

Hackathon

Brisa

*Leading the way to
improve mobility*





Challenge

Current system:

- Requires an identifier device in the vehicle
- Infrastructure needed at every toll
- Maintenance needed

Goal Develop technology to:

- Eliminate the in-vehicle device
- Reduce the need for physical infrastructure
- Maintain high detection accuracy

Alternatives Considered

License Plate Recognition

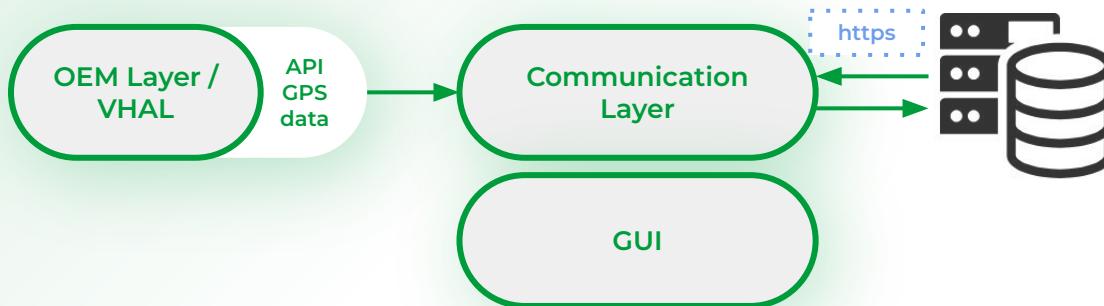
- Dependent on weather and external conditions

Vehicle Bluetooth Signal

- Requires new infrastructure at tolls
- Might raise OEM data security concerns



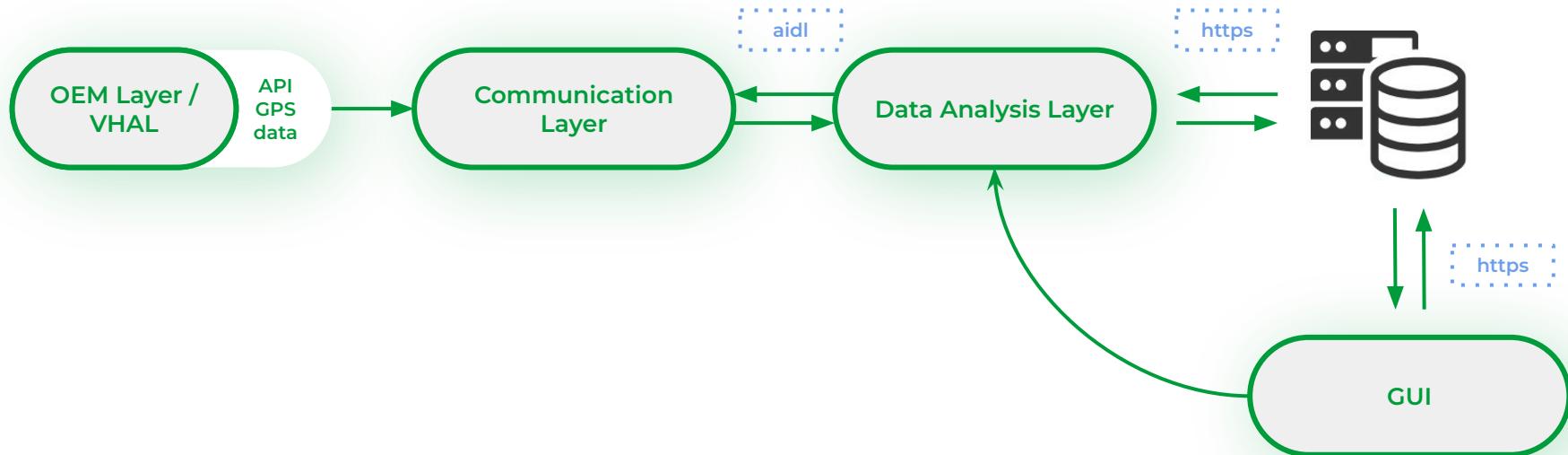
Alternatives Considered



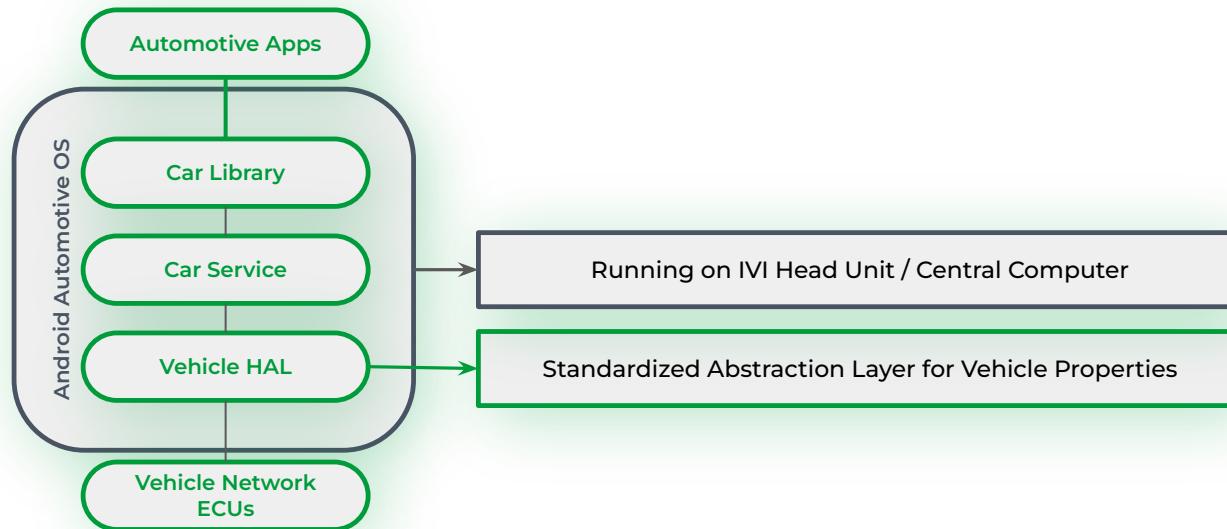
In-car app

- Sending GPS signal.
- Geofences

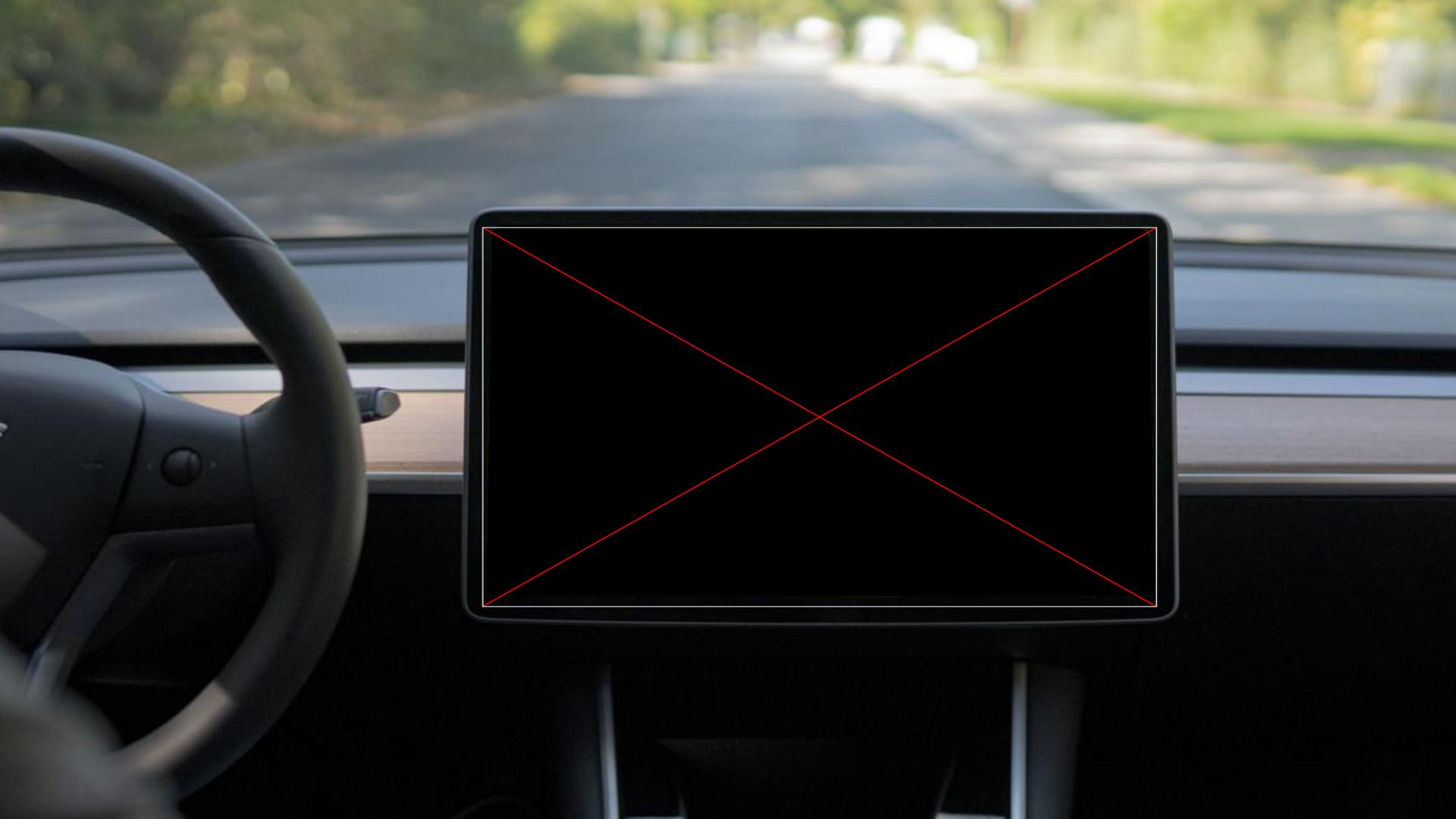
First Approach



First Approach









63°

63°





Viagem #10015

31 de julho de 2025

19h27min

Grijó - Feira

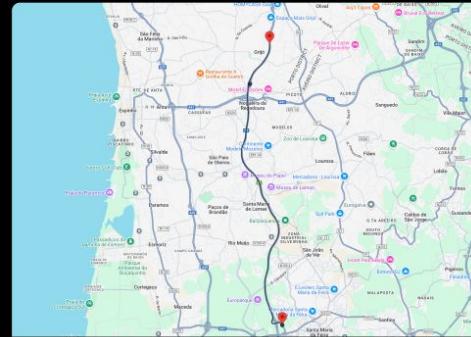
13km

33-CC-33

€1.50

9:57

Driver



63°



62°





First Approach : Results



Task accomplished

Get the GPS data from the car and assess car crossed a toll



Security

Minimum required data sent



GUI

Visual Interface to check history



Scalability

Applicable for increasing databases

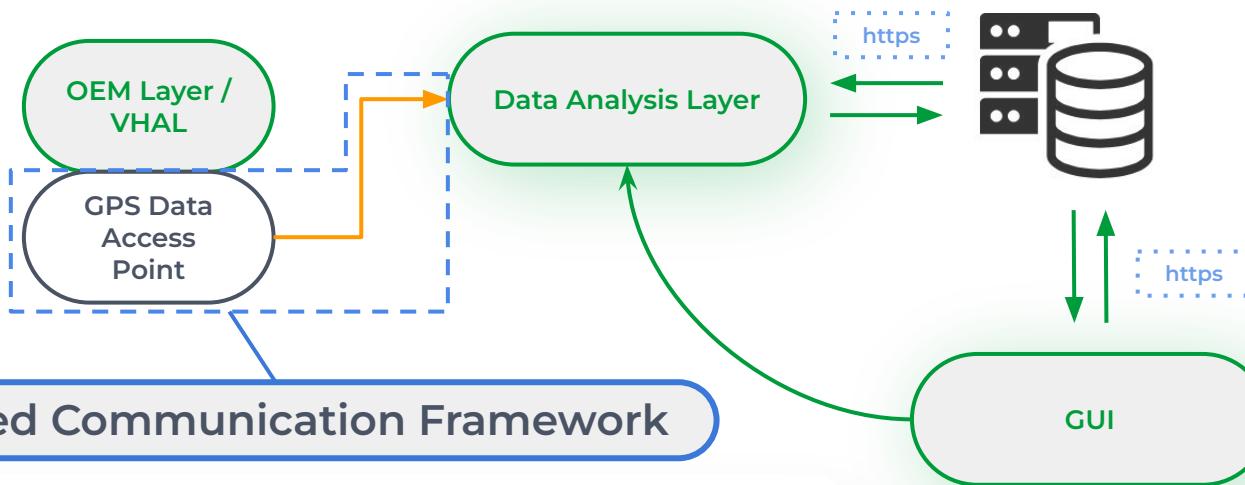
Possible Setbacks



- Different OS
- Different Data Access
- Data Protection Policies
- Latency

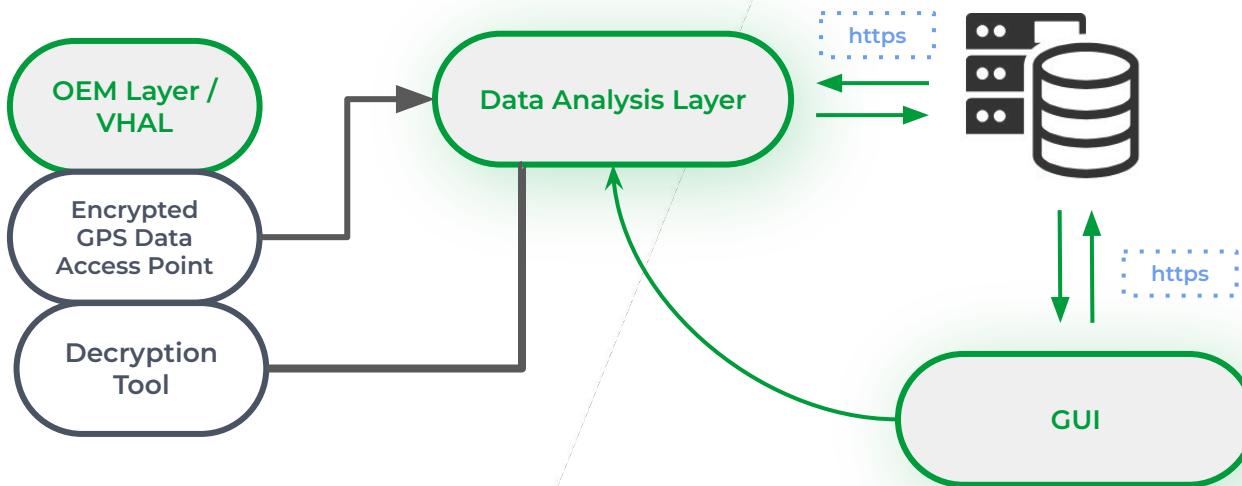


Solving Setbacks: Communication Rules



- Agreed upon set of rules of implementation
- Multi-brand support for ease of integration

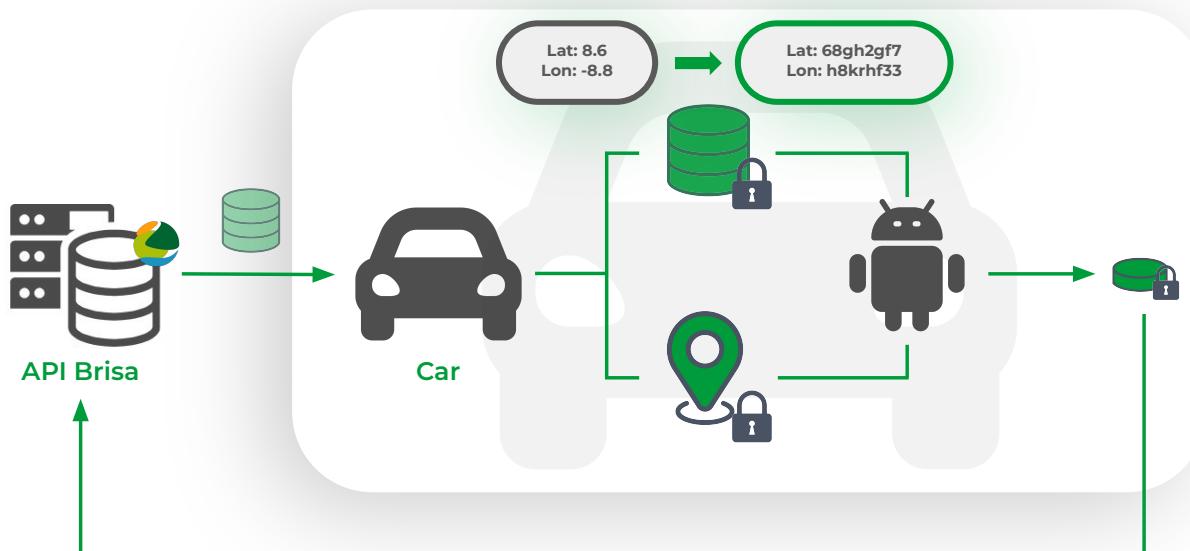
Solving Setbacks: Encryption



Solving Setbacks: Encryption

Using homomorphic Encryption

Microsoft - SEAL



```
Test 5: Expected: Queluz 1
- ● Hierarchical filtering: 24ms (reduced from 358 to 19 zones)
- ● Hierarchical filter: 24ms
- ✅ Precision checks: 119ms
- ✅ Total time: 143ms
- 🚧 Zones filtered: 339/358 (94.7% reduction)
- 🚧 Positive matches: 1
- ✅ TOLL DETECTED in:
  • 0901 (Queluz 1 (0901))
- Action: CHARGE TOLL

Test 6: Expected: Aveiro Sul
- ● Hierarchical filtering: 29ms (reduced from 358 to 251 zones)
- ● Hierarchical filter: 29ms
- ✅ Precision checks: 1422ms
- ✅ Total time: 1451ms
- 🚧 Zones filtered: 107/358 (29.9% reduction)
- 🚧 Positive matches: 1
- ✅ TOLL DETECTED in:
  • 0115 (Aveiro Sul (0115))
- Action: CHARGE TOLL

Test 7: Expected: Far outside
- ● Hierarchical filtering: 23ms (reduced from 358 to 16 zones)
- ● Hierarchical filter: 23ms
- ✅ Precision checks: 90ms
- ✅ Total time: 114ms
- 🚧 Zones filtered: 342/358 (95.5% reduction)
- 🚧 Positive matches: 0
- ✗ NO TOLLS DETECTED (Action: NO TOLL)

Test 8: Expected: South
- ● Hierarchical filtering: 23ms (reduced from 358 to 16 zones)
- ● Hierarchical filter: 23ms
- ✅ Precision checks: 91ms
- ✅ Total time: 115ms
- 🚧 Zones filtered: 342/358 (95.5% reduction)
- 🚧 Positive matches: 0
- ✗ NO TOLLS DETECTED (Action: NO TOLL)
```

Solving Setbacks: Latency

Using homomorphic Encryption

Microsoft - SEAL

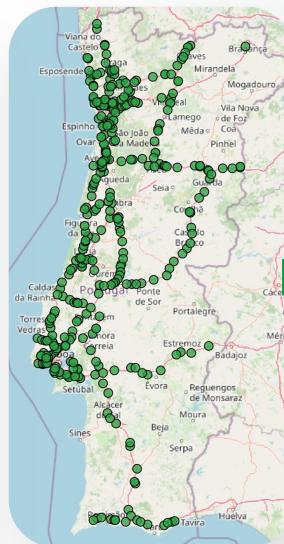
Test 5: Expected: Queluz 1
- Hierarchical filtering: 24ms (reduced from 358 to 19 zones)
- Hierarchical filter: 24ms
- Precision checks: 119ms
- Total time: 143ms
- Zones Filtered: 359/358 (94.7% reduction)
- Positive matches: 1
- TOLL DETECTED in:

- 0901 (Queluz 1 (0901))

Action: CHARGE TOLL

Aiming to reduce latency, we explored:

- binary search algorithms,
- zone filtering to reduce comparisons,
- longitude division



Conclusion and next steps

Accomplished

- Working service app
- Proof-of-concept using encryption
- Suggested plan of action to take to OEMs



Next Steps

- 6 months investment for MVP
 - Develop a minimum viable product
 - Thorough analysis of Brisa API
 - Analyze other geofence designs
 - Implement on-off feature on front app



Team



**Axel
Chabrerie**



Jorge Cruz



Luís Carvalho



Luiza Zilio



Rui Pires



Francisco Vieira



João Santiliano

Thank you!

