Lesson 11
Internet Connected Environment (Weather, Air Pollution and Forest Fire) Monitoring

Environment Monitoring

- Weather Uses of sensors for T, RH and Patm
- parameters, WSNs, access points, gateways and a cloud platform for smart weather monitoring service
- Air Pollution Uses of sensors for CO, CO_2 and T, RH and P_{atm} parameters and Computes AQI and Polluents dispersion
- Forest Fire Detection and Mapping

Weather-monitoring System

Weather Monitoring System

- Assigns ID to each measuring node for weather parameters
- Each node measuring the T, RH and other weather parameters at assigned locations
- Interconnections between nodes,
- A group of WSNs communicates using ZigBee and forms a network

Weather Monitoring System

- Each network has an access point, which receives the messages from coordinators for nodes, routers and access points
- Each access point associates a gateway

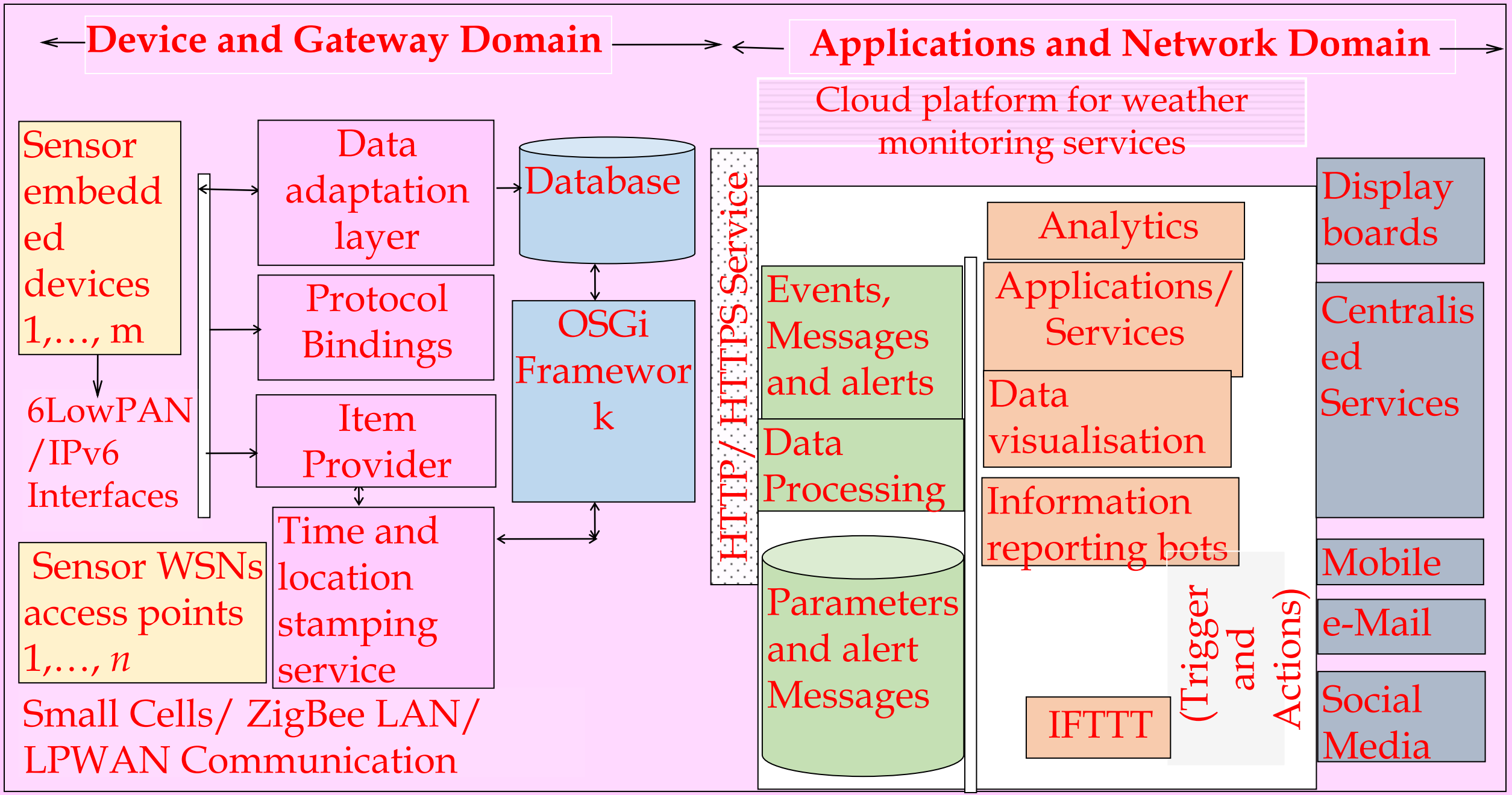

Fig. 12.12 Architecture reference model for the WSNs based monitoring services

Weather Monitoring System

- The nodes communicate the parameters up to the access point the parameters using WSNs at multiple locations.
- Forward and store the parameters on an Internet cloud platform
- Publishes weather messages for the display boards at specific locations in the city and communicates to weather API at mobile and web users

Weather Monitoring System

- Publishes the messages in real time and send alerts using a weather reporting application
- Analyse and assess the environment impact
- Enables intelligent decisions using data and historical analytics reports at city cloud
- weather data store

Devices Subdomain

- Hardware WSN board consists of Sensors for weather parameters
- Waspmote with sensors
- ultralow power dissipation
- multiple transceiver interfaces
- ZigBee
- Wi-Fi (for medium range)

Waspmote Devices

- RFID
- NFC
- Bluetooth 2.1 or BL LE (for short range)
- LPWAN, 4G, 3G (for long range)
- OTA programmability
- AES, RSA, MD5, SHA, Hash (as encryption libraries)
- Bus protocols, such as CAN and RS232C.

Gateway subdomain

- The parameters and alerts communicate to a local or remote web-service
- Time and location stamping service
- Item provider
- Protocol bindings and 6LowPAN/IPv6 modules

Gateway Subdomain

- Configuration setting and the configuration Administration service of OSGi framework
- The bindings between ZigBee LANs, 6LowPAN and LPWAN and IPv6 protocols used for networking of the devices
- WSNs, OSGi with the HTTP/HTTPS services.

Applications and Network Domain

- Applications and network domain deploys the applications and services High-level capabilities
- Analytics
- Data visualisation
- Display-board feeds, weather reporting application, and IFTTT triggers and actions
- Cloud platform can be IBM Bluemix, AWS IoT or TCUP

Devices Hardware Design and Code Development Environment

- A microcontroller circuit consists of memory, over the air programmability (OTP) and
- transceiver associated with each sensor or node. Weather monitoring circuit deploys
- sensors for T, RH and atmospheric pressure (Patm) and may include solar visible radiation,
- wind speed and direction, and rainfall..

Devices Hardware Design and Code Development Environment

- Edge devices and WSNs codes development uses IDE
- Arduino or Eclipse IDE for Java Developers..

Weather Reporting Bot(s)

- A bot communicates with an API using instant messaging (IM) or Internet relay Chat (IRC) or to twitter or Facebook
- A bot can also chat and give responses to the questions from user API

Features of Weather Reporting Bot

- Multitasking
- Fetches analyses and communicates information to a report seeking API
- Uses from the weather parameters and alert messages database and for forecast at analytics module at the cloud platform

Air Pollution Monitoring System

Smart Air Pollution Monitoring Service

- Air Pollution: Uses of sensors for CO, CO2 and T, RH and P_{atm} parameters
- WSNs
- Access points
- Gateways and
- Cloud platform

Polluen Monitoring Service

1. Monitor and measuring levels of CO: A gas dangerous

above 50–100 ppm level, Carbon dioxide (CO2): A gas causes of greenhouse effect and ozone (O3) a gas dangerous above 0.1 mg/per kg air level for controlling air pollution

2. Monitor and measuring levels of hydrogen sulfide (H2S): A highly toxic gas dangerous, which may contribute to global warming.

3. Monitor and measuring levels of hydrocarbons, such as ethanol, propane

Polluent Monitoring Service

4. Measure T, RH and P_{atm} parameters for calibrations of sensed gaseous parameters of each node
5. Investigate air quality and the effects of air pollution.
6. Computes air quality index (AQI) from the parameters, such as hourly or daily averages of air pollutant concentration, particulate matter (such as dust or carbon Particle)

Polluent Monitoring Service

7. Computes source and spatial dispersion of pollutants as a function of day conditions, wind-speed and direction, air temperature and air temperature gradient with altitude and topography using analytics.
8. Data visualisation
9. Reports the pollution status to monitoring authorities

Device and Gateway Domain

- S*ystem deploys m gas sensor embedded* devices at each WSN with a location-data sensor
- *n access-points for the WSNs*
- WSN board IO ports connect the sensors for gaseous, particulate matter and weather parameters.
- Each sensor node is configured by assigning a node ID.
- A node ID maps with the GPS location found earlier from GPS modules at the data adaptation layer at the gateway.

Device and Gateway Domain:

- The data adaptation layer gateway
- Aggregation, compaction and fusion computations for each sensor node data
- Queries for gathered sensed information from the database and the items selected communicate using HTTP/HTTPS/MPLS services..

Applications and Network Domain

- Cloud platform can be TCUP, AWS IoT, IBM Bluemix or Nimbits
- Deploys the applications and services and have high-level capabilities

Applications and Network Domain

- Events, messages, alerts and data processing, databases, applications and services, analytics, data visualisation, display-board feeds,
- Pollution reporting applications and services, and
- IFTTT triggers and actions.

Forest Fire Detection System

Fire Detection and Monitoring Services

1. Uses OTP features for programmable WSNs and gateways
2. Measures and monitors the T, RH, CO, CO2 and infrared light (fire generated) intensity in real time at preset intervals
3. Each WSN uploaded the program and preset measured intervals of t1 (say, 300 s) each and the preset measured intervals of t2 (say, on 1 or 5 s) instantaneously on sensed parameters values exceeding thresholds which can potentially trigger the fire-alarm algorithm

Smart Forest Fire Detection Monitoring Services

4. Configures the data adaption layers with calibration parameters
5. Communicates the WSN messages at the preset intervals to the access point associated for specific network area
6. Communicates alerts, triggers, messages and data at data adaption layer using an uploaded program at associated gateway
7. Uploads connectivity programs for gateways

Smart Forest Fire Detection Monitoring Services

- 8. Runs at the data-adaptation layer the faulty or inaccessible sensors at periodic
- intervals
- 9. Integrates data with the node locations found from mapping with node IDs, compute,
- and activate the alarms using an algorithm, input sensed and calibrated coefficients
- 10. Processes the layer data and database information, and communicate instantaneously
- to nearest mobiles and fire-fighting service near the access point gateway

Smart Forest Fire Detection Monitoring Services

- 11. Updates the database and communicate to a cloud platform, such as Nimbits,
- my.openHAB, TCUP, AWS or Bluemix platform
- 12. Modifies the preset measured intervals to t2 on activation of fire alarm after value
- changes above the configured threshold values
- 13. Uses analytics to evaluate reliability index of the preset, threshold and configuration
- values and need to update alarm-algorithm and if needs improvement then upload
- new algorithms

Smart Forest Fire Detection Monitoring Services

- 14. Uses analytics to generate and communicate topological maps for the currently fire
- infected forest area and reachability maps for the firefighting service equipments
- Sensors play vital role in the forest fire monitoring. The application has tenth ranking

Smart Forest Fire Detection Monitoring Services

- Gateways
- Real time analytics
- cloud platform for smart forest fire detection and affected area mapping

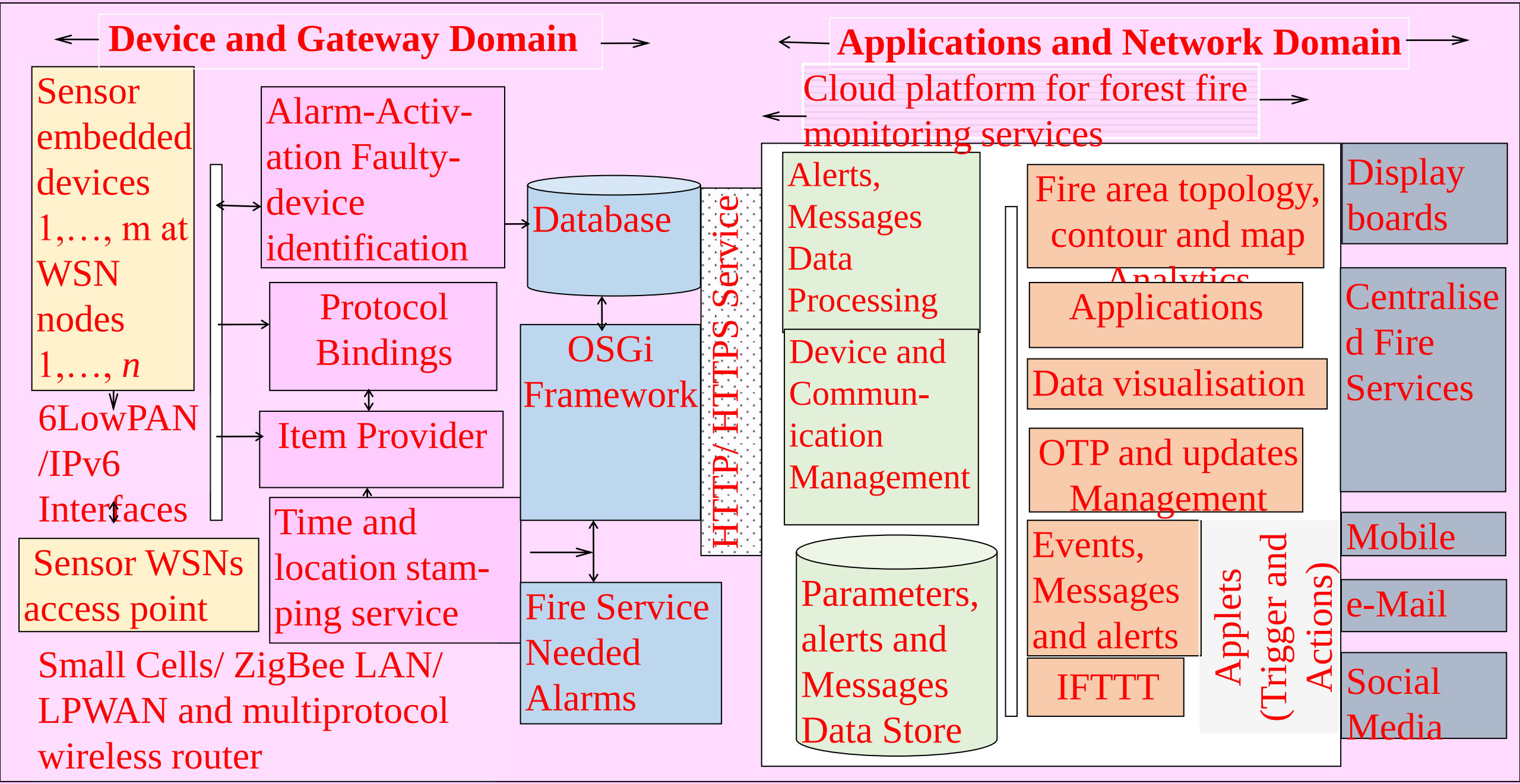

Fig. 12.13 WSNs based Forest Fire monitoring Service Data flow diagram and domains

Summary

We learnt

- Smart environment monitoring refers to actions that are required for characterising and monitoring the quality of the environment, such as air, soil and water.
- Weather monitoring systems WSNs at multiple areas

Summary

We learnt

- Measurements of the T, RH, P and other weather parameters;
- Weather monitoring service publishes weather-messages for the display boards at specific locations in the city and communicates to weather APIs at mobiles and web users.

Summary

We learnt

- A bot fetches analyses and communicates server information repeatedly for the report-seeking APIs
- Bots communicate the reports on a mobile app or web application
- A multitasking weather-bot uses JavaScript or node.js scripts for the weather reports autonomously

Summary

We learnt

- Smart air-pollution monitoring-service measures the levels of CO, CO2, particulate matter and other parameters.
- AQI from the parameters, such as, hourly or daily averages of air pollutant concentration and particulate matter (such as dust or carbon particle)

Summary

We learnt

- Computes source and spatial dispersion of pollutants as a function of day conditions, wind-speed and direction, air temperature and air temperature

Summary

We learnt

- Smart forest fire monitoring service deploys number of network of WSNs, interconnected access
- points and associated gateways. The gateways connect with Internet cloud platform enables
- forest fire detection and map the affected area.

End of Lesson 11on
Internet Connected Environment (Weather, Air Pollution and Forest Fire) Monitoring