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Shared Internet Of Things Infrastructure Platform: ADD Application Software Architecture (H09B5a and H07Z9a) – Part 2a

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Academic year 2016–2017

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1. Attribute-driven design documentation

1.1 Decomposition 1: SIoTIP System (Av3, P2, UC11, UC14, UC15, UC18)

1.1.1 Module to decompose

In this run we decompose the SIoTIP System.

1.1.2 Selected architectural drivers

The non-functional drivers for this decomposition are:

- *Av3*: Pluggable device or mote failure
- *P2*: Requests to the pluggable data database

The related functional drivers are:

- *UC11*: Send pluggable device data (P2)
This use case stores pluggable device data in the pluggable device data storage. This could be a sensor reading, or an actuator status.
- *UC14*: Send heartbeat (Av3)
This use case checks whether or not motes and pluggable devices are still operational.
- *UC15*: Send notification (Av3)
This use case sends a notification to a registered user.
- *UC18*: Check and deactivate applications (Av3)
This use case deactivates any application that requires deactivation, because of unavailability of essential pluggable devices or unassigned mandatory roles.

Rationale We chose Av3 first since it had high priority and it was more relevant to the core of the system (pluggable device data) than attributes M1 and U2. We chose P2 along with Av3 as it would force us to think about the way sensor data is handled. We believe this combination of pluggable device connectivity and storage of sensor data is the most defining feature of the system, and that handling this combination would give a better starting point than M1+U2 for later ADD iterations.

1.1.3 Architectural design

Application redundancy settings for Av3 Discussion of the solution selected for (a part of) one of the architectural drivers.

Failure detection for Av3 timers?
heartbeat/timestamp tactic

Application deactivation for Av3 same as Application redundancy settings for Av3?
degradation/removal from service tactic

Notifications for Av3 from application manager to cust orgs and apps
from gateway to infr owners
notifications tactic

Scheduling for P2 dynamic priority scheduling

tactics: schedule resource, prioritize events, also limit event response?

starvation avoidance

TODO ASK: The system checks whether the pluggable device has been initialised (cf. UC8: Initialise a pluggable device)

Pluggable data separation for P2 "pluggable data has no impact on other data" two databases

Alternatives considered

Alternatives for X A discussion of the alternative solutions and why that were not selected.

1.1.4 Instantiation and allocation of functionality

Decomposition Main aspects of the resulting decomposition.

ApplicationManager deactivate apps ???? check mandatory user roles set redundancy in the available pluggable devices If application suspended or re-activated, notify cust. org. If application uses failed plugg device, notify application (Av3)

Database General database for other data. Storage of notifications for now.

GatewayFacade receive heartbeats, send heartbeats/device lists, send application shutdown, send notification trigger (Av3)
forward data to applications

MoteFacade sends heartbeats

NotificationHandler Send notifications.
stored by system – > contact DB?
lookup communication channel
users choose delivery method?

PluggableDeviceDB store data related to pluggable devices

PluggableDeviceFacade send heartbeats

PluggableDeviceManager check list of devices and see if there are pluggable devices for applications check redundancy in the available pluggable devices contains application preferences (e.g. amount of sensors required) can send command to deactivate application If failure detected, notify inf owner (Av3). reactivate application if new/needed hardware detected

PluggableDeviceDataScheduler scheduling, detect overload mode, store data, forward data

Deployment Rationale of the allocation of components to physical nodes.

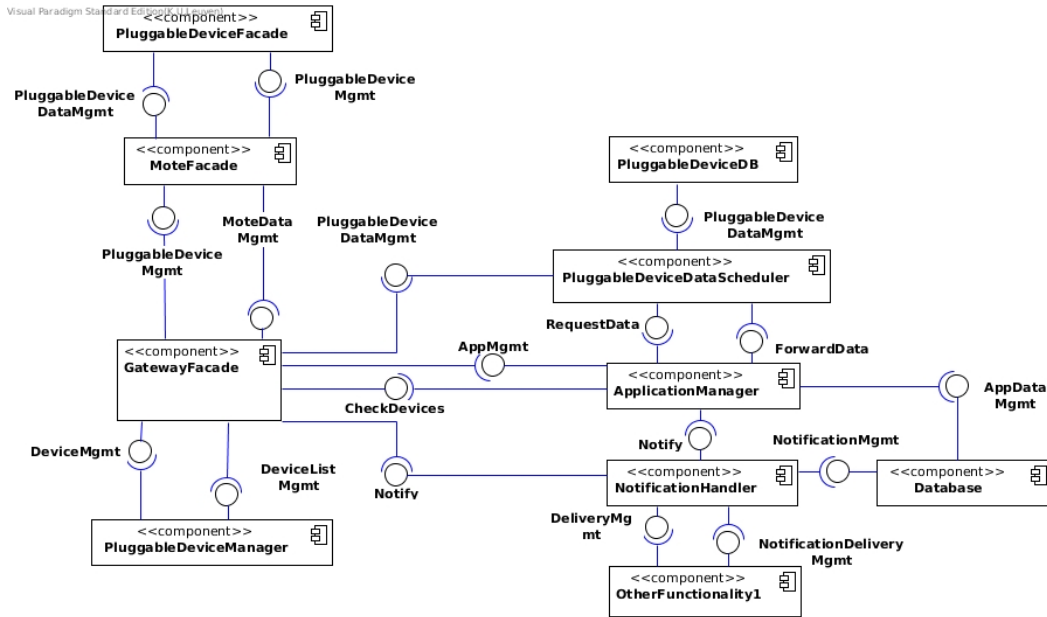


Figure 1.1: Component-and-connector diagram of this decomposition.

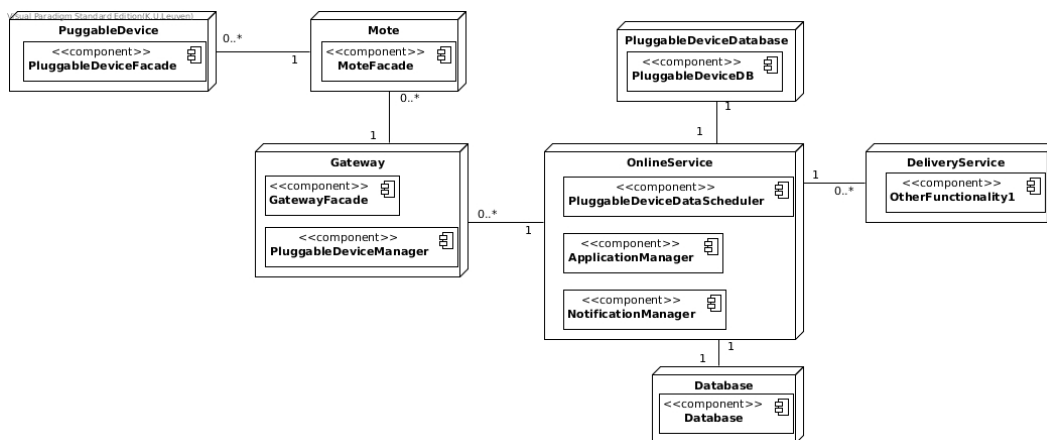


Figure 1.2: Deployment diagram of this decomposition.

1.1.5 Interfaces for child modules

ApplicationManager

- ForwardData
 - `void sendData(PluggableDeviceData data)`
 - * Effect: Send pluggable device data to an application that wants to use it
 - * Exceptions: None
- AppMgmt
 - `void deactivateApplicationInstance(int applicationInstanceID)`
 - * Effect: Deactivates a running instance of an application.
 - * Exceptions: None
 - `void activateApplicationInstance(int applicationInstanceID)`
 - * Effect: Activates a new instance of an application.
 - * Exceptions: None

Database

- NotificationMgmt
 - `int storeNotification(NotificationData data)`
 - * Effect: Stores a new notification entry in the database. Returns the id of the new notification.
 - * Exceptions: None
 - `void updateNotification(NotificationData data)`
 - * Effect: Updates an existing notification (e.g. change status to "sent").
 - * Exceptions: None
 - `int lookupNotificationChannelForUser(int userID)`
 - * Effect: Returns the type of communication channel a user prefers. Different communication channels are mapped to integers.
 - * Exceptions: None
- AppDataMgmt
 - `void updateApplication(ApplicationData data)`
 - * Effect: Updates an application in the database (e.g. change state to 'inactive').
 - * Exceptions: None
 - `void updateSubscription(SubscriptionData data)`
 - * Effect: Updates a subscription in the database (e.g. change state to 'disabled').
 - * Exceptions: None

GatewayFacade

- MoteDataMgmt
 - `void sendHeartbeat(int moteID, List<PluggableDeviceInfo> devices)`
 - * Effect: Sends a heartbeat to a certain gateway with information about operational devices.
 - * Exceptions: None
 - `void sendData(PluggableDeviceData data)`
 - * Effect: Sends pluggable device data to the connected mote.

- * Exceptions: None

- DeviceMgmt

- `void initialiseDevice(int deviceID, PluggableDeviceSettings settings)`
 - * Effect: Initialises a pluggable device for use with the system. TODO check QA's text
 - * Exceptions: None
- `List<DeviceInfo> getConnectedDevices()`
 - * Effect: Describe the effect of calling this operation.
 - * Exceptions: None
- `void timerExpired(int deviceID)`
 - * Effect: Lets the gateway know that a timer for pluggable device or mote has expired. This will generate a notification for an infrastructure owner.
 - * Exceptions: None
- `void deactivateApplicationInstance(int applicationInstanceID)`
 - * Effect: Deactivates a certain application. This could happen when mandatory pluggable devices for the application are missing.
 - * Exceptions: None
- `void reactivateApplicationInstance(int applicationInstanceID)`
 - * Effect: Reactivate an application instance. This could happen automatically after a broken sensor has been replaced.
 - * Exceptions: None

- CheckDevices

- `bool areEssentialDevicesOperational(int applicationID)`
 - * Effect: Returns true if all essential devices for the application with id "applicationID" are operational.
 - * Exceptions: None

MoteFacade

- PluggableDeviceDataMgmt

- `void sendData(PluggableDeviceData data)`
 - * Effect: Sends pluggable device data to the connected mote.
 - * Exceptions: None
- `List<DeviceInfo> getConnectedDevices()`
 - * Effect: Returns a list of information about devices that are connected to the mote.
 - * Exceptions: None

- PluggableDeviceMgmt

- `void initialise(int deviceID, PluggableDeviceSettings settings)`
 - * Effect: TODO check this with QA's: Initialises a connected pluggable device according to some settings
 - * Exceptions: None

NotificationHandler

- Notify
 - void notify(int userID, String message)
 - * Effect: Describe the effect of calling this operation.
 - * Exceptions: None
- DeliveryMgmt
 - void sendAcknowledgement(int notificationID)
 - * Effect: Sends an acknowledgement to the system for a certain notification.
 - * Exceptions: None

External notification delivery service

- NotificationDeliveryMgmt
 - void notify(JSONObject data)
 - * Effect: Deliver a notification to an end user using a specific delivery service.
 - * Exceptions: None

PluggableDeviceDB

- PluggableDeviceDataMgmt
 - void sendData(PluggableDeviceData data)
 - * Effect: Sends pluggable device data to the DB to be stored.
 - * Exceptions: None
 - List<PluggableDeviceData> getData(int deviceID, DateTime from, DateTime to)
 - * Effect: Returns data from a specific device in a certain time period.
 - * Exceptions: None
 - List<int> getApplicationsForDevice(int deviceID)
 - * Effect: Returns a list of applications that can use the device with id "deviceID."
 - * Exceptions: None

PluggableDeviceFacade

- PluggableDeviceMgmt
 - void initialise(PluggableDeviceSettings settings)
 - * Effect: TODO check this with QA's: Initialises the pluggable device according to some settings
 - * Exceptions: None

PluggableDeviceManager

- DeviceListMgmt
 - void sendHeartbeat(int moteID, List<PluggableDeviceInfo> devices)
 - * Effect: Send a heartbeat from a mote to check/update timers for operational devices.
 - * Exceptions: None
 - bool isDeviceInitialised(int deviceID)
 - * Effect: Returns true if the device with id "deviceID" has been initialized.

- * Exceptions: None
- `bool areEssentialDevicesOperational(int applicationID)`
 - * Effect: Returns true if all essential devices for the application with id "applicationID" are operational.
 - * Exceptions: None

PluggableDeviceDataScheduler

- RequestData
 - `List<PluggableDeviceData> requestData(int applicationID, int deviceID, DateTime from, DateTime to)`
 - * Effect: Request data from a specific device in a certain time period
 - * Exceptions: None
- PluggableDeviceDataMgmt
 - `void sendData(PluggableDeviceData data)`
 - * Effect: Sends pluggable device data to the scheduler to be processed.
 - * Exceptions: None

1.1.6 Data type definitions

PluggableDeviceData contains data from a pluggable device at a certain point in time (e.g. a sensor reading, an actuator status)

PluggableDeviceSettings contains settings for a pluggable device (power status, data update rate, ...)

PluggableDeviceInfo contains information about a pluggable device (device id, power status, data update rate, ...)

DateTime Represents an instant in time, typically expressed as a date and time of day.

NotificationData contains data about a notification (message text, recipient, communication channel, date, status, source, ...).

ApplicationData contains data about an application instance (instance id, running status, ...)

SubscriptionData contains data about a subscription (subscription id, subscription status, subscription period, ...).

1.1.7 Verify and refine

Completely handled: Av3, P2, UC11, UC14, UC15, UC18

This section describes per component which (parts of) the remaining requirements it is responsible for.

ApplicationManager

- *Av2*: Application failure
Prevention: a, b
Detection: a, b, c
Resolution: a, b, c
- *P1*: Large number of users: c
- *M1*: Integrate new sensor or actuator manufacturer: 1.c, 2.a
- *M2*: Big data analytics on pluggable data and/or application usage data: d, e
- *U1*: Application updates: a, b, c, d
- *U2*: Easy Installation: e
- *U12*: Perform actuation command
- *UC17*: Activate an application: 3, 4

Database

- None

GatewayFacade

- *Av1*: Communication between SIoTIP gateway and Online Service
Resolution: b, c, d
- *M1*: Integrate new sensor or actuator manufacturer: 1.a, 2.b
- *U2*: Easy Installation: a, c, d

MoteFacade

- *M1*: Integrate new sensor or actuator manufacturer: 1.a, 2.b
- *U2*: Easy Installation: b, c, d
- *UC4*: Install mote: 1, 2
- *UC5*: Uninstall mote: 1
- *UC6*: Insert a pluggable device into a mote: 2
- *UC7*: Remove a pluggable device from its mote: 2

NotificationHandler

- *UC16*: Consult notification message: 5
- *UC17*: Activate an application: 5, 6

OtherFunctionality

- *Av1*: Communication between SIoTIP gateway and Online Service
Detection: a, b, c, d Resolution: a
- *P1*: Large number of users: a
- *M1*: Integrate new sensor or actuator manufacturer: 1.d
- *M2*: Big data analytics on pluggable data and/or application usage data: a
- *U2*: Easy Installation: e
- *UC1*: Register a customer organisation
- *UC2*: Register an end-user
- *UC3*: Unregister an end user
- *UC4*: Install mote: 3
- *UC5*: Uninstall mote: 2.b
- *UC6*: Insert a pluggable device into a mote: 3: topology part; alternative 3a.1.b
- *UC7*: Remove a pluggable device from its mote: 3.b
- *UC8*: Initialise a pluggable device: 1, 2, 4
- *UC9*: Configure pluggable device access rights
- *UC10*: Consult and configure the topology
- *UC13*: Configure pluggable device
- *UC16*: Consult notification message: 1, 2, 3, 4
- *UC17*: Activate an application: 1, 2
- *UC19*: Subscribe to application
- *UC20*: Unsubscribe from application
- *UC21*: Send invoice
- *UC22*: Upload an application
- *UC23*: Consult application statistics
- *UC24*: Consult historical data
- *UC25*: Access topology and available devices
- *UC26*: Send application command or message to external front-end
- *UC27*: Receive application command or message to external front-end
- *UC28*: Log in
- *UC29*: Log out

PluggableDeviceDB

- *M1*: Integrate new sensor or actuator manufacturer: 1.a, 1.b, 2.b
- *M2*: Big data analytics on pluggable data and/or application usage data: b

PluggableDeviceFacade

- *U2*: Easy Installation: d

PluggableDeviceManager

- *U2*: Easy Installation: c, d
- *UC4*: Install mote: 4
- *UC5*: Uninstall mote: 2
- *UC6*: Insert a pluggable device into a mote: 3: uninitialised part; alternative 3a.1 3a.2 3a.4; 4
- *UC7*: Remove a pluggable device from its mote: 3.a, 3.c
- *UC8*: Initialise a pluggable device: 3,

PluggableDeviceDataScheduler

- *P1*: Large number of users: b
- *M1*: Integrate new sensor or actuator manufacturer: 1.a, 2.b
- *M2*: Big data analytics on pluggable data and/or application usage data: b, c

1.2 Decomposition 2: Module (drivers)

1.2.1 Module to decompose

In this run we decompose .

1.2.2 Selected architectural drivers

The non-functional drivers for this decomposition are:

- $x: \mathbf{x}$

The related functional drivers are:

- $x: \mathbf{x}$

Rationale

1.2.3 Architectural design

Topic Discussion of the solution selected for (a part of) one of the architectural drivers.

Alternatives considered

Alternatives for solution A discussion of the alternative solutions and why that were not selected.

1.2.4 Instantiation and allocation of functionality

Decomposition Main aspects of the resulting decomposition.

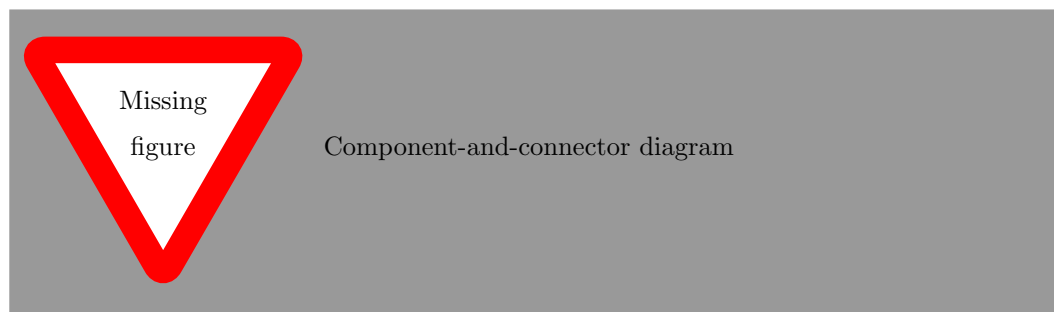


Figure 1.3: Component-and-connector diagram of this decomposition.

Behaviour If needed and explanation of the behaviour of certain aspects of the design so far.

Deployment Rationale of the allocation of components to physical nodes.

1.2.5 Interfaces for child modules

ModuleB

- InterfaceA
 - `returnType operation1(ParamType param1)` throws `TypeOfException`
 - * Effect: Describe the effect of calling this operation.

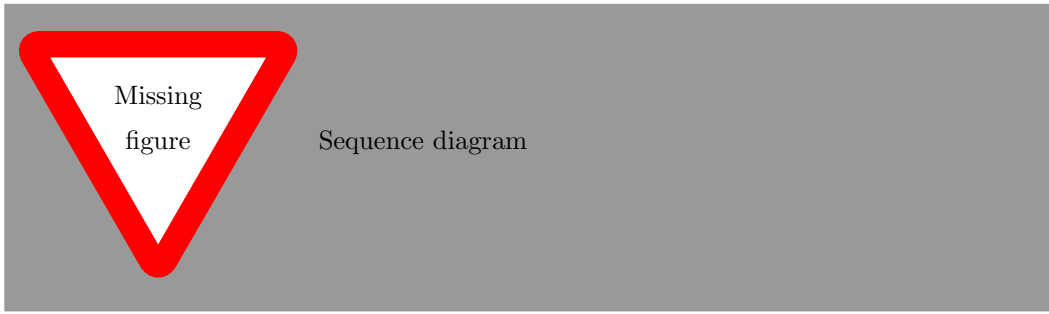


Figure 1.4: Sequence diagram illustrating a key behavioural aspect.

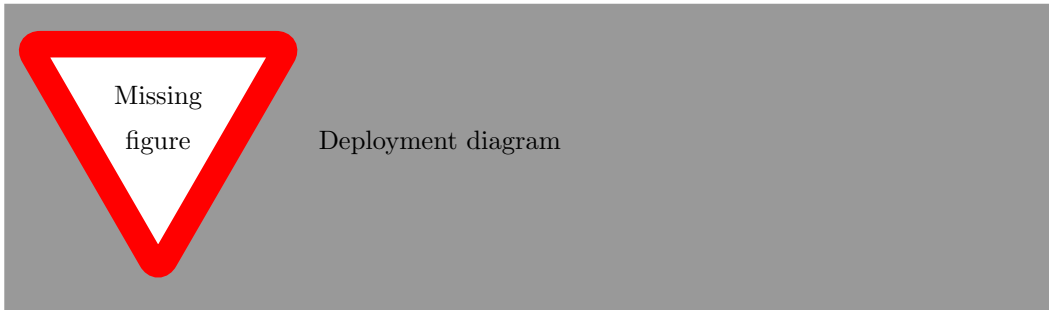


Figure 1.5: Deployment diagram of this decomposition.

- * Exceptions:
 - TypeOfException: Describe when this exception is thrown.
- returnType operation2()
 - * Effect: Describe the effect of calling this operation.
 - * Exceptions: None

1.2.6 Data type definitions

Describe per complex data type used in the interfaces what it represents.

returnType This data element represents X.

ParamType This data element represents Y.

1.2.7 Verify and refine

This section describes per component which (parts of) the remaining requirements it is responsible for.

ModuleB

- *Z1*: name
- *UCd*: name

ModuleC

- *UCba*: name
Description which part of the original use case is the responsibility of this component.

2. Resulting partial architecture

~~This section provides an overview of the architecture constructed through ADD.~~

*"Since you are a two-student team, you can skip the final step of the assignment/report ("2. Resulting architecture
This section should present the component diagram of the overall system (after two decompositions). At this point,
you are not required to provide the deployment diagram of the overall system.")"*