



Secure Transport Location Proofs for vehicle inspections

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Motivation

Heavy road vehicle inspections



Motivation

What can technology do to improve these kind of processes?



Related Work

GPS Location Systems

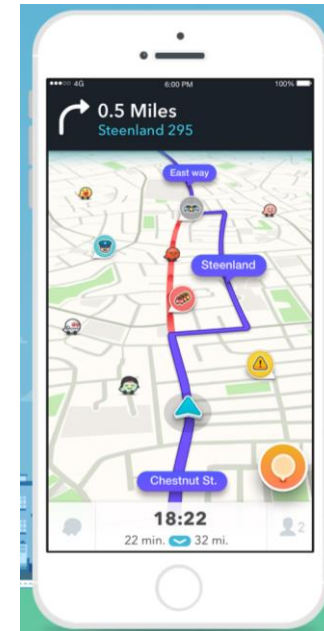


Location Tracking



Use of Location by Mobile Applications

Assumes trusted devices

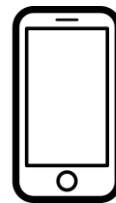


Location Certification



Location proof certicates the location of mobile devices with nearby trusted infrastructure or mobile devices.

Entities typically used:



Prover



Witness



Verifier



Certification
Authority

Goals



Location reporting of ongoing transportations

- Automated and accurate selection of vehicles for inspection

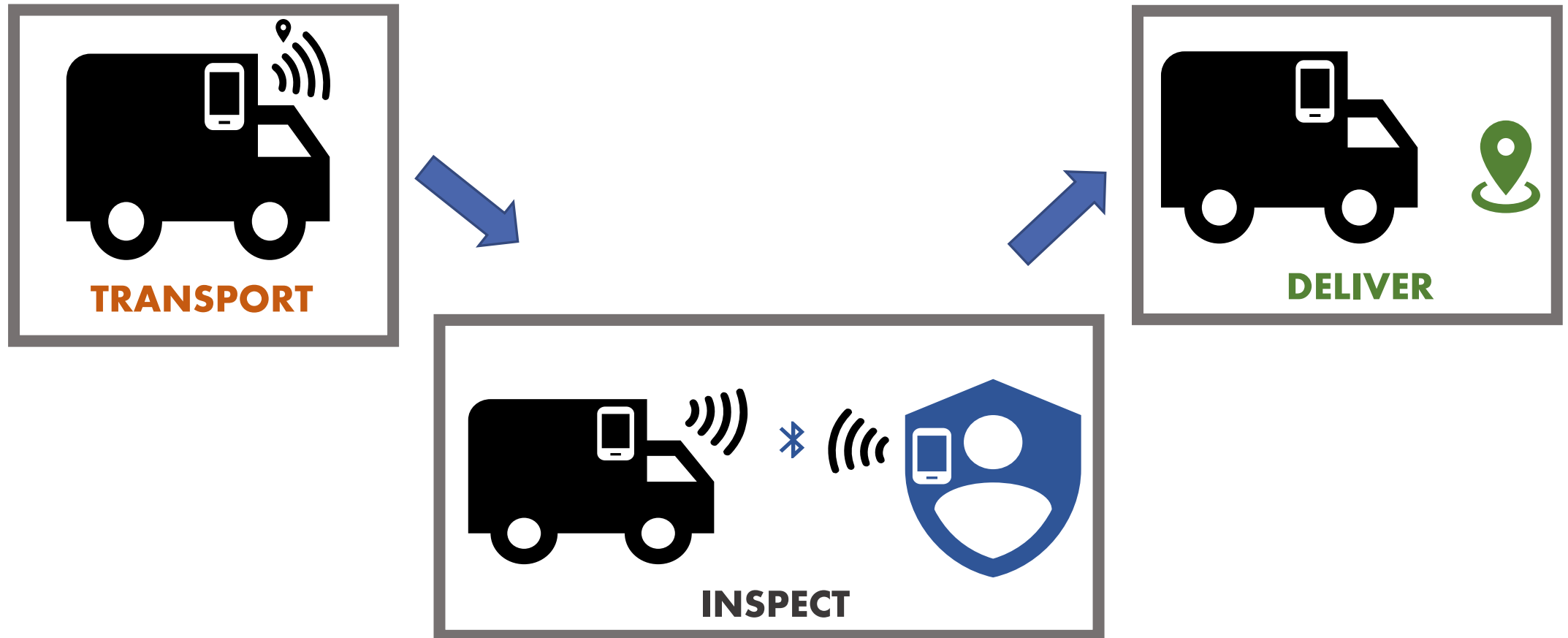
Digitalization of the required information for inspection

Certified inspection outcome digital reports

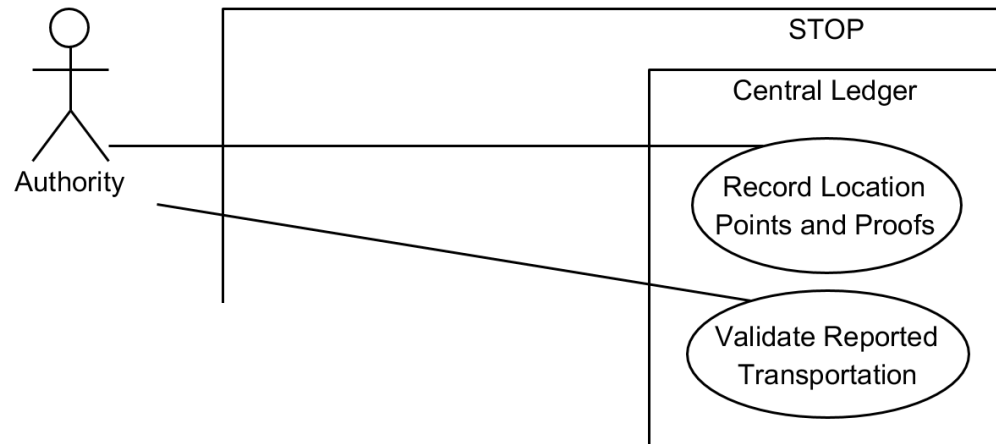
STOP System

Secure **T**ransport **L**ocation **P**roofs for vehicle inspections

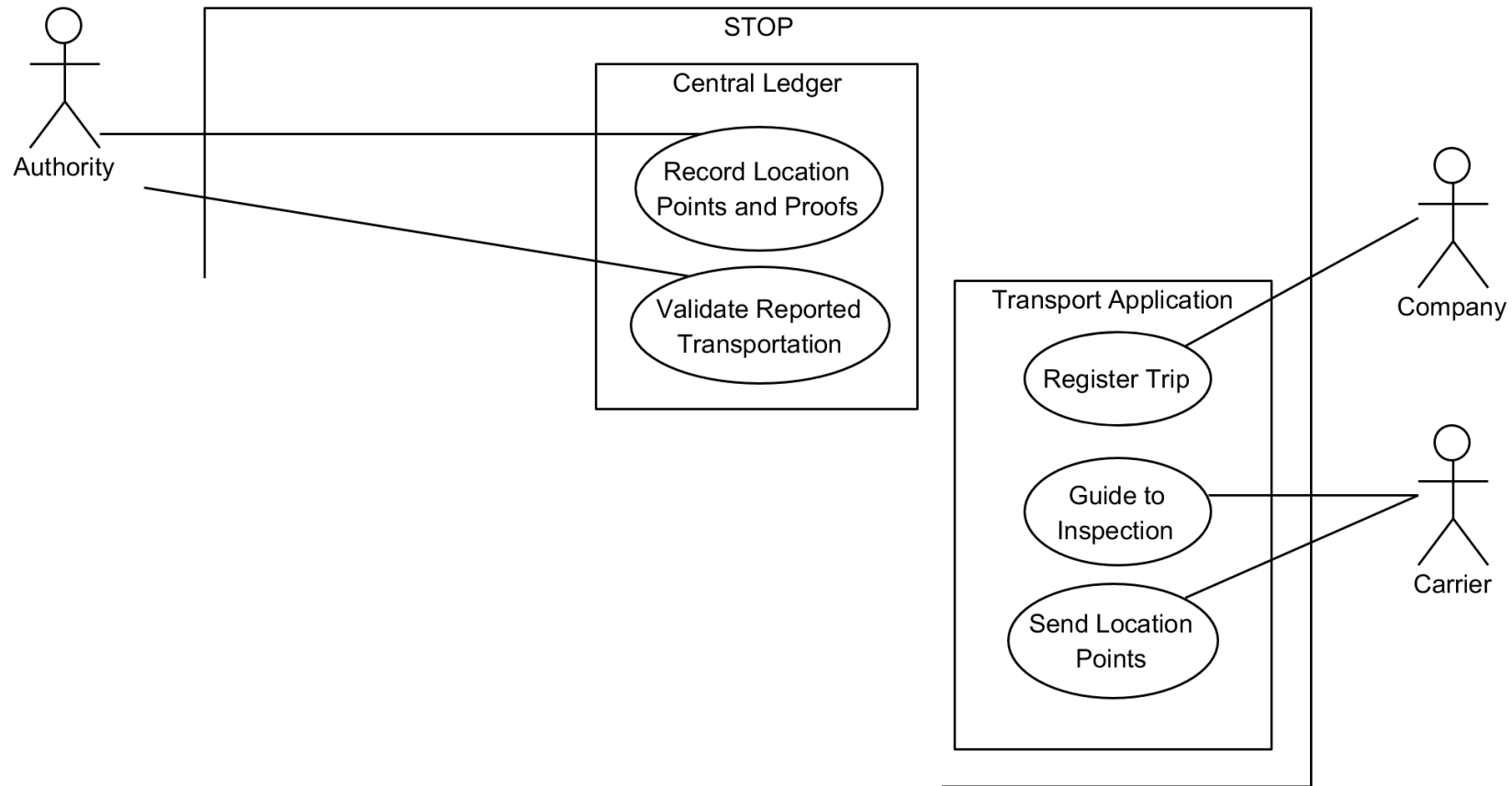
Process Overview



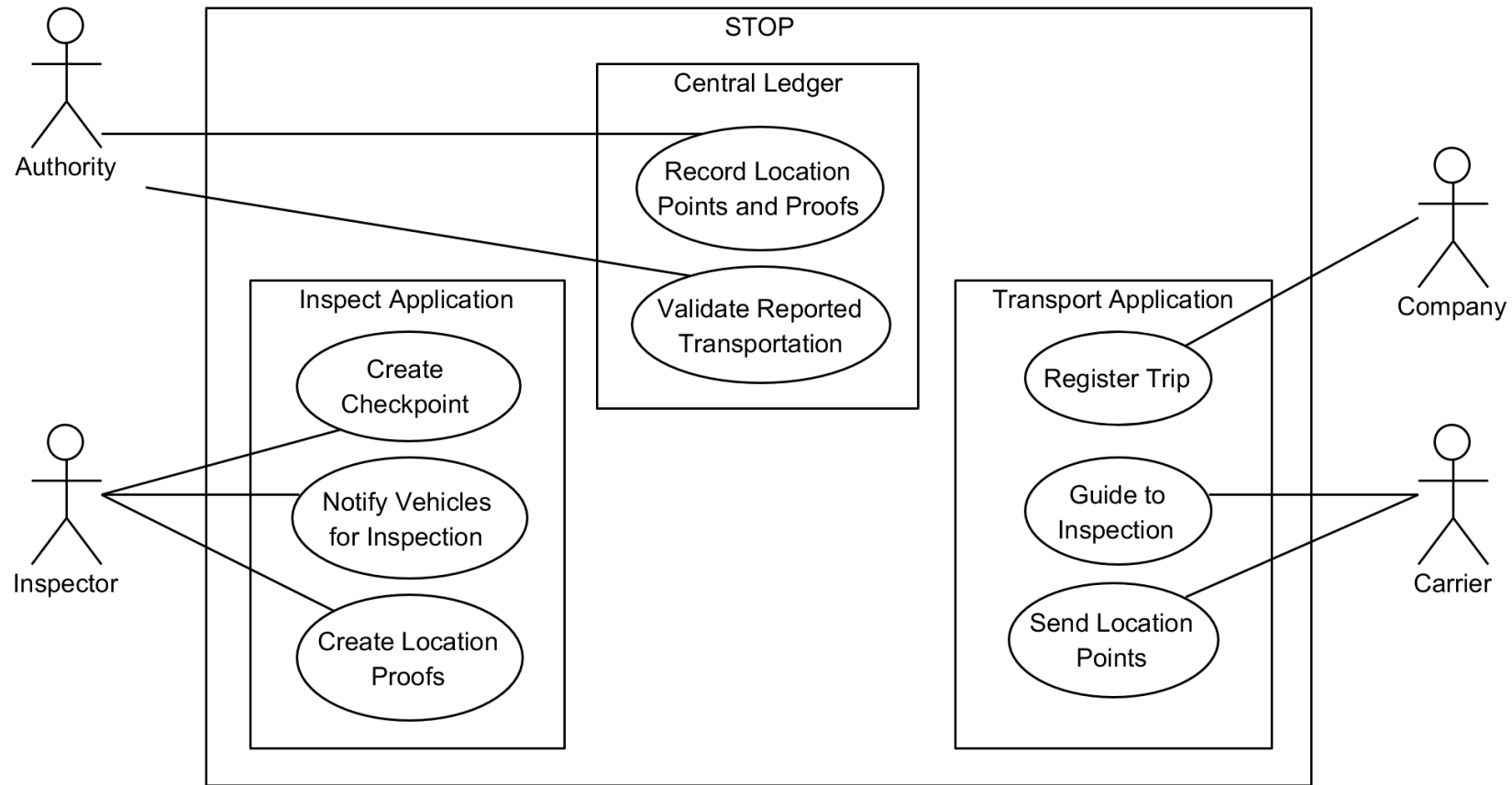
Roles and Components



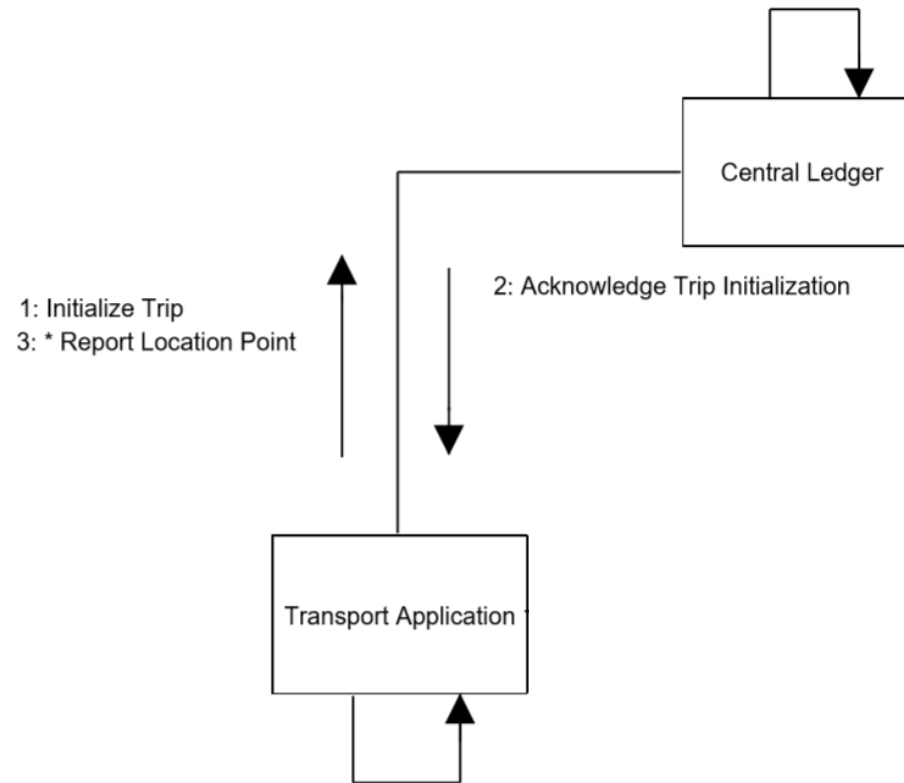
Roles and Components



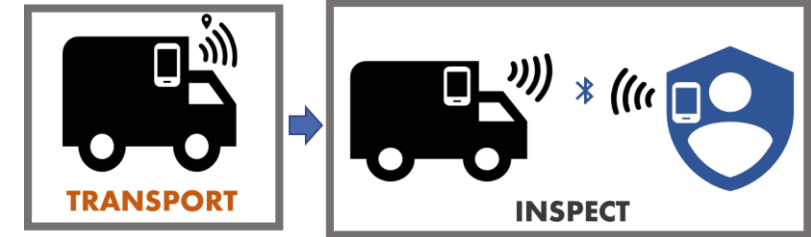
Roles and Components



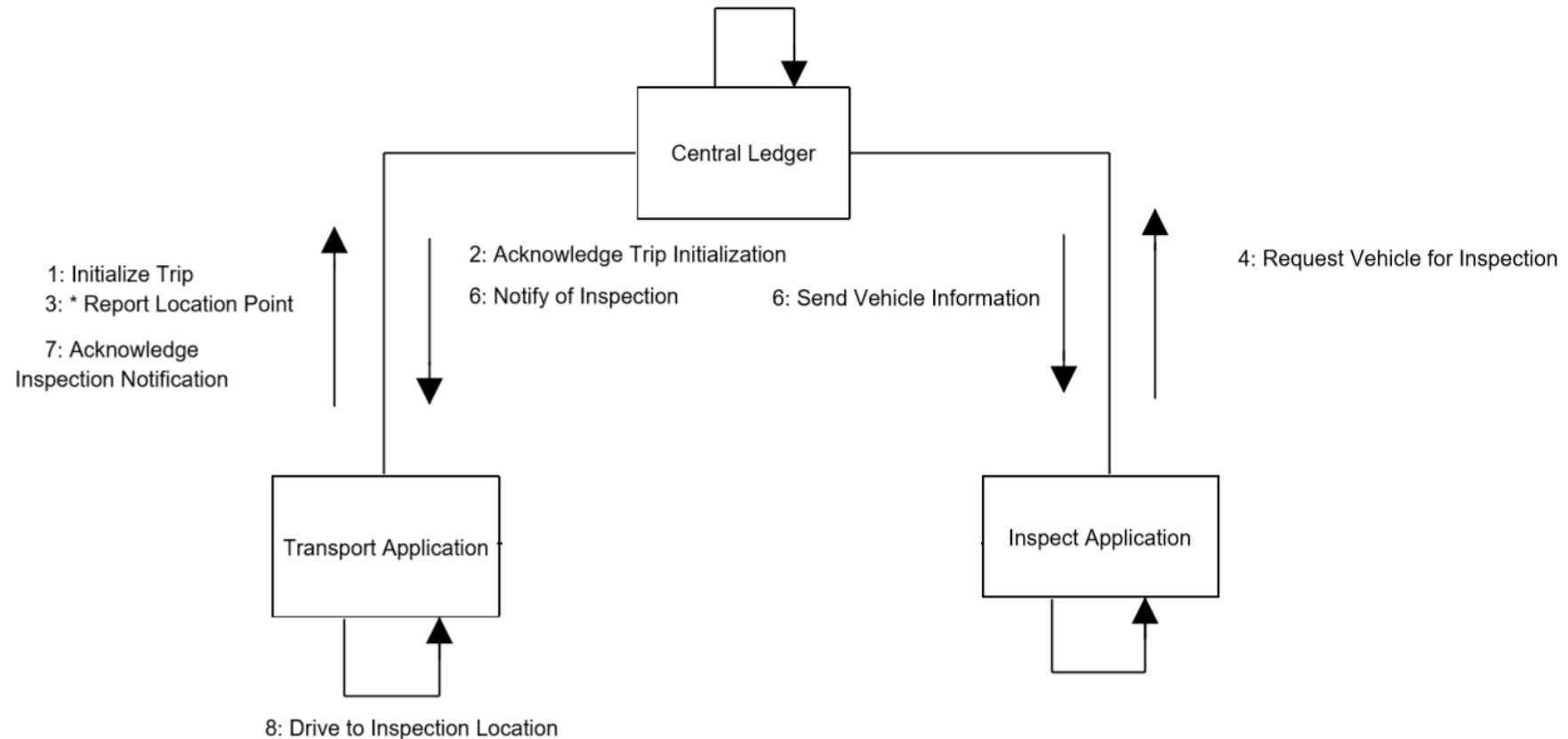
System Operation



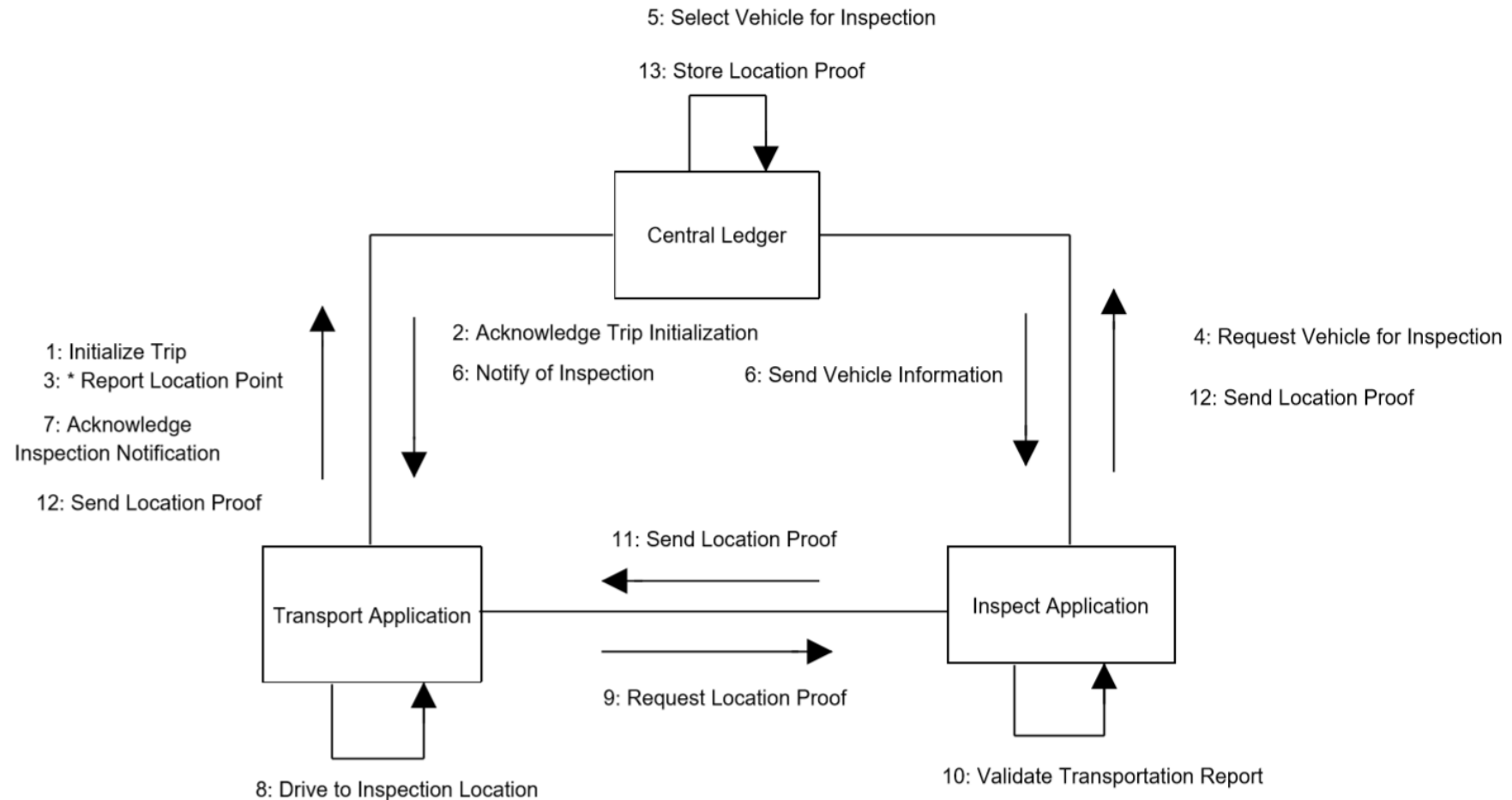
System Operation



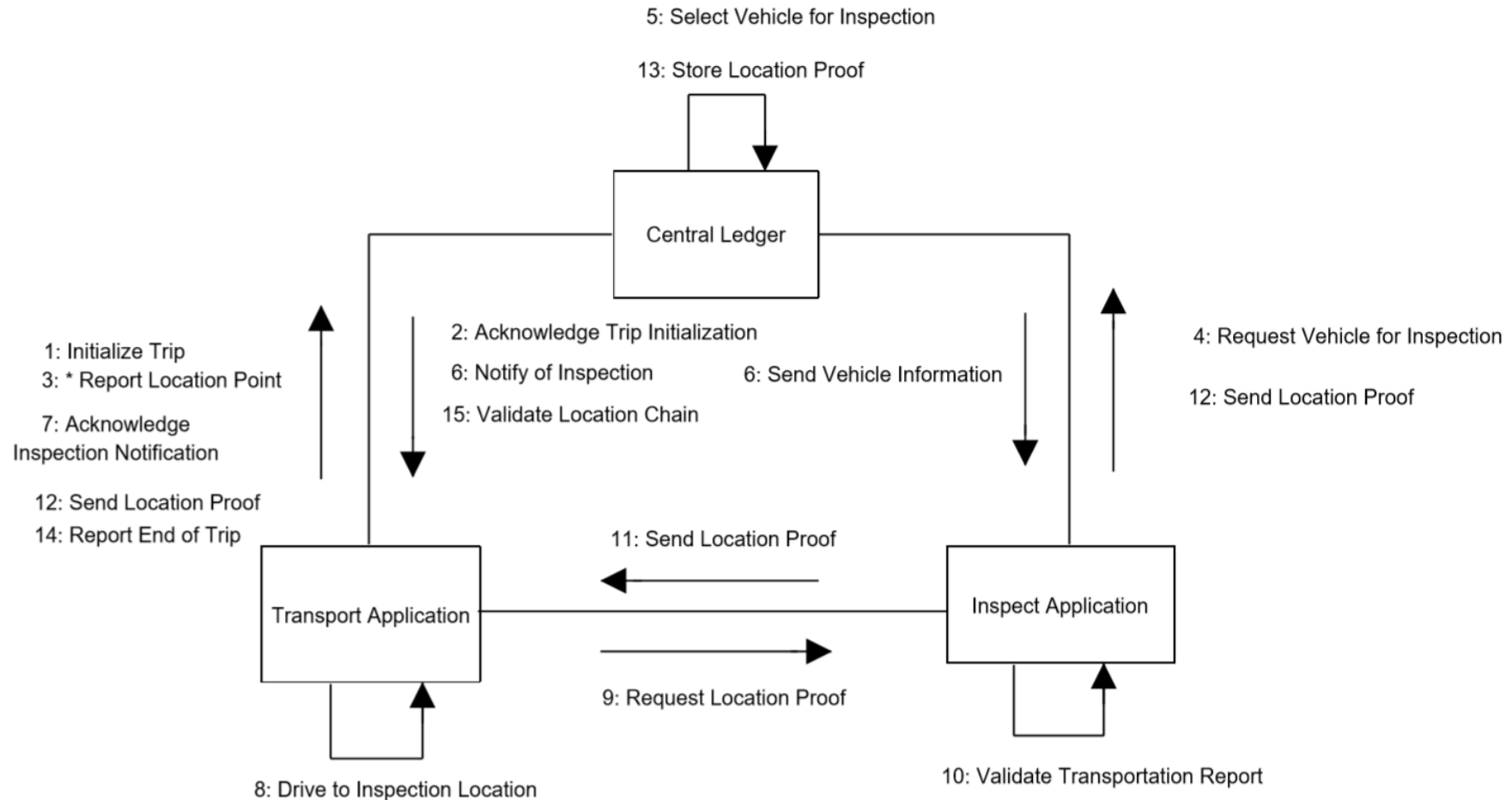
5: Select Vehicle for Inspection



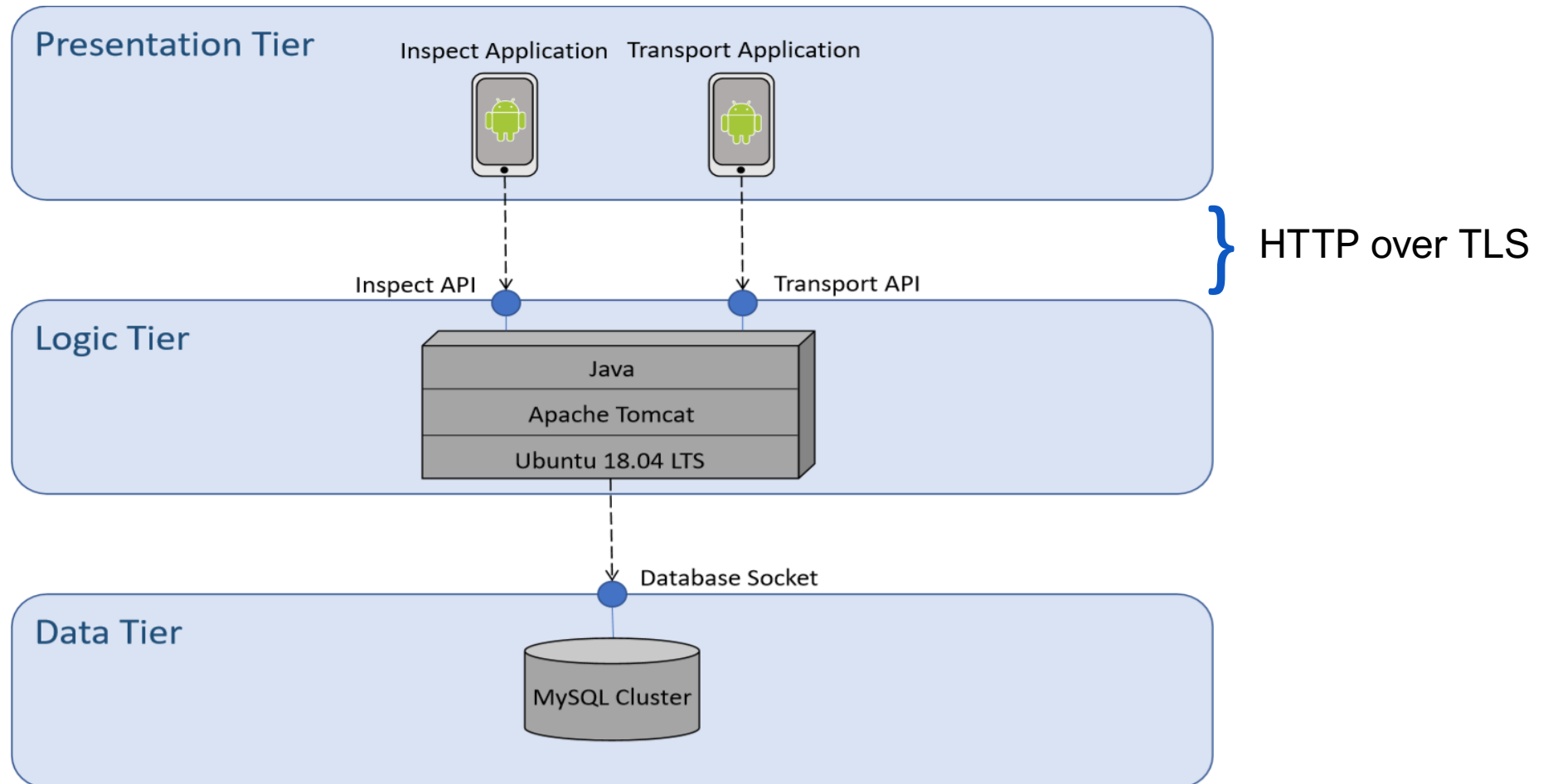
System Operation



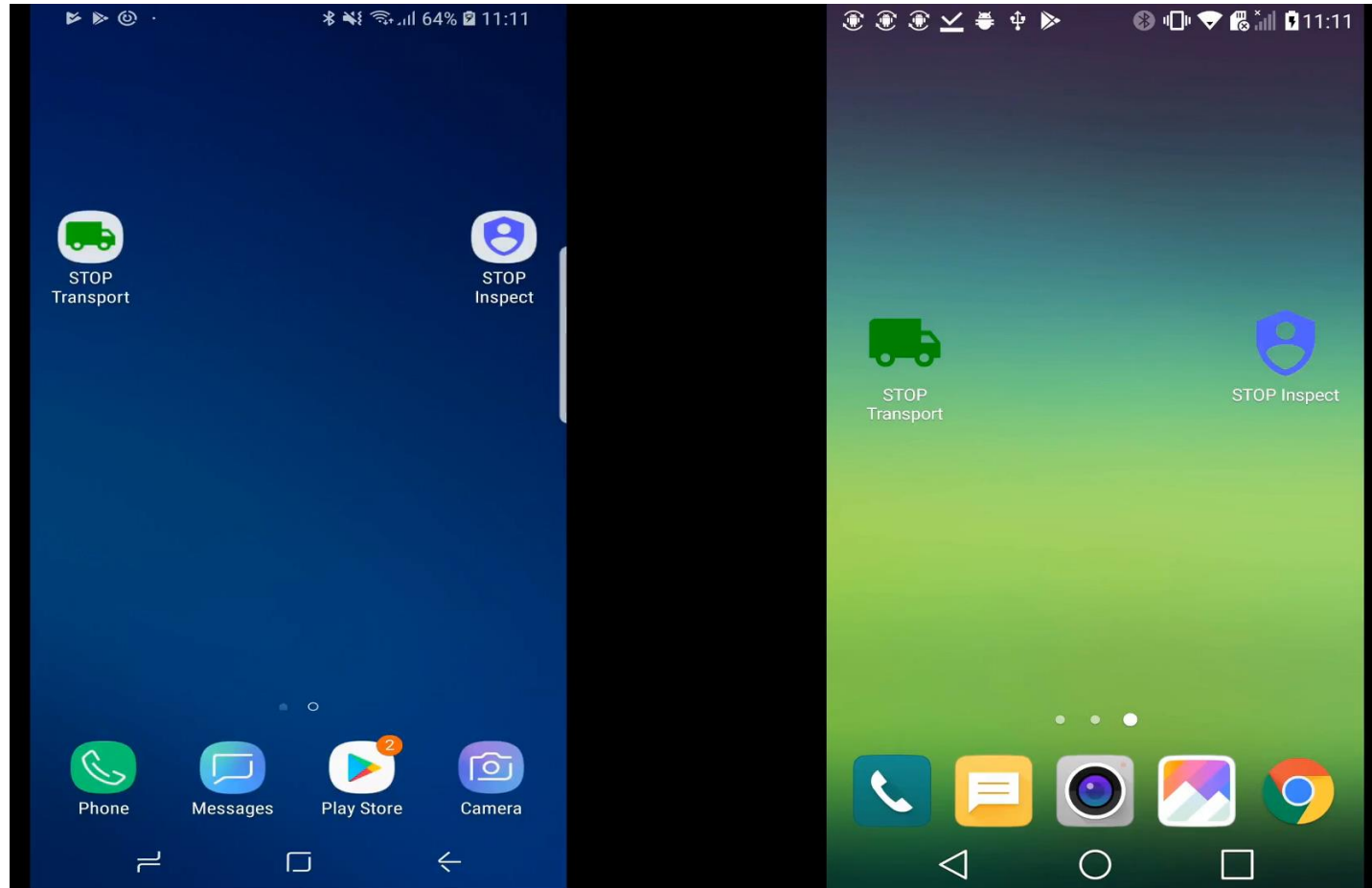
System Operation



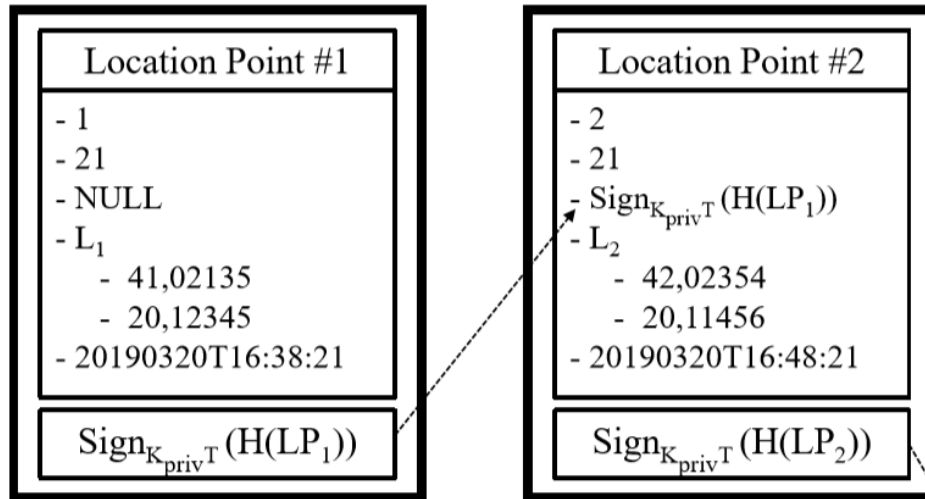
Prototype Architecture



Demonstration



Location Chain



T – Transport Application

I – Inspect Application

L_i – GPS coordinates at instance i

M – Message

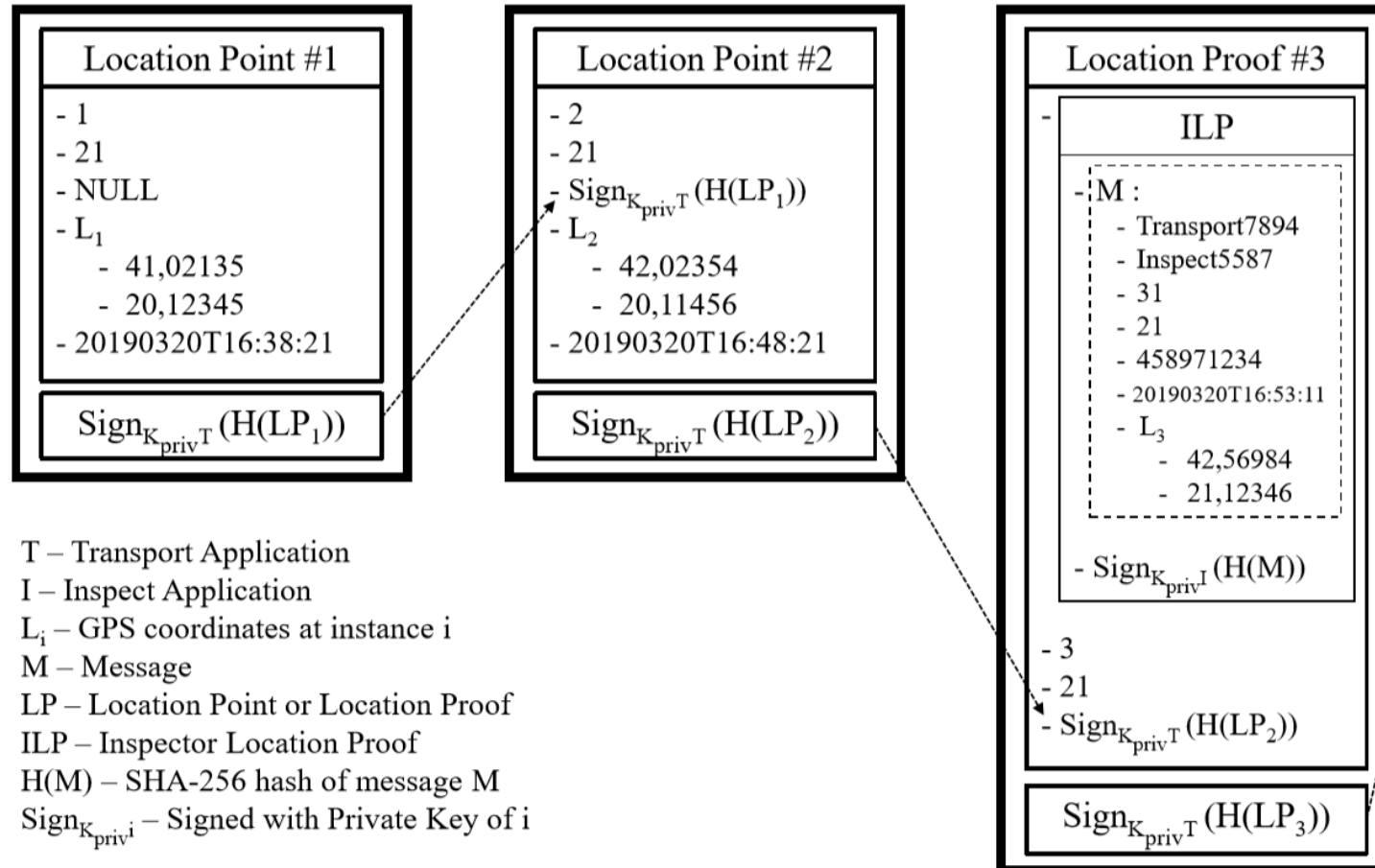
LP – Location Point or Location Proof

ILP – Inspector Location Proof

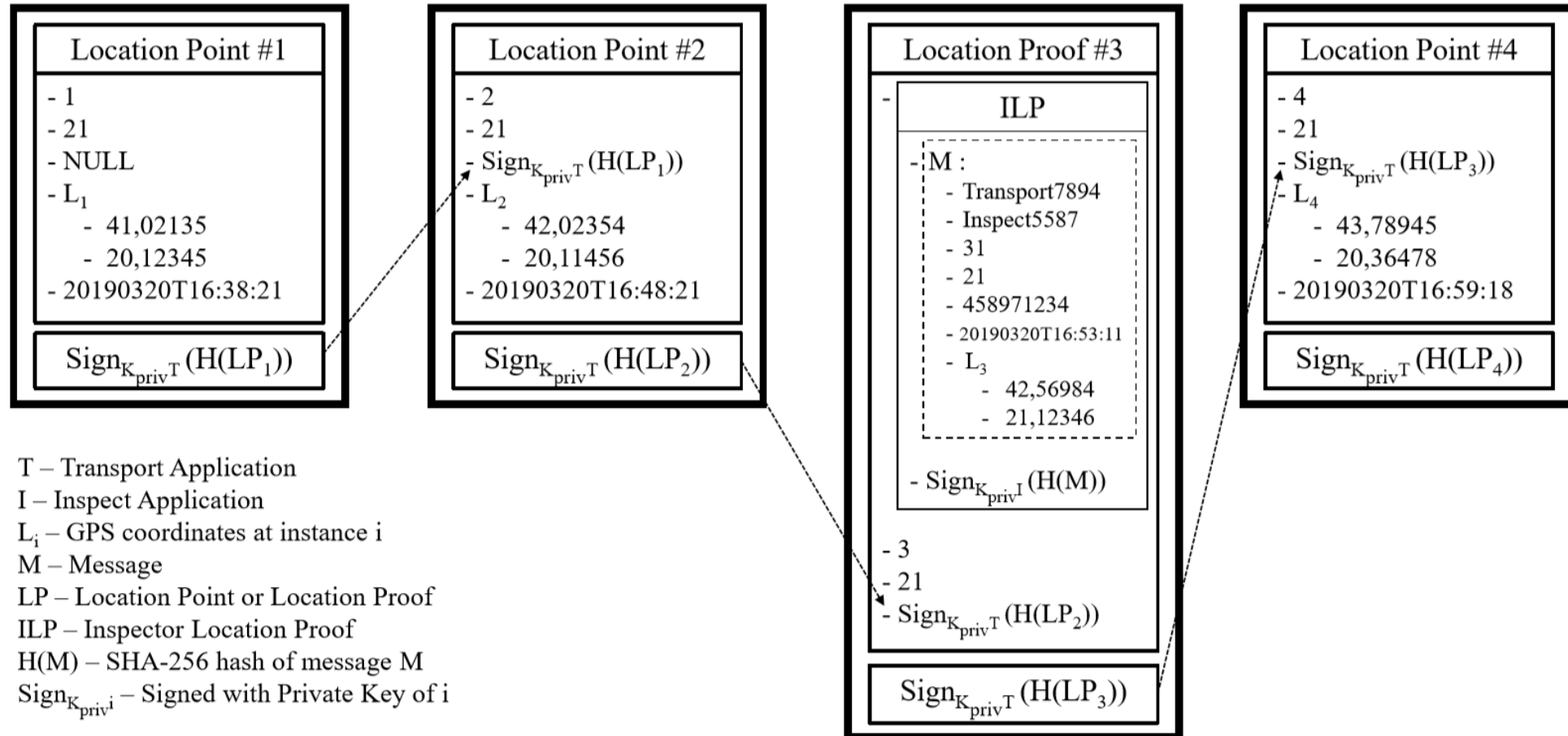
$H(M)$ – SHA-256 hash of message M

$\text{Sign}_{K_{\text{priv}i}}$ – Signed with Private Key of i

Location Chain



Location Chain



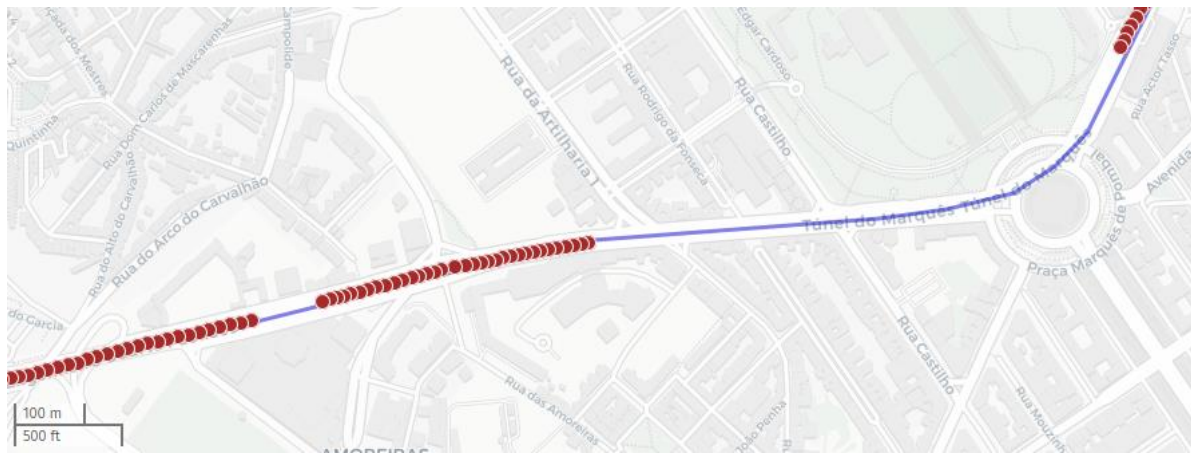
Evaluation

Experiments

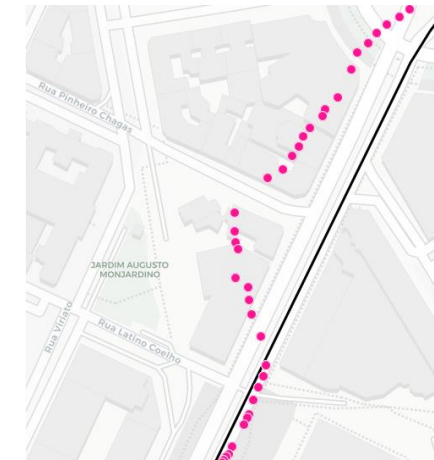
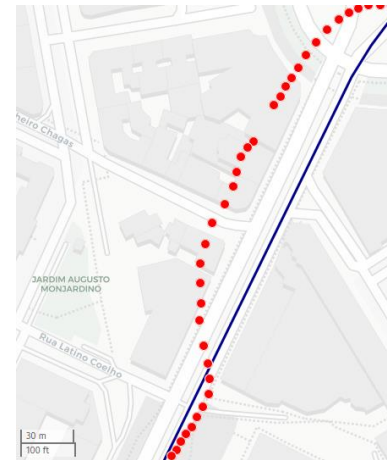


- Accuracy of the reported location of the used devices
- Ideal STOP parameters for selection of vehicles
- Inspection interaction protocol with Bluetooth

Location Accuracy



Issues inside of a tunnel



Issues with surrounding buildings

Location Accuracy



User	No. Points	Average distance (m)
A	1244	4,64
B	1673	5,57
C	832	7,32
D	1375	8,19
E	1376	8,94
F	1820	18,97
G	1885	7,51

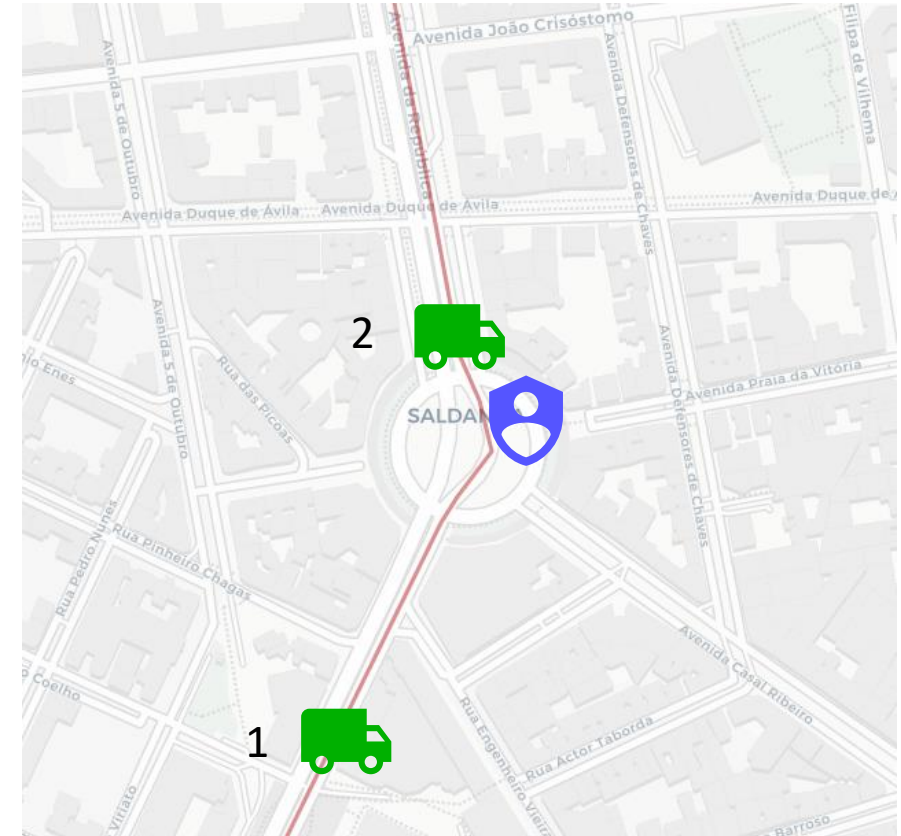
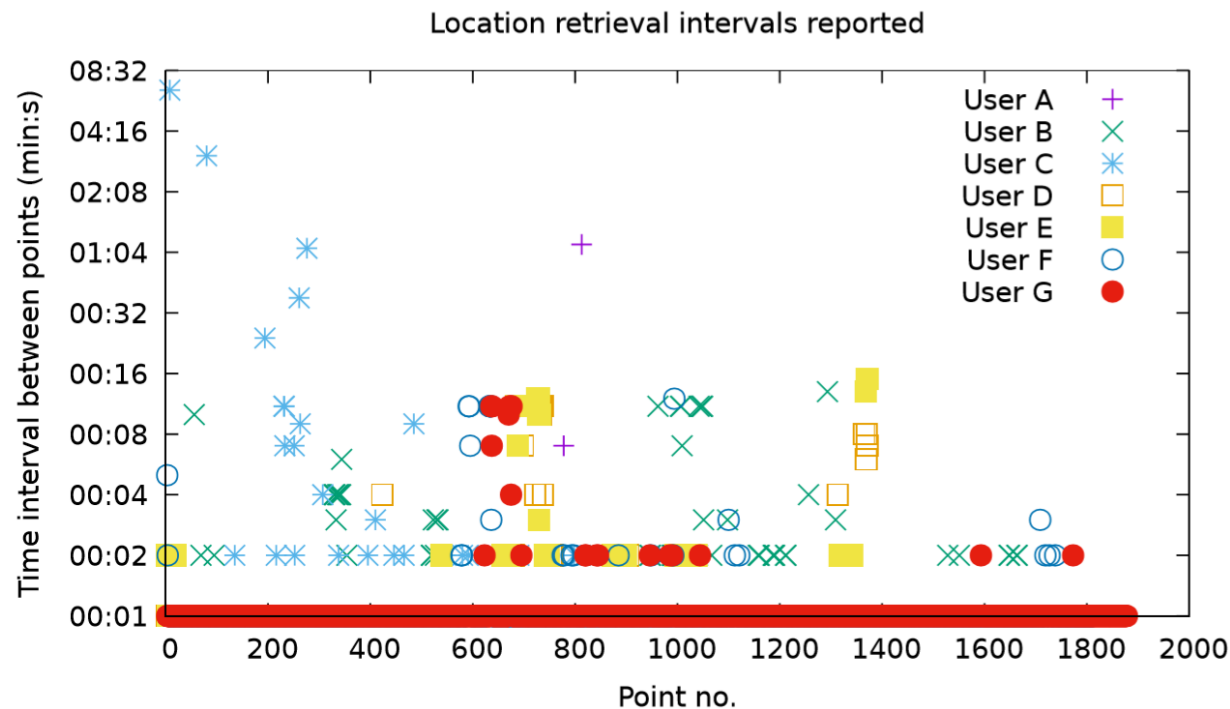
Location retrieval accuracy results

Selection Parameters



Location Retrieval Rate: 1 second

Inspection Selection Range: 500 meters



Selection issue with user B

Bluetooth Interaction



We assumed the Bluetooth connection would be maintained during the duration of the inspection procedure

- This was proven wrong
- Therefore we suggest a two-phase protocol



Standard Container in Truck

Conclusion



Our proposal:

- Provides a technological basis to support inspections
- Implemented Android applications and Central Ledger
- Collects location information of transportation vehicles
- Location Chain projects all location events of a transportation

The evaluation showed:

- Accurate location tracking
- Reliable location retrieval rate and optimal selection rule
- Feasibility of the inspection protocol



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Thank you!

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