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IIoT Applications: Power Plants

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Introduction

- Data collected from IIoT enabled devices increase productivity and efficiency.
- Using IIoT, the equipment can be monitored remotely.
- Sensors collect data and sends to cloud.
- Different machine learning and artificial intelligence based algorithms are used to analyze the data.



Drivers of IIoT in Power Plant

- Low cost powerful chips
 - WiFi chip, cameras, sensors, accelerometers are used.
- Standardization with IPV6
 - 3G, 4G, 5G networks are used, the devices are standardized with TCP/IP and IPV6 protocol.
- Standardization with software technology
 - Use of artificial intelligence algorithms, and cloud computing software makes it easier.

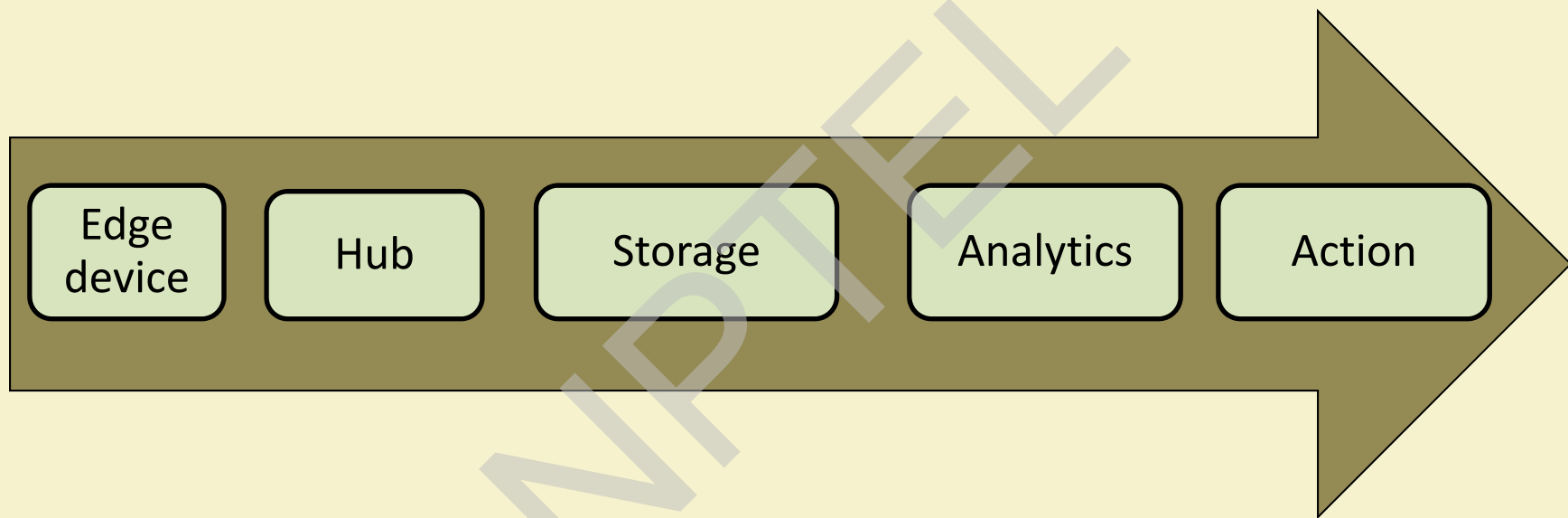


Digital Power Plant Benefits

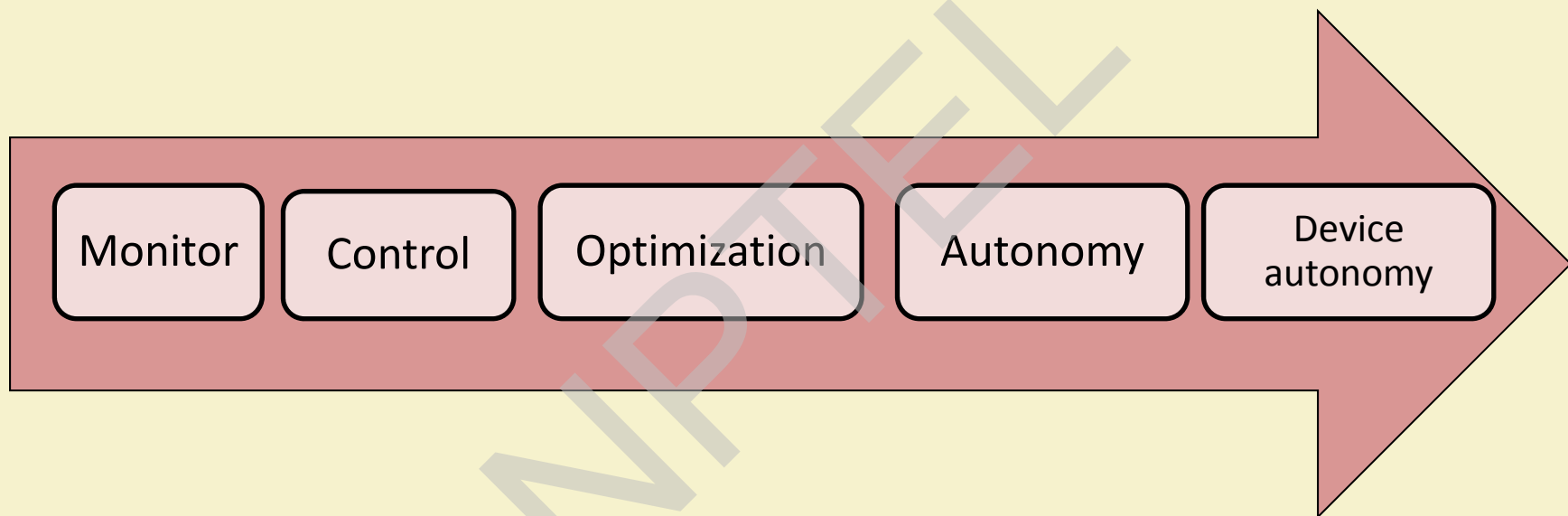
- Increase efficiency
 - Smart grid- automated devices increases efficiency and reduces manpower.
- Reduce cost
 - Automated devices- no need of money for manpower, fuel, maintenance.
- Improves performance
 - Turbine's performance improvement, remote monitoring.
- Reduce energy demands
 - Helps users to learn how to use energy in real time.



Architecture



IIoT Maturity Model

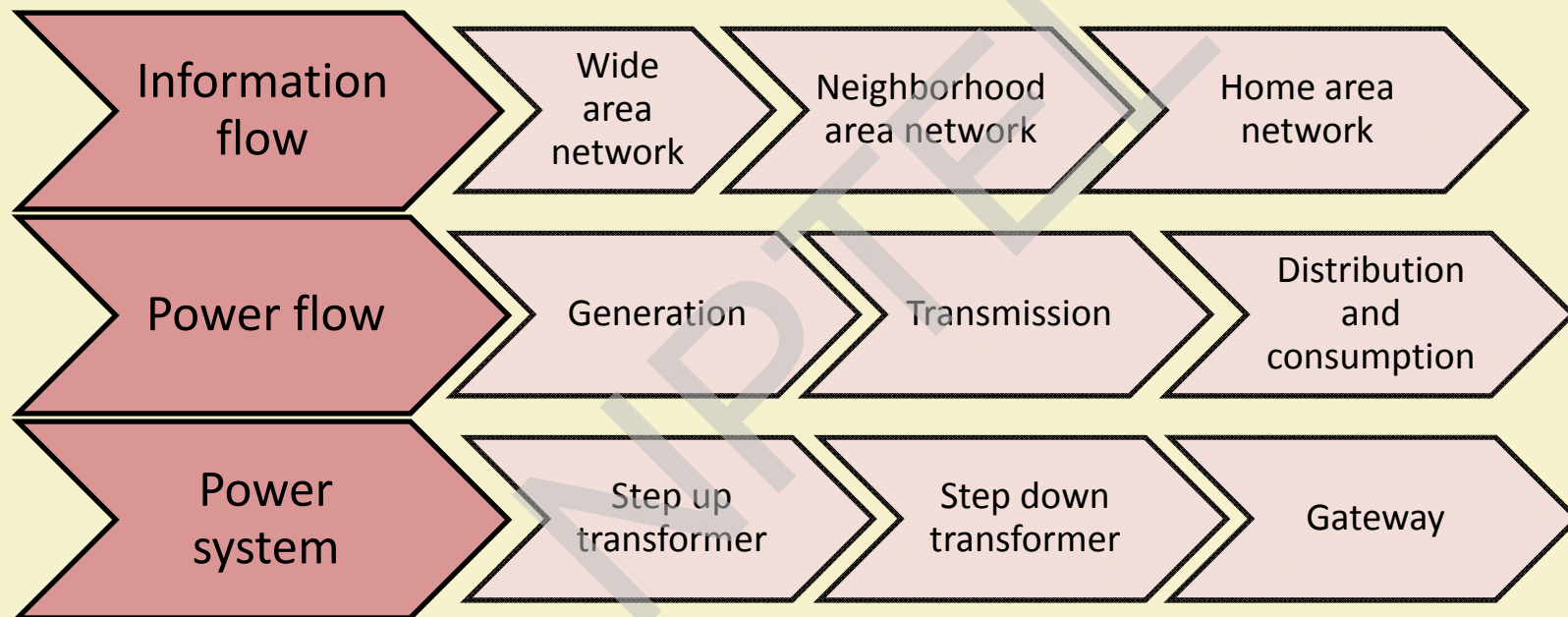


Communication Network

- Home area network
 - Covers in-home IoT devices. Wireless: Zigbee, 6LowPan
- Neighborhood area network
 - Distribution domain networks. Data collected from smart devices and sent to gateways.
- Field area network
 - Distribution domain networks. It includes controller, regulators, and data collector. Wireless: WiMAX, 3G, 4G. Wired: Ethernet.
- Wide area network



Smart Grid in Power System



IloT in Power Plants Applications

- Digital twins
 - Considered as virtual power plant, reduce fuel and energy consumption by incorporating data.
- Supply chain management
 - Sensors monitor product condition and optimize delivery time.
- Smart pumping
 - Combined with sensors and software. Automated flow control.



IIoT in Power Plants Applications

- Smart boiler
 - Customer can control it by mobile application
 - Energy efficient usage
 - Automatically reports if any defects are there
- Smart water monitoring
 - Detect flow of water and volume of water of a pipe in a time period.
 - Sends data to cloud storage.
 - Saves wastage of water.



IIoT in Power Plants Applications

- Smart metering
 - Important element of smart grid
 - IoT reduces operational costs as operations are remotely managed.
 - Reduces the chance of energy loss.
- Building automation
 - Monitors the building remotely.
 - Elevators, lighting systems, and other electronic systems are connected through internet.



Supervisory Control And Data Acquisition (SCDA)

- Software and hardware allows organization to process locally or remotely.
- Sensors gather real time data.
- Programmable logic controller or remote terminal units communicate with different objects and route the data to SCDA software.
- SCDA software processes the data. Then users analyze the data to make decision.



Advanced Metering Infrastructure(AMI)

- It comprises whole infrastructure- smart meters, communication networks.
- Smart meters: collect information about energy, water etc. Transmits the data to network.
- Communication network: Broadband over PowerLine, Fixed radio frequency are used.
- Meter data acquisition system: gathers data from smart meters
- Meter data management system: analyze the data.



IIoT in Electricity Sector

- Efficient power grid system
 - Collect data from sensors
 - Use the data to manage resources
 - Optimization, stakeholders take decision about power usage.
- Data collected from sensors can easily predict if any failure in grid.
- Predict earlier if any accident is going to happen.



IIoT in Water Sector

- Saves water using smart sensors.
- IoT sensors track water pressure, water quality etc.
- The gathered data is sent to utility company to analyze the data.
- It gives public useful information about how to stop wastage of water.
- It also predicts the water leakage.



IIoT in Wind Energy Sector

- In wind energy sector, large turbines are used. The factories also locate at remote location, It is hard to maintain.
- With IoT, the local control system can adjust switches and software.
- The remote location of farm is not an issue with IoT.
- IoT can predict any issues of turbines easily and it can be addressed earlier before any large scale damage.



IIoT in Solar Energy Sector

- In IoT based solar energy sector, sensors monitor their performances from the control panel.
- The gathered data is sent to cloud server to analyze.
- IoT helps to understand the problem of device whether it is hardware related problem or network related problem.
- IoT helps to detect any problem in real time.
- IoT can manage the largest solar grid.



Challenges of IIoT in Power Plant

- Security issues
 - Privacy issues, chances of denial of service attack.
- Low power devices
 - IoT devices are resource constrained devices, battery powered devices.
- Scalability issues
 - Number of devices are increasing, Increase of data bandwidth.



Challenges of IIoT in Power Plant

- Determinism of network
 - Using cloud makes the process delay about 200 msec or more.
- Poorly designed
 - Most of the devices are poorly designed as different protocols are used.
 - It lacks of standard authentication for the edge devices.



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