CHOReoS ”DynaRoute” scenario specification and requirements analysis (D8.1)

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Abstract

The purpose of this deliverable is to clarify the individual actions that take place among different actors of the “DynaRoute” scenario, as initially described in the DoW. People, services and Smart Things interact with each other synthesizing choreographies throughout the entire sequence of steps that compose the scenario which supports this specific use case of the CHOReOS project. This document also provides the involved in the “DynaRoute” use case domain experts’ requirements through a detailed requirement analysis. Moreover this deliverable presents an abstract overview of choreographies that take place in use case of "DynaRoute". In the end of this document addressed the methods of the assessment specifications that will be applied in demo and pilot application.

Keyword list

Use Case, DynaRoute, assessment, requirements, scenario definition, demonstration, Mobile Internet Device

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Acronyms & Abbreviations

Item	Description
BPMN	Business Process Modeling Notation
DoW	Description of Work
FI	Future Internet
GPS	Global Positioning System
LBS	Local Base Services
MID	Mobile Internet Device
NTP	Network Time Protocol
PDA	Personal Digital Assistance
POI	Points Of Interests

Table of Contents

1. Introduction

This document is the work product of Task 8.1 of the DoW, under the title "Scenario Definition & Requirements Analysis". It constitutes the first report of work package 8 aiming to record specifications, requirements as well as the design for the demonstration activities of the “DynaRoute” use case of CHOReOS project. Moreover, it specifies assessment methods to be used progressively during the work schedule, until a pilot, real-world demo application shall be released. The aforementioned pilot application will cover only a subset of the demonstrator that will be developed in the laboratory environment.

The purpose of this deliverable is to clarify the individual actions that take place among different actors of the “DynaRoute” scenario, as initially described in the DoW. People, services and Smart Things interact with each other synthesizing choreographies throughout the entire sequence of steps that compose the scenario which supports this specific use case of the CHOReOS project. The choreographies in the subject use case demonstrate a dynamic and adaptive behaviour, in order to respond to the challenges of the Future Internet.

In addition, this document mainly provides the involved in the “DynaRoute” use case domain experts’ requirements, along with a comprehensive list of requirements for the demonstrator applications. Despite the fact that the same requirements stand for the pilot application, this real-world demo is bound to be defined during the implementation phases that follow.

The rest of this document is organized as follows:

- Chapter 2 deals with the detailed description of the use case and identifies the roles of each participant. More specifically, we record the involved services that participate in the synthesis of “DynaRoute” choreographies, while providing eligible description for each one as well. The definition and specification of the choreographies is also presented in this chapter.
- Chapter 3 provides the requirements based on a story board. In this story board we extracted the specifications as those were defined by the stakeholders using the appropriate methodology.
- Chapter 4 presents the seven choreographies as these are formed from definitions, requirements and specifications in chapters 2 and 3. In this chapter the choreographies are presented providing a specific description, yet showing an abstract view, using the BPMN[1] standard.
- Finally, Chapter 5 describes the strategy through which it is possible to get valuable results from the laboratory and the real world demonstration, as soon as the DynaRoute demonstrator will be implemented.

It is crucial to note at this point, the section 2.3.5, that provides a response to the FI challenges tackled in the “DynaRoute” use case. Enumeration and scalability dimensions of the demonstrated applications are also presented, in order to investigate the possible impact of the use of these choreography-based applications in citizens’ life.

[1] Note that in this document, the acronym BPMN always refers to version 2.0 of the specification

2. Scenario Definition of Use Case "DynaRoute"

2.1. Overview description of scenario

The goal of the “DynaRoute” scenario is to illustrate a use case of tools and software developed under the CHOReOS project. The scenario description that defines “DynaRoute” sequence of events is provided in table 2.1.

Step	Scenario Description
Start	Collista is flying today back to Brazil after a 2-week vacation in Thessaloniki, Greece!
1	An itinerary is fixed for her by her Mobile Internet Device, a.k.a. MID (which can be PDA, smart phone, netbook), in order to spend her last day in Greece most efficiently (and not miss her flight, too!). The schedule contains: a 2-hour shopping spree, 1-hour site-seeing and finally a taxi drive to the airport.
2	After getting up late and talking a bit more on the phone with her boyfriend, she is ready to leave her hotel, however, being 2.5 hrs behind schedule!
3	As a result, her MID modifies on-the-fly her itinerary and she is now instructed to skip the shopping and site-seeing and ask right away for a taxi; she confirms her device’s suggestion and leaves the hotel immediately.
4	Collista waits for a taxi by the street, outside the hotel. MID sets on a “waiting for taxi” beacon transmitting locally its position and the desired destination coordinates.
5	A nearby passing taxi receives the mobile device's beacon message. The taxi GPS device notifies the driver for the request. He accepts, and an acknowledgement is sent to Collista’s device.
6	The taxi driver reaches the place where Collista is waiting. Her MID receives the taxi's acknowledgement and notifies her to enter the taxi. The MID gives the airport destination to the taxi’s navigator and an optimal route is computed.
7	While heading to the airport, the airport authorities announce a 3-hour delay for Collista's flight and the airline sends a 3G (cellular) notification to Collista’s device.
8	Collista's device receives the notification and re-evaluates its itinerary. Collista can still do her shopping and site-seeing! (She confirms ecstatic, responding to her device’s suggestion!)
9	A new destination (e.g., Tsimiski Str., the main shopping street of Thessaloniki) is set by the device and provided to the taxi's navigator. The navigator computes the new route and re-routes the taxi to Tsimiski Str., (confirming to the device a 20 min drive delay).
10	Collista exits the taxi and her device receives a “70% Sales on shoes!” beacon message from a nearby shoe-store. Her mobile device informs Collista and she gladly accepts the suggestion!
11	The device sets a route to the given coordinates and instructs Collista how to get there fast!
12	While Collista is window-browsing and shopping, her boss, Valeria, happened to be nearby. Valeria's Mobile Internet Device identified Collista's

Step	Scenario Description
	device in range, as they are both in each other's access lists and user directories.
13	Valeria sends a “request for a short meeting” to Collista, including coordinates of the café, where Valeria is sitting at; Collista accepts and her mobile device sets a route to the café.
14	Valeria and Collista meet and talk over frappe (coffee).
15	At some point Collista's MID reminds her that the site-seeing is due, so Collista tells her boss that she has to leave.
16	Collista waits for a taxi by the street (again, same sub-scenario as above, at the hotel).
17	Collista's MID provides the taxi's navigator with the desired sequence of destinations for site-seeing.
18	While passing by the White Tower, the monument's beacon broadcasts a message, inviting tourists for some tourist info or tour. The MID relays this message to Collista and she accepts the info stream.
19	After evaluating their velocity, the Tower decides to transmit to them the short version of the tour and not call for a tour guide.
20	While site-seeing, a traffic-info message is relayed to the taxi driver (from another taxi, passing nearby), indicating a traffic jam at the Ring-Road, due to a car accident. (The Ring-Road is on Collista's way to the airport).
21	The taxi's navigator 'thinks' it's wise to inform Collista's mobile device about this ~45 min estimated delay.
22	Collista’s MID realizes that the site-seeing must be interrupted and the taxi should head to the airport. So, it sends a “new destination” (= the airport's) coordinates to the taxi's navigator, the navigator computes the shortest route and reaches the airport in time!
23	Collista gets off the taxi and waits for a porter to carry her 3 pieces of luggage; Her device sets a “request luggage porter” beacon.
24	A nearby available porter receives the beacon request and moves to the given coordinates.
25	The porter picks up Collista's luggage and his MID checks with the Departures service, in order to make sure he has enough time to pick up some more luggage. Meanwhile, Collista has some free time to spend shopping and browsing around.
26	Upon the airline’s notification, the porter takes Collista's luggage to the check-in counter and notifies Collista’s device (and others’) to meet him at the airline’s check-in counter.
End	Collista is happy for spending her time efficiently and her mobile device is happier for serving its boss wisely!

Table 2.1: DynaRoute Scenario Description

The above described scenario is depicted in Figure 2.1. External events triggering changes during the play of the scenario are noted along the different steps. Some of the internal steps described in table 2.1 have been merged, in order to achieve the expected visual understanding for this use case.

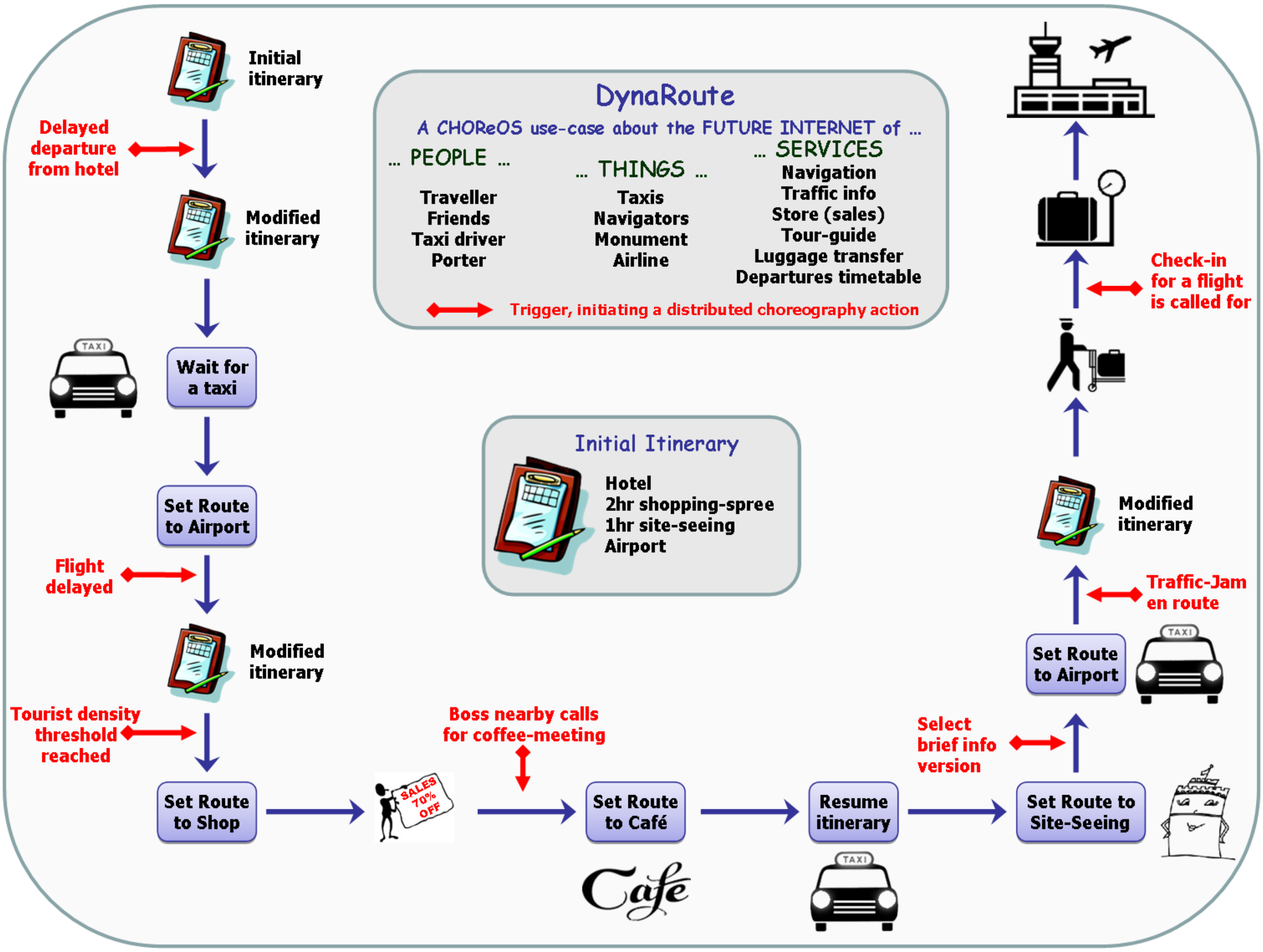


Figure 2.1. An overview of DynaRoute use case scenario.

2.2. Method of scenario development

In the following sections we define the main services of the "DynaRoute" scenario and we show how each individual service interacts with other services to produce the next logical step for the choreography. We follow a "bottom up" approach where we identify the communication requirements that are actually met through services and then introduce the actors of the scenario. Afterwards, we describe the inputs and outputs of each service and how they interact with each other so in the end they all form respective choreographies (specification of the choreographies is refined in 2.3.4). All involved parties in this use case include People, Services and Things, which have been initially defined in deliverable D1.2 “Choreos perspective on the Future Internet and Initial Conceptual Model” [1].

In the beginning of the scenario Collista sets the basic requirements for her schedule of the day. A personal itinerary is created by her intelligent assistant MID, in order to spend efficiently her last day in Greece and finally catch up with her flight. The schedule created for Collista contains a 2-hour shopping spree, 1-hour site-seeing and finally a taxi drive to the airport. The exact details of the schedule (which retail store, which tour guide) are either predefined by Collista herself or are approximated by MID, based on some pre-existing preferences by Collista. In any case MID must contact a number of services in order to obtain the current information on the details of the schedule. The interaction between the services initiates the first and main choreography of our scenario, namely the *C1 - context-aware adaptive itinerary choreography*.

Unfortunately, Collista gets up late and is now ready to leave the hotel 2.5 hours behind schedule. MID discovers this delay by using core functionalities and sensors of the device such as the clock (or the GPS sensor as described later) and triggers a notification that the schedule has changed so as to modify on-the-fly the itinerary and meet the new change in time. So, MID instructs Collista through notifications to skip shopping and sightseeing and ask immediately for a taxi. Collista proceeds to confirm this notification and leaves the hotel immediately.

Collista has checked out of the hotel and is waiting on the road for a taxi. Through MID, she sets up a beacon service asking for available taxis in the area. An available taxi receives the beacon message and after the necessary criteria have been met, picks up Collista at the predefined GPS position and sets route for the airport. In a more general fashion, this interaction between m people and n taxis, where the various services attempt to assign a subset of people to each taxi in a dynamic way, represents the *C2 - co-taxi-ing choreography*.

Following the scenario, Collista's MID is informed about a 3-hour delay of the flight so it notifies Collista about this change in schedule. After Collista acknowledges this notification, MID proceeds to dynamically re-evaluate her itinerary and re-organize the shopping and sightseeing tasks in her schedule. After this change of plan, Collista has time for shopping and sightseeing so she selects a new (shopping) destination. The taxi's infrastructure receives the new destination coordinates from Collista's MID which passes them along to the navigator to compute the optimal route. In this case, we have one airline and m passengers where upon notification from the airline, the passengers' schedule is modified and adapted accordingly. This is the *C3 - distributed alert system choreography*, where services communicate with each other in order to broadcast critical information notifications.

After Collista arrives at the new destination and exits the taxi, her MID receives a new beacon message that says "70% sales on shoes" that is coming from a nearby shoe-store. Collista accepts this notification and the shop's coordinates are confirmed in MID which navigates Collista to the shop.

However, while Collista was shopping, her boss Valeria happened to be nearby. Valeria's MID used the social proximity service to identify that Collista's MID is in range, as they are both in each other's access lists and user directories. Note that in order for this scenario step to work, both MIDs should run these services so they can exchange instant messages and set up a relationship. In this context, when Valeria's and Collista's MIDs have been authenticated and validated for further communication, Valeria sends a "request for a short meeting" notification to Collista including coordinates of the cafe where Valeria is sitting etc. Collista accepts by sending a notification to Valeria and her MID sets a route to the cafe. Finally, Collista and Valeria meet and talk over frappe (greek coffee). This "social interaction" of services represents the *C4 - context aware, distributed ad hoc social networking choreography*, where the main focus point is to establish social relationships through people with the use of instant messaging.

Sometime after, Collista's MID notifies her that the sightseeing is due, so Collista tells her boss that she has to leave. At that point, Collista repeats the same step of the scenario when she was outside the hotel. A beacon service is activated and soon a nearby taxi responds to the request and picks up Collista and her itinerary is resumed.

While passing by the White Tower, its beacon service broadcasts a message inviting tourists on a guided tour. MID notifies Collista about this event and she continues to respond "I am mobile user, need only text description" and accept the info stream on her MID. Since she is on a tight schedule (and a moving taxi) she does not have enough time for a guided tour, so she can only accept text/video messages on MID. Monument infrastructure service acknowledges this and transmits the short tour and does not call for a tour guide. This is the *C5 - context-aware, touristic guide choreography*, where we have a main monument infrastructure that transmits (and accepts) information from n tourists.

Collista continues sightseeing however at some point a traffic-info message is delivered to the taxi infrastructure indicating a traffic jam on the Ring-road (which is Collista's way to the airport) due to an accident. This happens because other taxis that have already passed from the Ring-road have notified the traffic detection service about the traffic conditions in the area and the service has concluded that there is a significant traffic jam. During Collista’s trip to the airport, the taxi’s infrastructure polls the traffic query service for possible traffic jams along the route. When a traffic jam is detected, a notification is sent to Collista to modify her itinerary. In this event, the sightseeing stops prematurely and Collista begins heading to the airport. During these steps of the scenario there are a number of services that run on taxis that report traffic, a main traffic detection service and a traffic query service; this is the *C6 - distributed ad-hoc traffic management choreography*.

As soon as Collista arrives at the airport and exits the taxi, she setups a beacon message requesting a luggage porter. After some time a porter comes which qualifies the criteria that Collista has given. If the porter has enough time he arranges to pick up more luggage. Meanwhile, Collista continues shopping and waits for the check-in opening. Porter’s MID checks the departure table of the airport. When specific flight’s time is due, porter’s MID issues a notification to all flight passengers MID’s that he is carrying their luggage to meet at the check-in counter. This way Collista’s MID notifies her to meet the porter at the airline's check-in counter. This procedure synthesizes *C7 - personalized, airport ground service choreography*, which is quite interesting for our use case since it involves services of many different types and different actors.

All aforementioned communication between actors (services & people) represent the basic sources of information that Collista’s MID has to interact with in order to establish a well-designed and flexible schedule.

2.3. The “DynaRoute” scenario

In the following sections we elaborate the scenario description, in order to clarify the main characteristics of the involved actors. People, Things and Services that participate in this scenario, are defined as the actors of the scenario. The last section of this chapter gives the choreographies description, as the synthesis of their components.

2.3.1. People

During the play of “DynaRoute” scenario, people are the end users of applications provisioned by choreographed services. Choreographies that are demonstrated by this scenario provide applications in the transportation and traveling living of citizens.

People that participate in the “DynaRoute” scenario are:

- **Citizen**

  Collista is a citizen that acts as an airplane traveler, taxi passenger in city routes, shops/mall visitor, tourist sightseeing, social life actor, airport guest.

  Valeria is a citizen that acts as a friend of Collista, also her boss and social event participant.

- **Taxi driver**
  These actors provide taxi service by making use of electronic call system and traffic information.
- **Porter**
  Acts as the professional to provide luggage transfer service for the airport guests.

2.3.2. Services

The main philosophy behind these services is that they accept as inputs some predefined parameters such as date & time etc. and return as output the availability of the service with any additional limitations and general information that is needed. As mentioned before, MID is the main presentation media to Collista for the synthesized result that these services provide. Also, MID itself provides services that participate as well in the synthesis process.

The services that play role in the scenario "DynaRoute" are the following:

- **Notifications**
  Description: Each mobile device is able to produce audio, visual and vibration signals to the user of the device.
  Used by: Citizen's MID, taxi's navigator, Porter's PDA
  Inputs: textual message, some event
  Outputs: Audio signal, Visual on-screen message, Vibration signal
- **Location service**
  Description: A fine (GPS) or rough (GSM) estimation of the location coordinates of the mobile device is provided.
  Complementary: Usage of location-based social networking websites (such as Foursquare, Facebook Places) that enable users to check-in at particular venues.
  Provided by: Citizen's MID, taxi's navigator, Porter's PDA
  Inputs: satellite signals (GPS), mobile carrier cell signals (GSM), internet (3G)
  Outputs: location coordinates estimate (longitude, latitude)
- **Time/clock service**
  Description: The current time/date provided by either a clock or by using the NTP protocol through internet
  Provided by: Citizen's MID, taxi's navigator, Porter's PDA
  Inputs: internet (3G), mobile carrier cell signals (GSM)
  Outputs: time/date
- **Task list / calendar service**
  Description: A list which stores to-do tasks and is organized in a calendar basis.
  Provided by: Citizen's MID
  Inputs: predefined tasks from Collista, pre-existing preferences
  Outputs: an organized to-do list of tasks
- **Beacon service**
  Description: This service is able to receive, transmit or relay short messages between actors and things based on proximity criteria.
  Provided by: Citizen's MID, monument/shoe shop infrastructure
  Inputs: message
  Outputs: broadcasted message
- **Tour guide service**
  Description: Upon successful confirmation of a tour request by a tourist, this service sends either text/video messages or issues a request for a tour guide.
  Provided by: monument infrastructure
  Inputs: N/A
  Outputs: text/video messages, requests for tour guides

- **Device pairing service**
  Description: Each mobile device is able to pair with another device for exchanging information such as schedule changes and beacon messages.
  Provided by: Citizen's MID, taxi's navigator
  Inputs: the ids of the devices to be paired
  Outputs: a pairing connection
- **3G Access service**
  Description: Each mobile device is able to access the internet using this service and exchange information with other devices.
  Provided by: Citizen's MID, taxi's navigator, Porter's PDA
  Inputs: N/A
  Outputs: an internet connection
- **POI maps**
  Description: POI query service
  Provided by: Web service
  Inputs: POI/area, category
  Outputs: a list of POI coordinates
- **User preferences**
  Description: This service compiles all the user preferences in categories while simultaneously being accessible to new information about schedule changes and general information that may affect the user's preferences on the schedule.
  Provided by: Citizen's MID
  Inputs: various user preferences
  Outputs: a chronological schedule of the to-do tasks of the user
- **Airline announcement service**
  Description: A service that is responsible for the information announcement for specific flight(s) and/or corresponding passengers.
  Provided by: Airline server infrastructure through Future Internet
  Inputs : airline's flights of the day, passenger list for each flight, general announcements
  Outputs : notifications for flight's status (cancellation, delay etc.), notification on special offers [optional], personalized notification for clients (e.g. updated on miles status) [optional]
- **Navigation**
  Description: A service provided by specialized software such as a navigator, that offers navigation instructions to the user.
  Provided by: Citizen's MID, taxi's navigator
  Inputs: satellite signal (GPS)
  Outputs: navigation instructions
- **Retail store info service (shoe-store)**
  Description: Announcements and information about the store is provided in a specific range of local area (approx. 100m).
  Provided by: Store's wireless infrastructure
  Inputs: date & time & duration of visit, abundance of specific products [optional]
  Outputs: feasibility of visit, abundance of specific products [optional], special offers notification messages by the shoe-store.
- **User directory**
  Description: A sorted catalogue of the people that the MID's owner is associated with.
  Provided by: Citizen's MID
  Inputs: N/A
  Outputs: sorted catalogue of contacts

- **Social proximity service**
  Description: A service that enables social interactions (meetings setups, instant messaging) based on proximity criteria.
  Provided by: Citizen's MID
  Inputs: user directory
  Outputs: validation of the user's proximity
- **Instant messaging**
  Description: A service that offers instant send-and-receive messages between people that belong in each other's user directory.
  Provided by: Citizen's MID
  Inputs: N/A
  Outputs: instant messages
- **Traffic detection service**
  Description: A service that detects area traffic based on incoming messages received by taxis.
  Provided by: Taxi company infrastructure services
  Inputs: incoming traffic messages by taxis
  Outputs: traffic conditions of areas
- **Traffic query service**
  Description: A service that receives requests for traffic information about the ongoing traffic on the taxi's area.
  Provided by: Taxi company infrastructure services
  Inputs: traffic information request messages
  Outputs: traffic information messages
- **Airport departures announcement service**
  Description: A personalized information services offered by the airport on flight status and general information.
  Provided by: Airport infrastructure services
  Inputs : traveller information
  Outputs : departures times of flights, general information

2.3.3. Smart Things

Things involved in the "DynaRoute" scenario are smart phones, PDAs, laptops and taxis' GPS navigators of involved people. The devices in this scenario provide the way to interact between choreographies and people, while utilizing its built-in features to participate the choreographies itself.

In the context of "DynaRoute" scenario actors are equipped with Mobile Internet Devices, that except the interconnection capabilities they provide also carry sensors and are featured with traditional service applications:

- **Citizen's MID**
  This device could be an Android Smart Phone equipped with 3G, GPS, clock, calendar, device pairing (bluetooth), beacon RX/TX, user directory and audio/visual notifications.
  In the "DynaRoute" scenario, this type of device is owned by Collista and Valeria.
- **Taxi's GPS navigator device**
  This device could be an Android Smart Phone with special GIS software like MLS Destinator or a dedicated GPS device from MLS series with Internet connection feature. Characteristics for this device include GPS, navigation service, device pairing (BT) and beacon RX/TX.

- **Porter’s MID**
  This device could be an Android Smart Phone or Android tablet equipped with GPS, clock, beacon RX/TX and audio/visual notifications.

2.3.4. Choreographies

The components of choreographies are services, as they have been described in the previous section 2.3.2. In this section we describe, for each choreography in “DynaRoute” use case: (i) features provision, (ii) goal to achieve and (iii) components (services) to synthesize. In the following list (i) and (ii) are presented:

- **C1 - Adaptive itinerary**
  The Adaptive itinerary choreography C1 represents the main choreography of the “DynaRoute” scenario. It is synthesized and initiated by the MID’s services and starts executing with a predefined schedule of activities. External events from services or other choreographies trigger adaptive behavior in the itinerary. Also self awareness contributes in the interaction with other services and choreographies.
- **C2 - Co-taxi-ing**
  The Co-taxi-ing choreography C2 is dynamically synthesized among *m people and n taxis*, attempting to assign a subset of people to each taxi.
- **C3 - Distributed alert system**
  The Distributed alert choreography C3 is synthesized between *one airline company and m passengers*, It provides notifications about the passenger’s flight such as possible delays, change of departure gate, personalized offers etc.
- **C4 - Distributed ad-hoc social networking**
  The Distributed ad-hoc social choreography C4 is dynamically synthesized between *two persons*. Its instantiation is based upon the existence of the persons’ identities in each other’s access lists and/or user directories and is triggered from proximity criteria. After the initial recognition both MIDs exchange credentials so as to verify the relationship and further options are revealed to [ACTOR-owner/s of MID] such as greeting notification, appointment request etc.
- **C5 - Tourist guide**
  The Touristic guide choreography C5 is dynamically synthesized among *1 monument and n nearby tourists*. It is instantiated upon proximity criteria and it is highly adaptable so as to match the tourist’s interest and traveling status for a short and fast (text-only) description, a longer video or a regular guided tour.
- **C6 - Distributed ad-hoc traffic management**
  The Distributed ad-hoc traffic choreography C6 is synthesized among *m taxis*. This choreography is based on the notion that each taxi is able to identify traffic jams independently and pass this information along from taxi to taxi, hop by hop, in a fully distributed fashion.
- **C7 - Personalized airport ground service**
  Personalized airport ground choreography C7 is synthesized between *m travelers and n porters* whereas each porter selects which traveler to serve.

These seven choreographies interact each other during the “DynaRoute” scenario is being played. The main choreography is C1, which adapts events created or triggered by the other choreographies. Following we provide a picture (figure 2.2) presenting the choreographies synthesized and the relation among them.

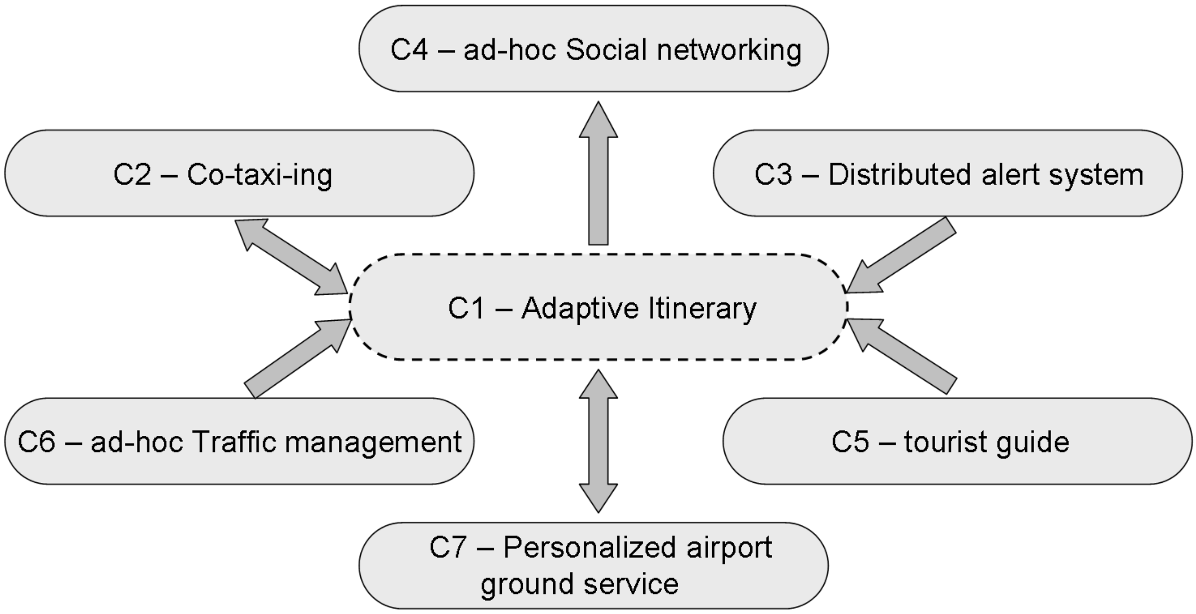


Figure 2.2. Interaction among choreographies in “DynaRoute”.

The interaction can be bidirectional or single-directional, denoting a “dialogue” of messages between choreographies in the first case and an external trigger event in the former case.

“DynaRoute” choreographies are presented in further detail and also specified using the BPMN standard in Chapter 4.

Each choreography is a synthesis of various services, as described in section 2.2. We provide a mapping of the composed services for the choreographies of DynaRoute in the below table 2.2.

Choreography	Choreographed Services
C1 - Context-aware adaptive itinerary	MID notifications MID location service (GPS, GSM, web service) MID time/clock service MID task list / calendar service MID beacon service (transmit, receive) MID device pairing service MID 3G access service MID user preferences (shopping, flight details) POI maps (web service) Retail store info service
C2 - Co-taxi-ing	MID location service (GPS, GSM) MID notifications MID beacon service (transmit, receive) TAXI notifications

	TAXI location service (GPS) TAXI beacon service (transmit, receive) TAXI navigation
C3 - Distributed alert system	Airline announcement service (web service) MID 3G access service MID user preferences MID notifications
C4 - Context-aware, distributed ad hoc social networking	MID location service (GPS, GSM) MID user preferences MID notifications MID setup meeting MID user directory MID Instant Messaging
C5 - Context-aware, touristic guide	Monument beacon service MID beacon service (transmit ,receive) MID notifications MID location service (GPS, GSM) Monument data transmit service (short text guided tour)
C6 - Context-aware distributed, ad hoc traffic management	TAXI beacon service (transmit, receive) TAXI location service (GPS) TAXI notifications MLS Maps Service
C7 - Context-aware, personalized airport ground service	MID beacon service (transmit, receive) Porter device beacon service (transmit, receive) MID notifications Porter's device notifications MID user preferences MID location service (GPS, GSM) Airport departures announcement service

Table 2.2: Choreographies and Services mapping

2.3.5. Use Case "DynaRoute" and FI Dimensions

The main goal of this use case is to demonstrate the service and innovation levels that users could gain while in the same time considering that the requirements in Future Internet are extremely challenging. "DynaRoute" actors as described in this report involve People, Services and Things introducing this way all of the requirements and challenges in the Future Internet as already described in deliverable D1.2 "Choreos perspective on the Future Internet and Initial Conceptual Model" [1].

The central storyline in the "DynaRoute" scenario anticipates for an "Adaptive Itinerary" software management application. In this use case, this is synthesized as a choreography of services among Smart Things and Business Services interacting with People. The requirement for adaptability is demonstrated from the fact that external events can be managed on the fly, as well as interaction with third party provided applications, to modify or perform actions listed in the itinerary of a user. User preferences, situation (location, time) and external constraints (traffic jam) are also computed in the “Adaptive Itinerary” application covering other adaptability and awareness requirements of this application. The concept of awareness is then again demonstrated in the applications of “ad-hoc Social Networking” and “ad-hoc Traffic Management”. In the first application a choreography is synthesized between Smart Things of the users, to utilize MID location sensors and user preferences friend list, in order to provide social networking using proximity criteria. The second application provides traffic management services for taxis in a city, by synthesizing location and speed sensors along with map services.

One critical challenge that we need to respond is the very large number of the networked entities and users in the Future Internet. In the table 2.3, we provide estimated numbers of the actors that are involved during “DynaRoute” use case. The estimate is based on empirical approach for a city with 500 thousands population. Although the scenario story describes the point of view of the citizen (Collista), the same scenario could be played in parallel for other citizens in the same regional area. For our estimation we assume a medium populated city of 1 million citizens (like Thessaloniki), as the regional area that the choreography-based software applications are deployed.

Type of Actors	DynaRoute Actors	Number Estimate
People	Travellers	1 – 10 thousands
	Friends	10 – 100 thousands
	Taxi drivers	1 – 10 thousands
	Porters	100 – 1000
Things	Taxis	1 – 10 thousands
	Navigators	1 – 10 thousands
	Smart Mobile Devices	10 – 100 thousands
	Monuments	10 – 100
	Airline companies	10 – 100
Services	Navigation	1 – 10
	Traffic query	1 – 10
	Retail store info	1 – 10 thousands
	Tour guide info	10 – 100
	Luggage transfer	1 – 10
	Departure timetable	1 – 10

Table 2.3: Estimated numbers of actors

One significant characteristic of this scenario is the use of Location Based Services. The same software application can be provided across several cities in EU or global, which could multiply the above numbers of involved actors (people, services, things). The choreography provided applications could be concurrently available to citizens of several cities concurrently. Thus, the distributed nature of choreographies deployment demonstrated in “DynaRoute” use case can allow a really large number of citizens to take advantage of services, that for the time being are provided by centralized web services, like navigation and map service or social networking. According to the statistics provided by Eurostat for “Population and living conditions in Urban Audit cities, larger urban zone” [2], across the EU there are 140 cities with over 500 thousand people population, which citizens’ could take advantage of choreography-based software application like these demonstrated in the “DynaRoute” scenario.

3. Requirement Analysis

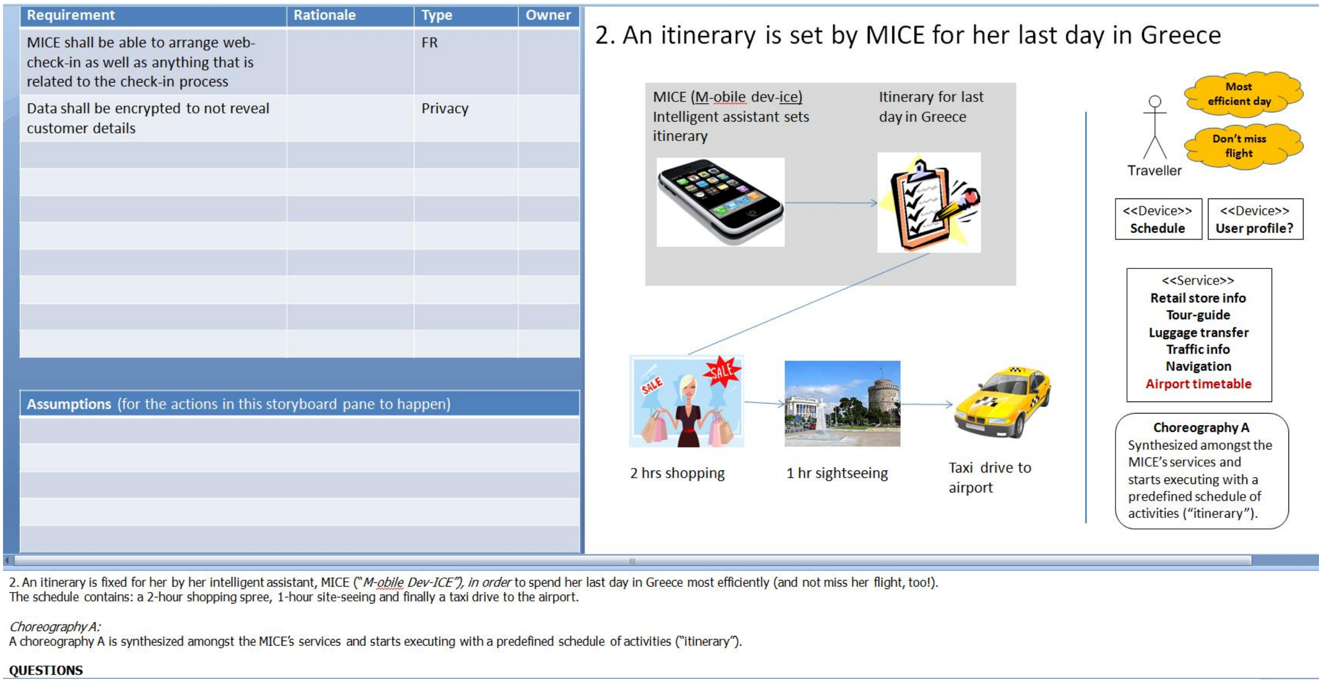
A detailed requirements analysis was used to identify the specifications and functionality of services and choreographies for the “DynaRoute” use case. The requirements specification specifies both functional and non-functional characteristics for the assessment of the solution developed within the CHOReOS dynamic development process.

3.1. Methods for eliciting and managing requirements

The requirements process for CHOReOS builds upon a method developed for the EU Framework VII MIRROR integrated project[2]. High level requirements are elicited using a structured scenario-based approach. Using the scenario as a means of requirements elicitation enables the requirements analyst to ground questions in context through the sequence of events in the scenario.

To present the scenario to stakeholders, a storyboard was developed featuring one frame per event, or scenario step, and a section for requirements related to that action. Figure 3.1 shows a detailed example from the storyboard containing:

- Notes section including the event description, choreography (NB there are 7 choreographies labeled A to G) and questions related to the event and areas for further exploration.
- Storyboard frame including a pictorial representation of the event and a section containing the involved actors, devices, services and the choreography.
- Requirements table for documenting the requirement, rationale (in case the purpose of the requirement is not clear), type and owner.
- Assumptions table for documenting statements of fact that are assumed true for the actions in the scenario step to happen.



Requirement	Rationale	Type	Owner
MICE shall be able to arrange web-check-in as well as anything that is related to the check-in process		FR	
Data shall be encrypted to not reveal customer details		Privacy	

Assumptions (for the actions in this storyboard pane to happen)

2. An itinerary is fixed for her by her intelligent assistant, MICE (“*M-obile Dev-ICE”), in order* to spend her last day in Greece most efficiently (and not miss her flight, too!). The schedule contains: a 2-hour shopping spree, 1-hour site-seeing and finally a taxi drive to the airport.

Choreography A:
A choreography A is synthesized amongst the MICE’s services and starts executing with a predefined schedule of activities (“itinerary”).

QUESTIONS

Figure 3.1. An example frame taken from the “DynaRoute” storyboard showing the storyboard frame and requirements, assumptions and notes sections.

[2] Requirements process developed by the Norwegian University of Science and Technology and City University London as part of the MIRROR EU Framework VII Integrated Project

By walking through the scenario, the aim of the process was to capture user and system requirements from the stakeholders according to a set of requirements types. Taxonomies of requirements are used to improve understanding, analysis and testing of the solution. The following types were specified for the DynaRoute use case to be used for the elicitation exercise – see Table 3.1. These types included those specified for the DynaRoute Future Internet requirements in deliverable D1.2[1].

Service consumer requirements		
Functional [FR]:	Something (service, behaviour, function) that a product must do	e.g. The boss shall send a request for meeting
Performance [PR]:	The desired times and/or throughput rates that an actor should be able to undertake	e.g. The traveller shall receive a revised route within 10 seconds
Availability [AvR]:	The minimum required levels of access that stakeholders have to MID and related work activities	e.g. The traveller shall be able to access flight departure information at all times
Usability [UR]:	The desired levels of tolerable user errors and frequencies of error	e.g. The passenger shall set a beacon message with less than one error per 1000
Accuracy [AcR]:	The error rate produced by the service calculated on the basis of the expected results.	e.g. The traveller shall receive their current position accurate to $10m^2$
***Security (& privacy and trust) [SR]:**	The minimum levels of security that a person using MID and related work activities should be exposed to	e.g. The passenger shall provide authentication in order to access their user profile details

Service developer (system) requirements		
***Scalability [ScR]:**	The capability and system's ability to process more users' requests, operations or transactions in a given time interval.	e.g. a few hundred to thousands of services in choreography C1
***Interoperability [IR]:**	The ability of a software component to interact with other components or systems.	e.g. Different devices (navigators, smart phones)
***Awareness [AwR] & Adaptability [AdR]:**	The level of awareness and predictability of upcoming changes & the ability of the system to change to	e.g. adapt to circumstances like choreography C1 for

	new specifications or operating environments	the itinerary
***Mobility [MoR]:**	The platforms, devices and operating systems that MID should be required to run on	e.g. mobile sensor / ad hoc network
Maintainability [MR]:	The minimum acceptable levels of time and resources needed to upgrade of MID	e.g. this could be concerned with supportability of a service
Reliability [RR]:	The minimum levels of failure that MID and related systems should demonstrate	e.g. the product shall achieve 99% up time

*denotes requirement types where requirements already exist for D8.1

Table 3.1. Requirements types for the DynaRoute Use Case

A set of stakeholders was identified to take part in the analysis of the scenario and the elicitation of requirements. The stakeholders covered the key areas of the scenario – tourism, taxi company, shopping mall and airport:

- IT department head from Municipality of Thessaloniki
- Mr. Mantelos Dimitris (CEO) from IT company who support the taxi company "MERCEDES club"
- Mr. Dimitris Paraschos (MLS) for mall requirements, given his previous experience working in this domain.
- MLS team members for airport requirements. The selected stakeholders had experience of similar projects in the airport domain.

City University London facilitated a requirements scenario walkthrough workshop on 3rd June 2011 with Mr. Mantelos Dimitris along with partners from MLS and VTRIP. The result was a set of 58 requirements, which were specified at one of two levels:

- System-wide requirements which relate to the system as a whole
- Action-level requirements which relate to an individual step in the scenario

Following the workshop, stakeholders from MLS added a further 17 requirements for the scenario steps related to the mall and the airport. The requirements are detailed in the following two sections.

3.2. System-wide requirements

System-wide requirements are the high-level requirements that express desirable properties of the system as a whole. The following requirements were captured during the scenario walkthrough:

- FR005: The service consumer shall be able to request higher prioritization regarding calls or arrangements made using MID
- SR001: MID data shall be encrypted to not reveal service consumer details [Security – Privacy]
- IR001: MID shall be able to transmit data to different devices/services/servers

Additionally, a set of high-level future internet requirements specific to the "DynaRoute" scenario and systems is presented in CHOReOS deliverable D1.2. These cover the requirements types: scalability; interoperability; mobility; awareness and adaptability.

3.3. Requirements presented by scenario step

Action-level requirements are the more detailed requirements that relate to the individual steps in the scenario. The following requirements were captured during the scenario walkthrough with stakeholders and subsequent follow ups. The graphical representations of each scenario step are simplified version of the rich pictures used in the actual scenario storyboard (presented in Annex A).

Notes

The requirements were given a type and number identifier according to the order in which they were elicited.

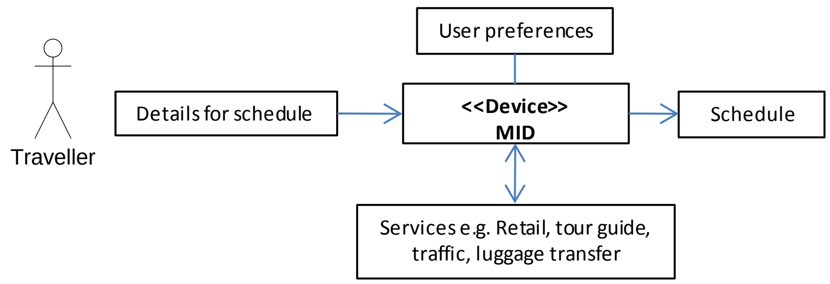
- • Requirement specific to scenario step (event)
- ○ Requirement shared by more than one scenario step
- + Requirement from scenario step specified as a system-wide requirement

[Supporting information]
For requirement type codes see the glossary.

“MID” refers to the traveller’s intelligent mobile device. Other devices are specified by actor e.g. Porter’s MID.

Start: The citizen is flying back to Brazil after a 2-week vacation in Thessaloniki, Greece!

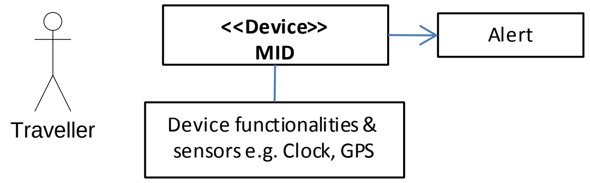
1. An itinerary is fixed for her by her intelligent mobile device (which can be PDA, smart phone, netbook), in order to spend her last day in Greece most efficiently (and not miss her flight, too!).
The schedule contains: a 2-hour shopping spree, 1-hour site-seeing and finally a taxi drive to the airport.



Choreography C1

- • FR001: MID shall be able to arrange web-check-in as well as anything that is related to the check-in process
- + SR001

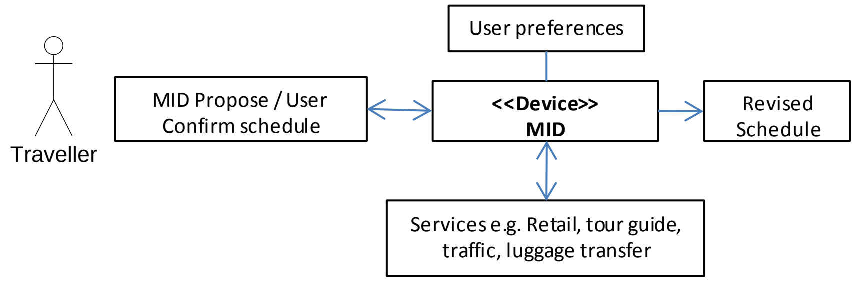
2. After getting up late and talking a bit more on the phone with her boyfriend, she is ready to leave her hotel, however, being 2.5 hrs behind schedule!



Choreography C1

- FR002: MID alerts shall be voice and vibration

3. As a result, MID modifies on-the-fly her itinerary and she is now instructed to skip the shopping and sightseeing and ask right away for a taxi; she confirms her device's suggestion and leaves the hotel immediately.



Choreography C1

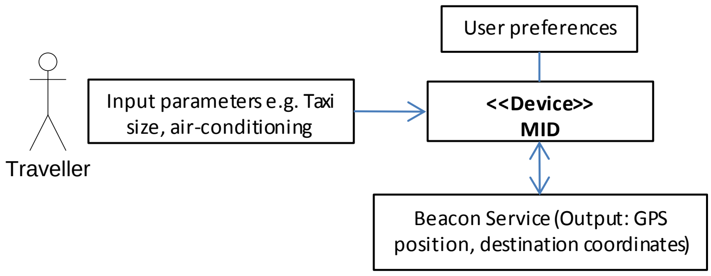
- FR003: Traveller shall be able to arrange beforehand when the taxi shall arrive
- FR004: Taxi company shall be able to receive a confirmation a couple hours before the reservation time from MID
- FR006: Traveller shall be able to subscribe to VIP taxi subscriptions to enhance prioritization
- FR007: MID shall be able to receive weather forecasts

+ FR005
+ IR001
+ SR001

Assumptions:

The taxi company do not accept reservations of less than 1 hour from the time of the request

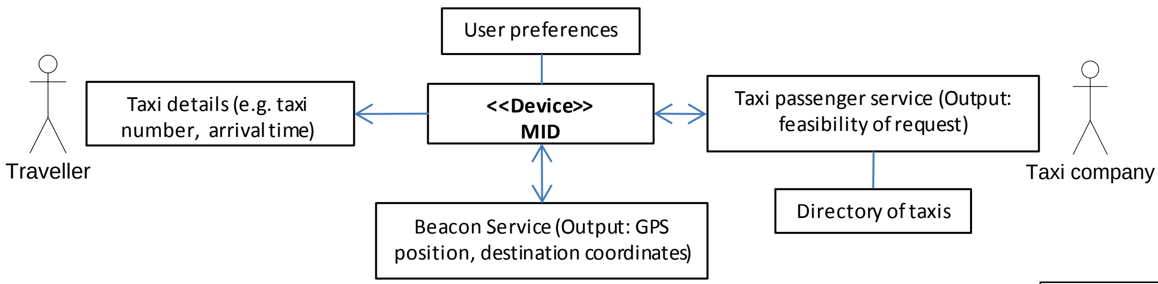
4. Collista waits for a taxi by the street, outside the hotel. The intelligent device sets on a "waiting for taxi" beacon transmitting locally its position and the desired destination coordinates.



Choreography C1

- FR008: MID shall be able to transmit location coordinates to taxi company
- FR009: Traveller shall be able to choose type of car, big boot, air-conditioning, etc.
- FR010: Traveller shall be able to request a taxi driver who speaks English
- FR011: Traveller shall be able to request a taxi with green card

5. A nearby passing taxi receives the mobile device's beacon message. The taxi GPS device notifies the driver for the request. He accepts, and an acknowledgement is sent to Collista's device.



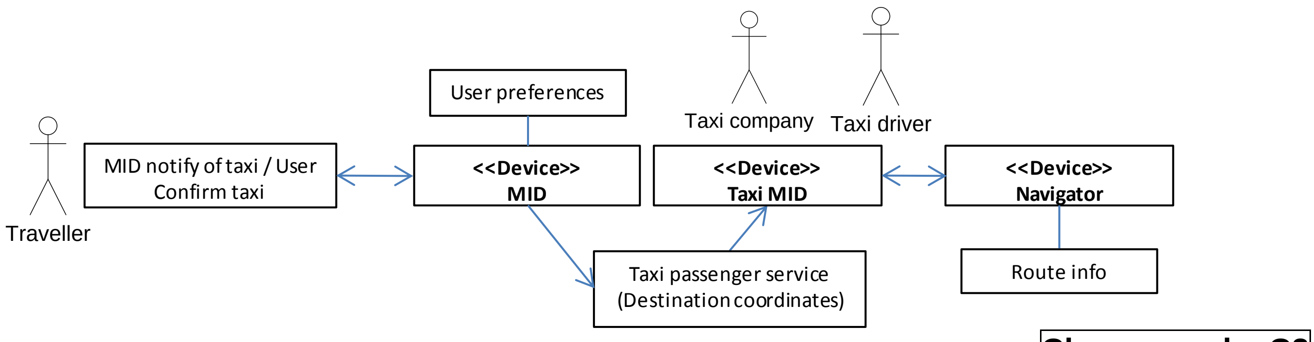
Choreography C2

- FR012: MID shall be able to transmit traveller (customer) details to the taxi company
- FR013: MID shall be able to display the taxi number that will pick up the traveller (customer)
- FR014: Traveller shall be able to know how long it will take for the taxi to arrive
- FR015: Traveller shall receive an alert with regards to how long it will take for the taxi to arrive
- AcR001: Traveller shall be able to receive the position of the taxi with an accuracy of 30m radius
- FR016: MID shall allow the traveller (customer) to change the pickup location and position and inform the taxi company of the changed location
- FR017: MID shall be able to inform the traveller (customer) just before the taxi arrives
- FR018: Taxi company shall be able to send another taxi in case of problems with original taxi
  [MID receives new details]

Assumptions:

Only one set of customer(s) for every taxi - cannot take other customers apart from the one who called (currently in Greece)

6. The taxi driver reaches the place where Collista is waiting. Her MID receives the taxi's acknowledgement and notifies her to enter the taxi. The MID gives the airport destination to the taxi's navigator and an optimal route is computed.



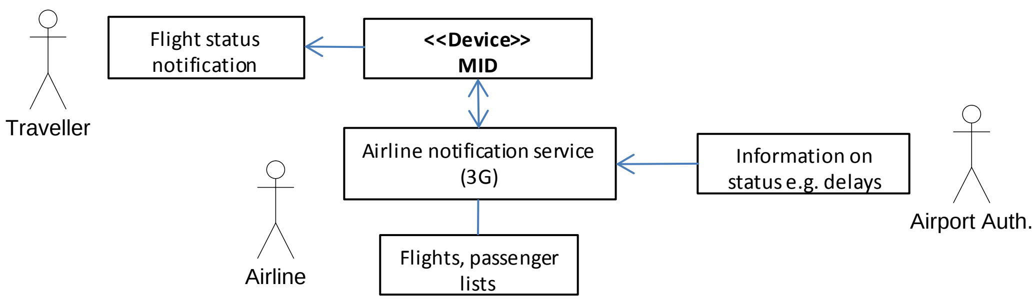
Choreography C2

- FR019: Navigator shall be able to show the coordinates graphically
- FR020: Taxi driver shall be able to recognize customer, not only "optical" recognition
- IR002: MID shall be able to transmit destination details to taxi navigation device (wireless, bluetooth)
- IR003: Navigator shall be able to accept navigation details sent by MID

Assumptions:

Greece: taxi company cannot send navigation information to taxi driver on his navigation device

7. While heading to the airport, the airport authorities announce a 3-hour delay for Collista's flight and the airline sends a 3G (cellular) notification to Collista's device.



Choreography C3

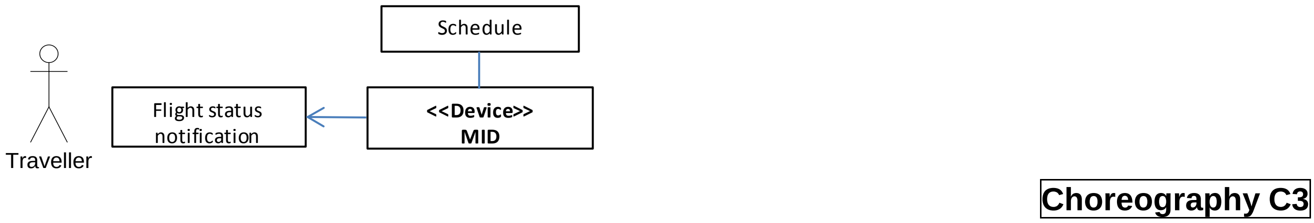
- FR040: Airport authorities shall transmit information about flight delays to airline companies
- FR041: Airline service shall send flight status notifications to passengers

Assumptions:

Airline company has data for passenger lists and destinations

Airport authorities and airline companies will be able to transmit/receive data between each other

8. Collista's device receives the notification and re-evaluates its itinerary. Collista can still do her shopping and site-seeing! (She confirms ecstatic, responding to her device's suggestion!)



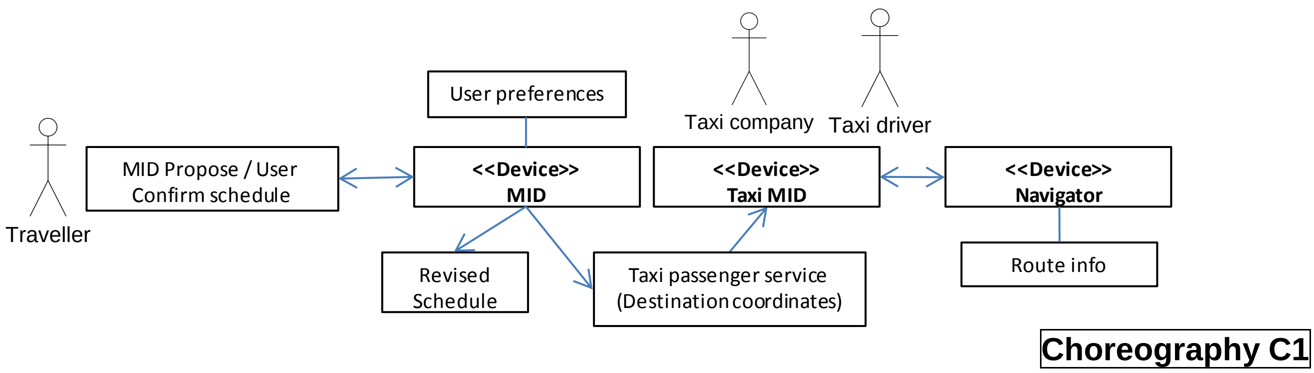
- IR004: MID shall be able to receive and decode the information transmitted from the airline service
- FR042: MID shall have the ability to evaluate the importance of information and notify the traveller accordingly
  [e.g. sound alert, visual effect , vibrate]
- FR043: MID shall repeat the notification periodically until confirmation is received from the traveller

Assumptions:

MID has enough battery power to receive and display notifications

MID has a strong enough signal to receive notifications

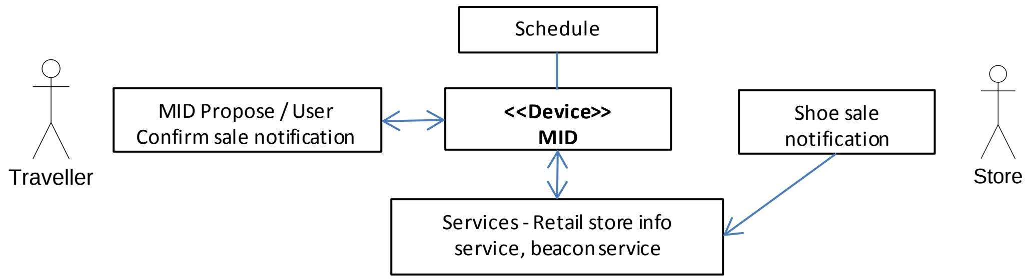
9. A new destination (Tsimiski Str., the main shopping street of Thessaloniki) is set by the device and provided to the taxi's navigator. The navigator computes the new route and re-routes the taxi to Tsimiski Str., (confirming to the device a 20 min drive delay).

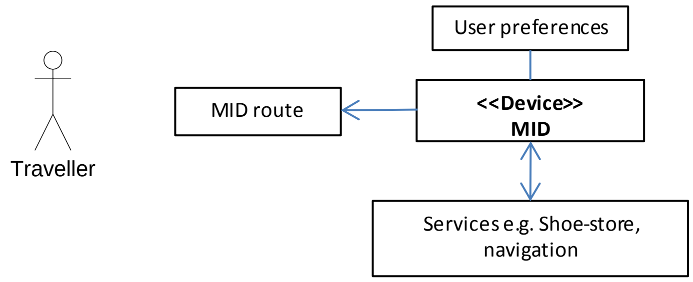


- FR021: MID shall be able to inform navigator about changed coordinates
- FR022: MID shall be able to send the location of where the taxi shall pick up the customer

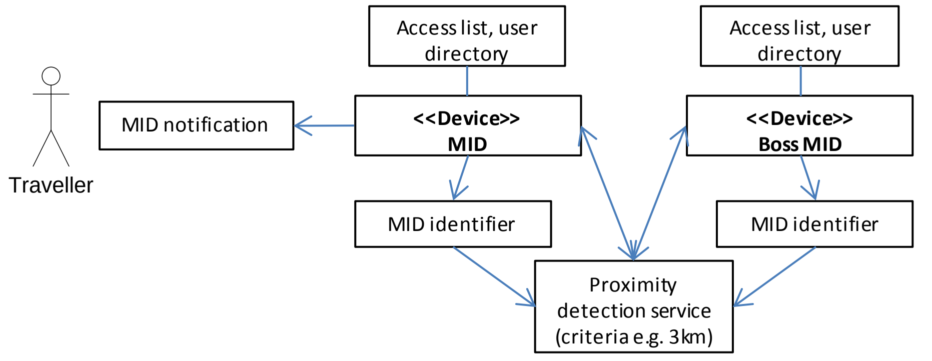
Assumptions:

Taxi driver does not to have to inform taxi company about the change of destination

10. Collista exits the taxi and her device receives a "70% Sales on shoes!" beacon message from a nearby shoe-store. Her mobile device informs Collista and she gladly accepts the suggestion!
 **Choreography C1**
• FR044: Mall shall transmit data on offers and marketing to the CHOReOS platform periodically • AcR003: MID shall receive a notification based on user profile from nearby shops (10m range) • FR045: Choreos platform shall provide to MID specific instructions for the exact location of mall's shop [Due to lack of the GPS in internal areas of the mall] **Assumptions:** MID has enough battery power to receive and display notifications MID has a strong enough signal to receive notifications

11. The device sets a route to the given coordinates and instructs Collista how to get there fast!
 **Choreography C1**
• FR023: MID shall be able to send a reminder regarding the itinerary • FR024: MID shall be able to detect the phase of the itinerary ○ AvR001: MID's location service shall be able to access the servers at all times (hot-spot wi-fi)]

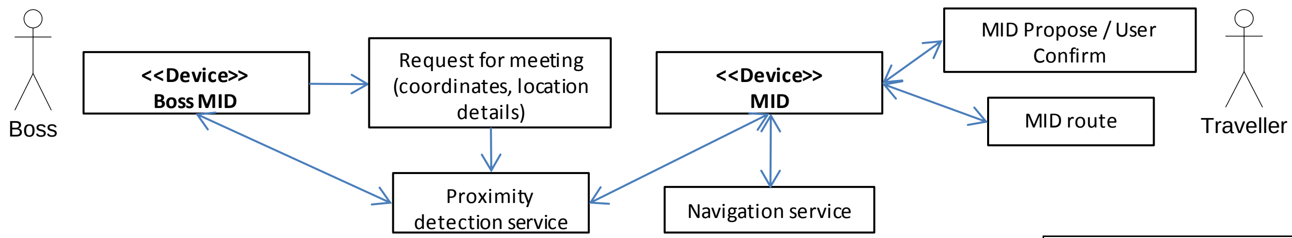
12. While Collista is window-browsing and shopping, her boss, Valeria, happened to be nearby. Valeria's intelligent device identified Collista's device in range, as they are both in each other's access lists and user directories.



Choreography C4

- FR025: MID shall be able to upload the location and its user identifier
- AwR001: MID shall be able to detect nearby "friends"

13. Valeria sends a "request for a short meeting" to Collista, including coordinates of the café, where Valeria is sitting at; Collista accepts and her mobile device sets a route to the café.



Choreography C4

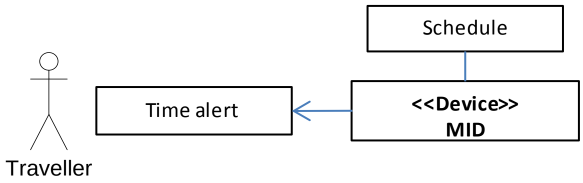
- UR001: Service consumer shall be able to send requests by selecting contacts from the contacts menu easily

14. Valeria and Collista meet and talk over frappe (coffee).

Choreography C1 suspended

- FR026: MID shall be able to detect the movement of the traveller and the time that they spend at a location
  - AvR001: MID's location service shall be able to access the servers at all times (hot-spot wi-fi)

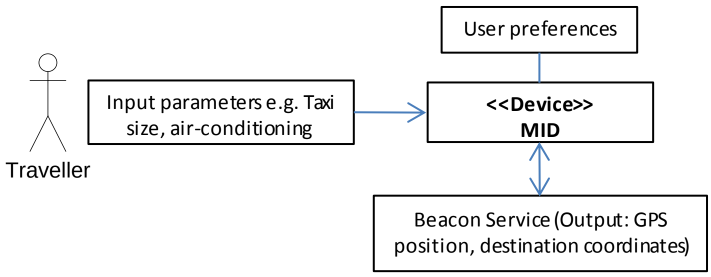
15. At some point Collista's device reminds her that the sightseeing is due, so Collista tells her boss that she has to leave.



Choreography C1

- FR027: Traveller shall be able to access a list of top attractions nearby
- FR056: MID shall be able to access a network that detects customer location and directs to top attractions

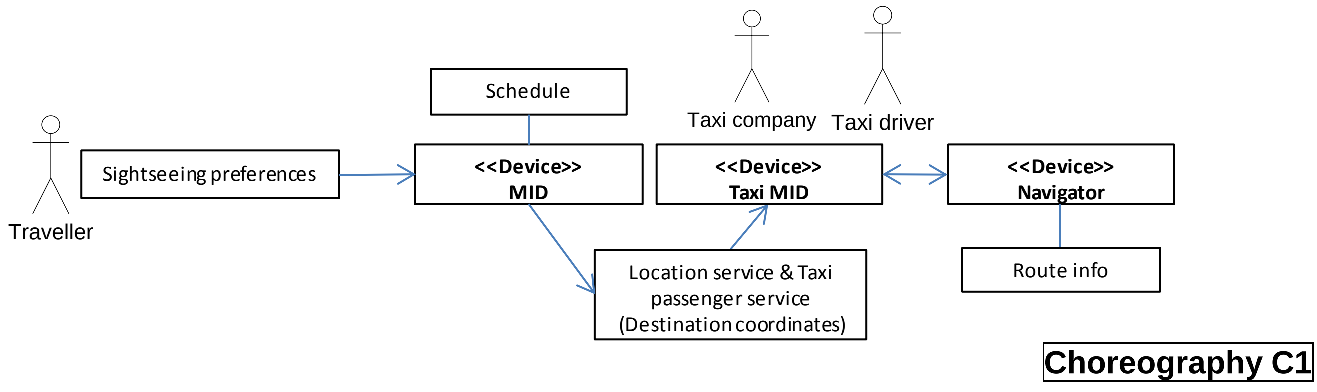
16. Collista waits for a taxi by the street (again, same sub-scenario as above, step 5 at the hotel).



Choreography C1

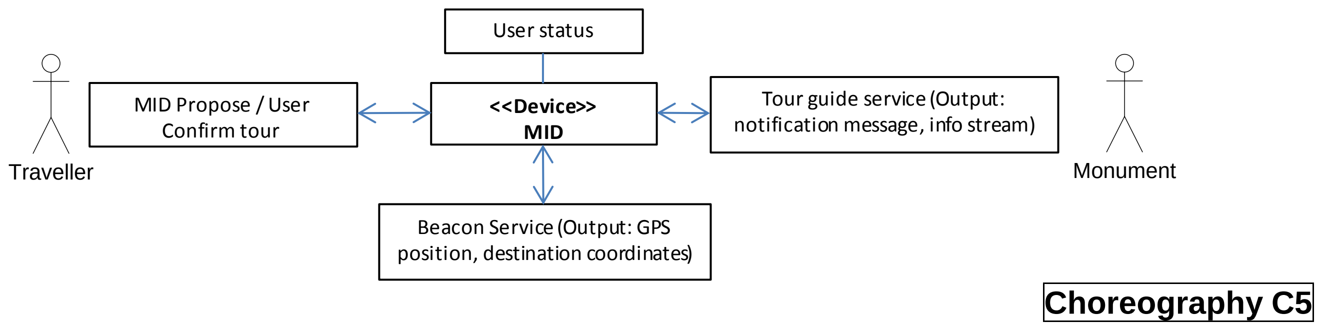
- FR028: MID shall be able to show locations of taxi stands nearby
- FR029: MID shall be able to transmit destination information to nearby taxis
- FR030: MID shall be able to contact taxi company of where customer is

17. Collista's device provides the taxi's navigator with the desired sequence of destinations for sightseeing.



- AwR002: MID shall be able to dynamically change route depending on nearby attractions
- FR031: MID shall be able to inform navigator/taxi driver of route to be taken to destination

18. While passing by the White Tower, the monument's beacon broadcasts a message, inviting tourists for some tourist info or tour. The mobile device relays this message to Collista and she accepts the info stream.

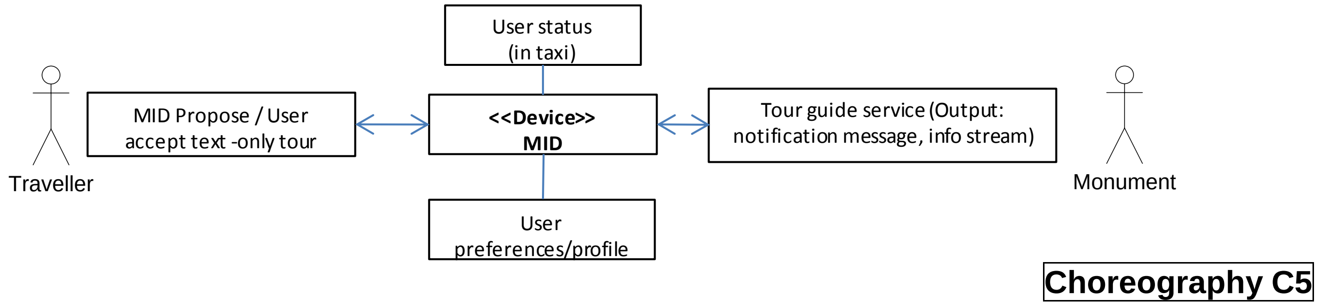


- FR032: MID shall be able to receive information for specific attraction [currently leaflet or brochures]

Assumptions:

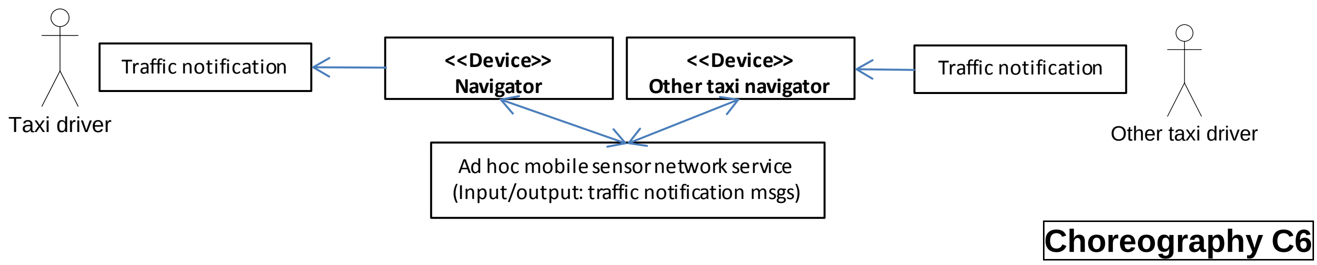
Support from tourist office for getting this

19. After evaluating their velocity, the Tower decides to transmit to them the short version of the tour and not call for a tour guide.



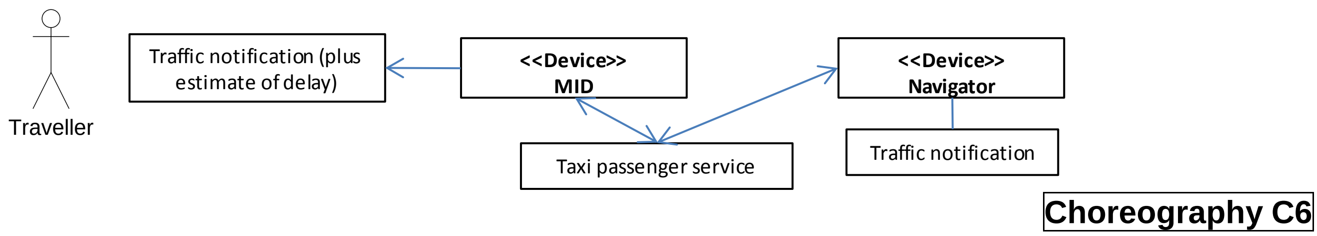
- FR033: MID shall be able to retrieve locations of souvenir shops (or shops, restrooms, etc.) nearby
- FR034: MID shall be able to retrieve opening times, events that happen at particular days/times
- FR035: MID shall be able to filter attractions depending on a user profile

20. While sightseeing, a traffic-info message is relayed to the taxi driver (from another taxi, passing nearby), indicating a traffic jam at the Ring-Road, due to a car accident. (The Ring-Road is on Collista's way to the airport).



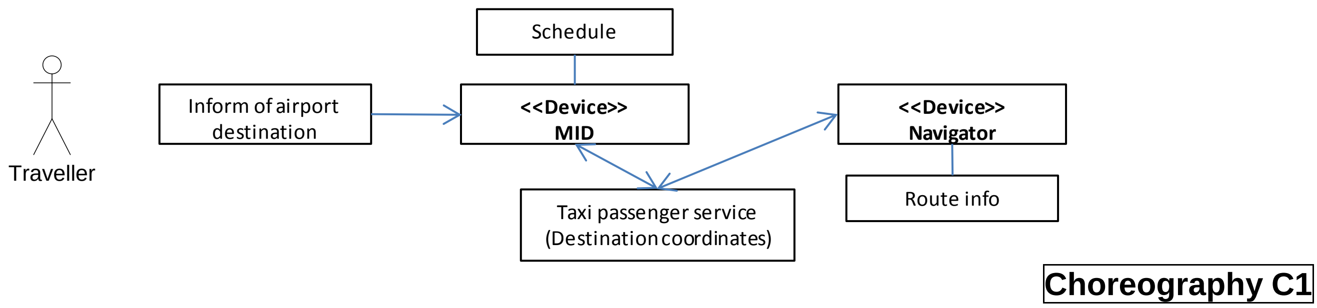
- FR036: Taxi driver shall be able to inform of their location and the problem they may encounter on that route
- FR037: MID shall be able to retrieve current status of route (red, yellow, green indicators)
- MoR001: MID shall receive information from the MLS Map Services Provider to detect traffic situations
- RR001: Ad hoc mobile sensor network service shall provide reliable traffic jam information that relates to everyday situations
  [>certain %]
- AvR002: Ad hoc mobile sensor network service shall provide traffic jam information that relates to sudden and unusual situations that is available within 3 minutes
  [Sudden and unusual situations e.g. accidents or change of weather]

21. The taxi's navigator 'thinks' it's wise to inform Collista's mobile device about this ~45 min estimated delay.



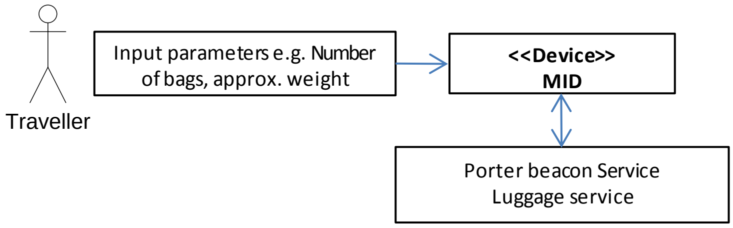
- UR002: Traveller shall be able to view alerts without problems
- AcR002: MID shall be able to accurately determine any delay
- PR001: MID shall be able to retrieve new information about delays every 30 seconds

22. Collista's device realizes that the sightseeing must be interrupted and the taxi should head to the airport. So, it sends a "new destination" (= the airport's) coordinates to the taxi's navigator, the navigator computes the shortest route and reaches the airport in time!



- FR038: MID shall be able to find quickest route
- FR039: Traveller shall be able to accept new route even if it is longer but quicker

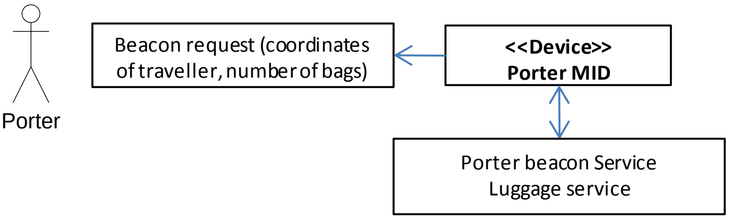
23. Collista gets off the taxi and waits for a porter to carry her 3 pieces of luggage; Her device sets a "*request luggage porter" beacon.*



Choreography C1

- FR046: MID shall recognize traveller's location and distance-time from airport based on a GPS signal
- AcR004: MID shall send a bacon message to porter's service within a range of 1km of the airport

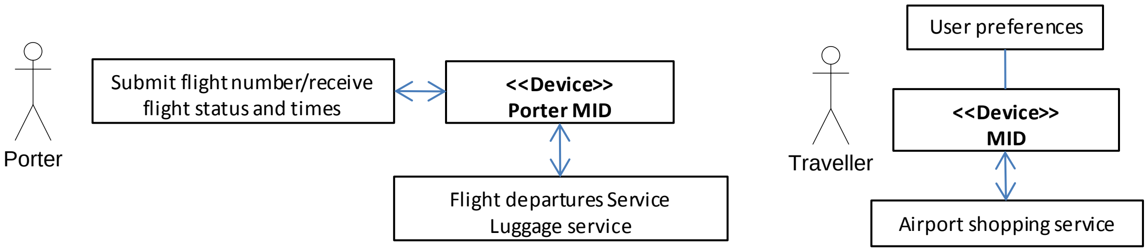
24. A nearby available porter receives the beacon request and moves to the given coordinates.



Choreography C7

- FR047: Porter's MID shall receive the beacon message from the porter beacon service
- FR048: Porter shall be able to express their availability through their MID in response to a beacon request
- FR049: Porter's MID shall receive further customer details and position data after porter availability has been sent

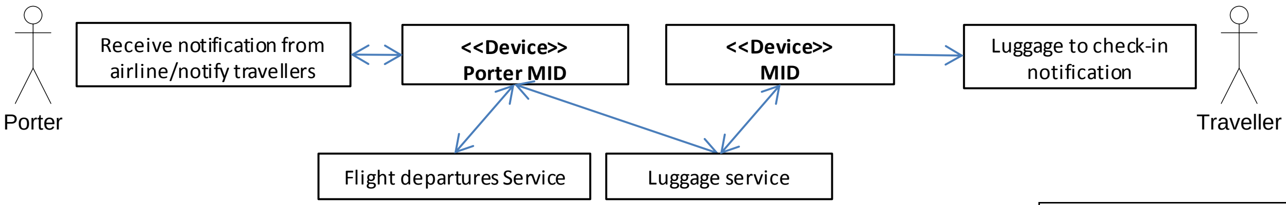
25. The porter picks up Collista's luggage and his intelligent device checks with the Departures service, in order to make sure he has enough time to pick up some more luggage too. Meanwhile, Collista has some free time to spend shopping and browsing around.



Choreography C7

- FR050: Traveller shall be able to confirm porter's beacon message for pickup and send flight details using MID
- FR051: Porter's MID shall receive transmitted data for flight details
- FR052: MID shall be able to receive data for a shop's offer in the airport based on the traveller's (customer's) profile
- FR053: MID shall able to schedule a walk to the airport's shops based on a flight time

26. Upon the airline's notification, the porter takes Collista's luggage to the check-in counter and notifies Collista's device (and others') to meet him at the airline's check-in counter.



Choreography C7

- FR054: Porter's MID shall be able to receive notification from airline company based on traveller's flight schedule
- FR055: MID shall be able to receive notification to go to check-in from porter/luggage service
- AcR005: MID shall recognize porter's MID within a 5 meter range

End: Collista is happy for spending her time efficiently and her mobile device is happier for serving its boss wisely!

3.4. Summary and analysis of requirements

In total, 75 requirements were specified during the elicitation process. The requirements specified were mainly functional, 56 of them, and these added detail and definition to the steps in the scenario. There was a good coverage across the non-functional requirements types, with 19 specified in total across 9 types. However, there were no requirements specified for the scalability, adaptability and maintainability types. In the case of scalability and adaptability, requirements in these areas are defined in deliverable D1.2. A breakdown of the requirements by type is presented in Table 3.2.

Requirement type	Number of requirements
Accuracy [AcR]	5
Adaptability [AdR]	0
Availability [AvR]	2
Awareness [AwR]	2
Functional [FR]	56
Interoperability [IR]	4
Maintainability [MR]	0
Mobility [MoR]	1
Performance [PR]	1
Reliability [RR]	1
Scalability [ScR]	0
Security [SR]	1
Usability [UR]	2
Total	**75**

Table 3.2. Number of requirements by type for the DynaRoute Use Case

3.4.1. Analysis with respect to the FI challenges and requirements

In this section, the five main FI challenges and requirements from deliverable D1.2 are analysed with respect to the requirements elicited from the scenario.

Awareness and Adaptability

Both context and self-awareness are needed in the DynaRoute scenario. For example, in step 12 the detecting of other devices is required:

AwR001: MID shall be able to detect nearby “friends”

Self-awareness is important as mobility increases, as is self healing, optimization, configuration and maintenance. It is worth noting here the lack of maintainability requirements elicited during the scenario as there will be no IT support for the actors. Self manageability will be required to support the mobility requirements in the scenario.

Monitoring and measurement is a key feature of the DynaRoute environment, in particular for traffic monitoring and awareness of tourist attractions. For example, the traveller is made aware of nearby attractions and the route is adjusted dynamically:

AwR002: MID shall be able to dynamically change route depending on nearby attractions

Fast recovery, reliability, incident detection and analysis are major requirements for DynaRoute to support the overall service provided to, and consumed by, the end users. Levels of seconds should be considered as the minimum acceptable recovery times. Many of the elicited requirements need to be supported by reliability and recovery. An obvious example in this scenario is the notification of flight status from the airline, which is a key requirement for the passenger to reach their main goal to fly home:

FR041: Airline service shall send flight status notifications to passengers

For adaptability, we can use the example of the context-aware adaptive itinerary. This choreography adapts to different circumstances and interacts with all of the other choreographies. For example, in step 8 the itinerary is re-evaluated based on the notification of the flight delay. The ability to adapt to new circumstances is needed and reflected in requirements such as:

FR042: MID shall have the ability to evaluate the importance of information and notify the traveller accordingly

FR021: MID shall be able to inform navigator about changed coordinates

Interoperability

A number of different devices will need to be supported, as reflected in the system-wide requirement:

IR001: MID shall be able to transmit data to different devices/services/servers

This requirement applies across the whole scenario and supports interactions between travellers, friends, porters etc. via their devices. An example implementation of this requirement is:

IR002: MID shall be able to transmit destination details to taxi navigation device (wireless, bluetooth)

Dynamic content integration is an important consideration, particularly concerning multiple data views in the information exchange between taxis and through information transmitted by the airline, for example:

IR003: Navigator shall be able to accept navigation details sent by MID

IR004: MID shall be able to receive and decode the information transmitted from the airline service

DynaRoute relies upon dynamic service composition in all of the choreographies. For example, the following requirement captured in step 26 associated with the context-aware personalized airport ground service (NB recorded as a functional requirement):

FR055: MID shall be able to receive notification to go to check-in from porter/luggage service

Overall, many of the user requirements across all 7 choreographies depend on the system-wide interoperability requirements.

Mobility

The nature of the DynaRoute scenario is one of mobility and features strongly in the choreographies. For example, native support/integration of mobility is required for the ad hoc mobile sensor network service in step 20:

MoR001: MID shall receive information from the MLS Map Services Provider to detect traffic situations

This requirement also depends on routing efficiency, stability and robustness – captured in the reliability requirement:

RR001: Ad hoc mobile sensor network service shall provide reliable traffic jam information that relates to everyday situations [>certain percentage]

Finally, it is important to consider the resource demands of mobile devices, in particular battery power. For the traveller, the scenario presented may cause issues regarding battery life which supports the vast majority of the user requirements.

Scalability

Scalability can be viewed from a number of dimensions – the number, size and quality of networked entities; storage (scale and size of content and sensors' data); discovery (search and retrieval); streaming data, addressing and naming. However, no specific scalability requirements were elicited from the scenario walkthrough. This may be because users have the tendency to express requirements from their own perspective and do not consider the scale involved with other users, devices, services etc.

For the number and size of networked entities, an example where this requirement is appropriate is in step 7 where the airline notifies all of the passengers of the delay. The following requirement depends on the message scaling to all passengers concerned:

FR041: Airline service shall send flight status notifications to passengers

Storage is not expected to be an issue and is not a focus of CHOReOS. The elicited requirements seem to assume that devices will be able to store the size of data required, for example the user profile:

FR035: MID shall be able to filter attractions depending on a user profile

Discovery is a challenge, as demonstrated in the example of matching friends with different itineraries and geographical areas in the context-aware social network. For example, the following requirement needs to be scalable across many users:

FR025: MID shall be able to upload the location and its user identifier

The biggest streaming challenge for DynaRoute is in step 19 where the monument transmits tours to different tourists with different needs, e.g. quality of service for device:

FR032: MID shall be able to receive information for specific attraction

Addressing and naming of devices assumes IPv6 and is expected to suffice for the case study. No particular requirements from the scenario walkthrough relate to this aspect of scalability.

4. Choreographies description

In this section we describe the choreographies designed for the DynaRoute scenario. These choreographies are the natural outcome of the interaction of services that happen during the various steps of the scenario. We proceed to formalize the communication between business participants and coordinate their interactions based on the exchange of information between them by introducing novel BPMN diagrams for each choreography.

To better understand the diagrams presented below we give a brief overview of the BPMN elements that we use in our choreographies:

- Flow objects: objects that interrupt the sequence flow and may lead to divergence/convergence.
- Connecting objects: objects that represent different types of associations between flow objects/data etc.

In order to implement the choreographies in the DynaRoute scenario we used MagicDraw Enterprise edition 17.0 modeling suite. Many tools and plugins are featured in this edition that aid the business modeler to leverage on the benefits of the UML and BPMN standards so as to design, create and test BPMN diagrams.

4.1. Choreography C1 - Adaptive itinerary

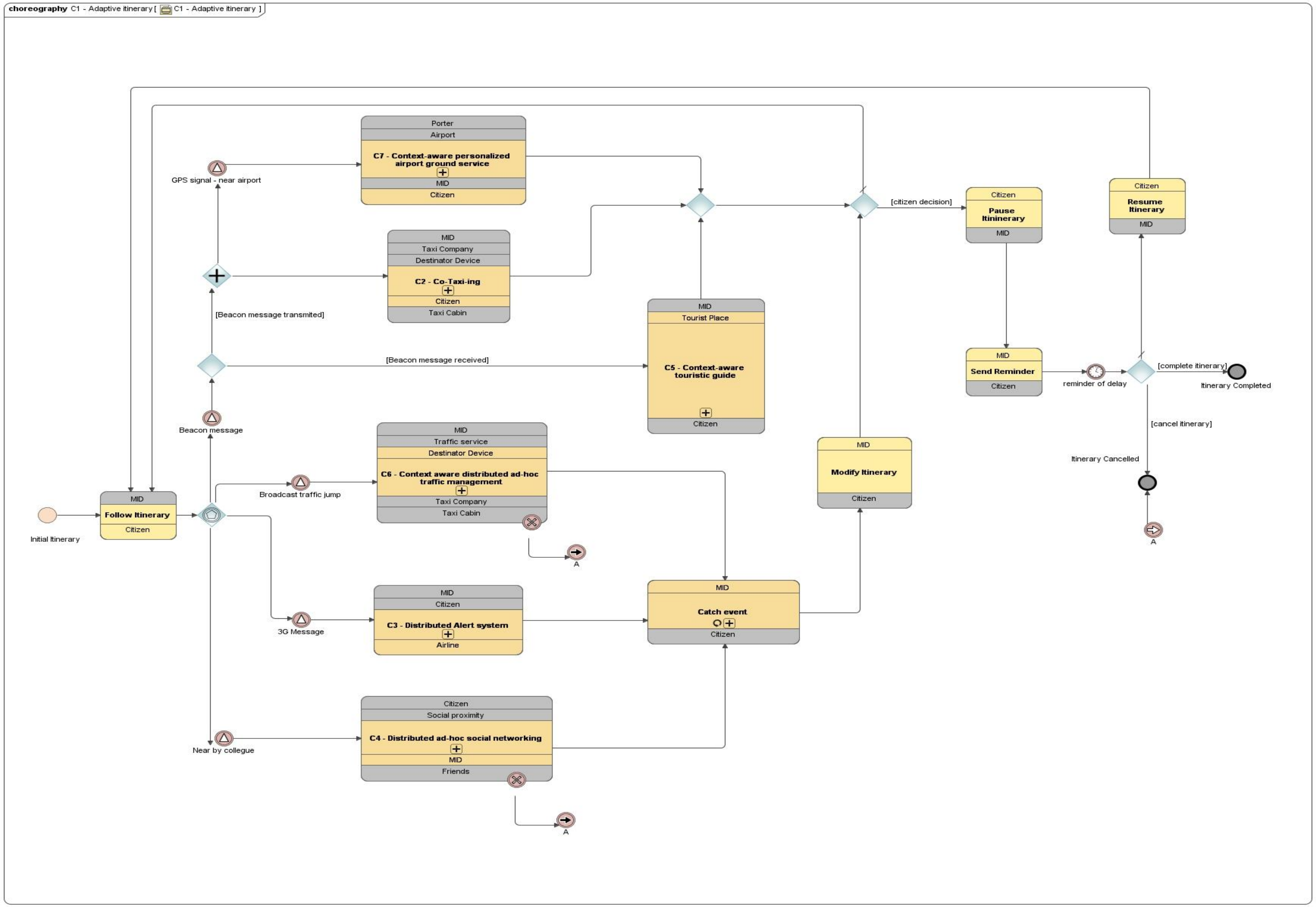


Figure 4.1. BPMN diagram of the Adaptive itinerary choreography

The Adaptive itinerary choreography (C1) is the central choreography in our scenario and is responsible for guiding Collista through her day schedule. As seen in Figure 4.1, Collista starts with an initial itinerary and then instructs MID to follow it. Based on incoming events we may need to pause or modify the itinerary. In the first case, Collista is the one who instructs her MID to pause the itinerary whereas in the latter, the MID decides to change the itinerary based on the incoming events it receives. If none of these happens, then the itinerary completes with success. However, when the itinerary is in pause mode, a reminder is sent in appropriate time from the MID to Collista in order to remind her to resume her itinerary. In this point it is up to Collista to resume and follow the itinerary or to cancel it altogether.

4.2. Choreography C2 - Co-Taxi-ing

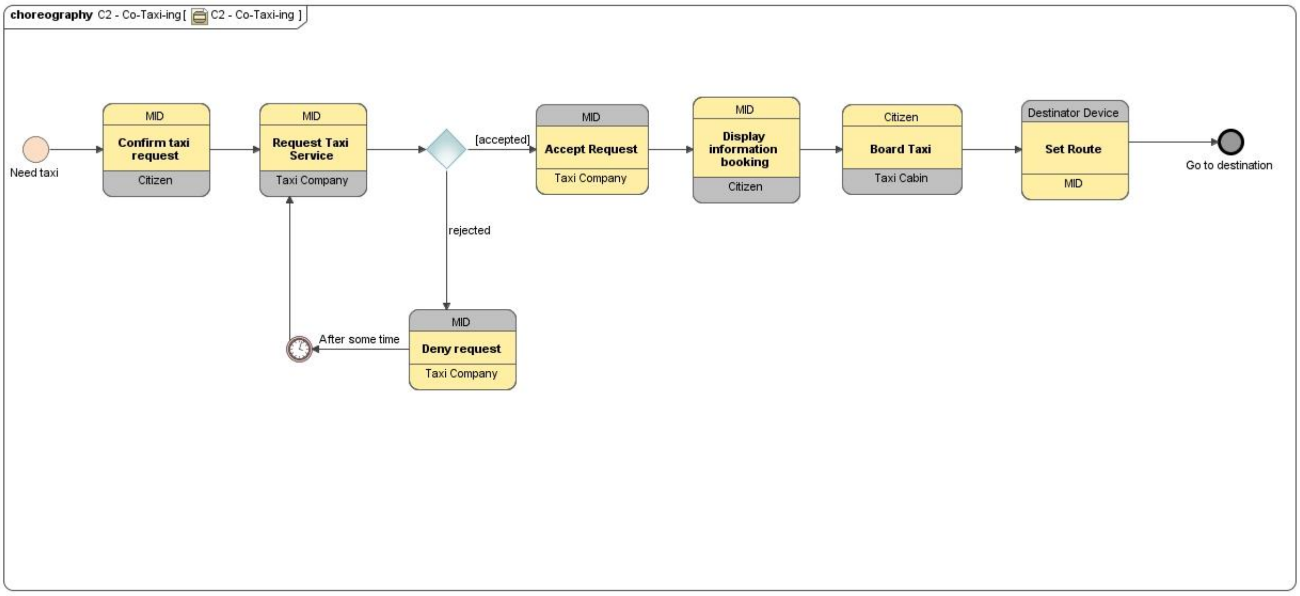


Figure 4.2. BPMN diagram of the Co-Taxi-ing choreography

The Co-Taxi-ing choreography (C2) in Figure 4.2 begins when Citizen exits the hotel and waits for a taxi. The MID sends a notification to Citizen to confirm the taxi request and after successful validation, it proceeds to send a request for a taxi to the taxi company. In this point we have two possible outcomes coming from the taxi company (expressed with a gateway exclusive object) : the taxi company either denies or accepts this request. In case of denial, the Citizen re-tries to issue the request after a specific period of time. In our case, Citizen's request is accepted and MID proceeds to display to Citizen all the information regarding the taxi booking (should be reservation not booking). Thus, when the taxi arrives Citizen boards it and her MID pairs with taxi's GPS device. The Destination Service which runs on the GPS device of the Taxi calculate the route based on data which it received from Citizen's MID and sets the route.

4.3. Choreography C3 - Distributed Alert system

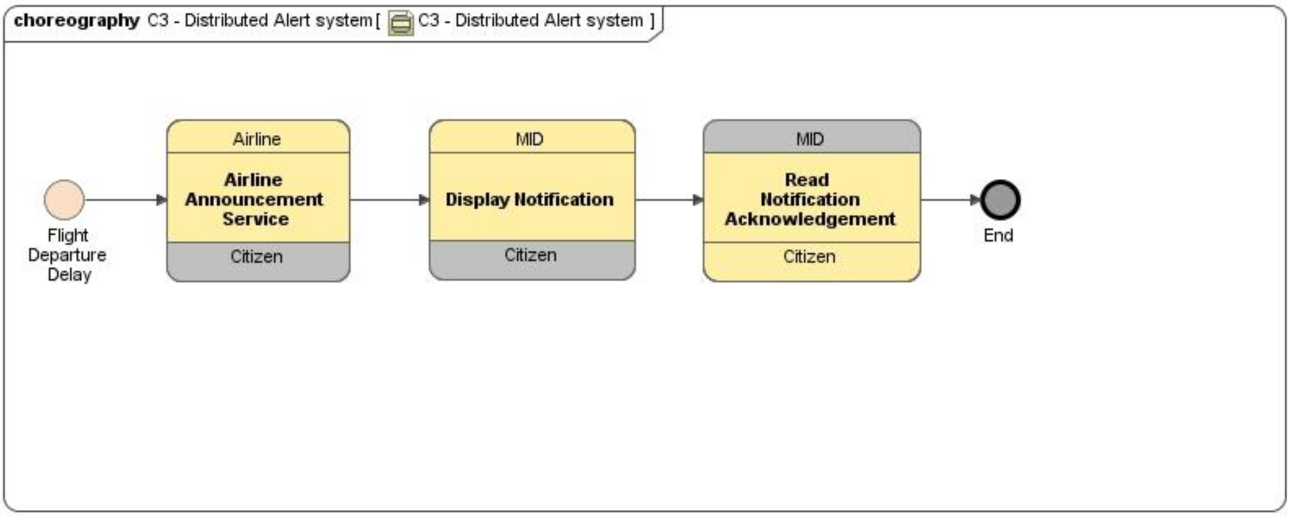


Figure 4.3. BPMN diagram of the Distributed Alert system choreography

The Distributed Alert system choreography (C3) represents the interaction between the flight company and its respective clients. As shows in Figure 4.3, this choreography starts by using the Airline Announcement Service to notify about a delay in Citizen's flight. MID receives this announcement and proceeds to display it to Citizen which reads and acknowledges this notification. Obviously, this announcement is sent to the respective services of all the interested parties in the flight (passengers, pilots etc.)

4.4. Choreography C4 - Distributed ad-hoc social networking

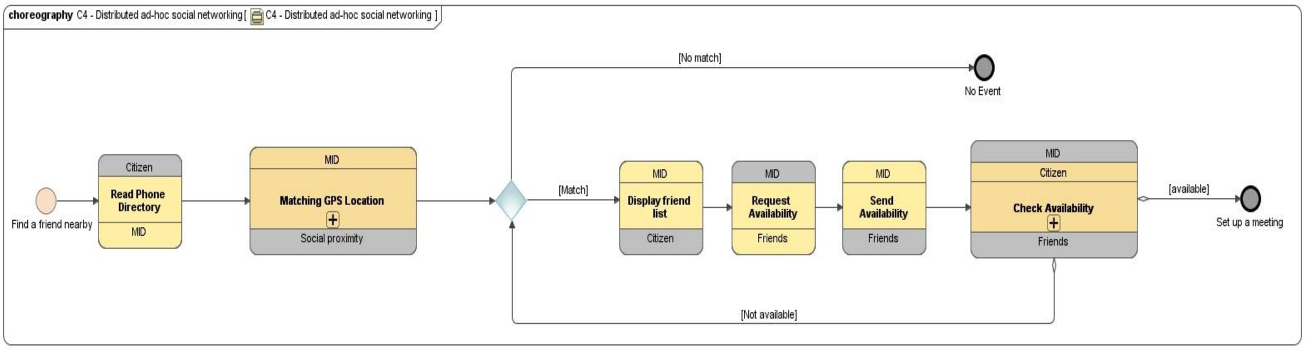


Figure 4.4. BPMN diagram of the Distributed ad-hoc social networking choreography

The Distributed ad-hoc social networking choreography (C4) in Figure 4.4 aims to create social interactions between people that know each other. In the beginning, MID reads Valeria's phone directory (who is Collista's boss) and then continues to match the GPS position of all contacts by using the social proximity service. If the contacts' GPS location cannot be matched effectively with Valeria's GPS position, then no event is created. However, in case contacts are found nearby, then the MID displays this list of contacts to Valeria. She proceeds to send a request availability notification to Collista that happens to be nearby and Collista acknowledges it and responds positively with a message to set up a meeting.

4.5. Choreography C5 - Context-aware touristic guide

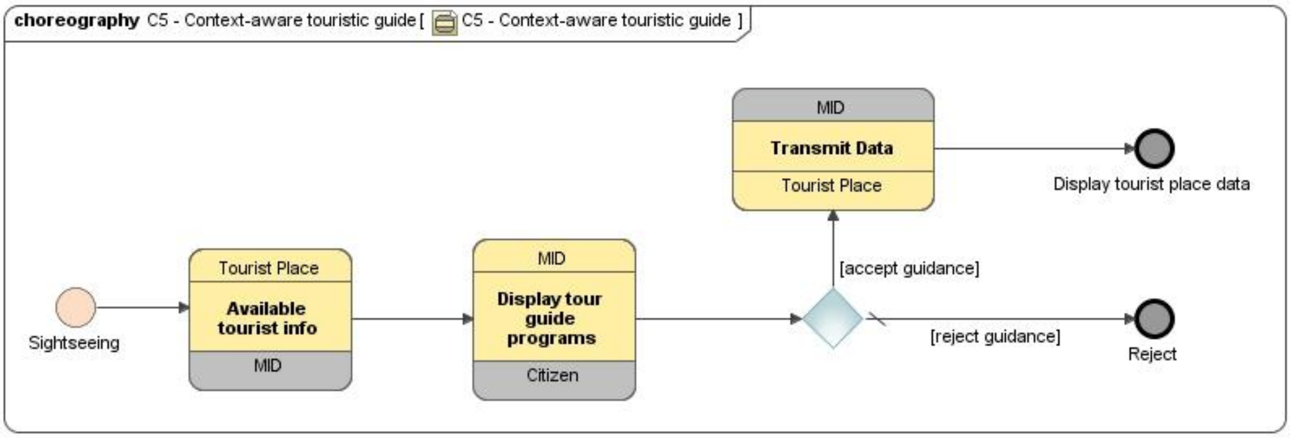


Figure 4.5. BPMN diagram of the Context-aware touristic guide choreography

The Context-aware touristic guide choreography (C5) represents the interaction between a tourist place and nearby tourists. As seen in Figure 4.5, the tourist place that is a monument sends a tourist information notification to the MID of available nearby tourists. The MID proceeds to notify our tourist, Collista, about the tour guide programs that this monument provides. In any case the tourist can reject this notification, but Collista accepts it by responding that is a mobile user and needs only mobile description so the tourist place starts to transmit the respective data to her MID.

4.6. Choreography C6 - Context aware distributed ad-hoc traffic management

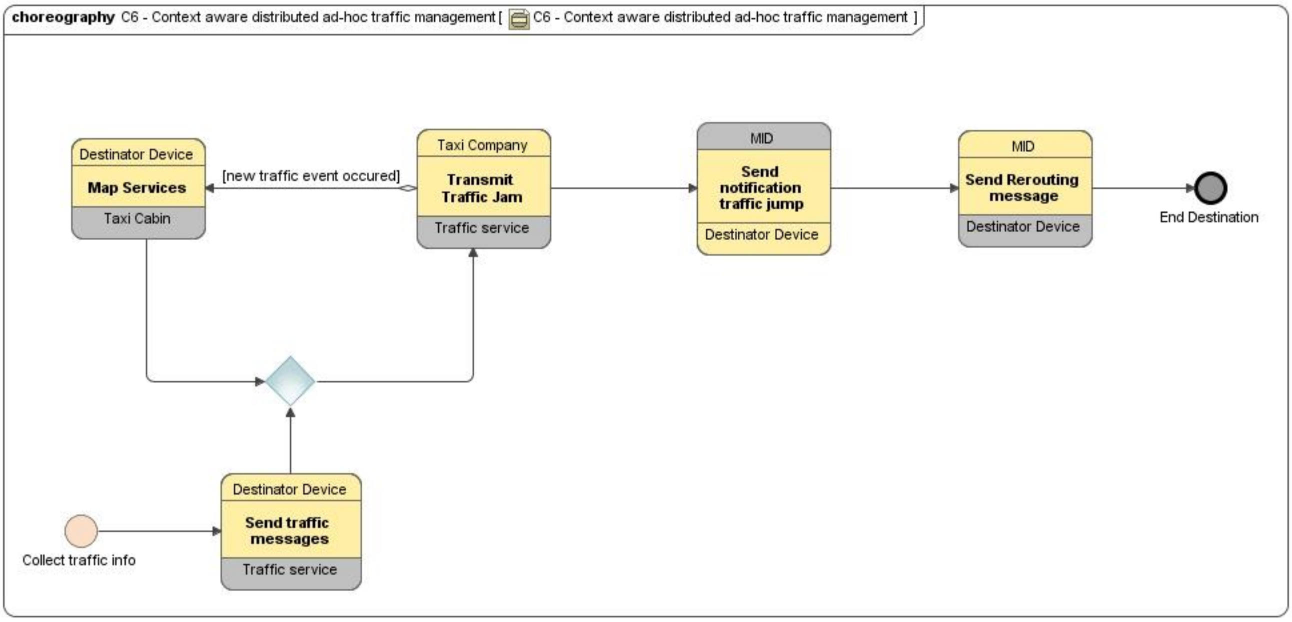


Figure 4.6. BPMN diagram of the Context-aware touristic guide choreography

The Context-aware distributed ad-hoc traffic management choreography (C6) collects traffic info and decides/announces information about traffic jams (Figure 4.6). In this choreography, each taxi sends traffic messages to the traffic detection service. This service uses both the incoming messages and the Map services to decide about an impeding traffic jam in the area. When such a traffic jam is detected, respective messages are announced to all taxis that are close to this area. As soon as the taxi receives such a notification, it forwards it to MID which then decides to send a rerouting message back to the GPS device.

4.7. Choreography C7 - Context-aware personalized airport ground service

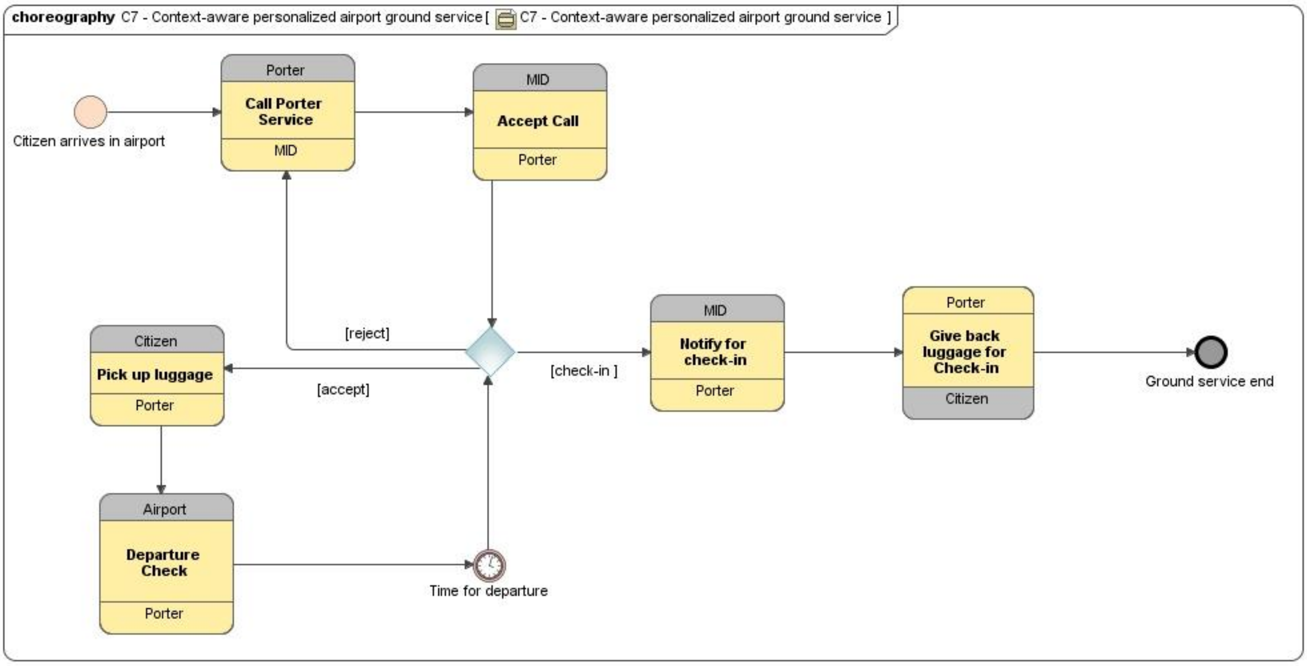


Figure 4.7. BPMN diagram of the Context-aware touristic guide choreography

The Context-aware personalized airport ground choreography (C7) begins when Citizen arrives at the airport (Figure 4.7). She proceeds to call for a porter by using the porter service through her MID. If an available porter exists he responds to Citizen's MID with a positive notification and continues to pick up Citizen's luggage. At that point, a timer is set which expires when the flight's check-in opens. When that happens the porter sends a notification to Citizen's MID that the check-in counter is open and proceeds to meet Citizen there and return her luggage.

5. Assessment specifications

5.1. Introduction

In this use case we will develop an application in two levels for scalability reasons. The first one consists of the lab version, where all services, actors and choreographies will take part. The other level is a pilot version where we determine specific actors, services and choreographies that will interact with each other. It is considered necessary to clarify a testing and evaluation methodology for both versions of the DynaRoute application that will be under a common format. According to the analysis of the requirements, we are able to identify that the evaluation methodology will cover qualitative and quantitative evaluation for both functional and non-functional characteristics

Generally, the services of the end application will be based on the following fields:

- Restful web services
  - Mobile Services
  - Local Base Services using GPS data (LBS)
- WS* services
  - User Profile Services
  - Map Services
  - Social Services

According to DoW and based on the use case of DynaRoute, the end application will be collaborative software, among components, middleware, actors, services and choreographies. In order to manage the complexity of the use case, we should put forward these rules and principles of evaluation to ensure the quality of the final services.

Due to the volume of information that we are able to manage among different users, services and devices that are involved in the flow of the use case should be invoked in the Ishikawa Diagram as seen in Figure 5.1, better known as a cause - effect diagram. It is a useful tool to be used for the evaluation methodology of the application on MID.

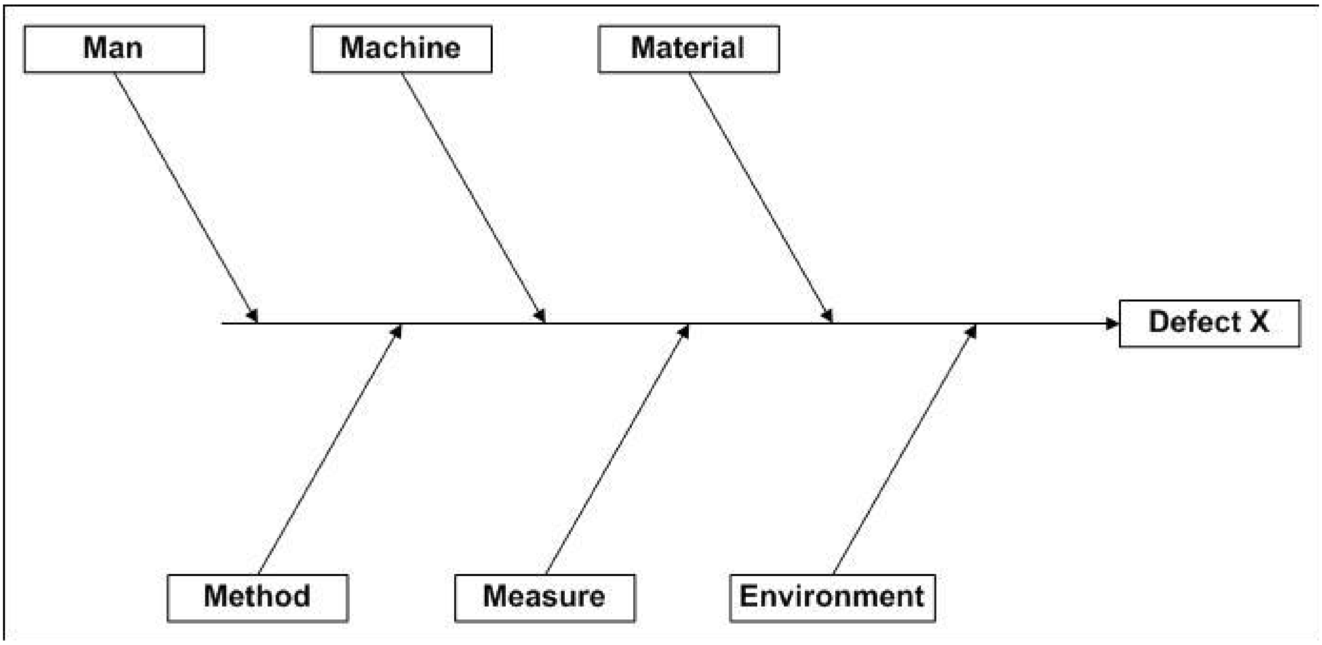


Figure 5.1. Ishikawa Diagram (6-M)

The above chart is based on the 6-M method (Man, Machine, Material, Method, Measure, Mother, Nature (Environment)). For each category we should define the relevant parameters and sub-parameters.

The main sections to which we will apply the methods of evaluation as they arise from requirement analysis are the following:

- Communication efficiency
- Filtering and validation transmitted information based in user profile
- Routing models for GPS device
- Stability and reliability of application
- Assessment of methods that used for the communication level between actors and MID
- Interoperability between devices and software components
- User Feedback

5.2. Quality Control of use case

Software reliability evaluations can be conducted at many stages during the design and development process. The ultimate goal should be to meet the targets set. But what is generally accepted is that the monitoring and evaluation of applications must be fulfilled before the end of development and certainly before making them available to end users.

Checking the proper functioning of the subsystems and ultimately of the entire application is not an independent, single stage, but follows each stage of the application development. So, this is a retrospective production evaluation method (recursive formative) through which various aspects of development, such as specifications, documentation, general issues of source code infrastructure (Technical Inspection) and, most importantly, an initial assessment of the usability and efficiency of the application, are examined.

Upon the completion of the application’s subsystems, a general, large scale summative evaluation will take place in order to ensure that possible errors and defects that were detected during the production evaluation and testing have been corrected.

The aforementioned approach for monitoring and evaluating has three important advantages:

- relieves designers from future problems and generally from undesirable situations which arise when tests take place only after the implementation phase,
- contributes significantly in improving the design and development procedures,
- all results of the evaluation can be used easily for possible future upgrades, targeting to the optimization of the final release.

As a result, the final evaluation of the application and its subsystems will operate mainly corroboratively (i.e. that all deficiencies will have been corrected), ensuring this way that no significant changes able to affect the cost and schedule of the project will take place.

5.3. Usability evaluation

Usability is a measure of interface quality that refers to the effectiveness, efficiency and satisfaction of users while performing tasks with a tool. Evaluating usability is now considered an essential part of the system development process and a variety of methods have been developed to support the human factors as professionally as possible in this field.

There is a variety of approaches to usability evaluation that one may choose to make use of. The methodologies can be divided into two broad categories: those that gather data from actual users and those that can be applied without the presence of actual users.

The selection of the appropriate method depends on:

- Evaluation Cost
- Appropriateness to project
- Time constraints
- Implementation cost
- Cost of training new users

Usability evaluations can be conducted at many stages during and after the design and development process. When selecting a method, it is important to calculate the cost not only in terms of time and materials involved, but also in terms of the impact on the end-users, especially considering the cost of losing return visitors to a website due to unusable design.

Historically, the concept of usability has been defined in multiple ways, most often on one of the following bases:

- Semantics: in this case usability is equated to terms such as 'ease of use' or 'user-friendliness', without formal definition of the properties of the construct.
- Features: here, usability is equated to the presence or absence of certain features in the user interface such as Windows, Icons, Menus or Pointing devices.
- Operations: where the term is defined in terms of performance and affective levels manifest by users for certain task and environmental scenarios.

The following diagram (Figure 5.2) shows the four types of tests required to evaluate the usability of the application and its subsystems. The tests are conducted at many stages of development contributing, this way, in a productive evaluation.

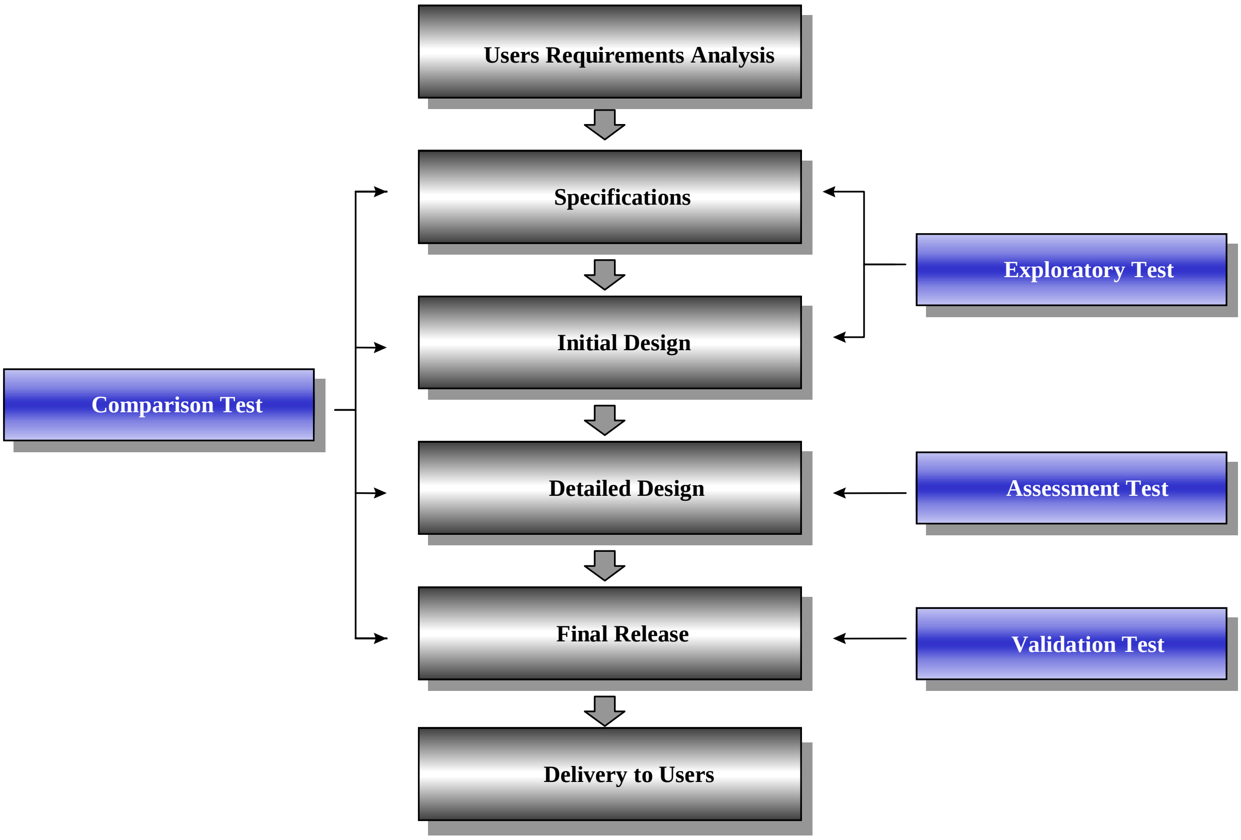


Figure 5.2. Detail plan of testing for development circle of life.

In accordance with the Directive 90/270/EEC of the EU, among others, are referred the specific requirements related to human-computer machine interaction. The software must allow easy handling operations, must be versatile and adaptable and focused to the user (user oriented).

These requirements are compatible with ISO 9241 (1994).

5.4. Exploratory Test

Exploratory test will take place at an early stage of the development of the environment of the platform, provided that it has been completed during the analysis of requirements. The exploratory test still requires the existence of a prototype which will perform the essential functions of the final system.
The objective of this test is to answer the following questions:

- What do users think about the application environment in general and also, every time they use it?
- Have the users ever used in the past a similar application environment?
- What further information should be given to the users in order to use the environment?
- Are all application's services/functions well understood without the need of further assistance? If not record the ones that are not.
- How easily can the application be used both by novice and experienced users?

Provided that the application environment will be completed at an advanced stage during the test the user will be asked to accomplish a first use (walk through) or a general overview (review). It should be noted, however, that the exploratory test is rather intuitive and has the main purpose of assessing the propriety (sounding) of the application rather than checking its individual characteristics.

These tests are characterized by the close cooperation between users and auditors. Since the most essential results are intuitive, an exploration of the mindset of users is essential. For this reason, the user is encouraged to "think aloud" during the audit or discuss with another user who also performs the same process. He is also encouraged to submit ideas and suggestions.

5.5. Assessment Test

The objective of the assessment test is to apply tests for a number of criteria and characteristics in the design level. For example checking the time management for each step of the use case in conjunction with the number of errors or mismatching of the application. Under this level of testing we will set the criteria for the next levels of testing as demonstrated in Figure 5.2.

The table 5.1 below contains a summary of the evaluation criteria of the units developed under this project with all the critical parameters / metrics. It should be noted that although these indicators are mostly qualitative rather than quantitative, they relatively easy to be estimated.

Evaluation Criteria	Critical parameters (indicators)
Degree of Interaction	Number of motivating the user side of the system.
Degree of Personalization	Ratio of number of different messages that the system allows to the number of different messages that can be sent by the user to the system
Rating Initiatives Taken	Number of possible initiatives
Rating Balance System	Time management for all processes in application and stability in communication between them. Time response under a specific rate e.g. 3''
Degree of Autonomy Implementation	Is the user able to understand all the messages from the application?
Degree of Creativity Application	Backed by the subunits of the system implementation Displaying hints during the tour (if yes, does it help the user to perform the correct action)

Table 5.1. Evaluation criteria

5.6. Validation Test

The validation testing scope is to validate and ensure the confidentiality of the end software application, which will interact with other applications and devices using the Choreos platform. In this level of testing, which will be applied in the end of development of pilot or lab version of application, we expect to measure the software quality in terms of the number of defects found in the software, the number of tests that we have run as well as the number of tests covered by the system itself. Validation tests will be run for both functional and non-functional attributes of the use case. Testers will check all parts of the application in the use case for connectivity in order to collect qualitative characteristics. As a matter of fact, we propose a distinct approach to perform this test in the following points:

1) Component Testing

   At this level we will control the parts of the application as classes, objects, modules that compose it. The aim of the tests that will be carried out in this testing type is to search for defects in the application. Moreover, the goal of the unit testing is also to isolate each part of the program and prove that the individual parts are correct. Additionally, this method, it is considered to be the appropriate control method of testing for Java language which is used for the development of application.

2) Integration Testing

   The scope of the integration testing is to verify functional performance and reliability of requirements also through this testing verified the development process. It is an important part of the validation model, where the interaction between the different interfaces of the components is tested. Under this testing we aim to collect quantitative characteristics as far as time effect in communication between the parts of system is concerned.

During integration testing it is crucial to create tests plans and produce test cases and test data based on those plans. The integration test cases specifically focus on the data flow, as well as the information and control from one component to the other. Integration test cases should typically focus on scenarios where one component is being called from another, please note that at this point the modelling of choreographies plays its role. Also the overall application functionality should be tested to make sure that the application works when different components are brought together. The integration testing is a continuous process due to the fact that when errors and bug are fixed it is obligatory to run the integration testing again.

3) System Testing

Upon completion of integration testing, system testing is started. System testing, also known as functional and system testing is carried out when the entire software system is ready. The scope of this testing is to validate an application's accuracy and completeness in performing the functions as they were initially designed. Another objective of this testing is to check the behaviour of the whole system as defined by the scope of the project. Moreover, the main concern of system testing is to test the system along with the specified requirements. While carrying it out, the tester is not concerned with the internals of the system, but only checks if the system behaves as expected.

This method of testing will be applied in the pilot version of the application because it is more appropriate for real life scenarios. Also during system testing, various other testing such as checking the software and hardware specification of the use case application can be applied. For example:

- Usability testing, the scope of this testing is to measure the efficiency, accuracy, recall and emotional response from end users of application. The results from these tests will be the baseline and a control type of measurement for the next versions of pilot application.
- Compatibility testing between devices - hardware and software level - from different manufactures. This test can measure the loyalty to communication protocols and also the interoperability of system in general.
- Performance testing can measure the qualitative characteristics as they derive from the requirements section and user questionnaires or other technical metrics.
- Security testing in order to measure the ability of protection of data that are transmitted among devices in the use case. Furthermore, through this testing we are able to apply metrics for functional and non-functional characteristics such as authorization, availability, authentication, integrity, confidentiality and non-repudiation of application.
- Scalability testing is essential in this application because of the increased number of users and services that take part in the use case.
- Reliability testing in order to discover potential problems that are caused due to the design of the application. it is undeniable that the application on MID will be a very complex system, so as a result reliability tests should be applied at several levels.

5.7. Comparison Test

Comparison Test can be applied at every stage of development. In early stages different development methodologies can be contrasted, while in the middle of development phase we have the ability to measure the effectiveness of different components of the application. With this methodology we also have the possibility to measure the strengths and weaknesses of an application along with other similar characteristics from different applications, probably from other use cases. Another approach of the comparison test methodology is checking similar services between different choreographies and measure the effectiveness and reliability based on the end users opinion. Last but not least, this test will be useful for the exploitation plan of Choreos platform and will also help to decide on the development of next generation of applications based on Choreos.

6. Glossary

Elicitation	"The discovery, gathering, or 'capture' of requirements, often by developing scenarios."
Functional requirement	Functional requirements define what the system must do in terms of the interaction between the machine and the problem domain, behaviours, functions and services to be provided. Functional requirements are either met or not met by the future system: they cannot be partially met.
Non-functional requirement	Non-functional requirements restrict the types of machine solution (i.e. system) which should be developed. Examples of non-functional requirements are those which relate to maintainability, reliability and usability. A more complete list of non-functional requirement types is given below. Unlike functional requirements, non-functional requirements focus on a whole system rather than its parts, and may not be formalisable.
Requirement	Requirements have variously been defined and described, for example: A requirement is "something that a product must do or a quality that the product must have". (Robertson & Robertson, 1999); Requirements are expressions of required phenomena that are shared between a machine (product) and the domain or environment (Jackson, 1995); "Requirements invariably contain a mixture of problem information, statements of system behaviour and properties, and design and implementation constraints" (Sommerville & Sawyer, 1997)

Requirement type	The CHOReOS use cases use the following requirement types: Functional requirements (FR) Non-functional requirements, including: Accuracy requirements (AcR); Adaptability requirements (AdR); Availability requirements (AvR); Awareness requirements (AwR); Interoperability requirements (IR); Maintainability requirements (MR); Mobility requirements (MoR); Organisational requirements (OR); Performance requirements (PR); Reliability requirements (RR); Scalability requirements (ScR); Security requirements (SR); Usability requirements (UR);
Scenario	An instance of a use case, expressed as a sequence of event . Holbatz describes a scenario as a "sequence of steps that defines a task performed to achieve an intent" (Alexander & Maiden, 2004)
Stakeholder	Someone with an interest in the future system who might have requirements on the system.
Step	"An action or event representing an atomic component of a scenario. In a use case, each step is normally described in a separate paragraph of text; in a storyboard, an image." (Alexander & Maiden, 2004)
Storyboard	"A sequence of diagrams or other images that narrates a scenario. Each such image or frame represents a step." (Alexander & Maiden, 2004)
Walkthrough	"A meeting in which stakeholders step through scenarios to discover errors, omissions, exceptions, and requirements. Often run as a facilitated workshop." (Alexander & Maiden, 2004)

7. References

[1] Choreos Project Team, D1.2 “Choreos perspective on the Future Internet and Initial Conceptual Model”, April 2011

[2] Population and living conditions in Urban Audit cities, larger urban zone (LUZ), Total population in Urban Audit cities,

http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00080&plugin=1

[3] Alexander I. & Maiden N.A.M., 2004, ‘Scenarios, Stories and Use Cases’, John Wiley

[4] Jackson M., 1995, ‘Software requirements and specifications’, ACM Press/Addison-Wesley

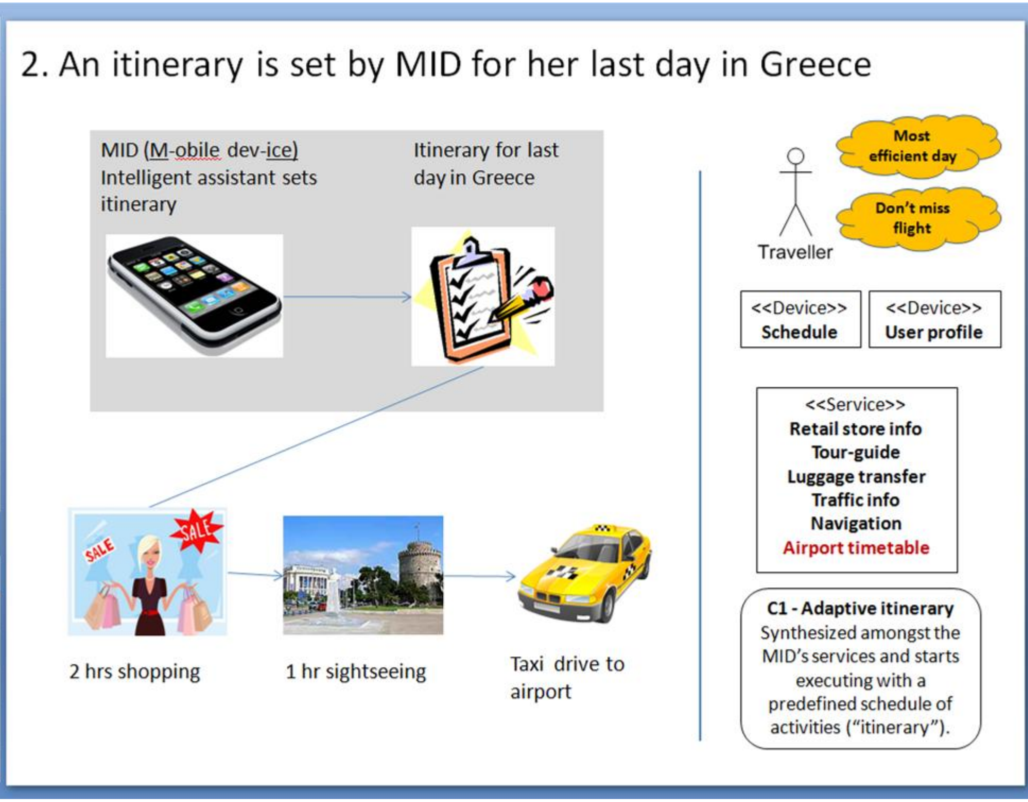
[5] Robertson S. & Robertson J., 1999, ‘Mastering the Requirements Process’, Addison-Wesley-Longman

[6] Sommerville I. & Sawyer P., 1997, ‘Requirements Engineering: A Good Practice Guide’, John Wiley

Annex A - Storyboard

Requirement	Rationale	Type	Owner
MID shall be able to arrange web-check-in as well as anything that is related to the check-in process		FR	
Data shall be encrypted to not reveal customer details		Privacy	

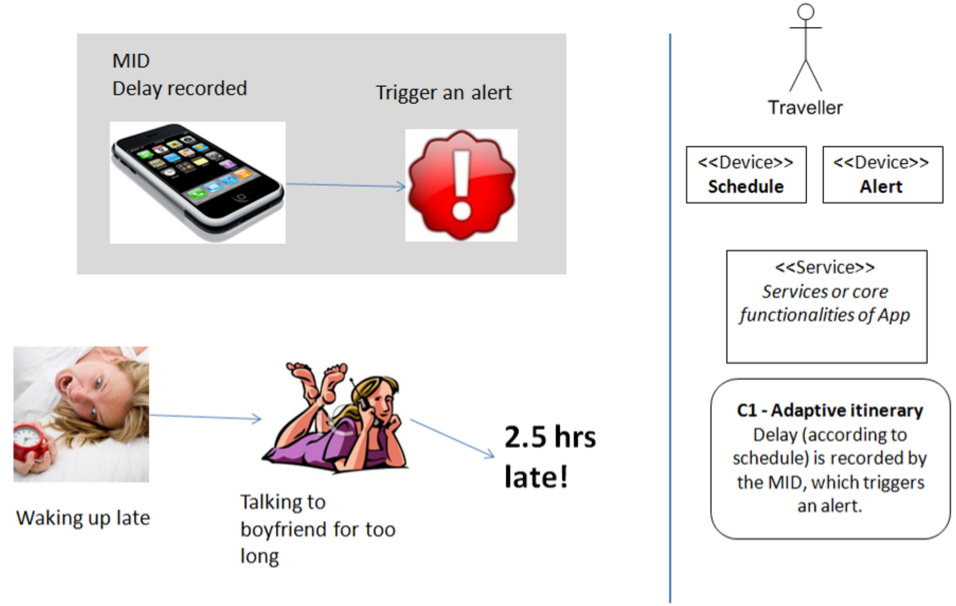
Assumptions (for the actions in this storyboard pane to happen)



Requirement	Rationale	Type	Owner
Alerts shall be voice and vibration		FR	

Assumptions (for the actions in this storyboard pane to happen)

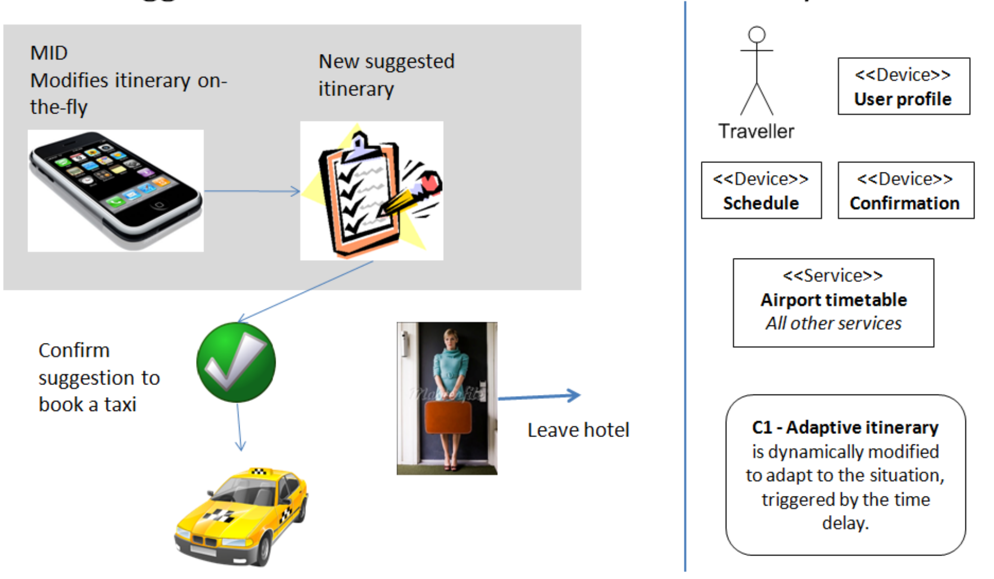
3. After getting up late she is ready to leave her hotel, 2.5 hrs behind schedule!



Requirement	Rationale	Type	Owner
Consumer shall be able to arrange beforehand when taxi shall come		FR	
taxi company shall be able to receive a confirmation couple hours before from MID		FR	
Consumer shall be able to request higher prioritization regarding calls or arrangements made using MID		FR	
Consumer shall be able to subscribe to VIP taxi subscriptions to enhance prioritization		FR	
MID shall be able to receive weather forecasts		FR	
MID shall be able to transmit data to different devices/services/servers		Interoperability	
Consumer information shall be encrypted		privacy	

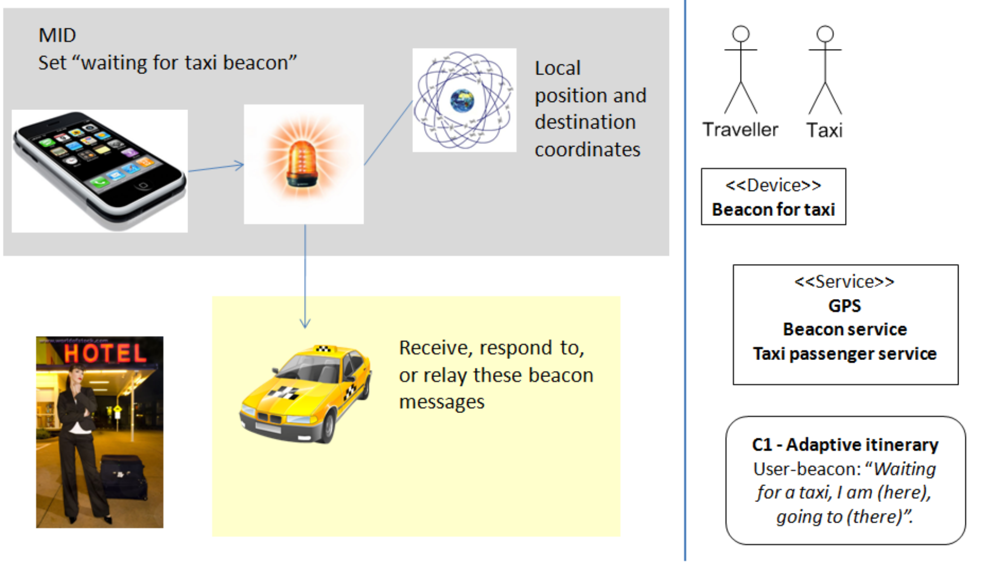
Assumptions (for the actions in this storyboard pane to happen)
Taxi company do not accept reservation less than 1 hour

4. MID modifies on-the-fly her itinerary and instructs her to skip shopping and sightseeing and ask for a taxi; she confirms MID's suggestion and leaves the hotel immediately.



Requirement	Rationale	Type	Owner
MID shall be able to transmit customer details to the taxi company			
MID shall be able to transmit location coordinates to taxi company			
Navigator shall be able to show the coordinates graphically			
MID shall be able to display taxi number that will pick up customer			
Consumer shall be able to know how long it will take			
Consumer shall be able to choose type of car, big boot, aircondition, etc			
Consumer shall be able to request a taxi driver who speaks English			
Consumer shall be able to request a taxi with green card			
Receive alert with regards to how long it will take for the taxi to arrive			
Traveller shall be able to accurately receive the position of the taxi (30m)		accuracy	
MID shall be able to allow consumer to change the pickup location and position and inform the taxi company of the changed location			

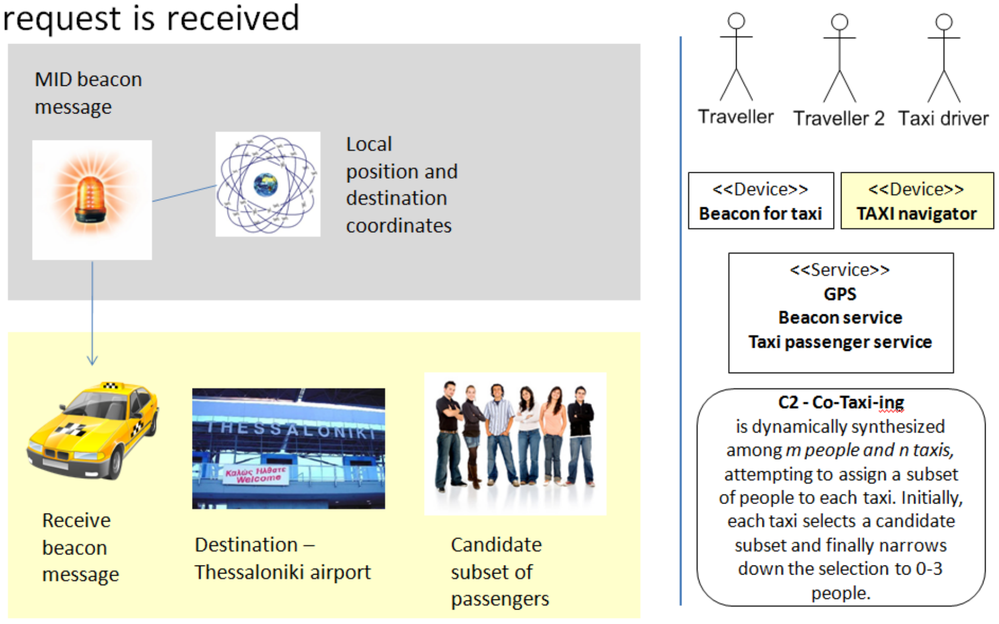
5. Citizen waits for a taxi by the street, outside the hotel. MID sets on a "*waiting for taxi" beacon* transmitting locally its position and the desired destination coordinates.



Requirement	Rationale	Type	Owner
MID shall be able to inform customer just before taxi arrives			
Taxi driver shall be able to recognize customer, not only optical recognition			
Taxi company shall be able to send another taxy in case of problems with original taxi -> MID receives new details			

Assumptions (for the actions in this storyboard pane to happen)
Only one set of customer(s) for every taxi - cannot take another customers apart from the one who called (currently in Greece)

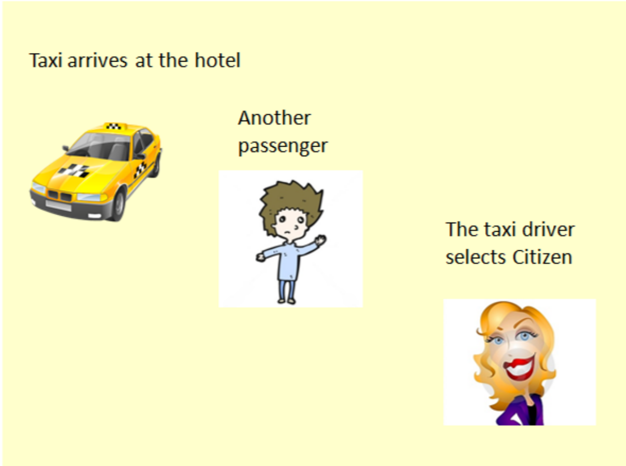
6. Nearby taxi receives beacon message and requested destination is on its way. Also, one more compatible beacon request is received

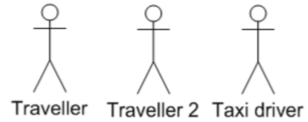


Requirement	Rationale	Type	Owner
This event cannot occur - cannot take another customers apart from the one who called			

Assumptions (for the actions in this storyboard pane to happen)

7. The taxi driver reaches the place where Citizen is waiting together with a man. The driver selects Citizen to serve.





<<Device>>
Taxi navigator

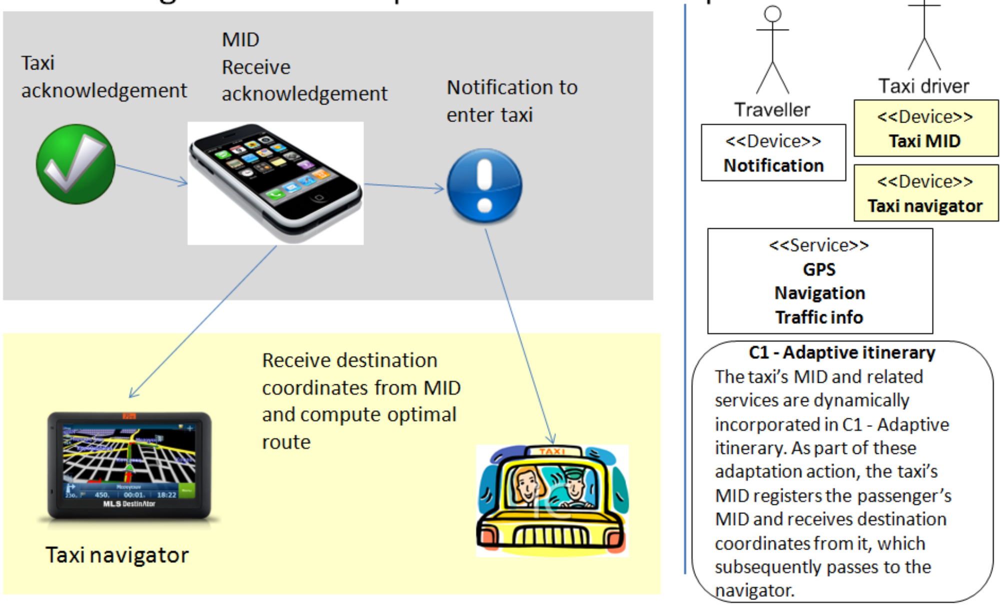
<<Service>>
GPS
Beacon service
Taxi passenger service

C2 - Co-Taxi-ing is dynamically synthesized among *m people and n taxis,* attempting to assign a subset of people to each taxi. Initially, each taxi selects a candidate subset and finally narrows down the selection to 0-3 people.

Requirement	Rationale	Type	Owner
MID shall be able to transmit destination details to taxi navigation device (wireless, Bluetooth)			
Taxi shall be able to accept navigation details sent by MID			

Assumptions (for the actions in this storyboard pane to happen)
Greece: taxi company cannot send navigation information to taxi driver on his navigation device

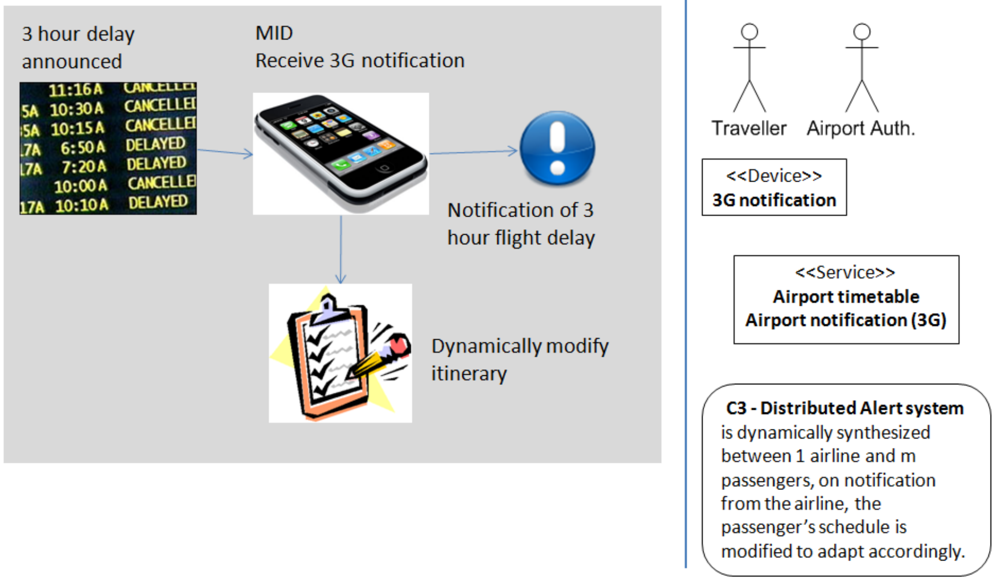
8. MID receives taxi acknowledgement and notifies Citizen to enter the taxi. The MID gives the airport destination to the taxi's navigator and an optimal route is computed.



Requirement	Rationale	Type	Owner
Airport authorities transmit information about flights delay to airline company			
Airline company has data for passengers lists and destinations			
Airline service send notifications to passengers			
MID shall be able to receive and decode the information transmitted.			
MID shall have the ability to evaluate the importance of information and notify properly (sound alert, visual effect , vibrate) Collista.			

Assumptions (for the actions in this storyboard pane to happen)
Either airport authorities either airline company will not be able to transmit/receive data
MID has not enough battery for notify alert or weak signal.
Collista ignores the notification, MID should repeat the notification periodically until confirmation.

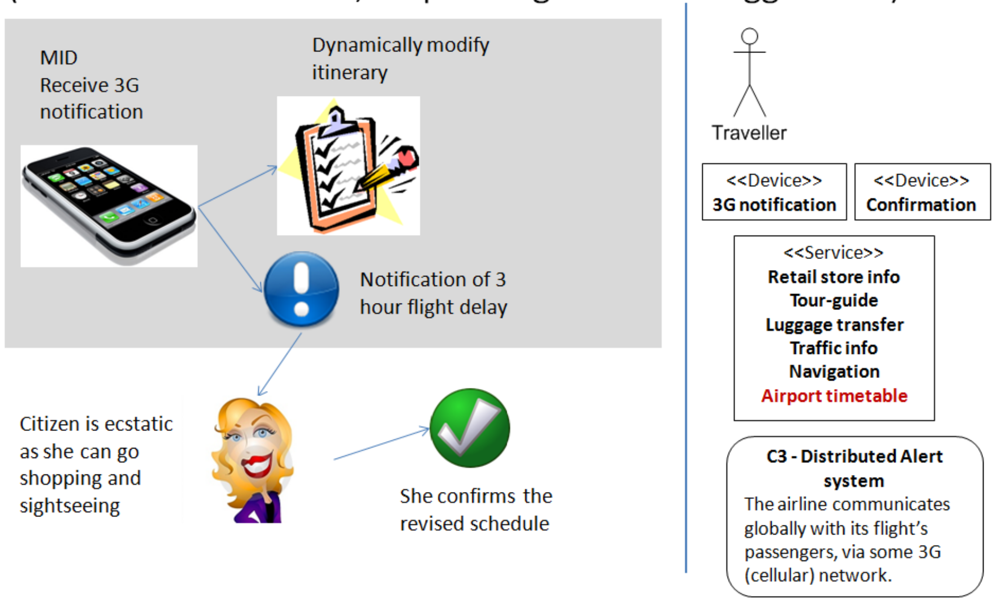
9. While heading to the airport, the airport authorities announce a 3-hour delay for Citizen's flight and the airline sends a 3G (cellular) notification to Citizen’s MID.



Requirement	Rationale	Type	Owner

Assumptions (for the actions in this storyboard pane to happen)

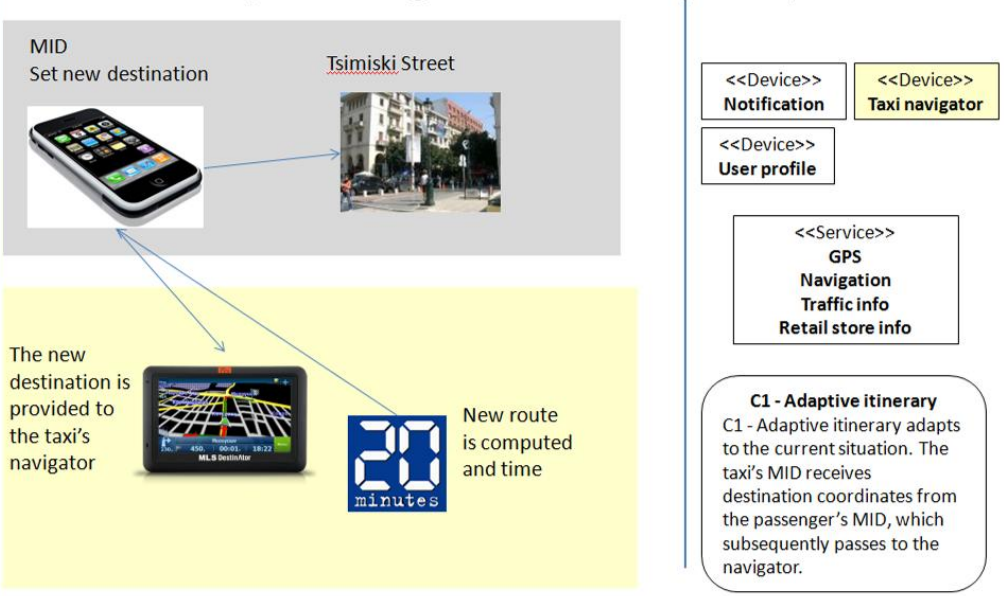
10. Citizen's MID receives the notification and re-evaluates its itinerary. She can still do her shopping and sightseeing!
(She confirms ecstatic, responding to MID's suggestion!)



Requirement	Rationale	Type	Owner
MID shall be able to inform navigator about changed coordinates			
MID shall be able to send the location of where taxi shall pick up the customer			

Assumptions (for the actions in this storyboard pane to happen)
Taxi driver does not to have to inform taxi company about the change of destination

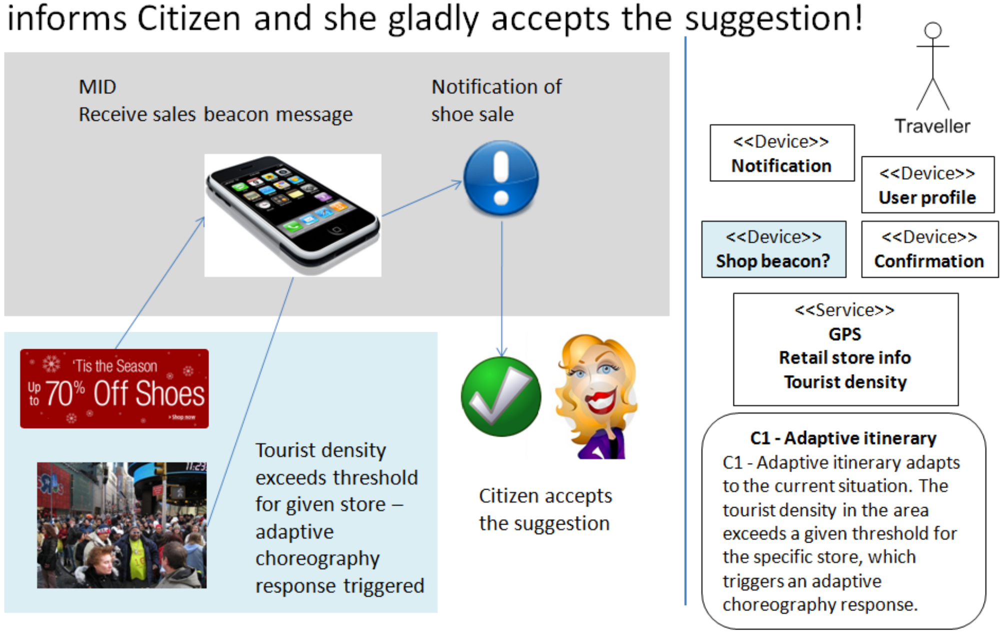
11. New destination (Tsimiski St) is set by MID and provided to the taxi navigator. The navigator computes new route and re-routes the taxi (confirming to MID a 20 min drive)



Requirement	Rationale	Type	Owner
Mall shall transmit periodically to CHOREOS platform data for offers and other marketing stuff.			
MID receive a notification based on user profile from shops around (10m range)			
Choreos platform shall provide to MID specific instructions for the exact location of mall's shop (Due to lack of the GPS in internal areas)			

Assumptions (for the actions in this storyboard pane to happen)
MID has not enough battery for notify alert or weak signal

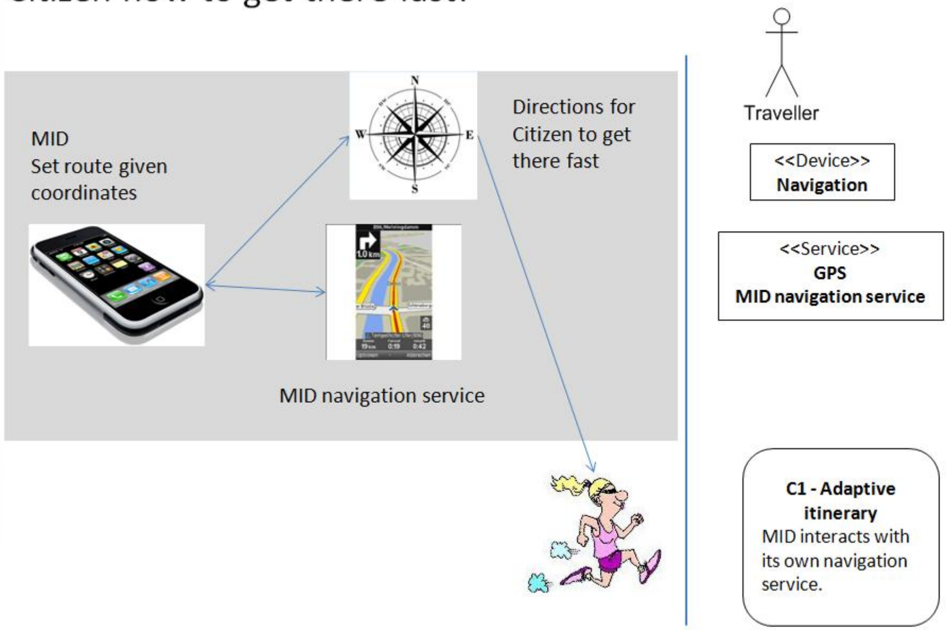
12. Citizen exits the taxi and her MID receives a *"70% Sales on shoes!" beacon message from a* nearby shoe-store. MID informs Citizen and she gladly accepts the suggestion!



Requirement	Rationale	Type	Owner
MID shall be able to send a reminder regarding itinerary			
MID shall be able to detect the phase of the itinerary			
MID's location service shall be able to access the servers at all times (what if no connection?)		avail abilit y	

Assumptions (for the actions in this storyboard pane to happen)

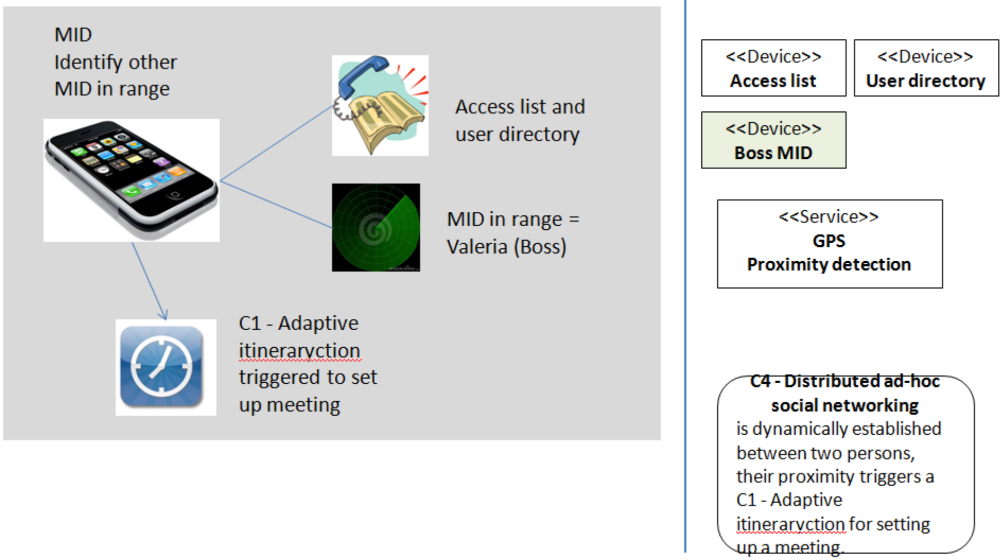
13. MID sets a route to the given coordinates and instructs Citizen how to get there fast!



Requirement	Rationale	Type	Owner
MID shall be able to upload the location and its user id			
MID shall be able to detect nearby "friends"		awareness	

Assumptions (for the actions in this storyboard pane to happen)

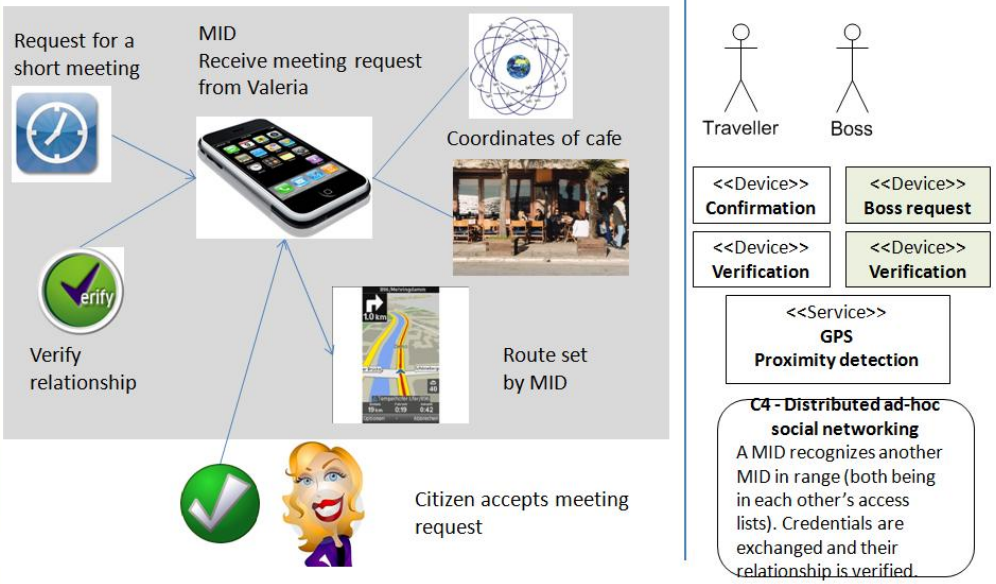
14. While Citizen is shopping, her boss Valeria happened to be nearby. Valeria's MID identified Citizen's MID in range, as they are both in each other's access lists and user directories.



Requirement	Rationale	Type	Owner
Consumer shall be able to send requests by easily select contacts from the contacts menu		Usability	

Assumptions (for the actions in this storyboard pane to happen)

15. Valeria sends a "*request for a short meeting*" *to* Citizen, including coordinates of the café, where Valeria is sitting at; Citizen accepts and her MID sets a route to the café.



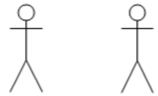
Requirement	Rationale	Type	Owner
MID shall be able to detect the movement of the consumer and time that he spends at the location			
MID's location service shall be able to access the servers at all times (what if no connection?)		avail abilit y	

Assumptions (for the actions in this storyboard pane to happen)

16. Valeria and Citizen meet and talk over frappe (coffee).

MID
Choreography suspended

Citizen and Valeria meet and talk over a frappe

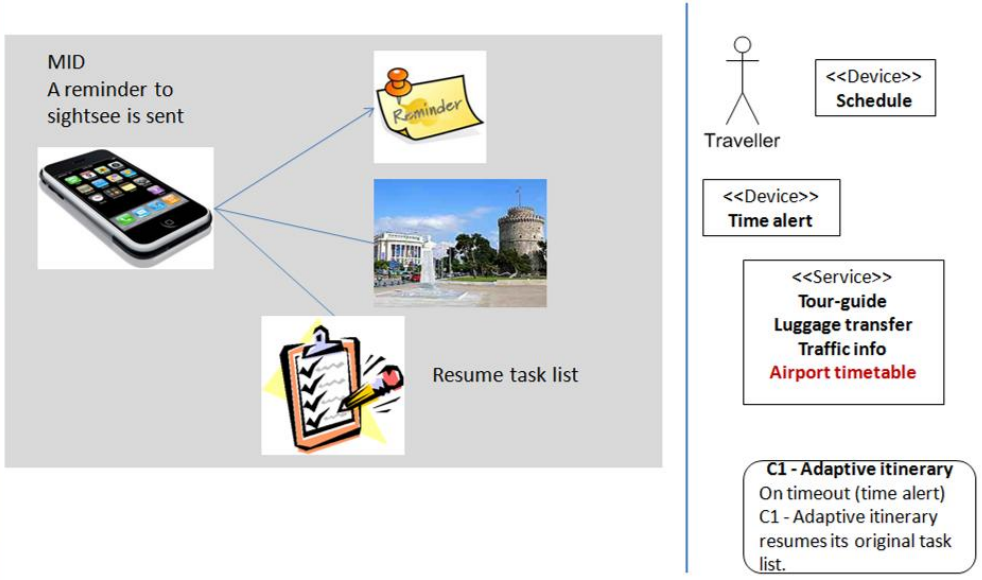


C1 - Adaptive itinerary
Suspended

Requirement	Rationale	Type	Owner
Customer shall be able to access a list of top attractions nearby			
MID shall be able to access a network that detects customer location and directs to top attractions			

Assumptions (for the actions in this storyboard pane to happen)

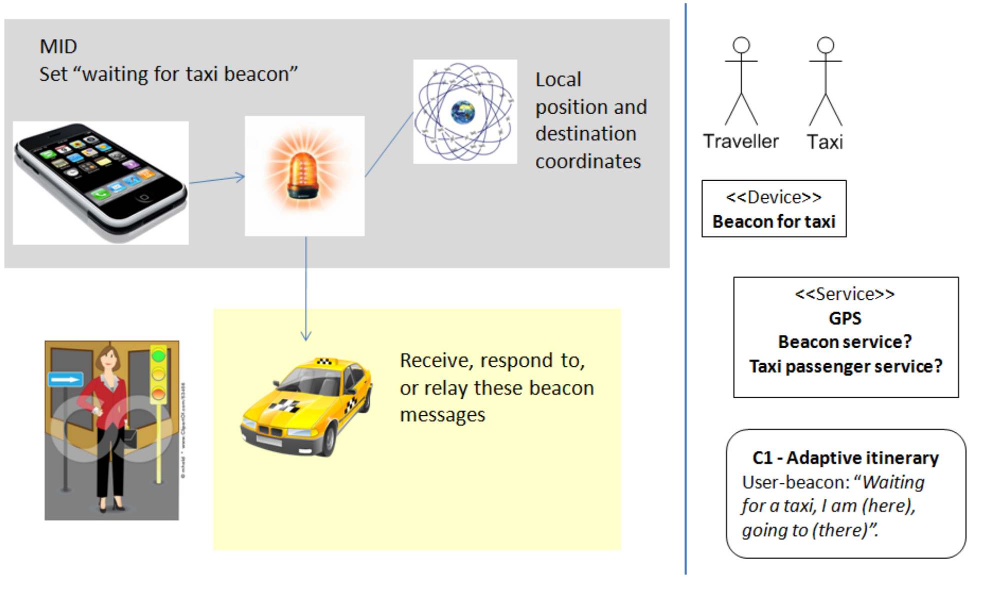
17. At some point Citizen's MID reminds her that the sightseeing is due, so Citizen tells her boss that she has to leave.



Requirement	Rationale	Type	Owner
MID shall be able to show locations of taxi stands nearby			
MID shall be able to transmit destination information to nearby taxis			
MID shall be able to contact taxi company of where customer is			

Assumptions (for the actions in this storyboard pane to happen)

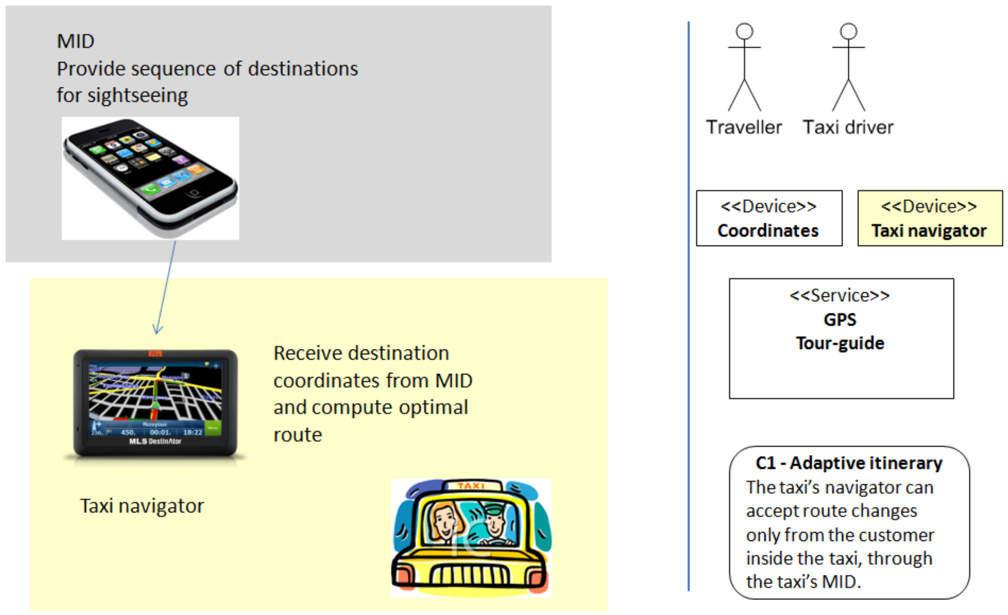
18. Citizen waits for a taxi by the street (again, same sub-scenario as above, at the hotel).



Requirement	Rationale	Type	Owner
MID shall be able to inform navigator/taxi driver of route to be taken to destination			
MID shall be able to dynamically change route depending on nearby attractions			

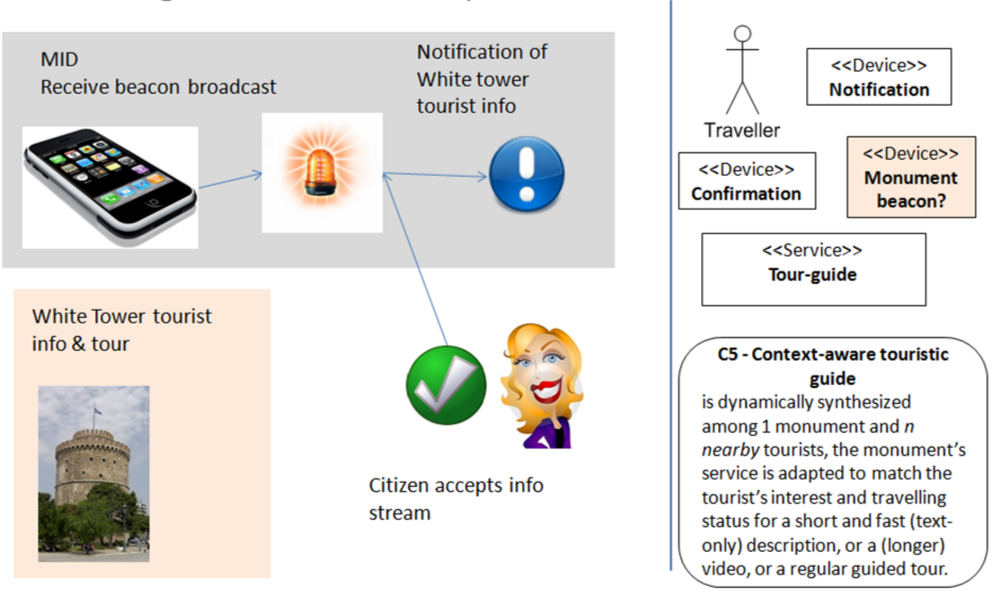
Assumptions (for the actions in this storyboard pane to happen)

19. Citizen's MID provides the taxi's navigator with the desired sequence of destinations for sightseeing.



Requirement	Rationale	Type	Owner
MID shall be able to receive information for specific attraction (currently leaflet or brochures)			
Assumptions (for the actions in this storyboard pane to happen)			
Support from tourist office for getting			

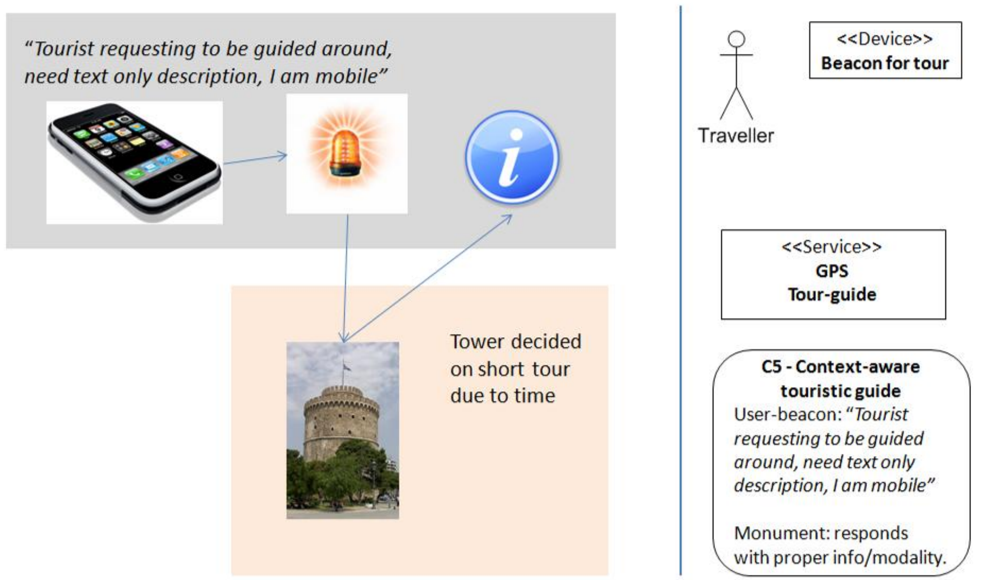
20. While passing by the White Tower it's beacon broadcasts a message inviting tourists to info or a guided tour. MID relays this message and Citizen accepts the info stream.



Requirement	Rationale	Type	Owner
MID shall be able to retrieve locations of souvenir shops (or shops, restrooms, etc) nearby			
MID shall be able to retrieve opening times, events that happen at particular days/times,			
MID shall be able to filter attractions depending on a user profile			

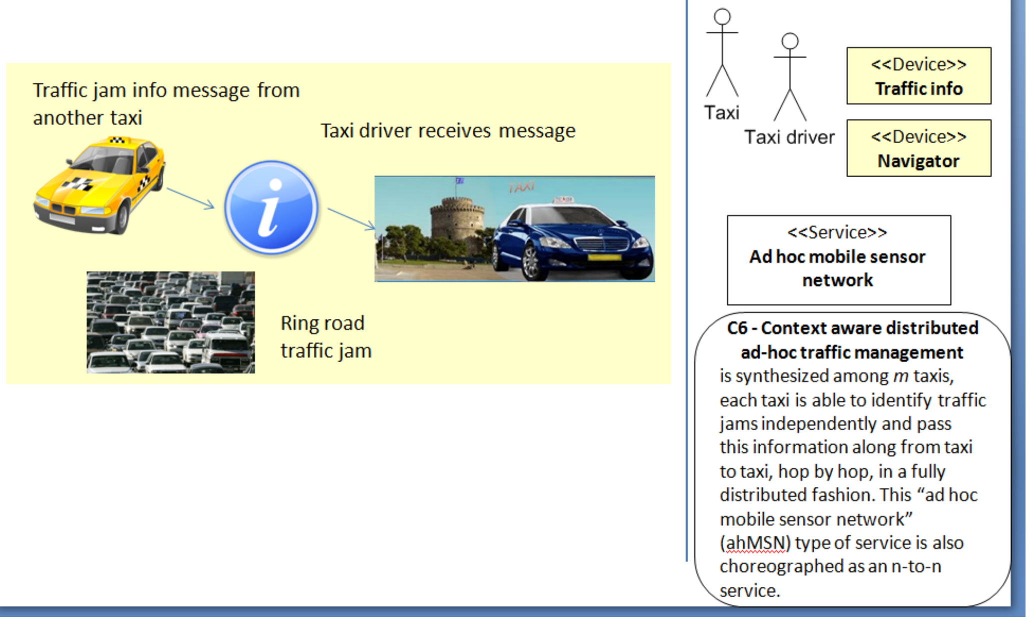
Assumptions (for the actions in this storyboard pane to happen)

21. After evaluating their schedule, the Tower decides to transmit the short tour and not call for a tour guide.



Requirement	Rationale	Type	Owner
Taxi drivers shall be able to inform his location and the problem he may encounter in that route			
MID shall be able to retrieve current status of route (red, yellow, green indicators)			
Customer shall be able to view alerts without problems		Usability	
MID shall be able to retrieve information from street sensors/cameras to detect traffic situation			
Traffic jam information (that relate to everyday situations) shall be reliable (>certain %)		Reliability	
Traffic jam information (that relate to sudden and unusual situations, e.g. accidents or change of weather) shall be available within 1 minute		Availability	

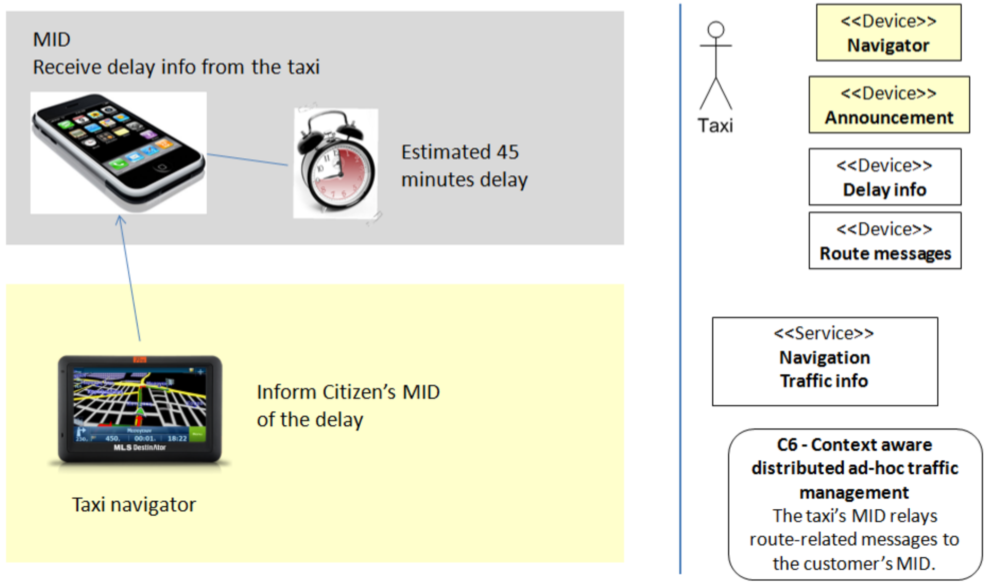
22. While sightseeing, a traffic-info message is relayed to the taxi driver (from another taxi), indicating a traffic jam on the Ring-Road (on Citizen's way to the airport) due to an accident.



Requirement	Rationale	Type	Owner
MID shall be able to accurately determine any delay		Accuracy	
MID shall be able to retrieve new information about delays every 30 seconds		Performance	

Assumptions (for the actions in this storyboard pane to happen)

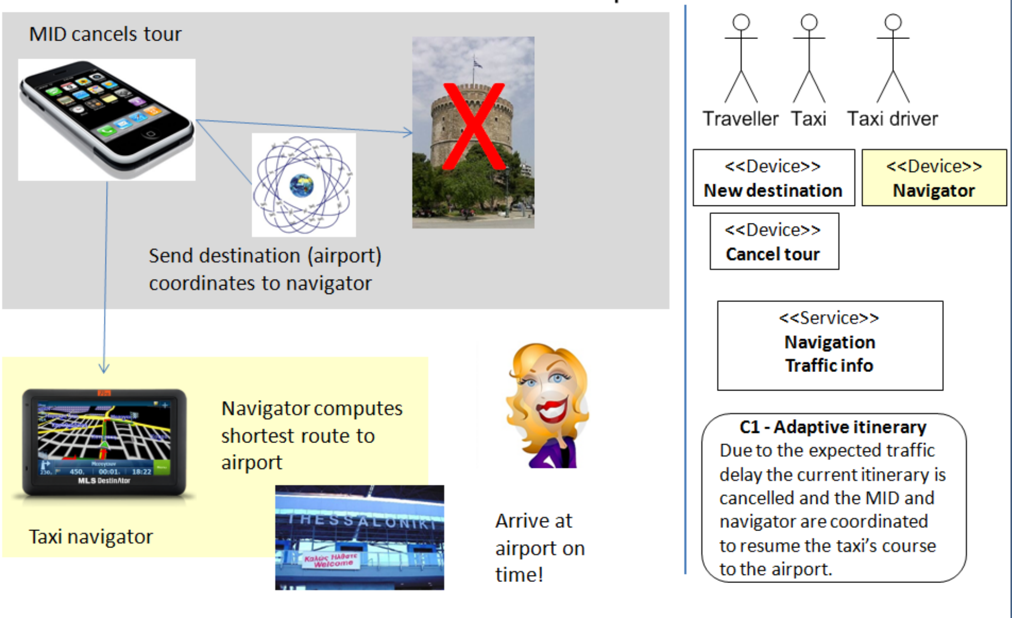
23. The taxi's navigator 'thinks' it's wise to inform Citizen's MID about this ~45 min estimated delay.



Requirement	Rationale	Type	Owner
MID shall be able to find quickest route			
Customer shall be able to accept new route even if it is longer but quicker			

Assumptions (for the actions in this storyboard pane to happen)

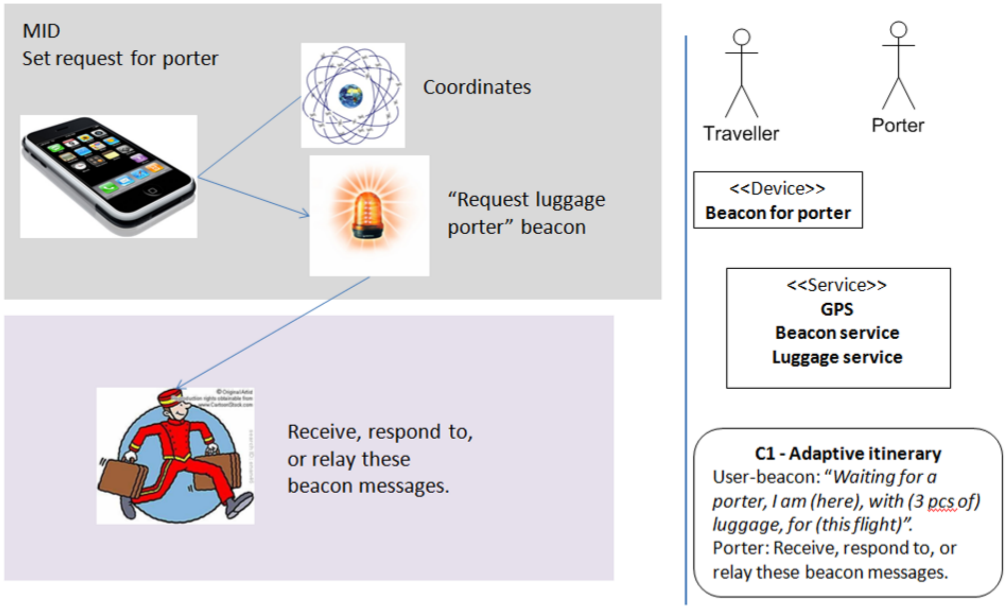
24. MID cancels the tour. It sends "new destination" airport coordinates to the taxi's navigator, the navigator computes the shortest route and reaches the airport in time!



Requirement	Rationale	Type	Owner

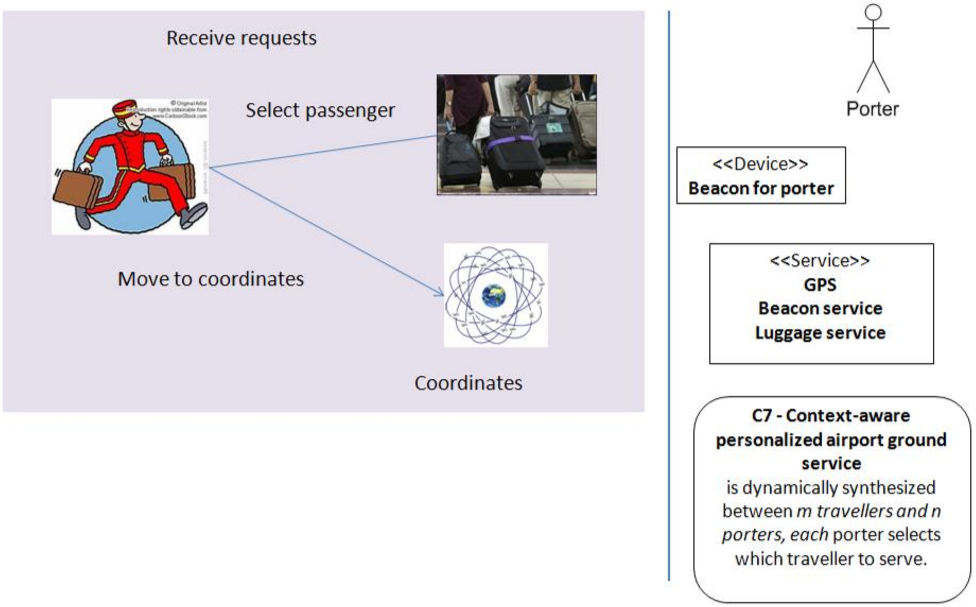
Assumptions (for the actions in this storyboard pane to happen)

25. Citizen exits the taxi, waits for a porter to carry her 3 items of luggage; her MID sets a *"request luggage porter" beacon.*



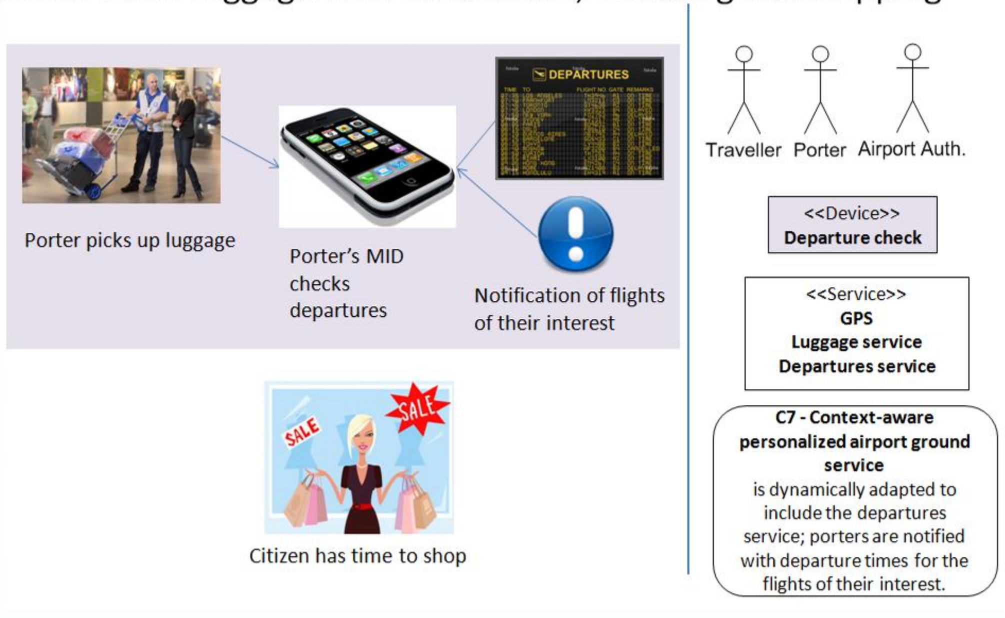
Requirement	Rationale	Type	Owner
Collista's MID shall recognize her location and distance-time from airport (based on GPS signal) . In a range of 1km send a bacon message to porter's service.			
Porter's service receives the beacon message and responses for availability. If a porter is available sends more details for the position and person who receive the luggage.			

26. A nearby available porter receives the beacon request and moves to the given coordinates.



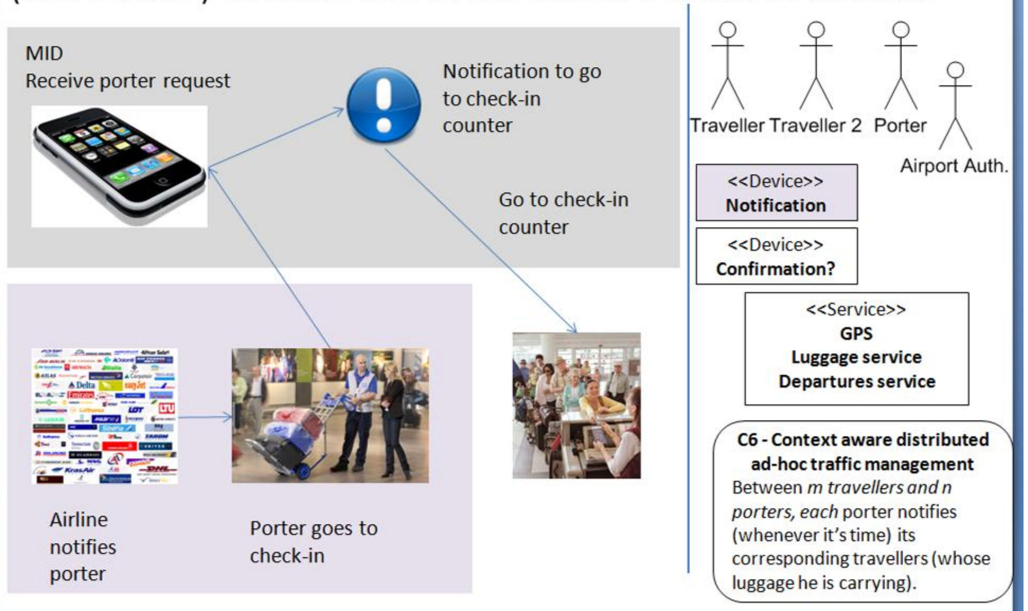
Requirement	Rationale	Type	Owner
Collista's MID confirms to porter's bacon message for pickup and send flight details.			
Porter's MID receive transmitted data for flight detail.			
Collista's MID receives data for shop's offer in airport based on her profile.			
MID schedules a walk to airport's shops based on flight time.			

27. The porter gets Citizen's luggage and his MID checks the departures service to make sure he has enough time to pick up some other luggage too. Meanwhile, Citizen goes shopping



Requirement	Rationale	Type	Owner
Porter’s MID receive notification from airline company based on Collista’s flight schedule			
Collista’s MID receive notification from porter service and Collista should go to check-in.			
Collista’s MID shall recognize porter’s MID in a range of 5m.			

28. Upon the airline’s notification, the porter takes Citizen's luggage to the check-in counter and notifies Citizen’s MID (and others’) to meet him at the airline’s check-in counter.



Requirement	Rationale	Type	Owner

Assumptions (for the actions in this storyboard pane to happen)

29. Bon voyage

Citizen

MID (M-obile dev-ice)

Citizen is happy with the help from her MID

Traveller

<<Device>>
Schedule

<<Device>>
User profile

<<Service>>
Retail store info
Tour-guide
Luggage transfer
Traffic info
Navigation
Airport timetable

Choreography
To be continued…