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Levels of IOT Applications

IOT Level and Deployment Templates

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End Device allows :

- *Identification*
- *Remote Sensing*
- *Actuation*
- *Monitoring Capabilities*

IOT system other than end device(s) comprises of multiple virtual & physical components

- *Resource* – Software components
- *Controller Service* – runs on device & interacts with web services
- *Database* – local/cloud; stores data generated by device
- *Applications* – interface to the user for control & monitoring

IOT Application Levels

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IOT applications are classified into different levels based on the complexity of the applications and the complexity of the elements used to build them

IOT Level 1

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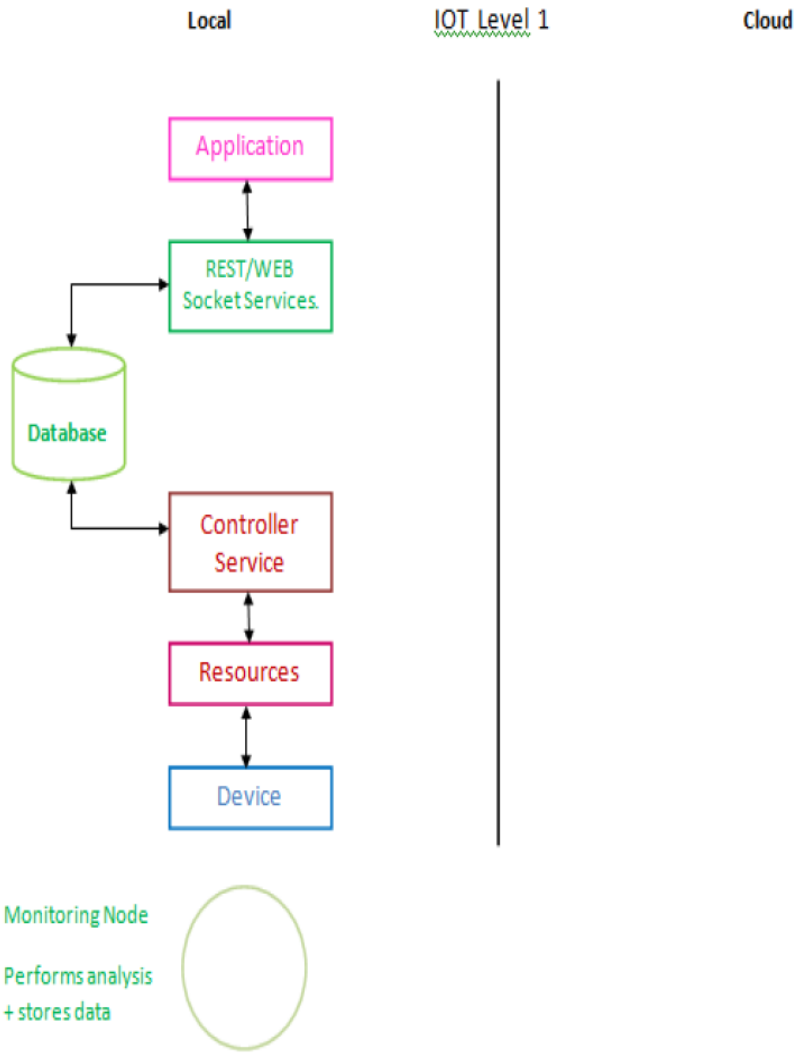
- Single node/device
- Sensing/Actuation
- Store Data
- Perform Analysis
- Hosts application

Suitable for

- Low cost
- Low complexity
- Where Data is not 'big'
- Analysis not computationally intensive



Example of level-1 IOT system – Home automation

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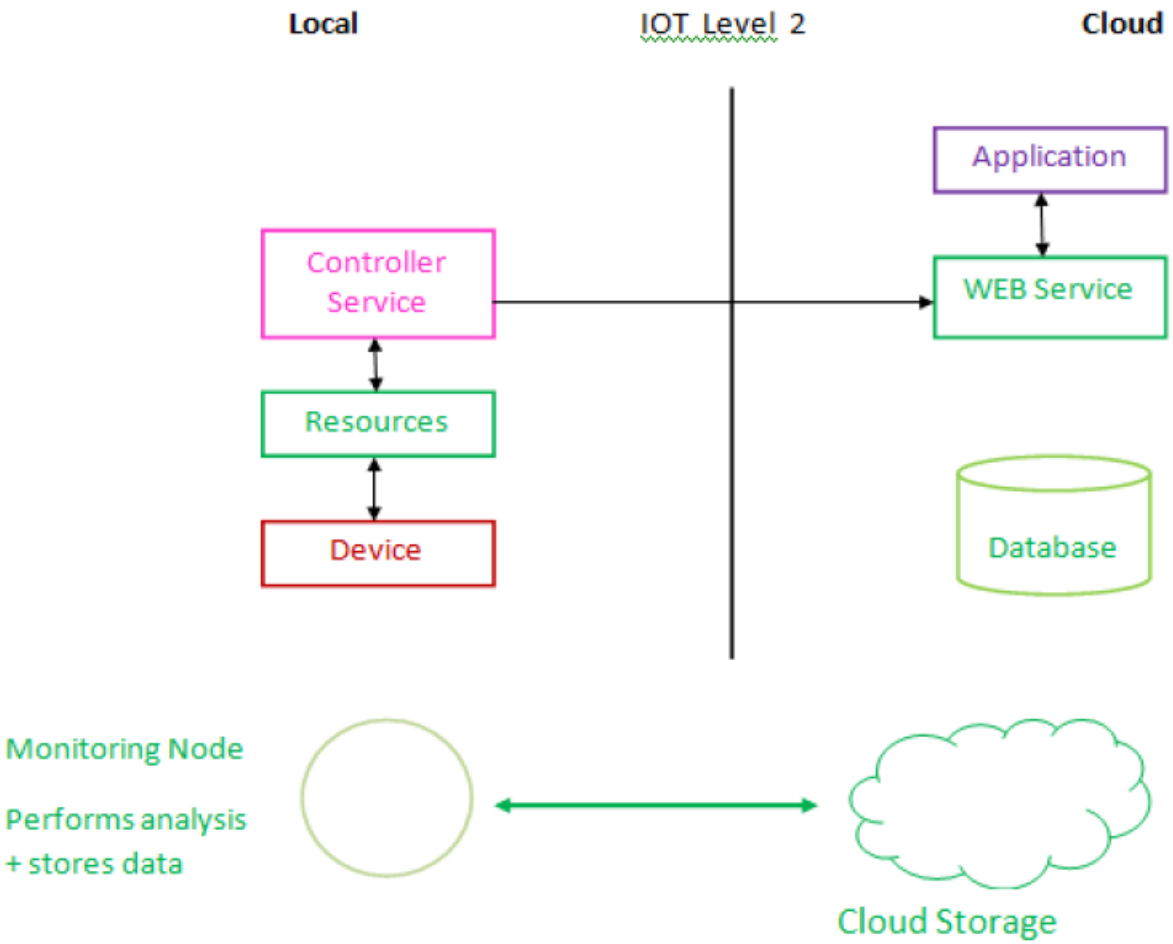
- Single node controlling lights/applications remotely.
- Interfaces using relays
- Status in local database
- REST services deployed locally for database status (retrieving & updating state of each light in database status)
- Controller service to trigger relays
- User interface for controlling lights/applications
- Connected to internet – most rudimentary IOT system

IOT Level 2

- Single big node
- Sensing/actuation/local analysis
- Data stored in cloud
- Cloud based application(usually)

Suitable when

- Data is ‘big’
- Primary analysis is not intensive & can be done locally



Example of level 2 IOT system – Smart Irrigation.

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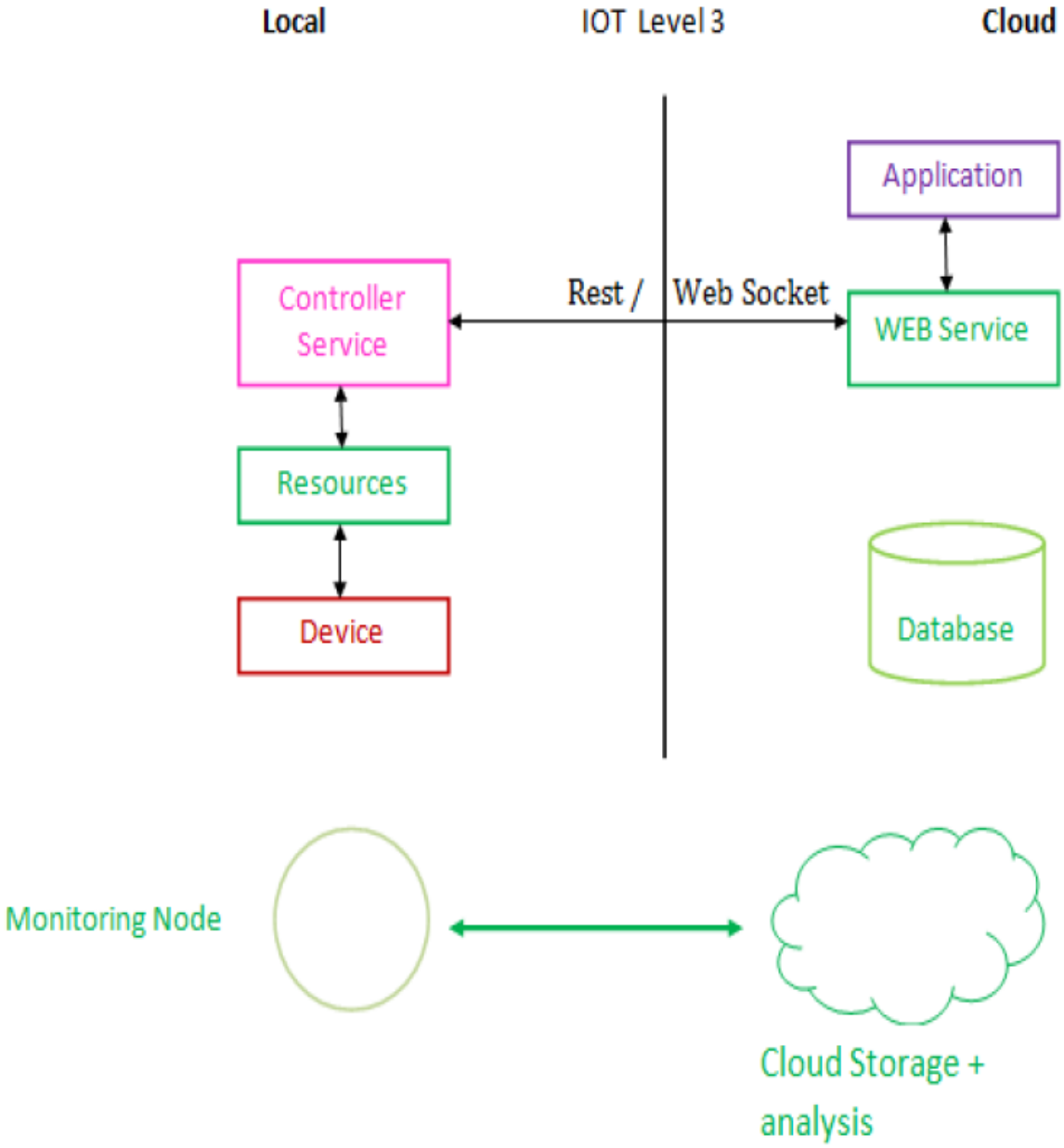
- Single node for monitoring Soil Moisture level and controlling irrigation system.
- Soil/Moisture data from sensors
- Continuous monitoring
- Threshold moisture level for irrigation

- Actuators – solenoid valves
- Cloud based web service for storing & retrieving moisture data
- Cloud based application for visualizing & making schedules

IOT Level 3

- Single Node
- Cloud based data storage & analysis

Suitable when
- Data is 'big'
- Computationally intensive analysis



Example of level 3 IOT system : Package tracking (single package)

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- Single node to monitor vibration levels
- Accelerometer & Gyroscope
- Send sensor data in Real-Time to cloud using web socket service
- Data stored in cloud.
- Data visualized using cloud- based application
- Triggers alerts if vibration levels > threshold

Advantage of using web socket service over REST

- sensor data can be sent in RT to the cloud
- Cloud based applications may subscribe to sensor data feeds for viewing the RT data

IOT level-4

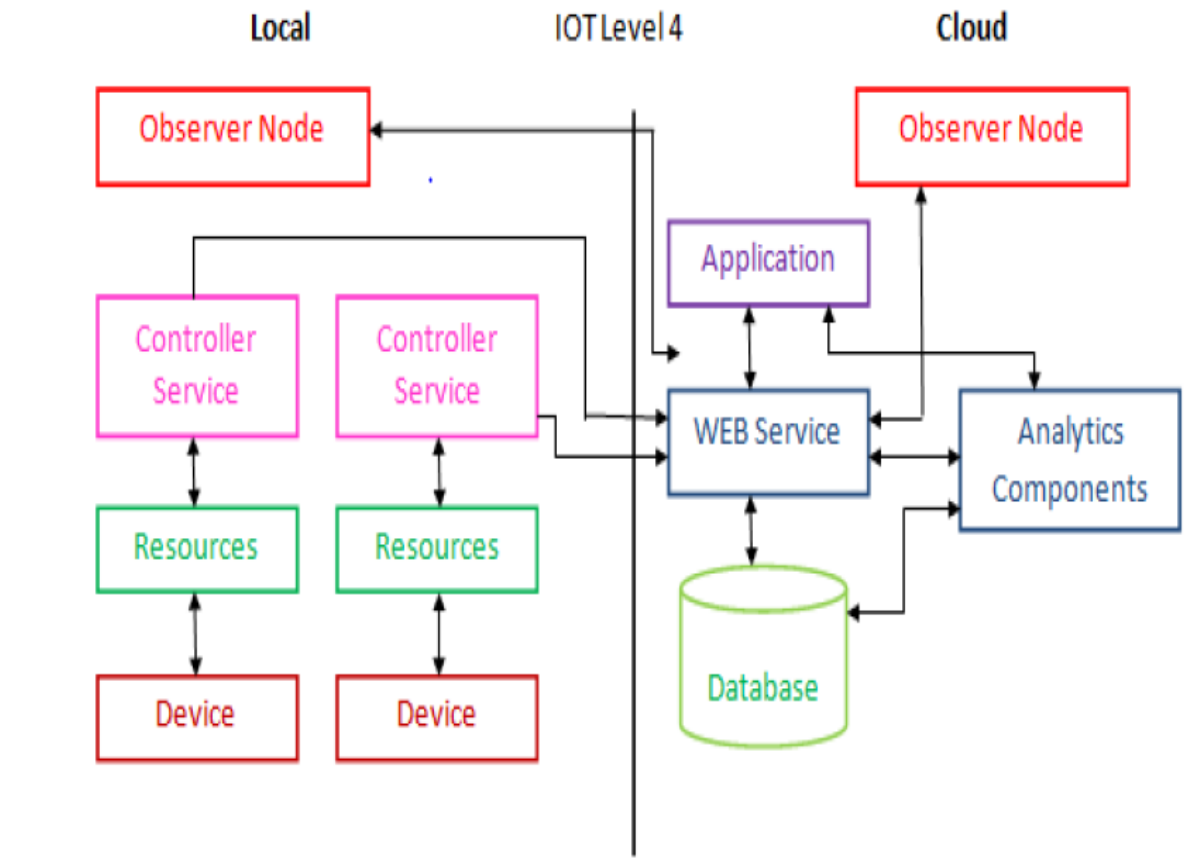
- Multiple Nodes
- Local Analysis
- Data stored in cloud
- Cloud based Application

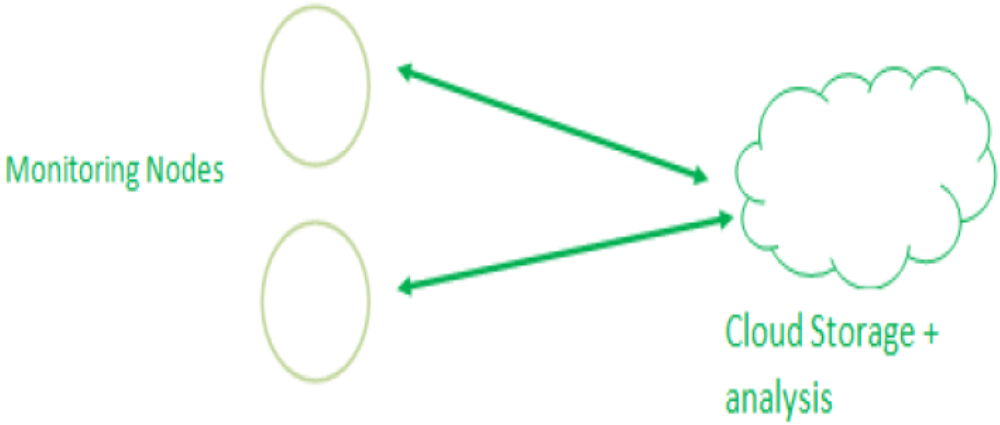
Observer Nodes

- Local & Cloud based observer nodes
- Process information and use it for various applications.
- Do not perform any control functions

Suitable for

- Multiple nodes required
- Data is 'big'
- Computationally intensive





Example of Level 4 system : Noise Monitoring

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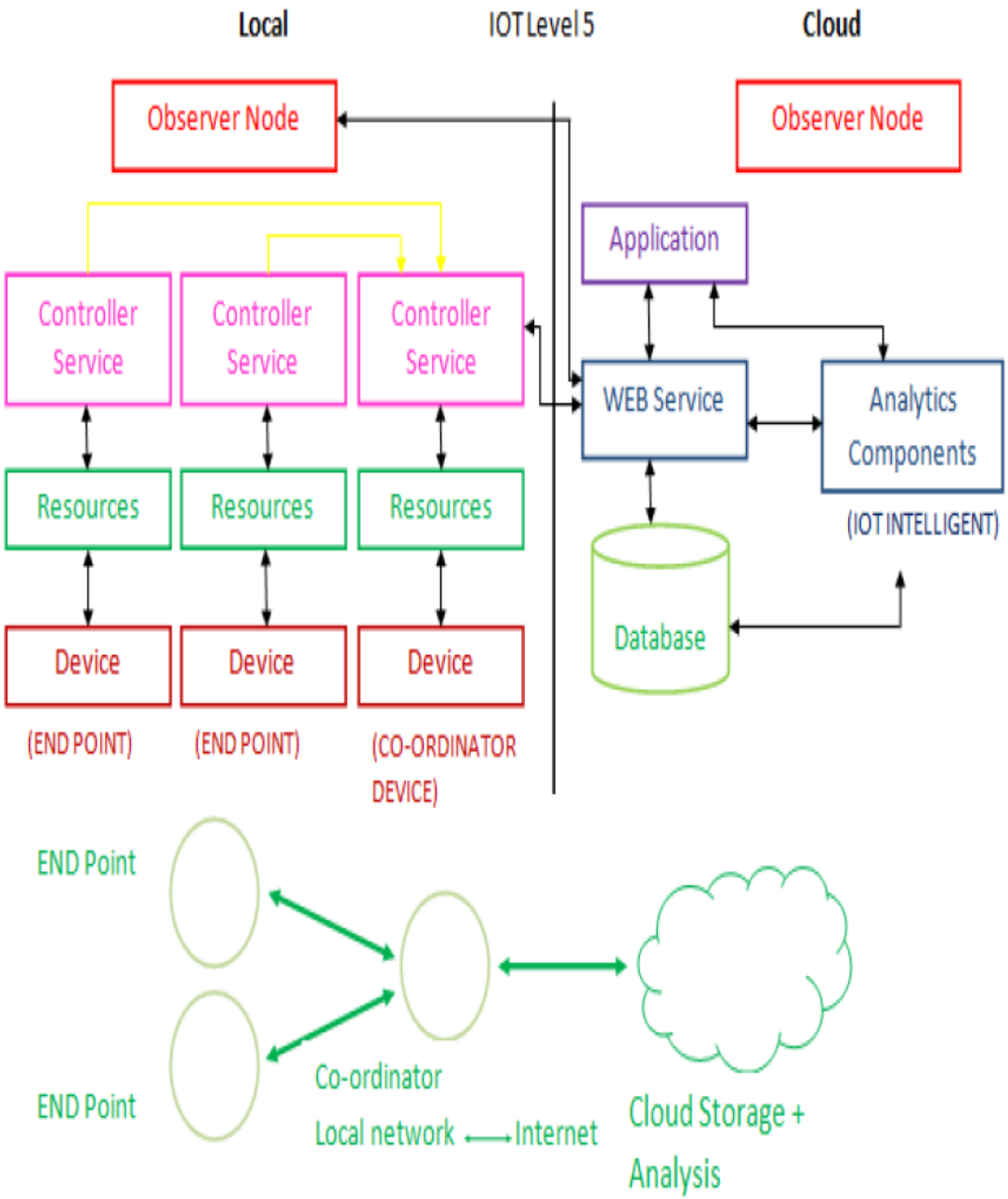
- Multiple nodes in different locations
- Nodes equipped with sound sensors
- Nodes independent of each other- each node runs its own controller service to send data to the cloud.
- Data stored in cloud database.
- Analysis of data from multiple nodes in the cloud.
- Cloud based application for visualizing the aggregated data.

IOT Level – 5

- Multiple end nodes + one coordinator node
- **End nodes** : Sending/actuation
- **Coordinator node**: collects data from end nodes and sends to the cloud.
- Data stored & analysed in cloud
- Cloud based application.

Suitable for

- Solutions based on WSN – data is 'big' & computationally intensive



Example of Level-5 System: Forest Fire Detection

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- Multiple nodes in different locations for monitoring temp, humidity, CO_2 in forests.

- Coordinator nodes collect data from end nodes & provide internet connectivity.
- Controller service on coordinator node sends data to the cloud.

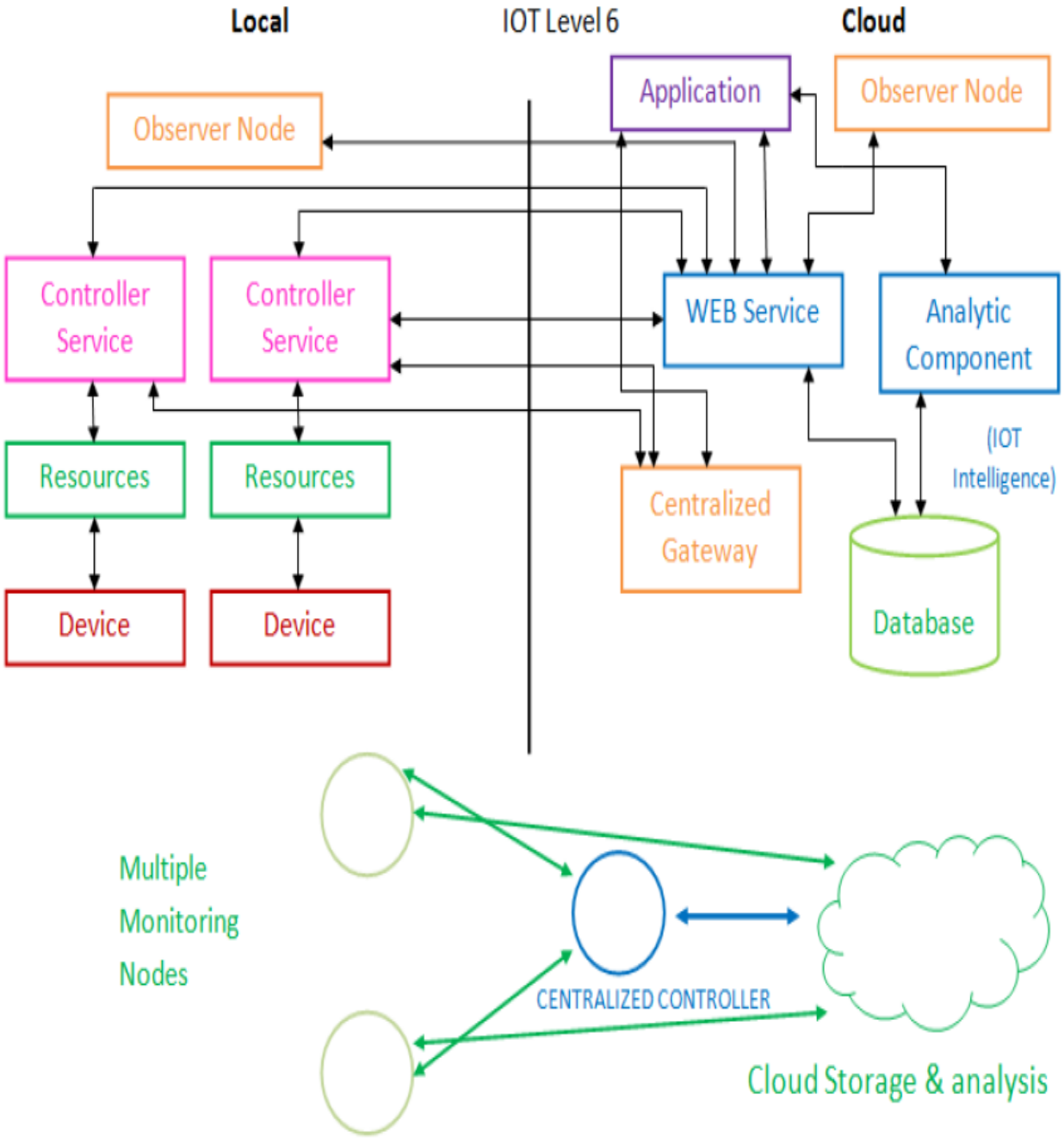
- Data stored in cloud database.
- Analysis to aggregate & make predictions.
- Cloud based application for visualizing data.

IOT Level 6

- Multiple independent end nodes
- **End nodes**: sensing, actuation and sending data to the cloud
- Data stored in cloud
- Cloud based application
- Cloud based analytics.
- Results stored in cloud
- Results visualized with cloud based applications.

Centralized cloud based controller :

- aware of the status of all the end nodes
- sends control commands to the nodes.



Example of Level-6 IOT system

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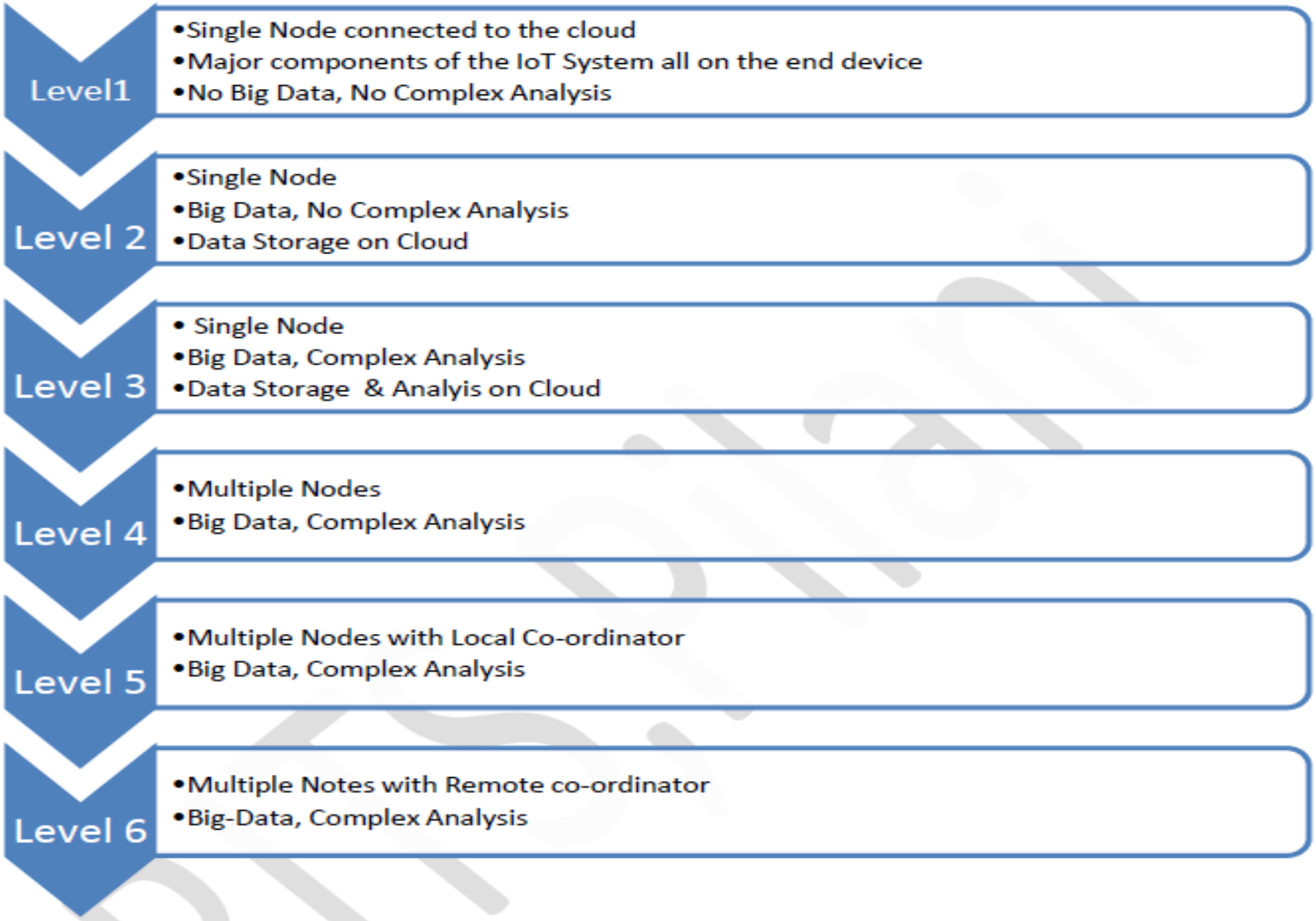
- Multiple nodes (end points) at different locations.
- Temperature, Humidity and pressure
- End nodes send data to cloud in RT using web socket service.

- Data stored in cloud.
- Analysis on cloud for predictions.
- Cloud based application for visualizing data

Each node directly connects to the cloud and coordinator is on the cloud.

Feature	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Cloud Storage	-	YES	YES	YES	YES	YES
Cloud Analysis	-	-	YES	YES	YES	YES
Ext Observers	-	-	-	YES	YES	YES
Coordinator	-	-	-	-	YES	YES
Controller	-	-	-	-	-	YES

Summary


Level1
•Single Node connected to the cloud
•Major components of the IoT System all on the end device
•No Big Data, No Complex Analysis
Level 2
•Single Node
•Big Data, No Complex Analysis
•Data Storage on Cloud
Level 3
• Single Node
•Big Data, Complex Analysis
•Data Storage & Analyis on Cloud
Level 4
•Multiple Nodes
•Big Data, Complex Analysis
Level 5
•Multiple Nodes with Local Co-ordinator
•Big Data, Complex Analysis
Level 6
•Multiple Notes with Remote co-ordinator
•Big-Data, Complex Analysis