Enabling Routes as Context in Mobile Services

Agne Brilingaite, Christian S. Jensen and Nora Zokaite

October 10, 2006

Introduction

System Architecture

Map-matching

Database

Conclusion

Introduction

- Agne Brilingaite, Christian S. Jensen & Nora Zokaite
- 12th International Workshop on Geographic Information Systems (ACM-GIS04) in Washington, DC, USA
- Add the concept of fixed routes to existing GPS technology
- Assumptions
  - Standard GPS receiver
  - Data connection (i.e. GPRS)

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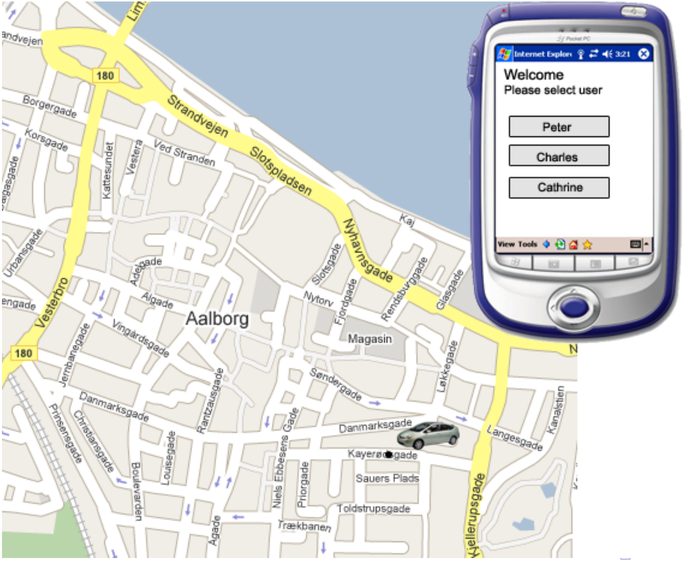
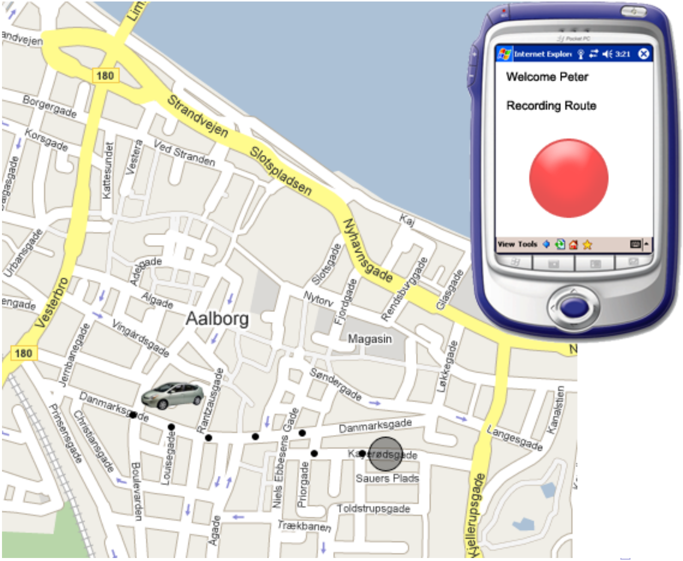


Welcome
Please select user


Internet Explorer 3:21
Welcome Peter
Recording Route
View Tools
Strandvejen
Slotspladsen
Nyhavnsgade
Aalborg
Magasin
Vesterbro
180
180
Borgergade
Korsgade
Ved Stranden
Kattesundet
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Adelgade
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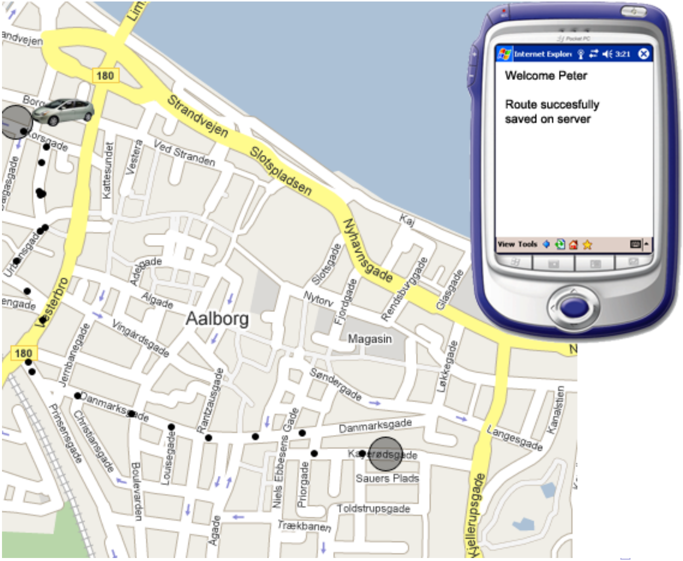
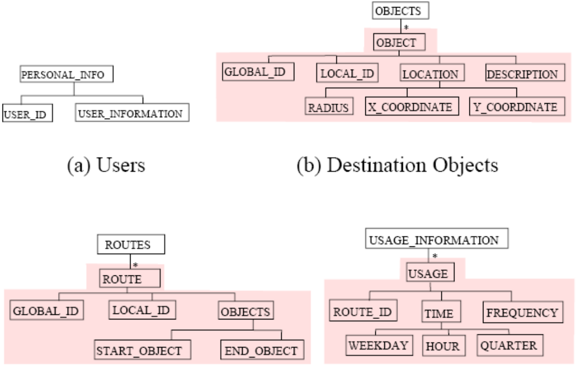


Welcome Peter

Route succesfully saved on server

System Architecture



(a) Users

(b) Destination Objects

(c) Routes

(d) Usages

- Oracle Application Server
- Records and Analyses data sent from client
- Stores everything, including user information
- Should utilize encryption

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- Server receives GPS data as well as information about the user and the user's destination objects.
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Data objects

- User information
  - *UserId*
  - *Undefined: User description*
- Object information
  - If known: Empty
  - If unknown: Description
- Standard information
  - Time and Date
  - GPS location
- Final format
  - *userId, startObjectId, endObjectId, routeId, (xStart, yStarti, radiusStart), (xEnd, yEnd, radiusEnd)*
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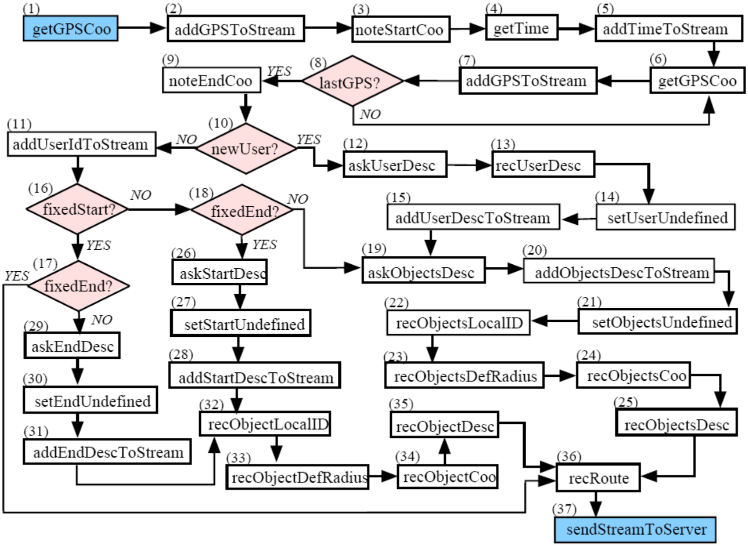
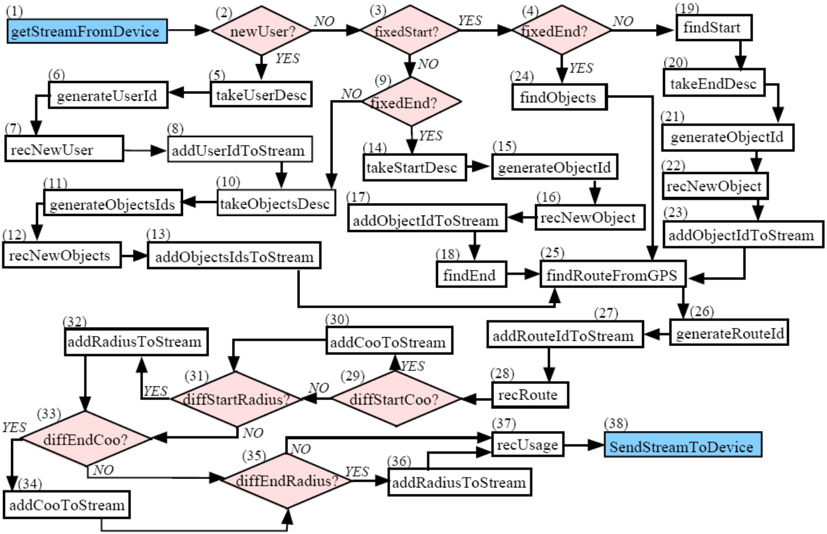


(1) getGPSCoo
(2) addGPSToStream
(3) noteStartCoo
(4) getTime
(5) addTimeToStream
(6) getGPSCoo
(7) addGPSToStream
(8) lastGPS?
YES
NO
(9) noteEndCoo
(10) newUser?
NO
YES
(11) addUserIdToStream
(12) askUserDesc
(13) recUserDesc
(14) setUserUndefined
(15) addUserDescToStream
(16) fixedStart?
NO
YES
(17) fixedEnd?
YES
NO
(18) fixedEnd?
NO
YES
(19) askObjectsDesc
(20) addObjectsDescToStream
(21) setObjectsUndefined
(22) recObjectsLocalID
(23) recObjectsDefRadius
(24) recObjectsCoo
(25) recObjectsDesc
(26) askStartDesc
(27) setStartUndefined
(28) addStartDescToStream
(29) askEndDesc
(30) setEndUndefined
(31) addEndDescToStream
(32) recObjectLocalID
(33) recObjectDefRadius
(34) recObjectCoo
(35) recObjectDesc
(36) recRoute
(37) sendStreamToServer


(1) getStreamFromDevice
(2) newUser?
NO
YES
(3) fixedStart?
YES
NO
(4) fixedEnd?
NO
YES
(19) findStart
(20) takeEndDesc
(21) generateObjectId
(22) recNewObject
(23) addObjectIdToStream
(5) takeUserDesc
(6) generateUserId
(7) recNewUser
(8) addUserIdToStream
(9) fixedEnd?
NO
YES
(10) takeObjectsDesc
(11) generateObjectsIds
(12) recNewObjects
(13) addObjectsIdsToStream
(14) takeStartDesc
(15) generateObjectId
(16) recNewObject
(17) addObjectIdToStream
(18) findEnd
(24) findObjects
(25) findRouteFromGPS
(26) generateRouteId
(27) addRouteIdToStream
(28) recRoute
(29) diffStartCoo?
YES
NO
(30) addCooToStream
(31) diffStartRadius?
YES
NO
(32) addRadiusToStream
(33) diffEndCoo?
YES
NO
(34) addCooToStream
(35) diffEndRadius?
NO
YES
(36) addRadiusToStream
(37) recUsage
(38) SendStreamToDevice

Map matching & Route construction

- Map-matching
- Route identification

- Polyline
  - A series of connected line segments treated as a single entity
- Subpolyline
  - (pl, l_{start}, l_{end}
- Route
  - Subpolylines
  - Start object (user, $circle_s$, $spls_s$)
  - End object (user, $cirlce_e$, $spls_e$)
  - Time

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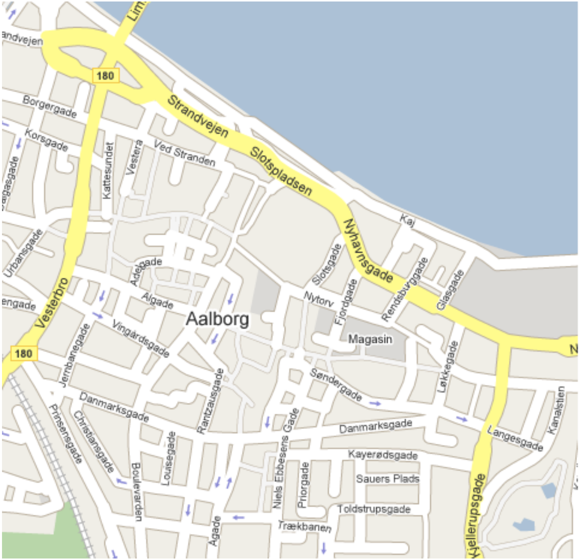
Lim
andvejen
180
Borgergade
Korsgade
Strandvejen
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Danmarksgade
Prinsensgade
Christiansgade
Kanalstien
Langesgade
Gade
Danmarksgade
Kayerødsgade
Louisegade
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Agade
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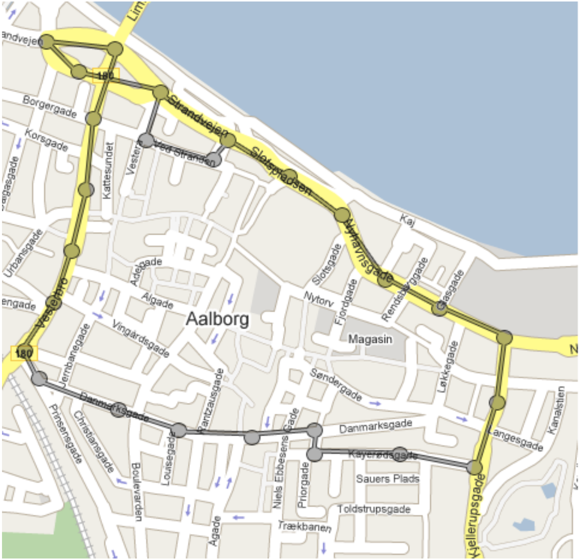
Kjellerupsgade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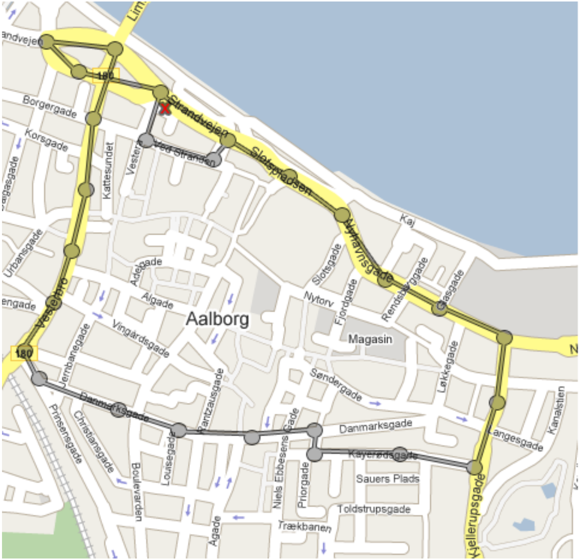
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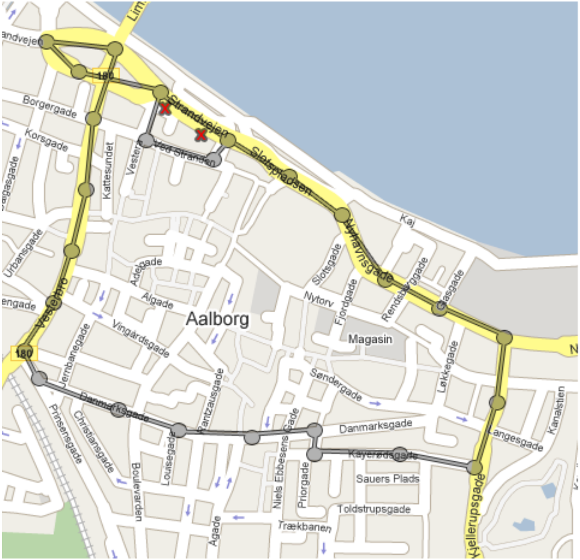
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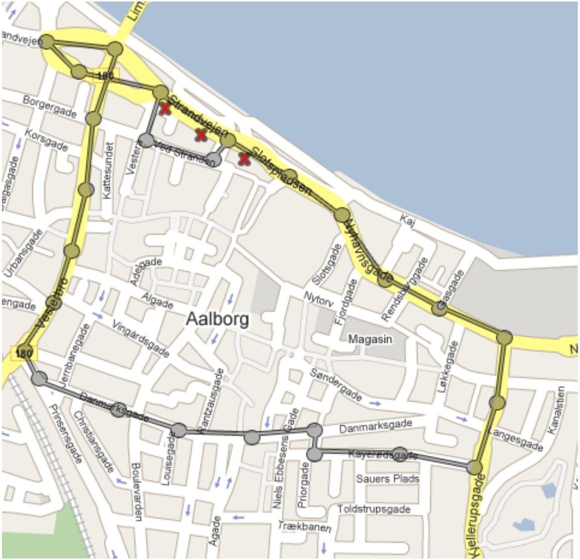
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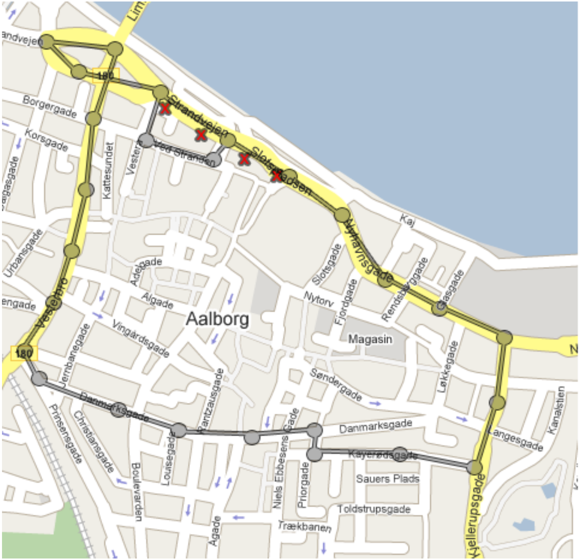
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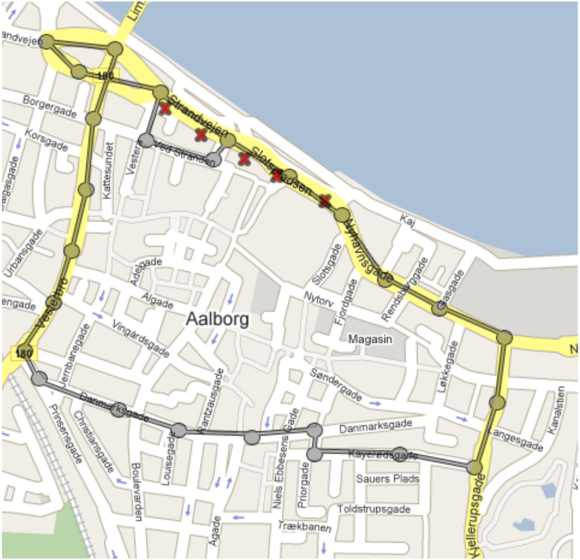
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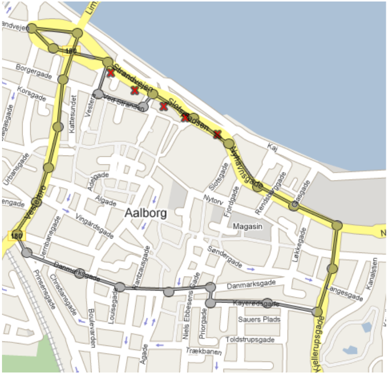
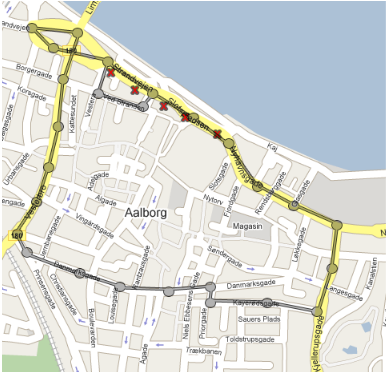


- Connection areas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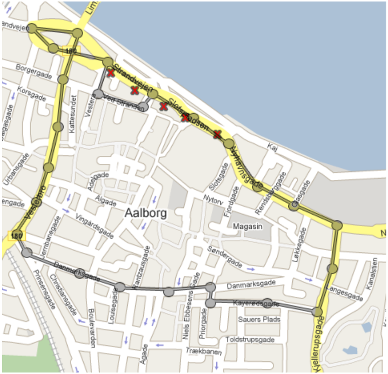
Fjordgade
Slotsgade
Magasin
Rendsburggade
Løkkegade
Kanalstien
Langesgade
Kjellerupsgade
Kaj
180

- Fill gap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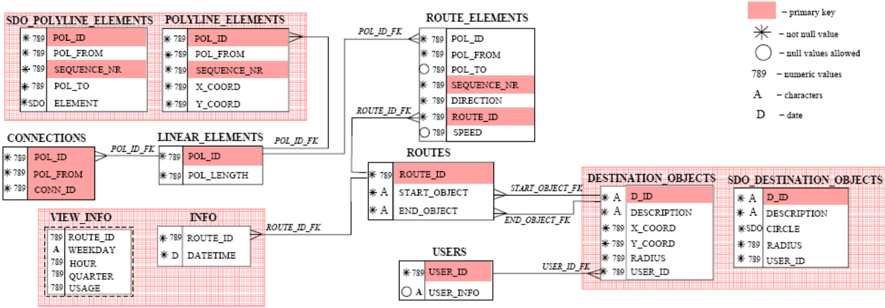
Kanalstien
Kjellerupsgade
180

- End zones

Architecture & Functionality

Database



SDO_POLYLINE_ELEMENTS

✳	789	🟥 POL_ID
✳	789	POL_FROM
✳	789	🟥 SEQUENCE_NR
✳	789	POL_TO
✳	SDO	ELEMENT

POLYLINE_ELEMENTS

✳	789	🟥 POL_ID
✳	789	POL_FROM
✳	789	🟥 SEQUENCE_NR
✳	789	X_COORD
✳	789	Y_COORD

CONNECTIONS

✳	789	🟥 POL_ID
✳	789	🟥 POL_FROM
✳	789	🟥 CONN_ID

LINEAR_ELEMENTS

✳	789	🟥 POL_ID
✳	789	POL_LENGTH

VIEW_INFO

789	ROUTE_ID
A	WEEKDAY
789	HOUR
789	QUARTER
789	USAGE

INFO

✳	789	ROUTE_ID
✳	D	DATETIME

ROUTE_ELEMENTS

✳	789	POL_ID
✳	789	POL_FROM
○	789	POL_TO
✳	789	🟥 SEQUENCE_NR
✳	789	DIRECTION
✳	789	🟥 ROUTE_ID
○	789	SPEED

ROUTES

✳	789	🟥 ROUTE_ID
✳	A	START_OBJECT
✳	A	END_OBJECT

USERS

✳	789	🟥 USER_ID
○	A	USER_INFO

DESTINATION_OBJECTS

✳	A	🟥 D_ID
✳	A	DESCRIPTION
✳	789	X_COORD
✳	789	Y_COORD
✳	789	RADIUS
✳	789	USER_ID

SDO_DESTINATION_OBJECTS

✳	A	🟥 D_ID
✳	A	DESCRIPTION
✳	SDO	CIRCLE
✳	789	RADIUS
✳	789	USER_ID

🟥 – primary key
✳ – not null value
○ – null values allowed
789 – numeric values
A – characters
D – date

Conclusion

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- Data model
- Depends on map

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