Information System For Individuals

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Acronyms and Abbreviations

CDI	Crowd Dynamics International Limited
EC	European Commission
EMT	Executive Management team
FZJ	Forschungszentrum Julich Gmbh
GA	Grant Agreement
INRIA	Institut National De Recherche En Informatique Et Automatique
KPIs	Key Performance Indicators
ONH	Onhys
PO	Project Officer
UL	University of Leeds
ULM	Universität Ulm
URJC	Universidad Rey Juan Carlos
UCL	University College London
WP	Work-package

Executive Summary

This report describes a potential system for providing information to individuals within crowded places. The innovations worked on through the CrowdDNA project and the potential crowd management system described in D4.3 could be used for influencing crowd and individual behaviours. This could be to avoid overcrowding of a particular area, encourage crowds to spread out across the site, to direct crowds to avoid an incident or direct them during emergency.

Research into communication with crowds has been undertaken and from this, a high-level concept of information system for individuals that can utilise these methods of communication is described. The aim is to consider how the different combined datasets and analysis can be used to influence crowd movement. i.e. what direction/instruction individuals in the crowd should be given, not the language, content of message or medium by which it is delivered.

1. Introduction

1.1. Purpose and Scope

This report outlines the potential for a system that can provide information to individuals in crowded places that would influence their movements based on centralised decision making. Crowd managers often need to direct crowds to avoid overcrowding, avoid dangerous areas where incidents have occurred and to reroute people away from busy routes. Crowds are then managed on the ground by physical methods (e.g. barriers), information (e.g. announcement for crowds), and management (e.g. staff directing people to go a certain direction).

This current way of working doesn't account for more tailored and individual communication with people. Pre-empting crowded situations and intelligently selecting people to communicate directions or instructions to would assist crowd management and thus improve crowd safety.

1.2. Aims

This report has the following aims:

- Research methods of communication with individuals in crowded places.
- How to influence crowd behaviour through communication.
- Describe high level description of the information system for individuals.

2. Methods of Communication

A wellrounded system for providing information to individuals can be most successful by communicating through multiple different channels. These different types of communication all have their best applications for the type of information they can provide, and whether it will impact a group or individuals with its message. The common ways of communicating with individuals in crowds are outlined in this section.

2.1. Event/Venue Website

A relevant website is likely to be visited by people during the lead up to an event, visiting a venue or other crowded place. Simple and subtle crowd management goals can be achieved through the information provided on the events website. For example, whilst also being informative as its key task; a webpage telling people how to get to the event can be used to try and balance crowds with its suggestions of how to navigate, what entrances to use, what the policies are, etc.

For more permanent crowded places such as an annual festival or a museum visit, information can be provided about historical and predicted level of crowding. This can be used to help influence the planned behaviour at the event by some individuals who will use that foreknowledge to avoid the crowds themselves and provide balance to overall levels.

This is much less dynamic than other communication means, but predictive or historical results for crowds as described in D4.3 could be used as part of this information for individuals.

2.2. Public Address System

Public Address (PA) systems are one of the oldest and still most direct ways to provide information to crowds at an event. PA systems are generally comprised of microphones, loudspeakers, amplifiers and other audio equipment. They are placed around a venue and are linked for providing audio messages and information. PA systems are usually placed around the events and venues to ensure that when information is passed out through them that as many people as possible will be informed. The systems are usually directly controlled from the central control room and are able to override other sound systems to ensure that they are heard.

2.3. Static Signage

Static signage plays an important role in all crowded places to inform and direct crowds. Static signage serves multiple functions:

- **Wayfinding**: Helping individuals navigate. This includes signs for entrances, exits, restrooms, and specific areas like stages at a festival, platforms at a train station or seating at a venue.
- **Information**: Providing necessary details such as schedules, event rules, and emergency procedures.
- **Branding and Aesthetics**: Enhancing the visual appeal of the venue and reinforcing brand identity through consistent design and placement.

Static signage can be better planned based on the results of crowd management planning described in D4.3. However, it is the least dynamic method of communicating and provides least interest for the information system for individuals. The information provided by static signage should not conflict with any other messages sent by more dynamic means.

2.4. Dynamic Signs

Dynamic signs are a way of providing up to date information to individuals who can see or pass by the sign. Variations of dynamic signs have been in use for many years, such as signs advertising how many spaces are available in car parking spaces; in areas that have multiple car parks in a close vicinity, such as shopping villages or town centres. These signs are dynamically updated to help direct and balance the amount of cars in and going to the car parks.

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In crowded places, dynamic signs could be used to help provide similar information on crowds by leveraging information processed by the system described in D4.3. This would include information about how busy different areas of the site are (e.g. at a festival how busy Food and Beverage areas are), to divert people along different routes if a particular route is deemed too busy now or in the future. Such information is provided already in certain settings:

- **Airports**: Flight information displays that update with real-time departure, arrival, and gate change info.
- **Train Stations**: Digital screens showing schedules, delays, and platform changes, helping passengers stay on track.
- **Venues**: Screens that highlight seating sections, concession stand locations, safety announcements, show performance schedules and emergency exits.
- **Theme Parks**: Digital signs indicating ride wait times, show schedules, and park maps.

An example of dynamic signage for crowds was researched as part of the EVAGUIDE project[1] for evacuation of crowded stadia (see Figure below). The Evaguide system associates the LDER (Location-Based Evacuation Route) with the location of the Dynamic Exit Sign and activates them accordingly (allowed or block direction). The LDER is calculated by a system similar to the predictive capabilities described in D4.3, but specifically for live emergency evacuations. Signs are deployed at junction points of routes. Arrows point to the optimal exit or a cross is shown to highlights that a direction should not be used.

Figure 1 - EvaGuide Dynamic Signage – EXUS Technologies

This principle can be applied to non-emergency situations and can provide navigational information to all individuals in a specific location as well as other more general information such as warnings of crowded areas and informing about alternatives.

These signs capture many people in their location, but do not tailor the information to specific individuals.

2.5. Smartphone App

Mobile applications are common for events, venues and transport hubs, but active crowd management using the app is not a widely used technology. Many events and venues already have their own apps that provide a variety of services for an individual in relation to that event. For example, festival apps often have a list of the bands performing on each stage and the times they will be performing at. They then let individuals create a

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[1] *www.evaguide.eu/*

plan of the bands they will go to see across the event based on their timings. Theme Parks have apps that show ride times, etc.

Mobile apps also usually are given permissions by the users to send them push notifications, which provides another route in which information can be sent directly to people to influence their behaviour.

The following apps were explored to highlight the variety of features currently available:
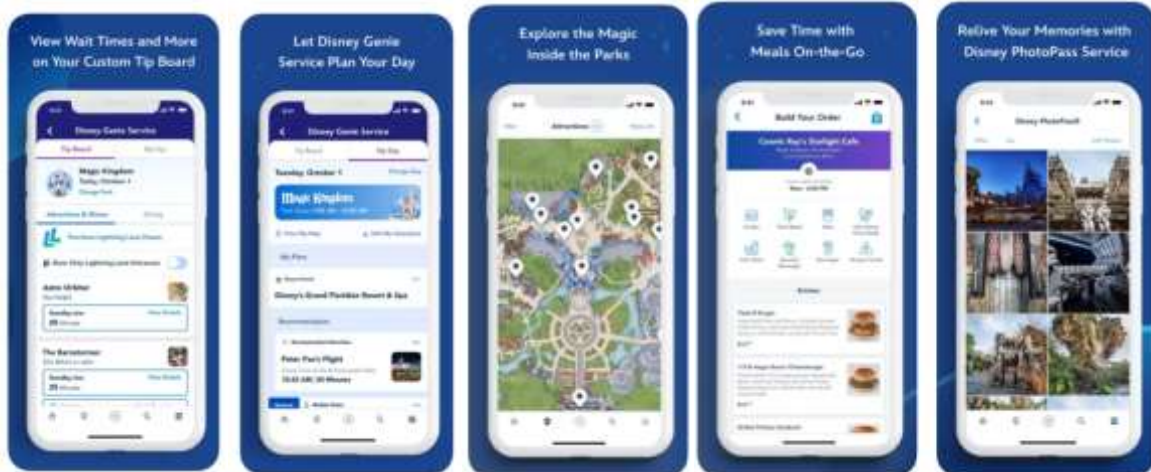
2.5.1. My Disney Experience App

Figure 2 - Screenshots of My Disney Experience App

App Capabilities

Disney's My Disney Experience App enables users to plan their vacation details and access an array of handy features for their visit.

- Disney Genie service – generates a personalised itinerary that guides you through the theme parks with tips that can help you to reduce time in lines and take out "the guess work".
- Access real-time wait times, park hours, character greetings, showtimes and more.
- Use the interactive, GPS-enabled map to explore the parks, facilities and amenities.
- Navigation with step-by-step directions.
- Browse restaurant menus, make and amend dining reservations, order meals from select locations.
- Search and filter activities to find exactly what you're looking for.
- Save your parking information at select parking locations with car locator.

App usage, privacy and GDPR related considerations

- Connecting to the Internet in the parks: Without a strong Internet signal, wait times, park hours & schedules may not update accurately.
- This app may request access to your camera to capture media & scan barcodes.
- Optional planning tools may also ask you to provide details about your travel party. Some features in this app include the ability to make purchases & will require a Wi-Fi or mobile carrier data connection.
- The app provides you with the option to receive push notifications for information relating to your visit to a park or a Disney Resort hotel.

Transferable app functions for CrowdDNA

The following can be used as part of the information system for individuals where CrowdDNA technologies could enhance the data provided and provide more suitable routes and information based on crowd levels:

- Real-time wait times.
- Interactive GPS wayfinding – shows various types of routes (quickest, less busy, past most attractions, etc.).
- Inform the best ways to navigate the park based on personal experience.
- Locator – find my friend style function to find family/friends.

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- ▪ Locator – amenities, facilities, car, etc.

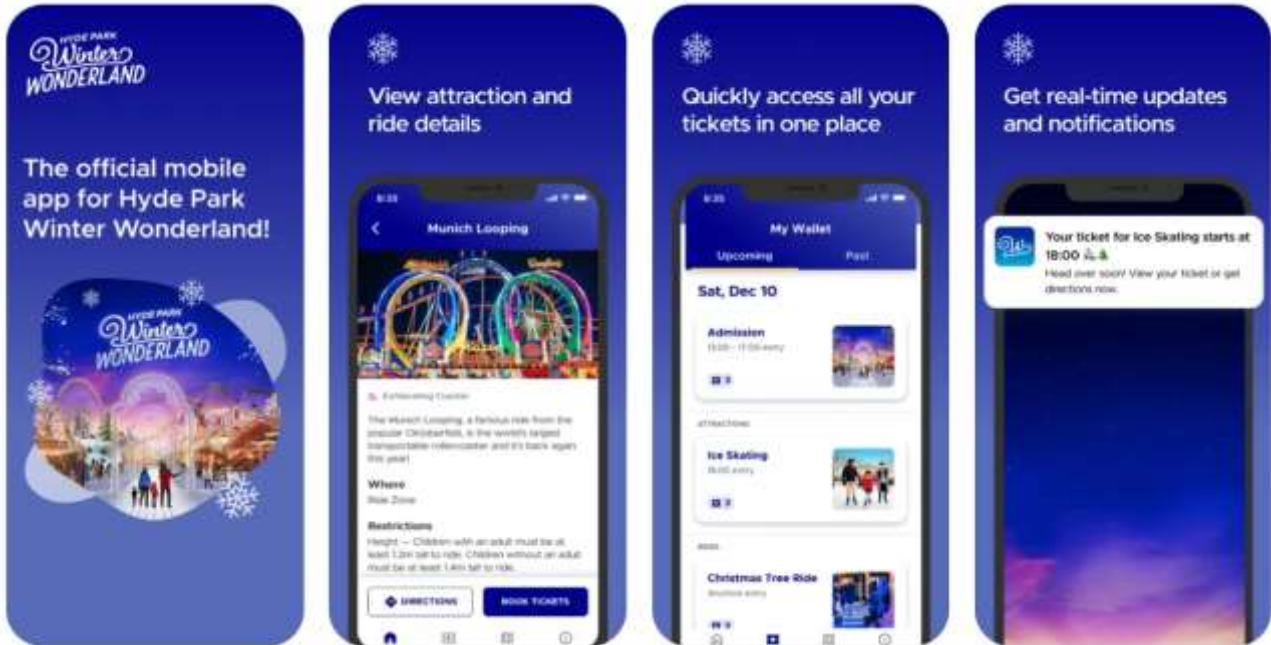### 2.5.2. Winter Wonderland App

Figure 3 - Screenshots of Winter Wonderland App

The official mobile app is a "digital assistant for everything before, during, and after your visit".

App Capabilities

- ▪ Access admission and attraction tickets.
- ▪ Get directions.
- ▪ Explore food and drinks.
- ▪ Book ride tickets in advance with a simple tap.
- ▪ Planning made easy with the wallet feature - see your events in chronological order so you won't miss a thing.
- ▪ Get real-time updates about your visit & get access to special offers.
- ▪ Browse new attractions & returning favourites with detailed information .
- ▪ View a GPS-enabled map and get directions to locations throughout the park.

App usage, privacy and GDPR related considerations

The following data is collected via the app: Location, Contact Info, Usage Data.

Transferable app functions for CrowdDNA

The following can be used as part of the information system for individuals where CrowdDNA technologies could enhance the data provided and provide more suitable routes and information based on crowd levels:

- ▪ GPS enabled map and directions.
- ▪ Redemption data from admissions.
- ▪ Real-time updates about your visit (assuming this includes queue lengths, busy areas, dynamic wayfinding, etc.).

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2.5.3. HellFest App

Figure 4 - Screenshots of Hellfest App

App Capabilities

- Band discovery and personalised schedule.
- Reloading and balance on cashless account.
- Site map.
- Practical information.
- "Prevention".

App usage, privacy and GDPR related considerations

- Financial information (for cashless payments).
- Contact info.
- Data not links: identifiers, usage data and diagnostics.

2.6. Social Media

Social media messaging is an important way to provide current information to individuals. Like with other weak influencers or information what is provided via social media cannot be assumed to be acted on by all individuals. However, we know through experience that users do check social media to help plan their events. Social media can provide lots of specific information that could influence the behaviour of people. In festivals updates about the stage times of bands and stage changes are information that are very important for ensuring crowds behave as wanted.

In a similar way to how push notifications are sent from an app, users can be notified when the event has posted new information it improves the likelihood of it being seen.

2.7. Mobile SMS

Emergency services use mass broadcast SMS messages during emergencies to inform people in an area about dangers. This is often used in areas of natural disasters. For example, Icelandic authorities will send out warning SMS messages to all mobiles that are in a certain proximity of volcanic activity. The same principle can be used in crowd emergencies to inform people how to evacuate etc.

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3. Influencing Individual Behaviour

3.1. What can be influenced?

D4.3 proposes to combine multiple data sources and analysis into a system that can be used for crowd management. The information provided to a crowd manager can allow a better understanding of when places are and are going to be overcrowded, which routes are overcrowded, etc. To be able to respond to this, they can deploy the communication means described in Chapter 2 to try and influence the following:

- **Destination:** Change intended destination of people to avoid overcrowding.
- **Routes:** How crowds move to a destination from different locations.
- **Dispersion:** Spread crowds out across a venue.
- **Direction:** At a location, direct crowds in a certain direction (e.g. during emergency to an exit point).

The proposed D4.4. information system for individuals would take information from D4.3, optimise which behaviour needs influencing to achieve the goal and how it can be achieved before evoking the relevant methods of communication.

3.2. How can behaviour be influenced?

The ways of influencing can be separated into weak and strong methods. Weak methods are more suggestive in nature and encourage people to change their behaviour in some way. Strong methods are more direct messaging that instructs people what to do.

3.2.1. Weak methods to influence behaviour

The following provides examples of suggestive means to influence behaviour:

- Inform about **areas of higher and lower crowding**. This allows people to make a decision as to whether they want to go to a crowded area or not, without specifically directing them to one.
- Provide tailored **commercial offers** for an area of a site (e.g. 20% off coffee in X location). This would attract people to an area that is more desirable for the crowd manager. It can also be used for routing people away from a direct route even if their destination remains the same. It can also disperse people around the site by providing offers in lesser used areas.
- Provide information on **queue times** to encourage people to use less busy queues or come back at different times.
- Suggesting **optimised schedules**. When planning a journey, the schedule of the journey can be suggested by optimising when people would arrive and suggesting alternatives to the schedule if it is likely to cause overcrowding.

Weak methods are appropriate for promoting general dispersion around the site, influencing destinations and routes when the crowded situation is not critical.

3.2.2. Strong methods to influence behaviour

The following provides examples of direct instructive means to influence behaviour:

- **Evacuation messages** like "please evacuate now following instructions given by staff".
- **Route navigation** – advise on routes people should take. E.g., if they are heading to one area and the natural direct route is too busy, inform them to choose another route. This can be done through GPS navigation on a map or identifying a route as closed. In a locality, this would involve directing individuals in a location to use a different route (e.g. dynamic signs, staff communication).
- **Destination full**. Inform people that they would not be able to go to an area because it is overcrowded. The message can be strengthened by informing them that they will not be able to get access and by suggesting an alternative destination.

Strong methods would be used in more safety critical situations. They can be complemented with weak methods.

4. Information System for Individuals

4.1. Overview

The information system for individuals needs to influence behaviour in a way that is aligned with the decisions and plans of the crowd manager. To do so, this system would need to be integrated into a system like the one proposed in D4.3. The high-level system is proposed on Figure below.
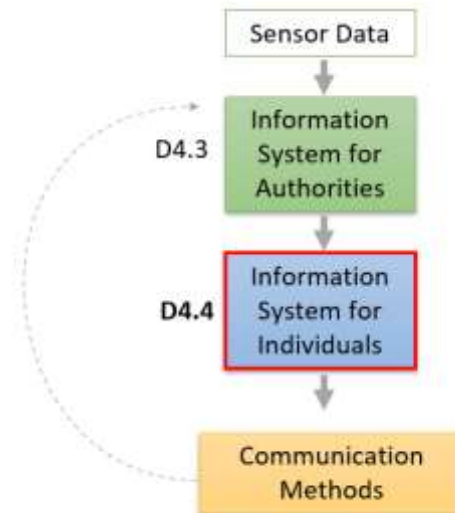

**Figure 5 - Diagram of System in context with other systems**

The sensor data would include IoT and video feeds as described in D4.3. The communication methods are as described in this document, with the most relevant being dynamic signage and smartphone app because they are the most dynamic methods of communication alongside staff intervention. The smartphone app could also feed information back into D4.3 by allowing individuals to raise alerts, to track their journeys or individual schedules to allow better predications of crowding into the future.

The information system for individuals sits in between D4.3 and the methods of communication. It translates the requirements for crowd management into actionable methods to influence the crowds.

4.2. Development of system

The system would be a back-end implementation with no user interface. It would allow the decisions taken using the D4.3 system to be communicated to crowds via the communication methods outlined. The following sections highlight examples of the system flow in determining the information to be provided to individuals.

4.2.1. Dispersion of Crowds
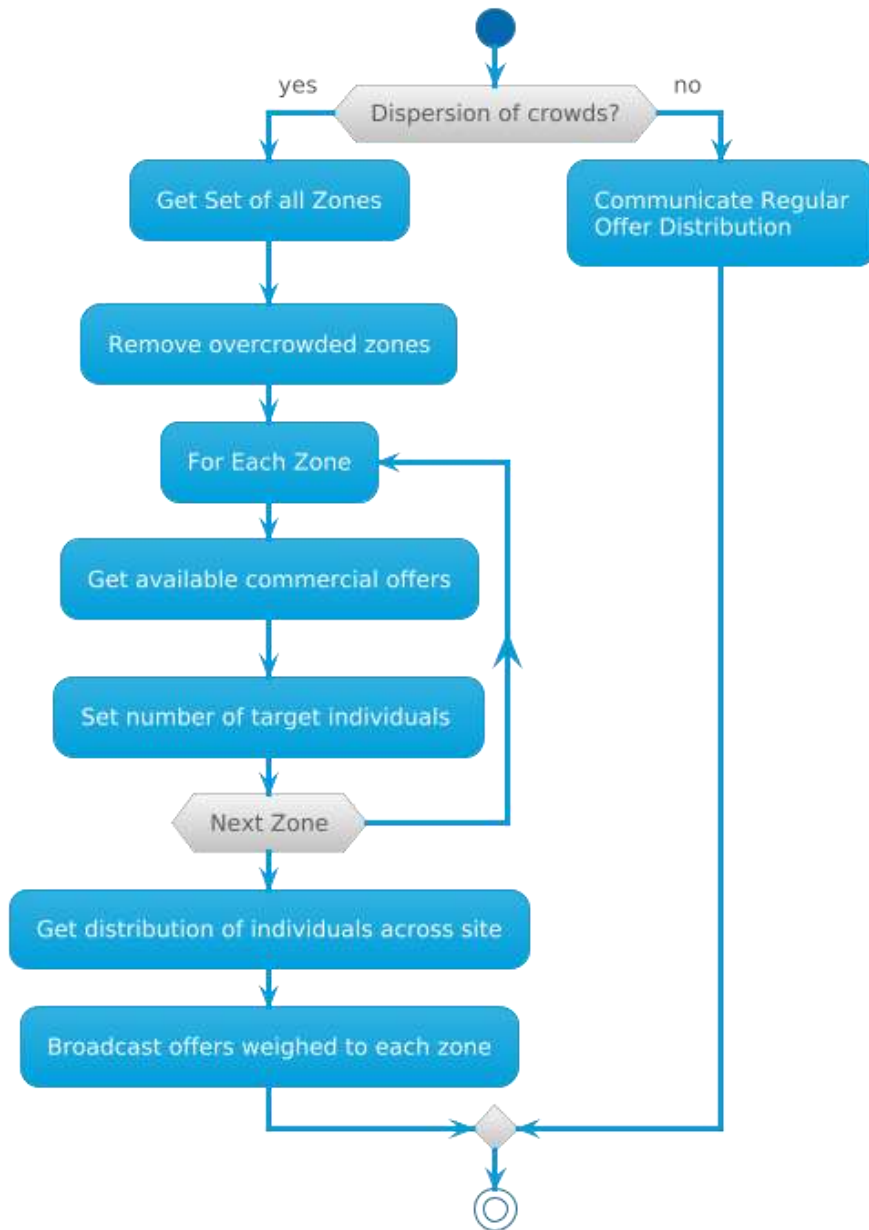
Figure 6 - High level system process for dispersion of crowd using commercial offers
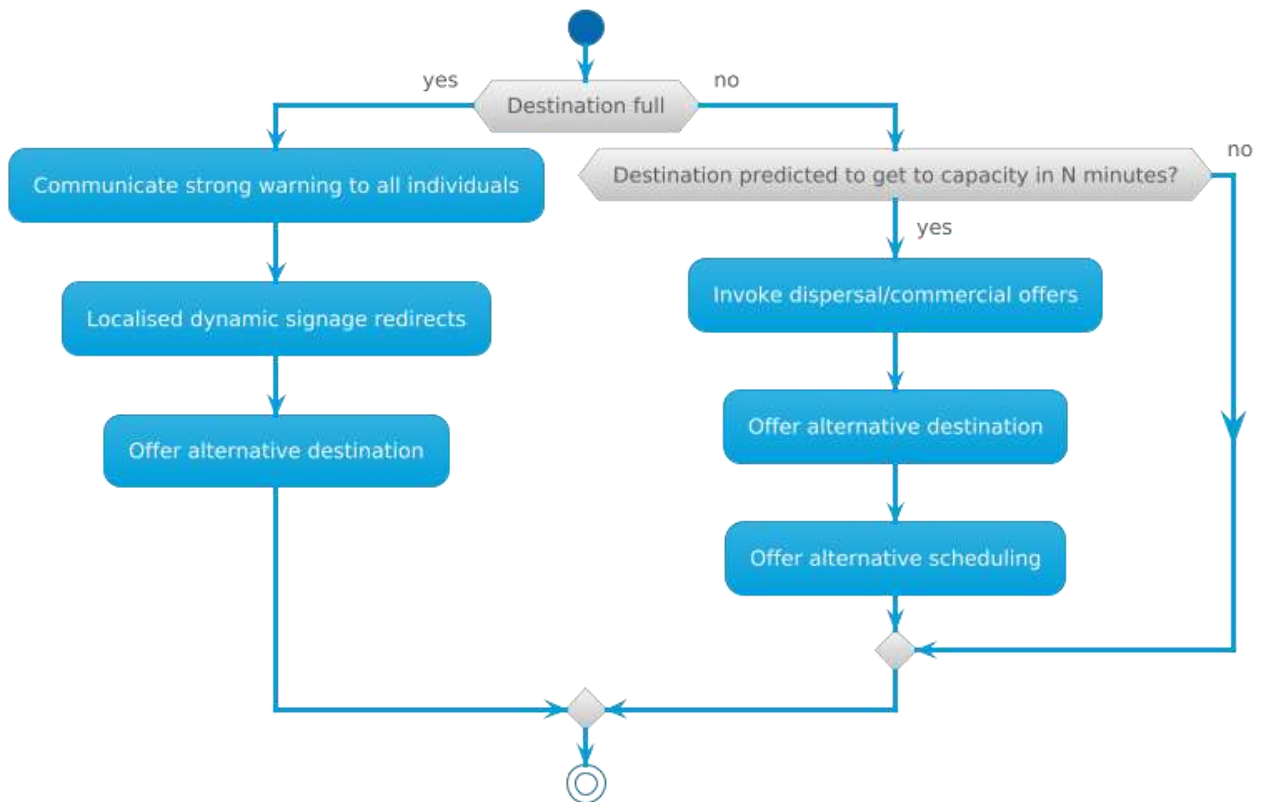
4.2.2. Destination reaching capacity

Figure 7 - High level system process for influencing destination
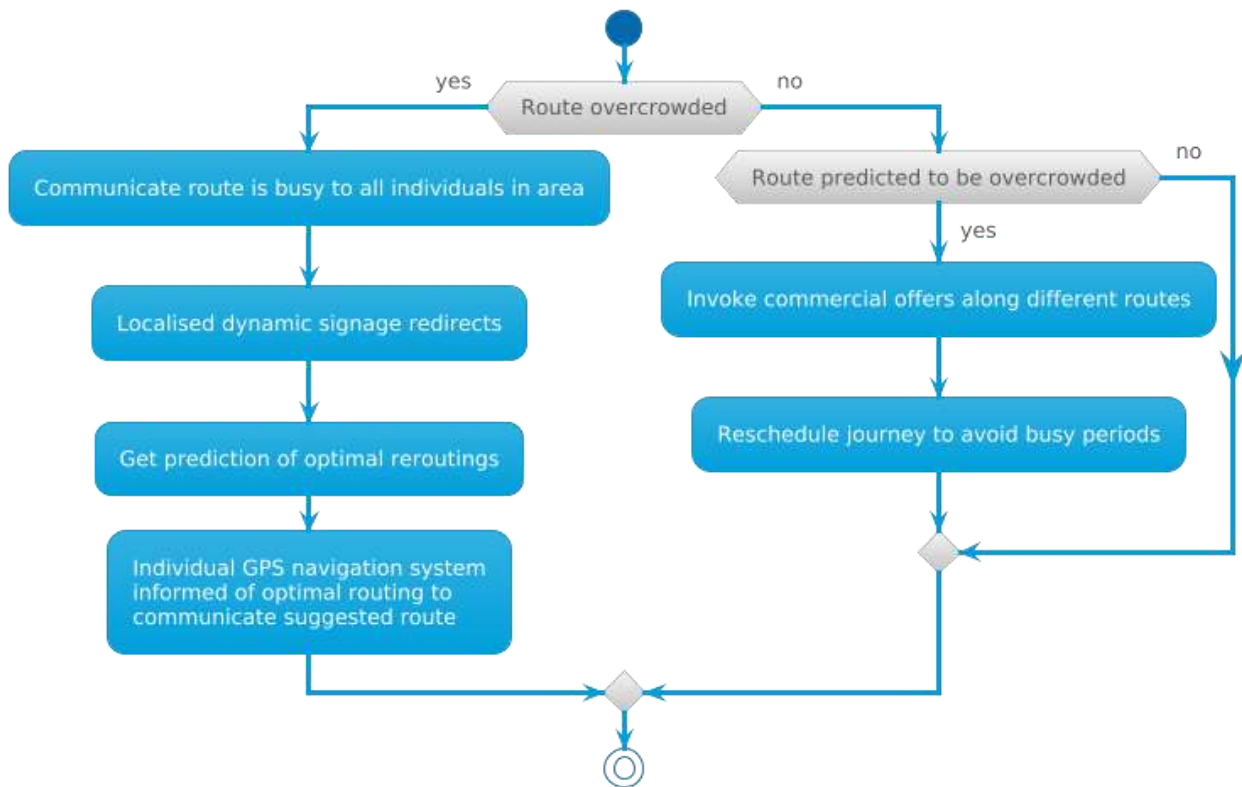
4.2.1. Rerouting

Figure 8 - High level system process for rerouting

4.3. Next Steps

The system flow processes describe how the system can determine which information to communicate to whom. The next steps would be to develop the individual components that can intelligently filter the individuals who receive certain types of information based on: their location; their likely destination (from scheduling or analysis of past behaviour); increased likelihood that a weak method would successfully influence their behaviour (e.g. targeted advertising); and whether they are using GPS navigation or other means of absorbing information. Further research could also consider the automatic generation of message text and information provision for staff and stewards.

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5. Concluding Remarks

This report has described an information system for communicating with individuals that would work hand in hand with the CrowdDNA analysis technologies and information system developed in D4.3 to guide people and optimise levels of crowding based on crowd manager decision making.

The system can be developed using this document as a basis, with further research needed into selection, filtering, and optimisation techniques to better target individuals. Future research could also consider the automatic generation of message text and information provision for staff and stewards.