Concept and prototype of a ground handling vehicle management system

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Outline

► Background
  ► Motivation, Projects, Partner, Airport Research Facility Hamburg, Vehicle Scheduling

► Concept
  ► Main Concept Ideas, Approach, General Operation Procedure

► Prototype
  ► System Overview, Onboard System, Ground System

► Summary
  ► Field Trials, Results, Outlook
Vehicle Management System

Background
Motivation

“Airports may become the bottleneck of the ATM System”

- Optimize airport ground handling operations
  - Avoid delays induced by ground operations
  - Increase safety due to improved situational awareness
  - Reduce costs by efficient utilization
  - Reduce emissions
  - Reduce workload

- Vehicle Management System (elements)
  - Detection and identification of vehicles
  - Communication by data link
  - Providing traffic situation
  - Support in scheduling of tasks
Projects

**CARMA**
- Technical and economical feasibility
- Concept development
- First technical implementation

**Airport 2030**
- Improved and integrated working positions
- Connection to a prototype APOC (Total Airport Management concept)

**W-F**
- Operational requirements
- Advanced technical system components
- Connection to operational airport systems
Airport Research Facility Hamburg

- Cooperation with DFS and Airport Hamburg (common research agenda)
- Two special equipped rooms for development, field trials and demonstrations
- Connection to real-time operational A-SMGCS Level 2 data and airport database
- Usable for A-SMGCS and Total Airport Management (TAM) research
Look Back (vehicle scheduling)

- ATM Seminar 2009 („AIRPORT SERVICE VEHICLE SCHEDULING“)

- Investigation of various algorithms for scheduling airport service vehicles

- Simulation runs for bus scheduling at Hamburg Airport and Dallas Fort Worth

- Results showed benefit in delay reduction and vehicle travel distances
Vehicle Management System

Concept
Main Concept Ideas

- Use of data link for dispatcher/driver communication
- Automatic recording of time stamps during the handling process
- Support of resource selection by providing an optimization module
- Providing a traffic situation to driver and dispatcher
- Reduction of number of information systems (monitors)
- Easy drag and drop operation and reduced workload
- Providing status information of task execution
Approach

**A-SMGCS**

**Aircraft System**
- HMI
- Position Calculation
- CPDLC
- TIS-B
- ADS-B
- Transponder Mode A/C/S

**Vehicle System**
- Transponder Mode S

**Vehicle Management System**

**Vehicle System**
- Position Calculation
- HMI
- Processing
- Interface

**Ground System**
- Database
- Interface

**Ground Processing Unit**
- (interface to external systems, data fusion, optimization)

**Controller Workplaces**
- Tower
- Apron

**Onboard**
- VDL2
- 1090 MHz ES

**Communication**
- 1090 MHz ES

**Wireless connection**

**Ground**
- Ground Unit
  - (data fusion, database, airport systems, …)
- Airport Ops.
- Ground Handler
  - …
General Operation Procedure

Start

Vehicle position

Traffic Situation (data fusion)

Aircraft position

Actual task status

Scheduling (with recommendation)

Flight plan

Task information

Task assignment

Accept/Decline

Status information

Task progress

Time stamps

Task completion

Aircraft served, removed from scheduling

Finish
Vehicle Management System

Prototype
System Overview

Traffic Situation Display

Sensor Adapter

Situation Server
Tracking/Prediction/Fusion

Data Adapter and Processing

Database

Optimization Module

Traffic Situation
Data Flow

Management Data Flow

Display Data exchange
Onboard System (components)

- Mounting device
- Magnetic roof box
  - GPS, USB, WLAN
- Netbook-PC and
  - 10“ touch display
- Power adapter,
  - Buffer-battery
Onboard System (interface)

- task description
- own ship position
- zoom
- menu
- traffic
- next leg
- next waypoint
- status GPS, WLAN
## Ground System (HMI)

<table>
<thead>
<tr>
<th>Traffic Situation</th>
<th>Management</th>
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</thead>
<tbody>
<tr>
<td>Position and identification (equipped vehicles and aircraft)</td>
<td>Status information (flights, resources, tasks)</td>
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<tr>
<td></td>
<td>Task assignment (drag and drop)</td>
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<tr>
<td>Bidirectional communication between displays (coupling of information)</td>
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Ground System (management interface)

Vehicle resources

Tasks

Flight plan

Details

Traffic load
Ground System (support systems / infrastructure)

- Secured virtual wireless Network within the existing WLAN at Hamburg airport

- Interface components to the A-SMGCS and the operational airport database

- Database

- Communication server
  (centralized communication between onboard and ground)

- Situation server
  (fusion of position information from vehicles and aircraft)

- Optimizer
  (processing of interactions of dispatcher and driver, scheduling)
Vehicle Management System

Summary
Field Trials

- Quality and coverage of the wireless infrastructure
  - Long term measurements on board of a follow me car

- Position calculation with additional vehicle sensors
  - Test runs with a special equipped vehicle

Overall Prototype system
- 2 weeks trial period
- Main focus - technical verification
- 2 test vehicles, 15 equipped luggage cars
- Dispatcher station besides the operational workplace
Results

- Quality and coverage of the wireless infrastructure good

- Use of GPS possible – better results and indoor navigation with additional sensors

- Connection to operational systems successful

- Proof of the overall system concept

- First feedback positive – especially from dispatchers

but

- Proof of operational benefits still missing – simulator trials
Outlook

- Improved dispatcher system

- Integrated solution (one display)

- Using the Eurocontrol Early Demonstration & Evaluation Platform (eDEP) as a base

Integration into a Total Airport Management concept
Thank You