Design of a Web-Based Services for Supporting AVL System

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May 3 2013

Topics of Discussion

- Introduction
- Problem Statement and Solution
- System Design
- System Analysis
- System Integration and Testing
- Lessons Learned

Introduction

- What is AVL?
- AVL and GPS
- How can AVL be used for fleet management?
- Zoom Information Systems
  - TerraFleet

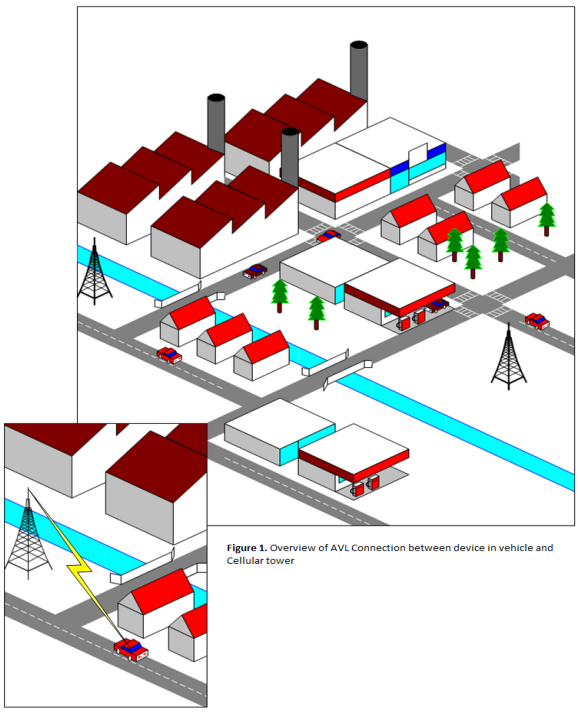


Figure 1. Overview of AVL Connection between device in vehicle and Cellular tower

Problem Statement

- Problems with the current systems
  - Flexibility
  - Portability
  - Expandable

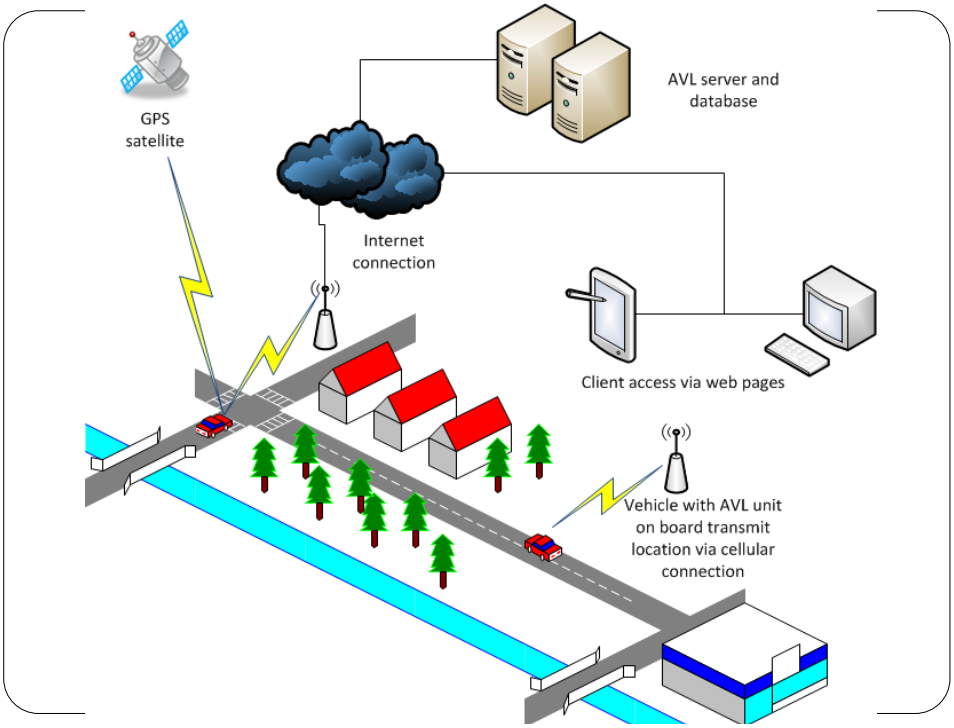
Source: calamp.com

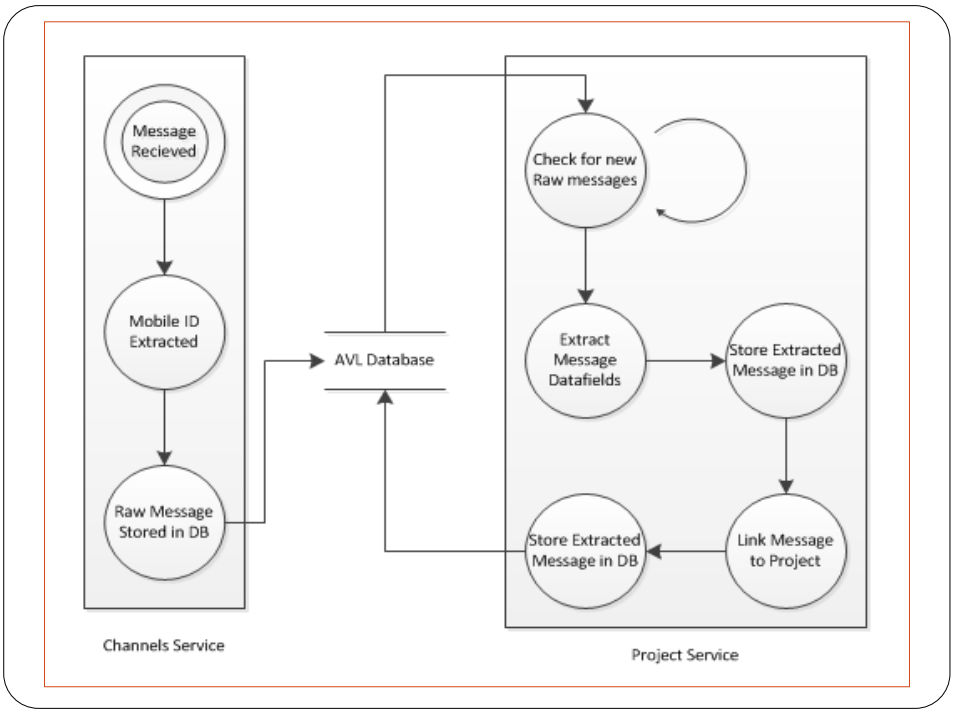
Solution

- Solution
  - Mobile devices
  - Elimination of dedicated hardware
- Added value to existing system
  - Android operating system
  - Integrated features

System Design

- Critical enabling technology
  - Internet
    - Necessary for server service to store data
  - Cellular carrier networks
    - Necessary for transmission of tracking data
  - Global Positioning System
    - Necessary to perform all tracking
  - Zoom's TerraFleet
    - Existing AVL platform


GPS satellite
AVL server and database
Internet connection
Client access via web pages
Vehicle with AVL unit on board transmit location via cellular connection


Message Recieved
Mobile ID Extracted
Raw Message Stored in DB
AVL Database
Channels Service
Check for new Raw messages
Extract Message Datafields
Store Extracted Message in DB
Link Message to Project
Store Extracted Message in DB
Project Service

Message Formats

Field	Length (bytes)	Description
Message Header	2	Known bytes for error check
Mobile ID	6	Unique identifier of the device
Message Sequence	2	Unique message sequence number
Message Type	1	Type of message (see Message Type table)
Payload Length	2	Length of the message payload
Payload	Variable	Specific to message types
CRC	1	Least-significant byte of the sum of all message bytes excluding Message Header and CRC

Message Types

Message Type Values		
Message Type	Value	Description
Acknowledgement (Ack)	1	Message acknowledgement
Negative Acknowledgement (Nack)	2	Signifies a problem with the message
User Data Message	4	User Information from QR code
Picture Message	9	Picture sent from Android device
Location Message	10	Generic location report

Acknowledgement Message

Field	Length (bytes)	Description
Message Header	2	Known bytes for error check
Mobile ID	6	Unique identifier of the device
Message Sequence	2	Unique message sequence number
Message Type	1	Value of 1 for Ack message
Payload Length	2	Length of the message payload
Mobile ID	6	Same Mobile ID as the message replying to
Message Sequence	2	Same sequence number as the message replying to

Complete Location Message Format		
Field	Length (bytes)	Description
Message Header	2	Known bytes for error check
Mobile ID	6	Unique identifier of the device
Message Sequence	2	Unique message sequence number
Message Type	1	Type of message (see Message Type table)
Payload Length	2	The value of the length for the location message is 21 bytes
Timestamp	4	Offset in seconds from GPS epoch (January 1, 1970 00:00:00 UTC)
Longitude	4	Actual longitude * 10000000 Decimal degrees
Latitude	4	Actual latitude * 10000000 Decimal Degrees
Altitude	2	Actual altitude * 100 Meters above sea level
Heading	2	Actual heading *100 Decimal degrees, 0 north increasing clockwise
Speed	2	Actual speed * 100 Meters per second
Distance	2	Actual distance * 100 Meters Distance accumulator from install time
GPS Quality	1	Indication of the strength of the GPS signal, 0, 1, or 2. 0 is worst.
CRC	1	Least-significant byte of the sum of all message bytes excluding Message Header and CRC

Complete Picture Message Format		
Field	Length (bytes)	Description
Message Header	2	Known bytes for error check
Mobile ID	6	Unique identifier of the device
Message Sequence	2	Unique message sequence number
Message Type	1	Type of message (see Message Type table)
Payload Length	2	The value of the length for the location message is variable
Chunk Number	2	Current piece of the image
Total Chunks	2	Total amount of pieces image has been split into
Image Chunk	Variable	Chunk of image bytes

System Analysis

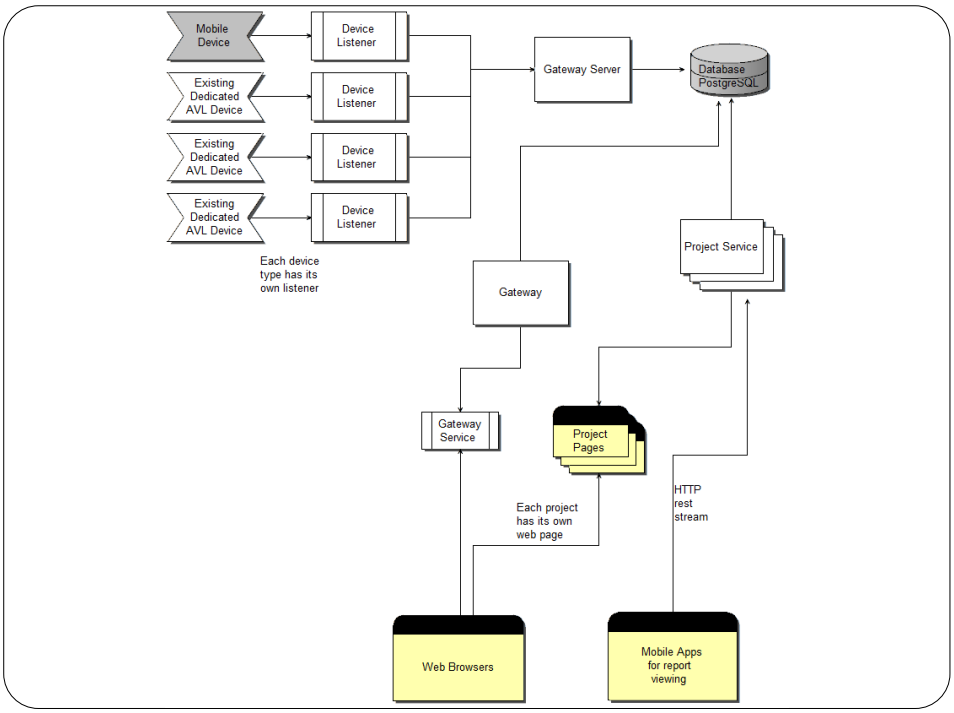
- Scope Definition
- Requirements analysis
- Logical design

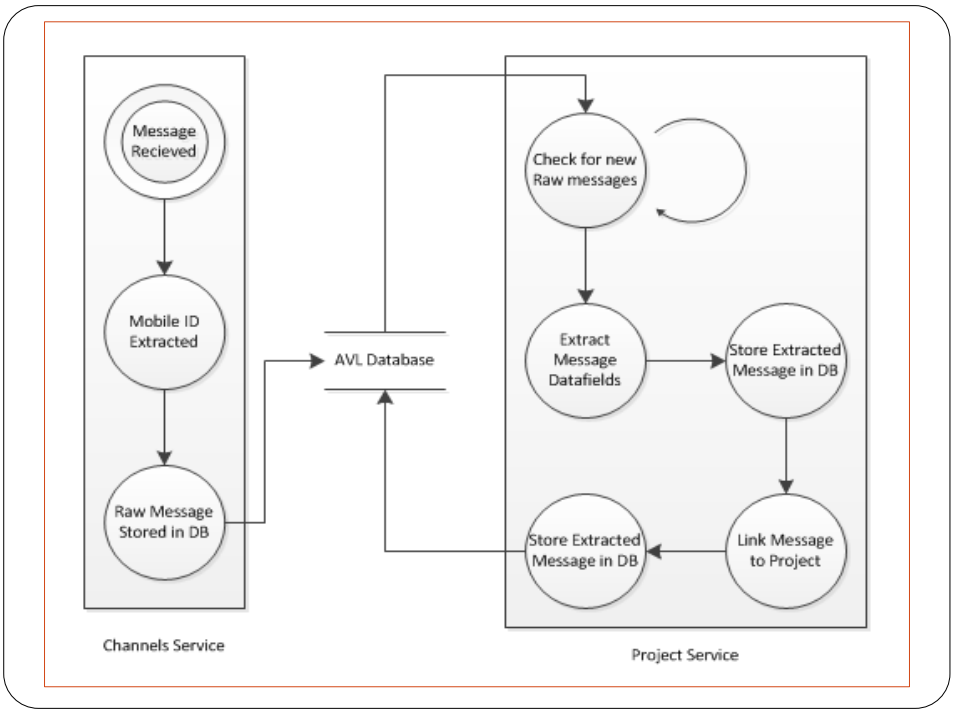
Scope

- The scope of this project will encompass the following:
  - Three additional class libraries to support the new protocol
  - Database modifications to allow for images

Key Requirements

- Project SHALL use message protocol established by Zoom
- Project SHALL integrate into existing TerraFleet software
- Project SHALL be compatible with existing AVL database


Mobile Device
Existing Dedicated AVL Device
Existing Dedicated AVL Device
Existing Dedicated AVL Device
Device Listener
Device Listener
Device Listener
Device Listener
Each device type has its own listener
Gateway Server
Database PostgreSQL
Project Service
Gateway
Gateway Service
Project Pages
Each project has its own web page
HTTP rest stream
Web Browsers
Mobile Apps for report viewing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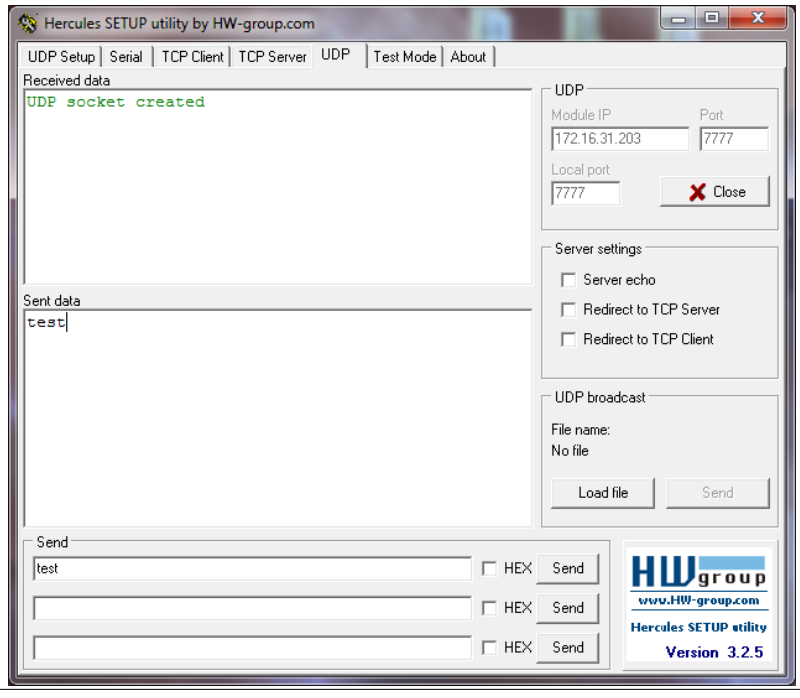
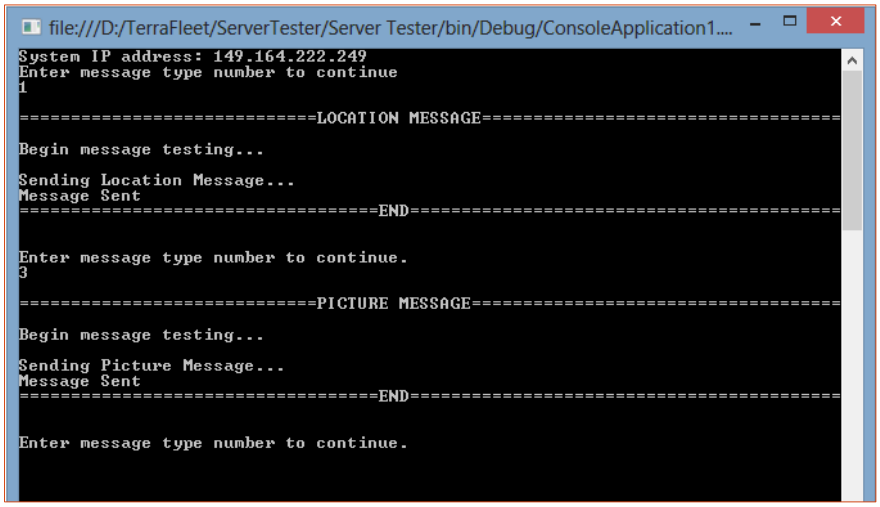
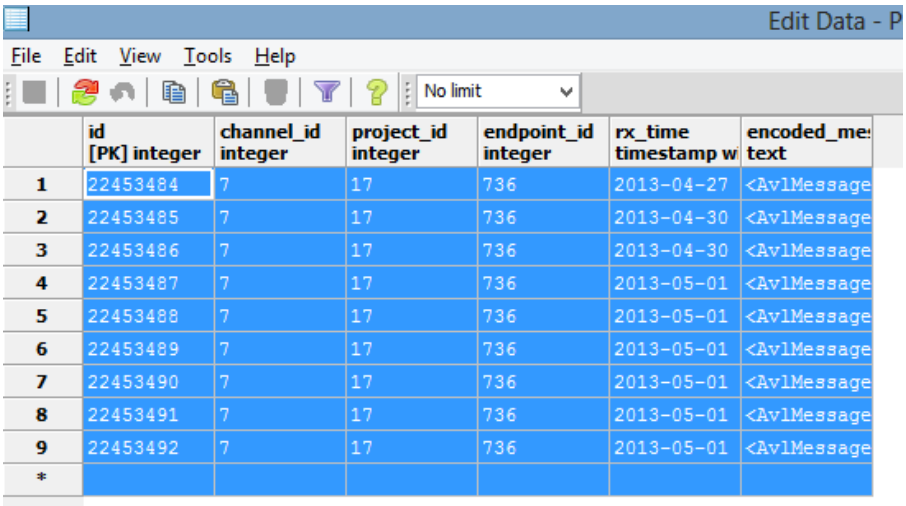
System Integration and Testing

- Testing Tools
  - Hercules SETUP Utility
  - ServerTester
  - Log2Console
- Testing Method







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2	22453485	7	17	736	2013-04-30	<AvlMessage
3	22453486	7	17	736	2013-04-30	<AvlMessage
4	22453487	7	17	736	2013-05-01	<AvlMessage
5	22453488	7	17	736	2013-05-01	<AvlMessage
6	22453489	7	17	736	2013-05-01	<AvlMessage
7	22453490	7	17	736	2013-05-01	<AvlMessage
8	22453491	7	17	736	2013-05-01	<AvlMessage
9	22453492	7	17	736	2013-05-01	<AvlMessage
*						

Lessons Learned

- Risk Assessment
- Schedule Monitoring
- Communication Protocols
- UDP vs TCP/IP

Demonstration