

# Wireless Sensor Networks

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**Credits: 6**



# Syllabus: Laboratory Activities

1. PAN Formation
2. Data Transfer (point-to-point)
3. MAC Protocol
4. **NET Protocol (small network)**



# NET Protocol

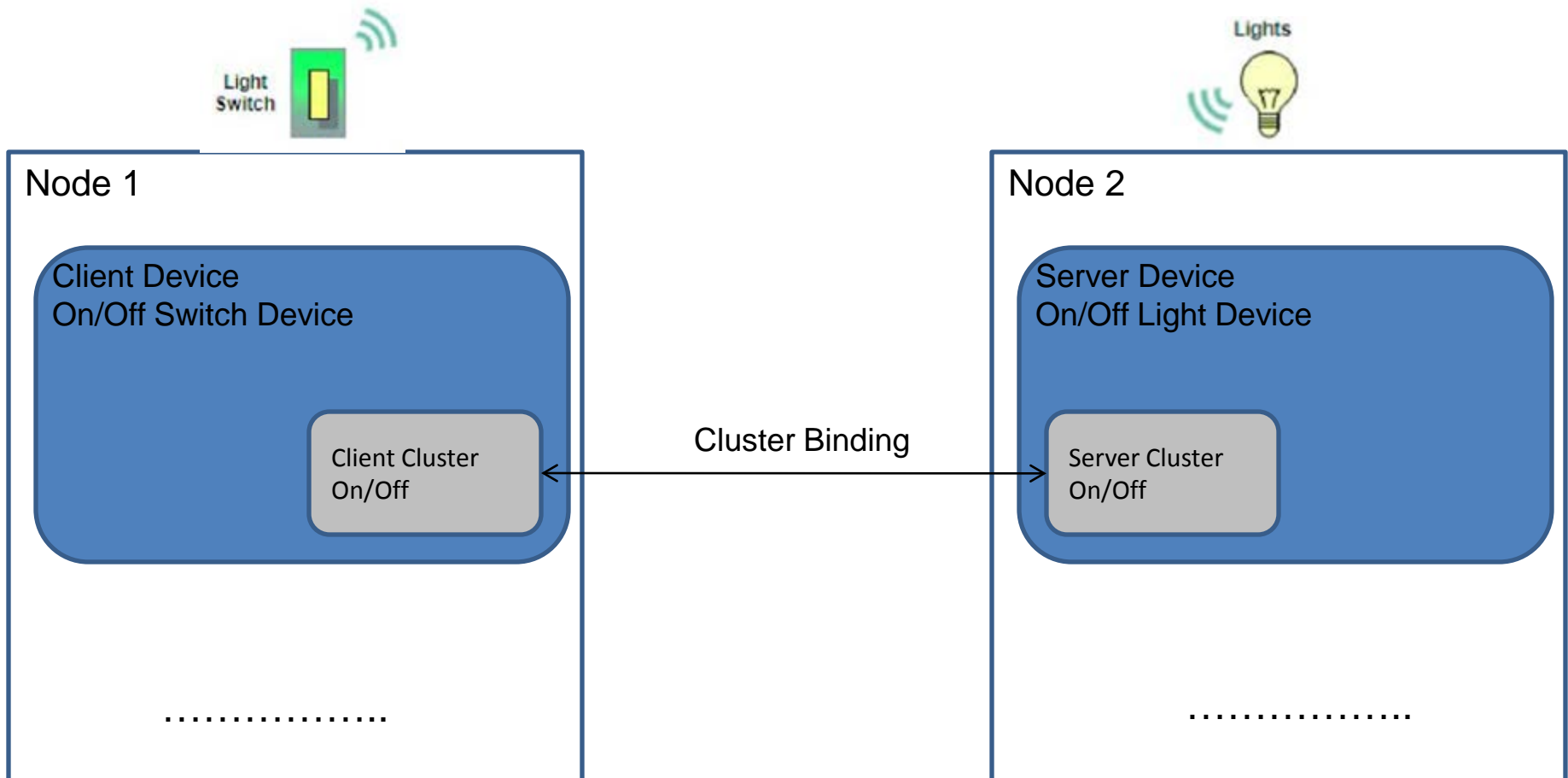
## (small network)



# Outline

1. Zigbee Upper Layers
2. Experiments

# The Light Switch Example

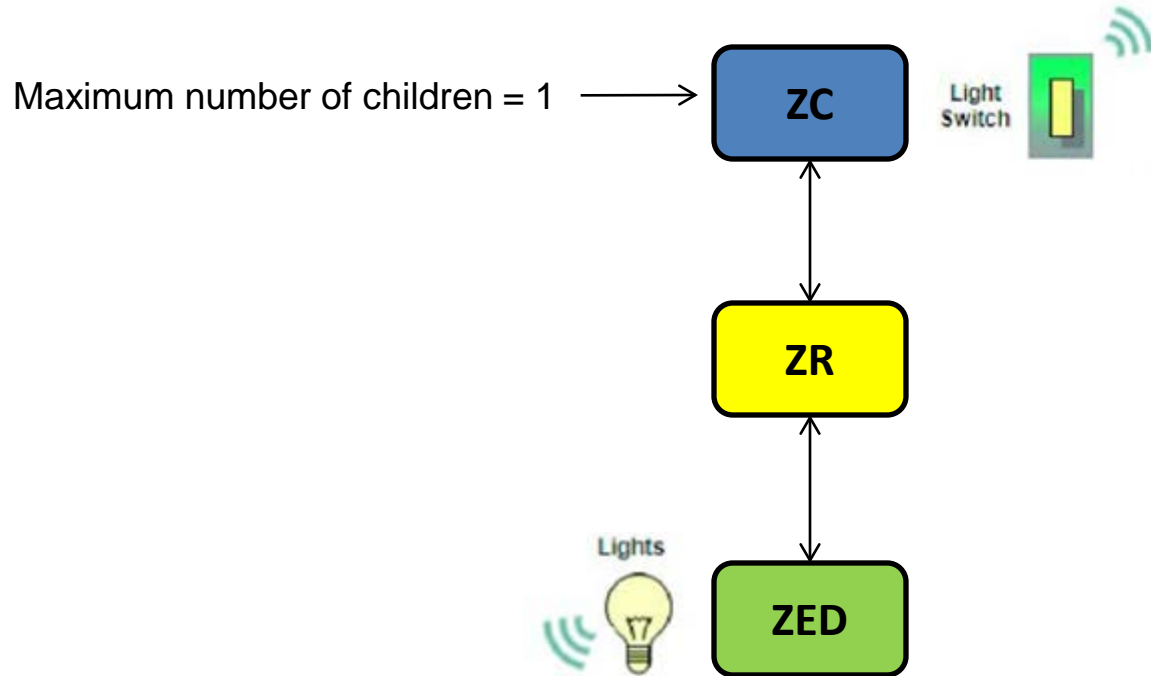


## The Application Layer: HA Profile

**Home Automation Profile** offers an affordable, reliable, expandable and easy way to control the environment, lighting, safety, and security in homes or small offices.

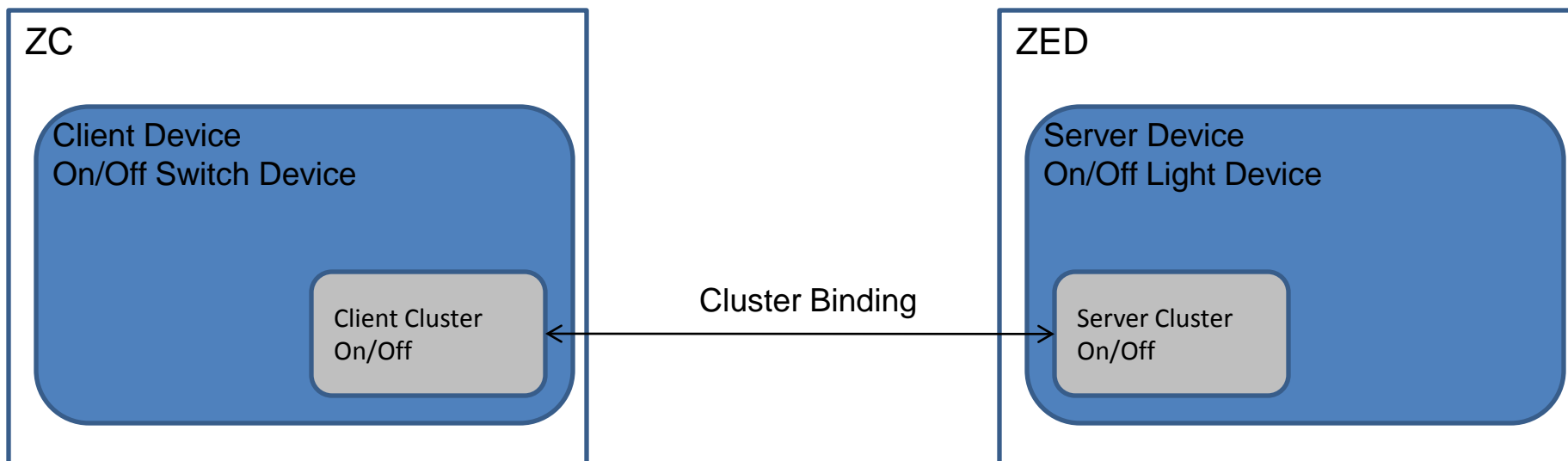
	Device	Server	Client	Description
General	On/Off Switch		X	Device able of sending on/off commands to the devices to switch them on/off.
	Level Control Switch		X	Device that controls, e.g., the level of brightness of a light.
	On/Off Output	X		The device that can be switched on/off.
	Level Controllable Output	X		The device can adjusted its characteristics.
Lighting	On/Off Light	X		The light device that can be switched on/off.
	Dimmable Light	X		The light device whose luminance level may be controlled.
	Color Dimmable Light	X		The light device whose luminance, hue, and saturation levels may be controlled.
	On/Off Light Switch		X	The switch that can send on, off and toggle commands to the lights.
	Dimmer Switch		X	The switch that can control the level of a characteristic of a device, typically the brightness of a light.
	Color Dimmer Switch		X	The switch that can control the luminance, hue and saturation levels of a multi-color light.
Closures	Shade	X		Device that provides the ability to open or close window.
	Shade Controller		X	The device that can control the level of a shade, and put it into configuration mode so that the user may adjust its limits.
HVAC	Heating/Cooling Unit	X		The unit that can heat or cool a space in a house.
	Thermostat	X		The device that sends heating and/or cooling requirement notifications to a heating/cooling unit.
	Temperature Sensor	X		The device that reports temperature measurements.
	Pump	X		Pump that may have variable speed. Typically used for pumping water.
	Pump Controller		X	The device that can configure and control a Pump device.
	Pressure Sensor	X		The sensor that measures the pressure of a liquid, typically water.

# The Zigbee Network



## Configuration Mode

- \* SW1 - Form/join network (form if ZC, join if ZR or ZED) with previous configuration
- \* SW3 - Use end-device-bind to bind to another node (e.g. switch to light)
- \* SW4 - Choose channel. Only functional when NOT on network.
- \* LSW1 - Toggle display/keyboard mode (Config and Application)





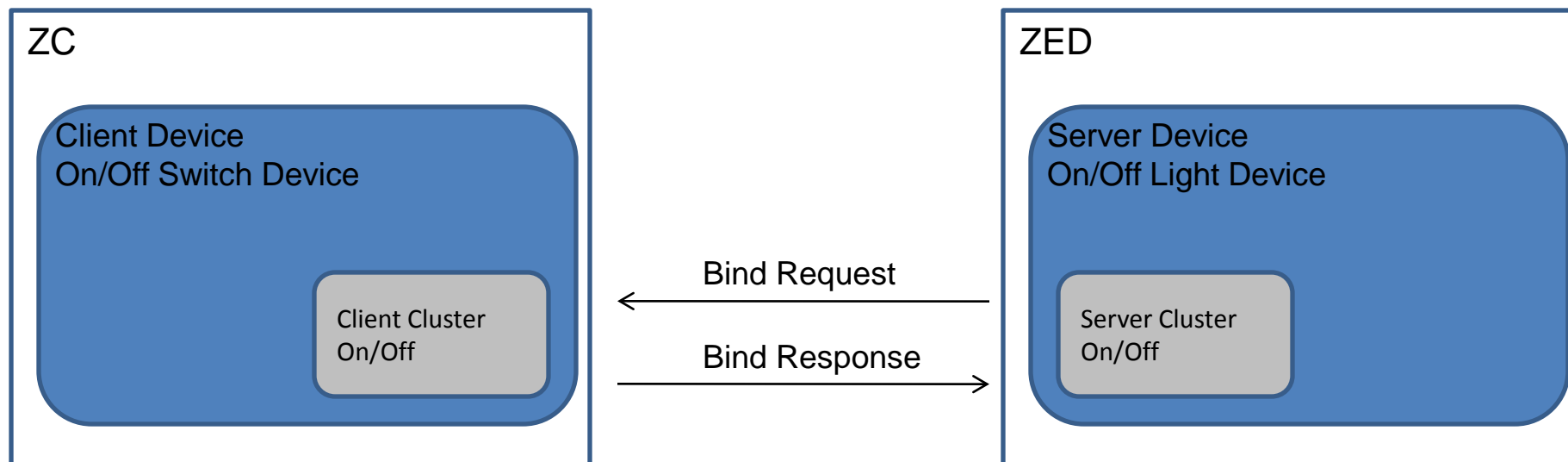
## Configuration Mode - Binding

APSME-BIND.request

```
{
  SrcAddr,
  SrcEndpoint,
  ClusterId,
  DstAddrMode,
  DstAddr,
  DstEndpoint
}
```

APSME-BIND.confirm

```
{
  Status,
  SrcAddr,
  SrcEndpoint,
  ClusterId,
  DstAddrMode,
  DstAddr,
  DstEndpoint
}
```



## On/off application mode

- \* SW1 - Toggle remote light → Toggle Command
- \* SW2 - Based on the SwitchActions attribute, moves the switch from state 1 to state 2 → On Command
- \* LSW1 - Toggle display/keyboard mode (Config and Application)
- \* LSW2 - Based on the SwitchActions attribute, moves the switch from state 2 to state 1 → Off Command

The ZC can send Zigbee commands to the bound ZED for switching on/off it.

Command Identifier Field Value	Description
0x00	Off
0x01	On
0x02	Toggle
0x03 – 0xff	Reserved



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