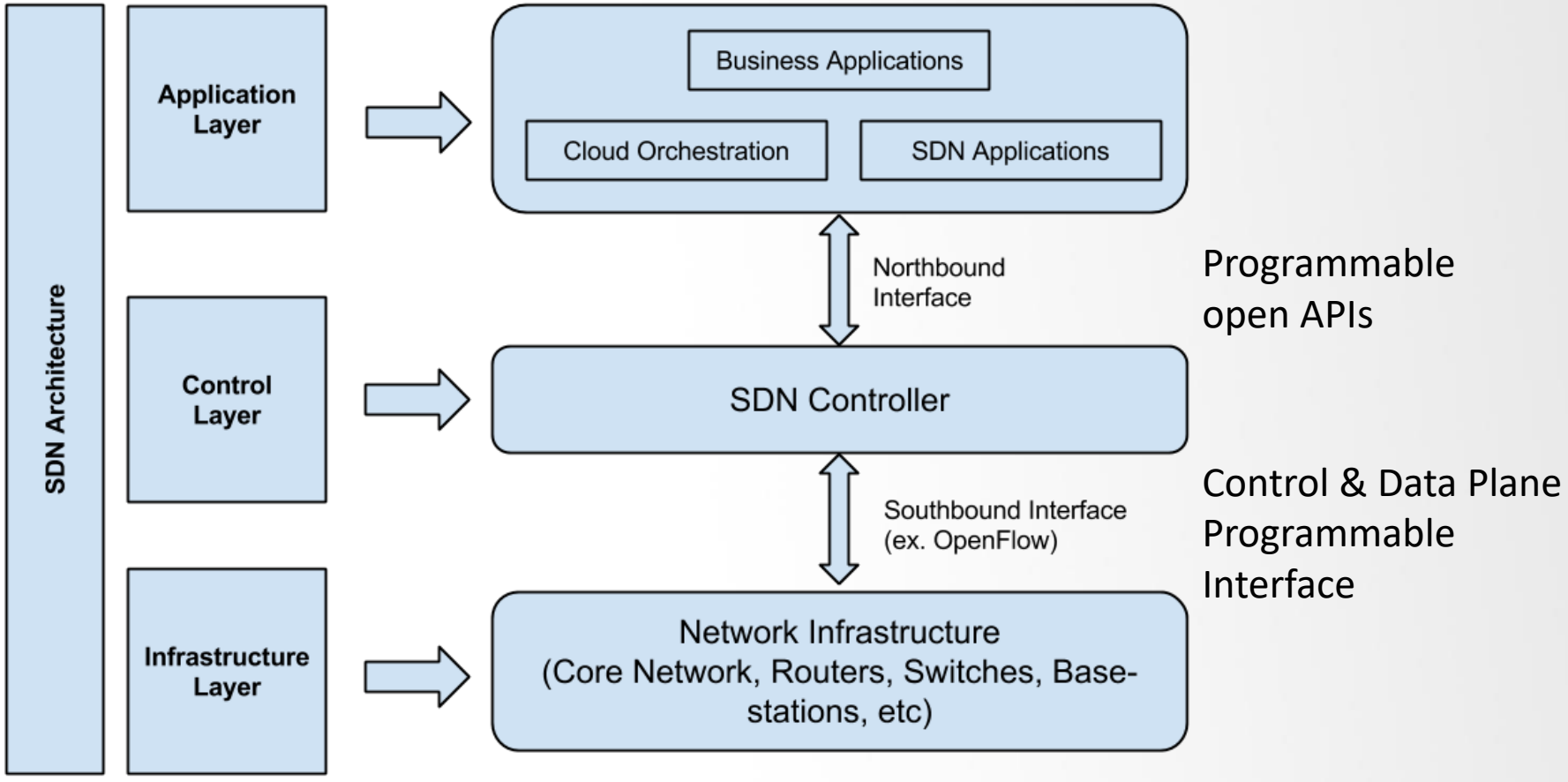


SDN Architecture

Key elements of SDN

- **Centralized Network Controller**
  - With decoupled control and data planes and centralized network controller, the network administrators can rapidly configure the network.
- **Programmable Open APIs**
  - SDN architecture supports programmable open APIs for interface between the SDN application and control layers (Northbound interface).
- **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 Southbound interface.

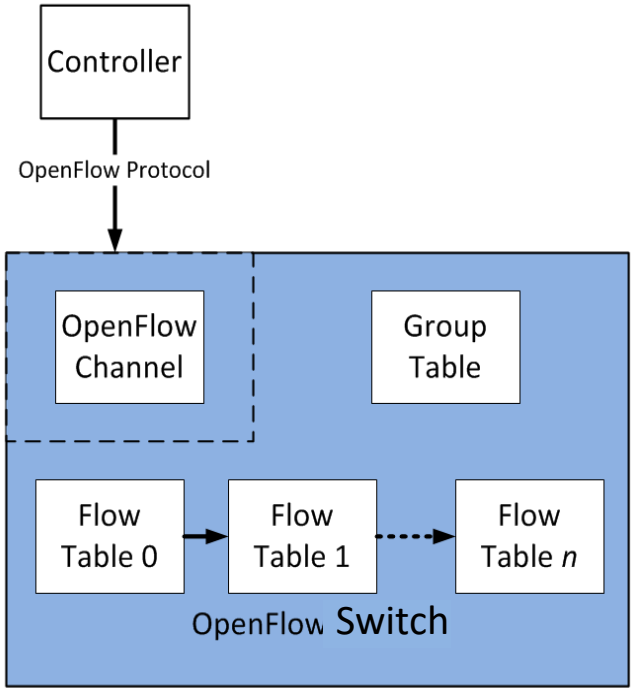
SDN



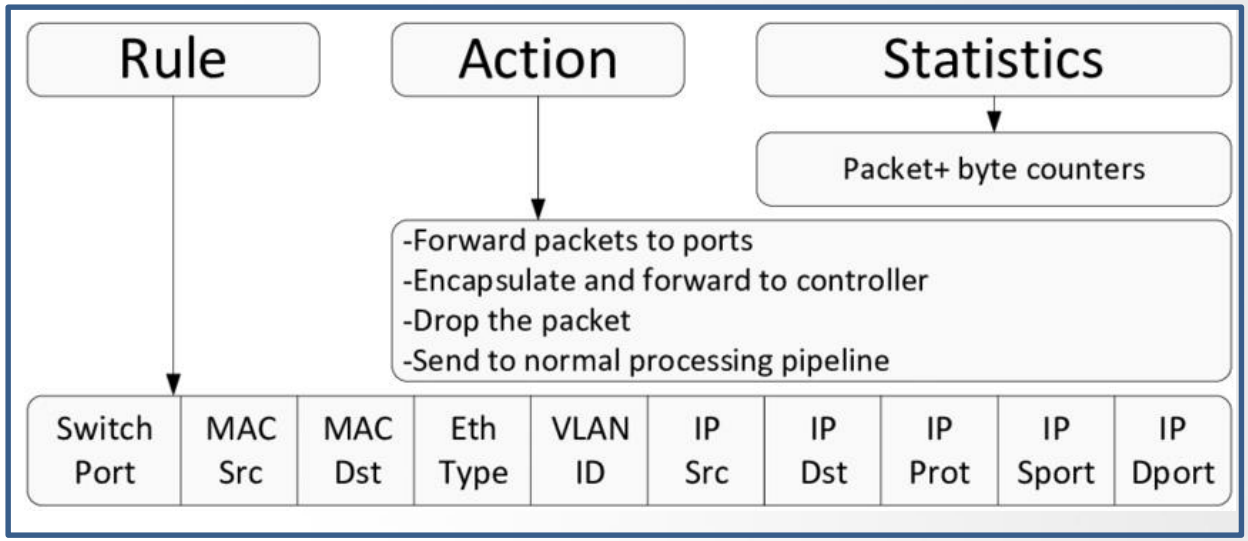
SDN Layers

OpenFlow

- **Uses concepts of flows to identify the network traffic based on predefined matches.**
- **Open Flow switch comprises one or more flow tables and a group table.**



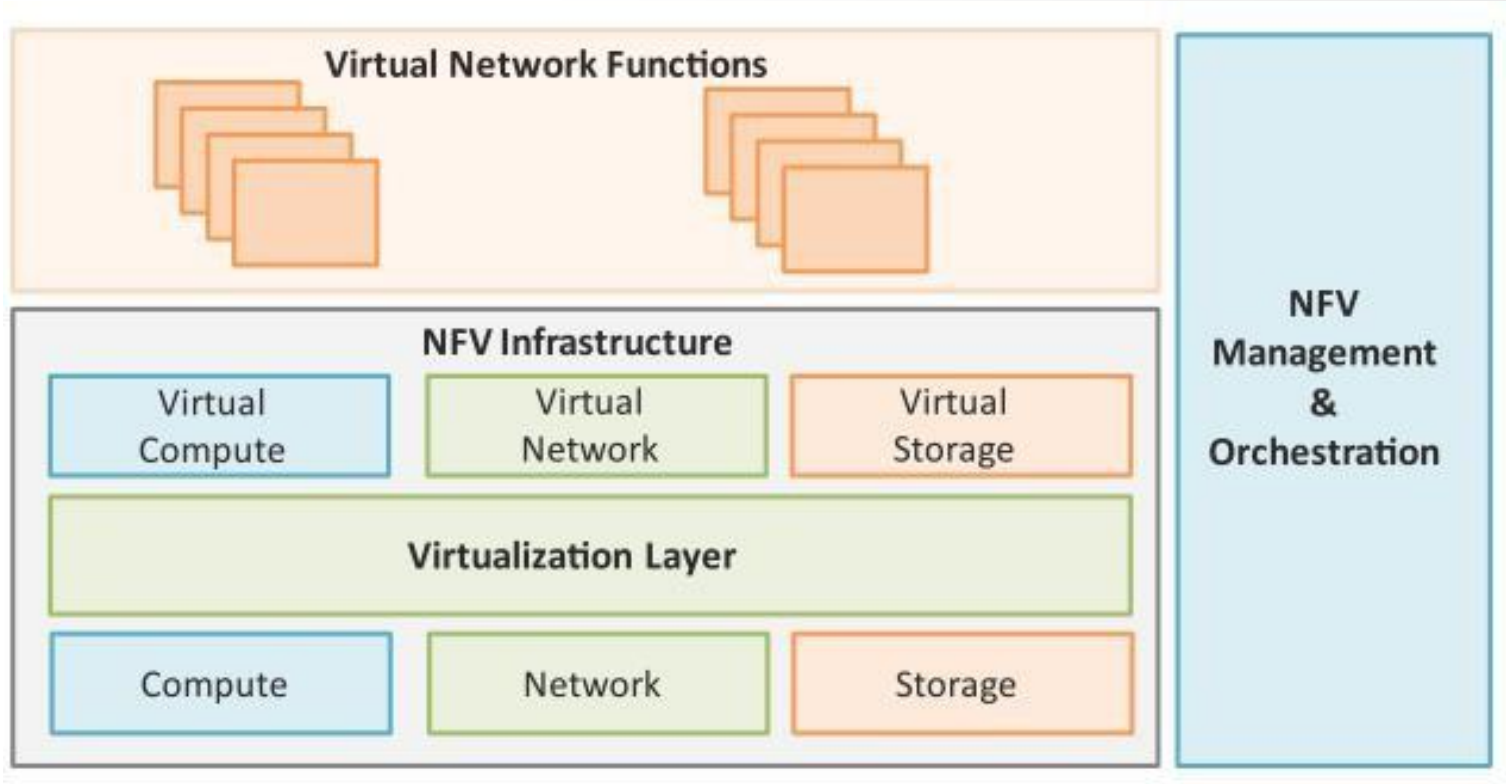
OpenFlow switch



OpenFlow flow Table

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 and storage.
- NFV is complementary to SDN as NFV can provide the infrastructure on which SDN can run.

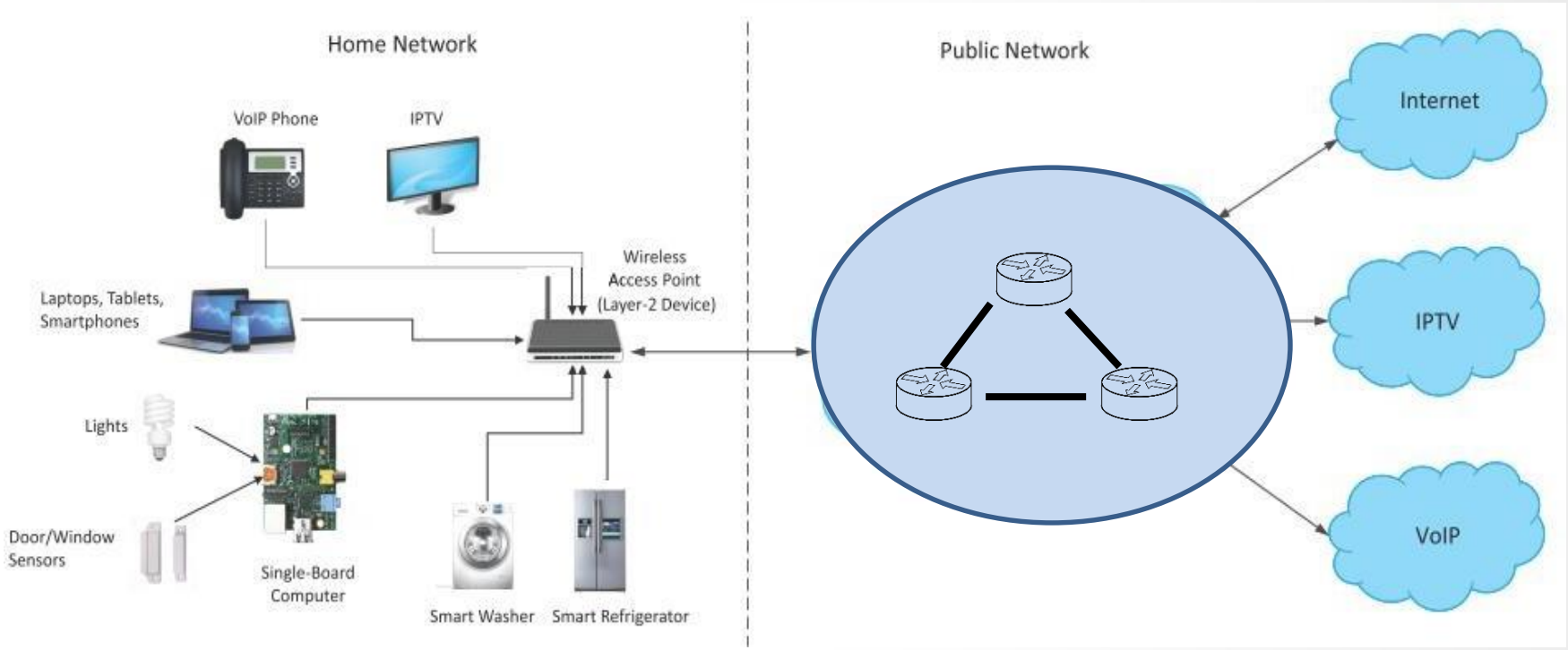


Key elements of NFV

- **Virtualized Network Function (VNF):**
  - VNF is a software implementation of a network function which is capable of running over the NFV Infrastructure (NFVI).
- **NFV Infrastructure (NFVI):**
  - NFVI includes compute, network and storage resources that are virtualized.
- **NFV Management and Orchestration:**
  - 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.

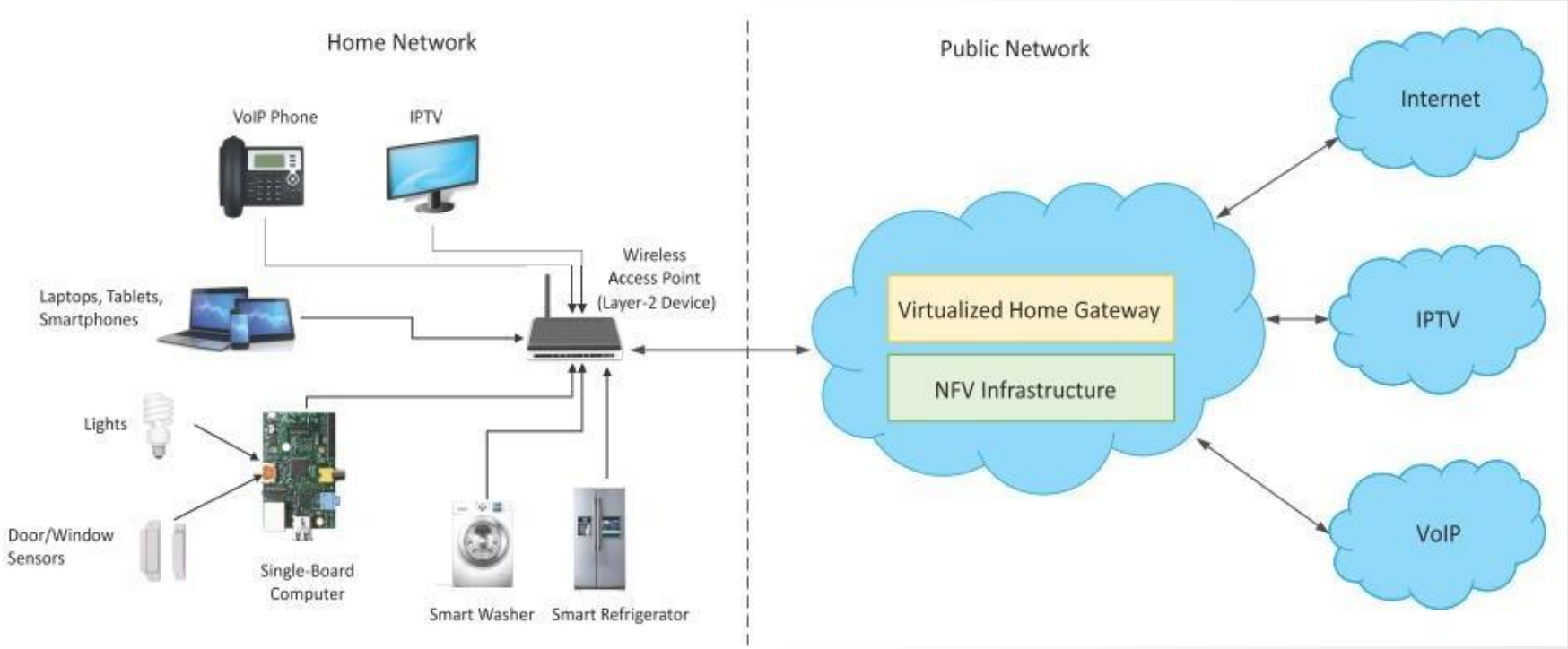
NFV Use Case

- Conventional home network architecture



NFV Use Case

- NFV can be used to virtualize the Home Gateway. The NFV infrastructure in the cloud hosts a virtualized Home Gateway. The virtualized gateway provides private IP addresses to the devices in the home. The virtualized gateway also connects to network services such as VoIP and IPTV.



Understanding the SNMP and NETCONF protocols