# Service Platform for Green European Transportation

**TU/e, Exodus, Hasso Plattner Institut,**
**IBM Zurich Research Lab,**
**Jan de Rijk Logistics, Portbase, PTV,**
**TransVer, Wirtschaftsuniversität Wien**
**Kuehne+Nagel, viaDonau, TomTom, DHL**

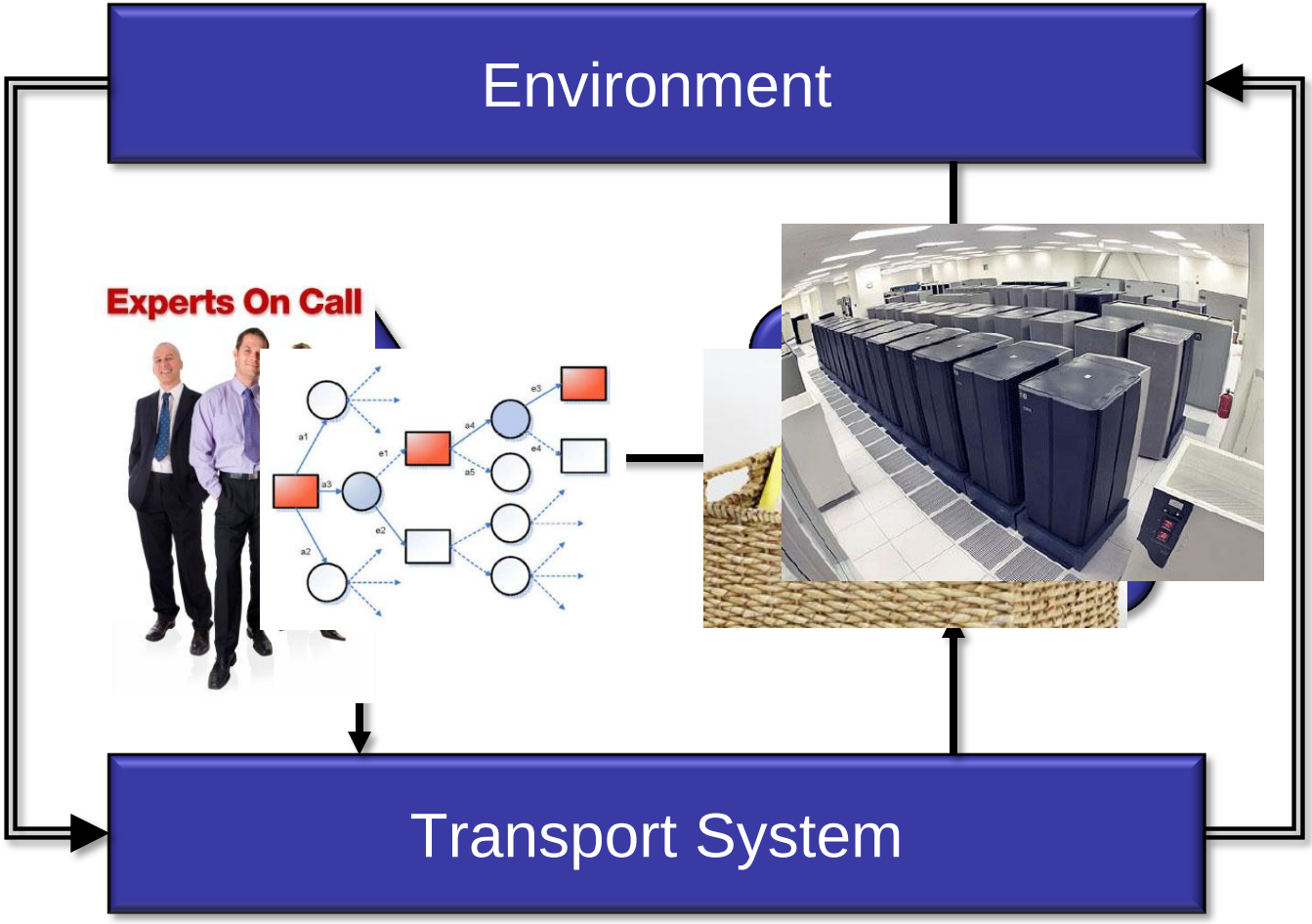
**Remco Dijkman, Paul Grefen**

GET SERVICE PLATFORM

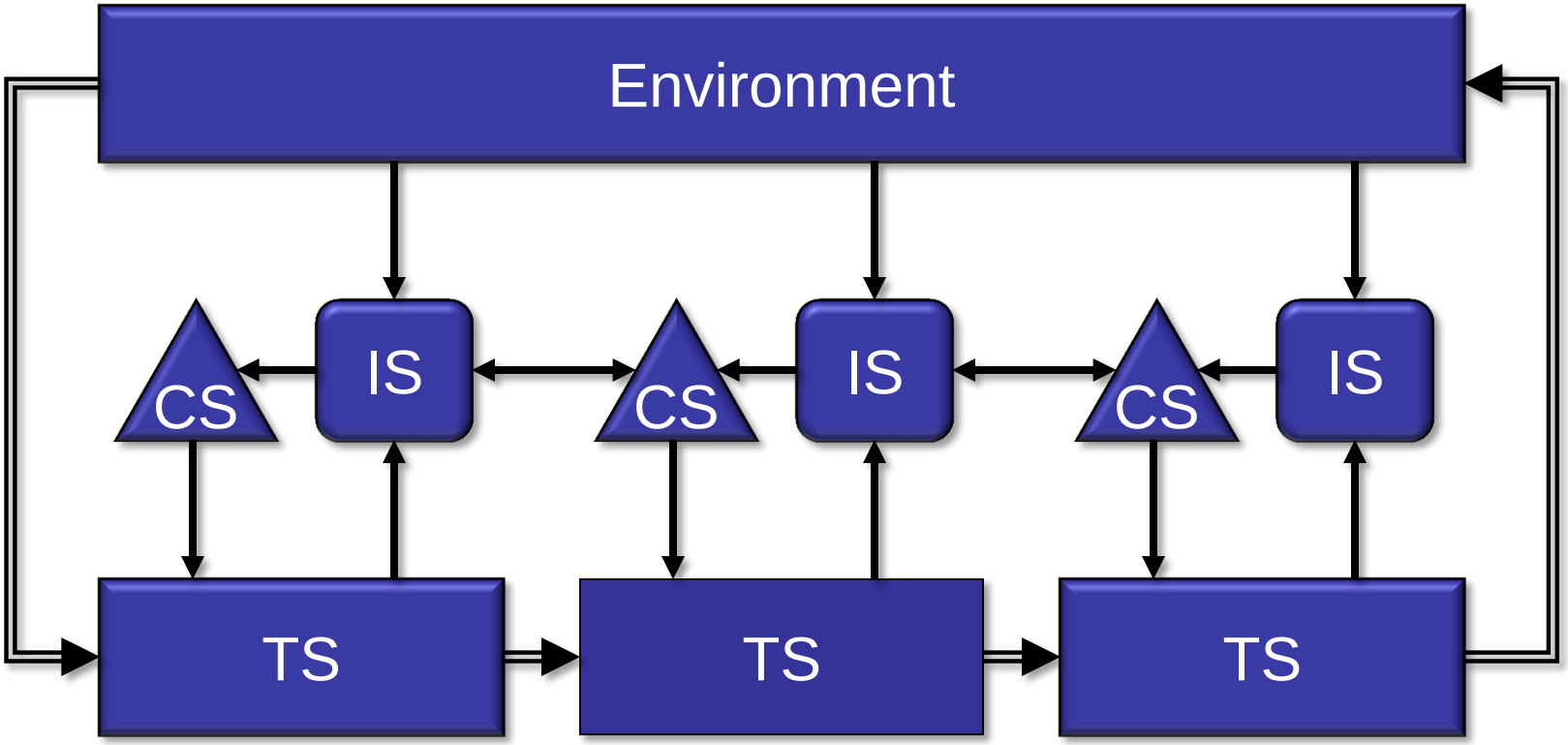
TU/e Technische Universiteit Eindhoven University of Technology

Where innovation starts

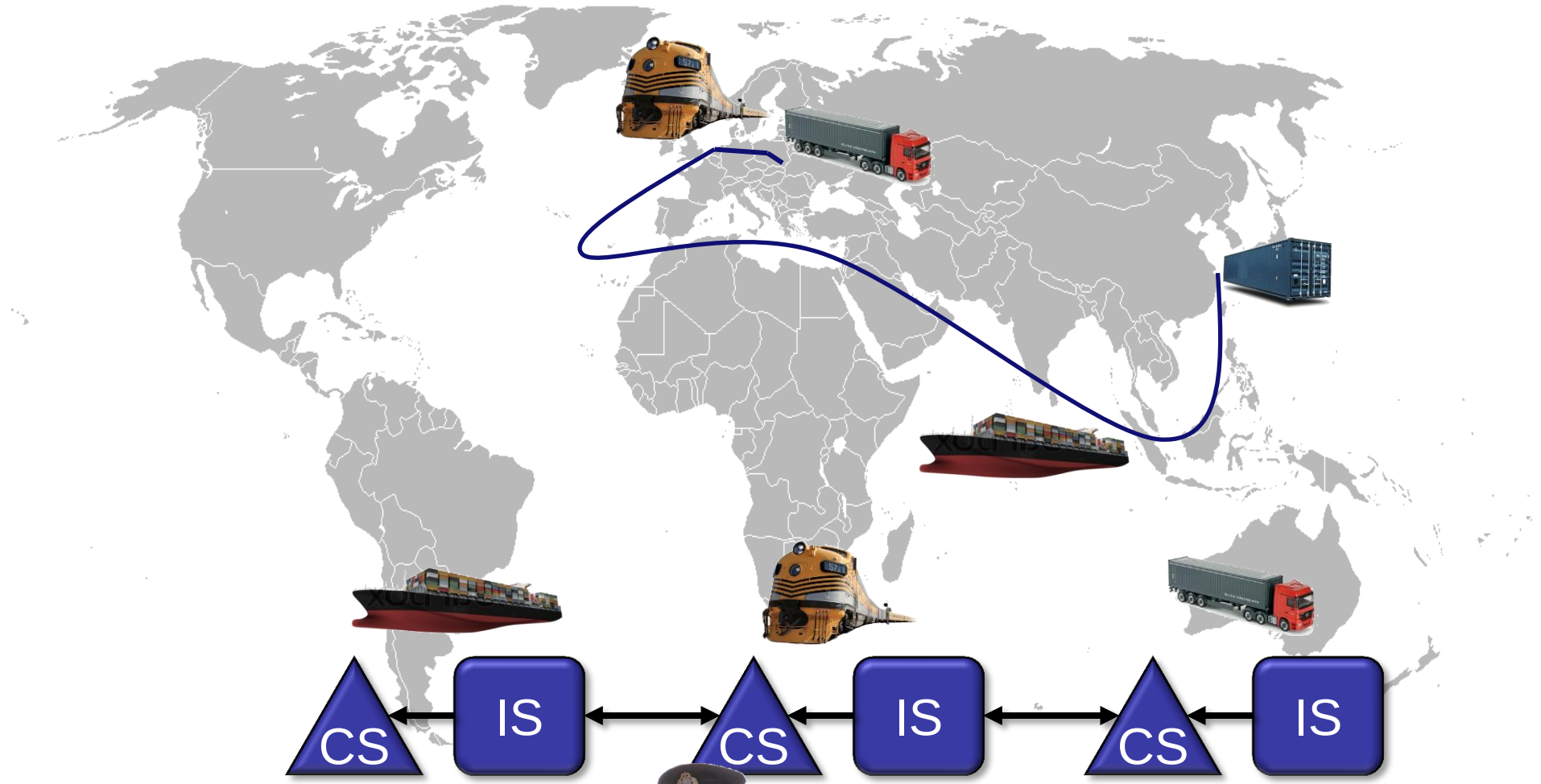
# Control Theory



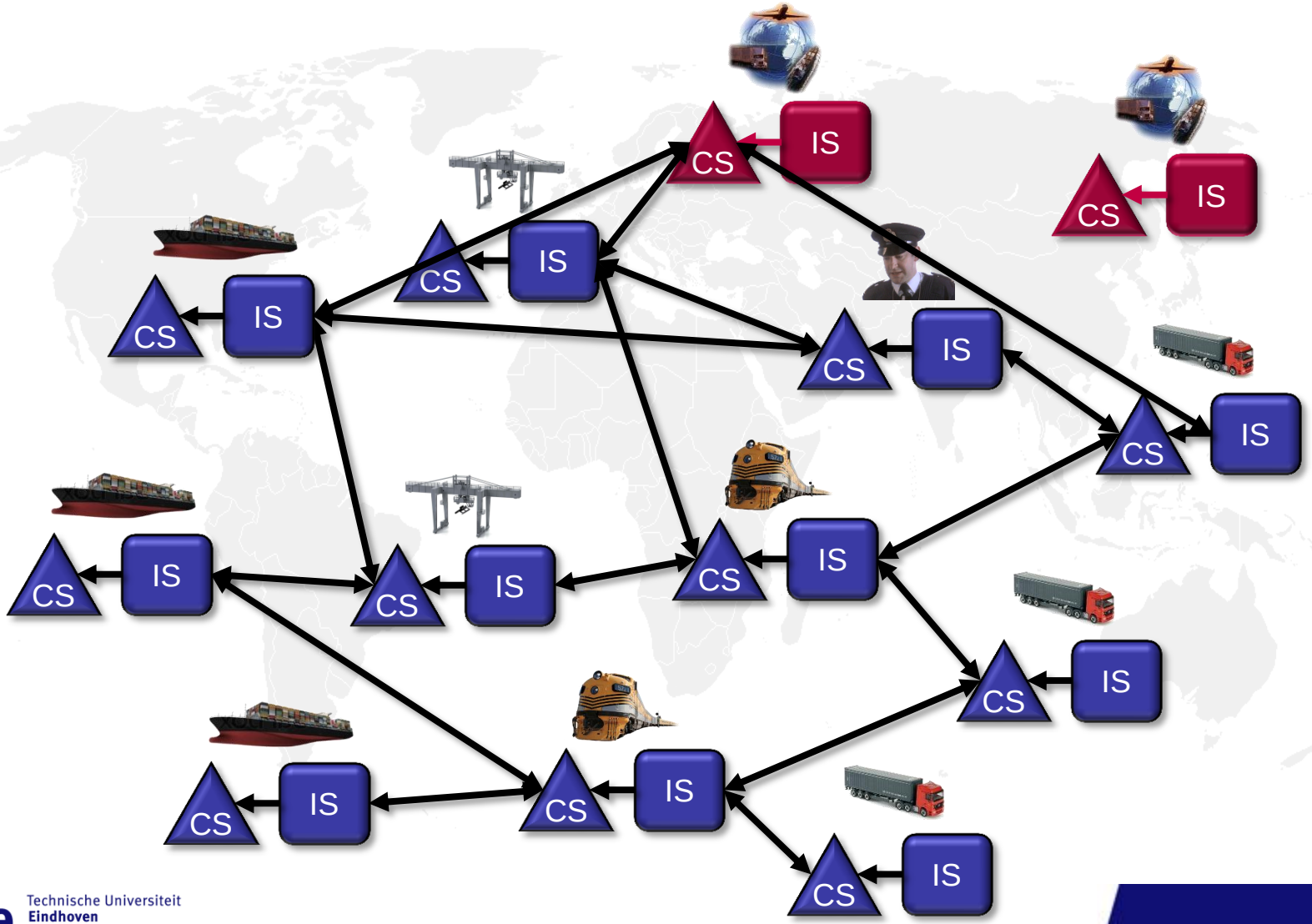
# Control Theory



# Context



# Context



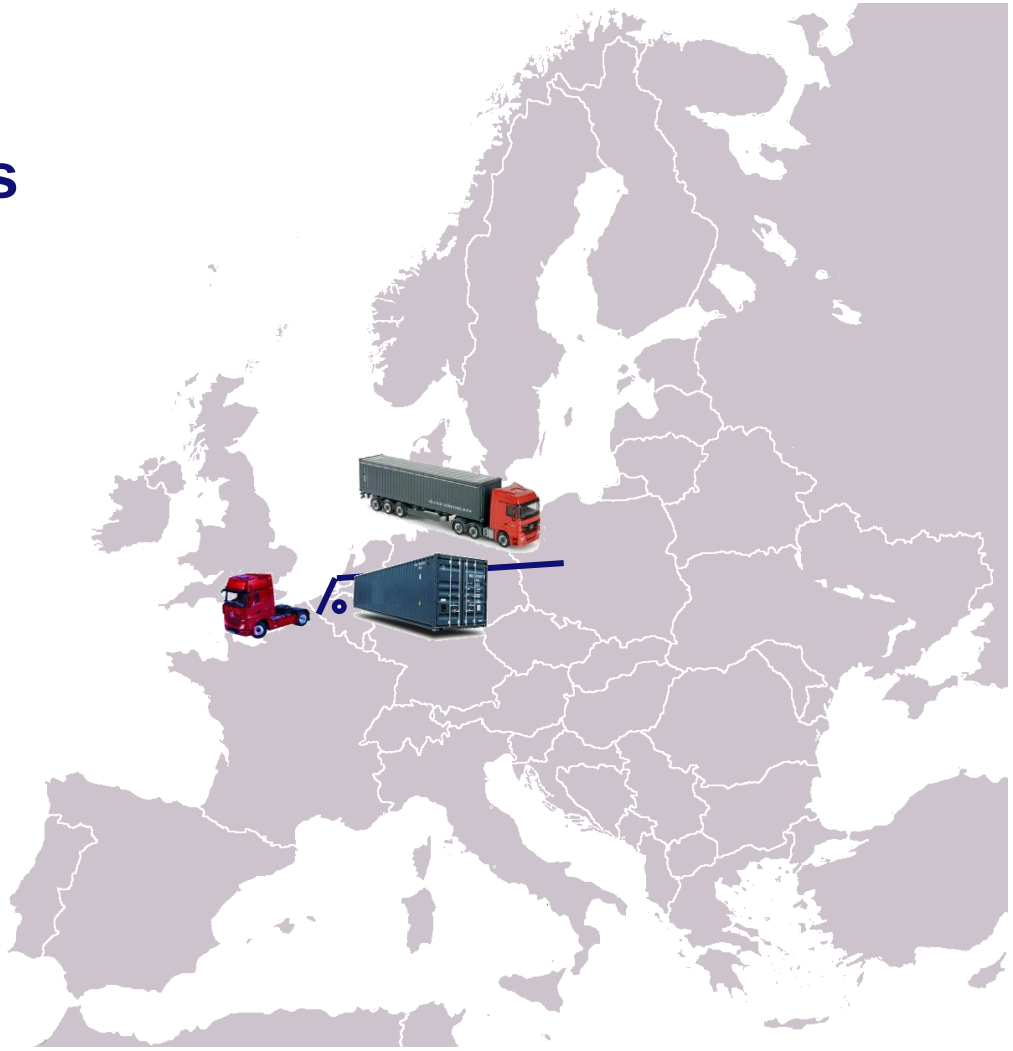
# Problems

- Limited information visibility
- Limited control

# Limited information visibility

**Example:**

**Empty miles**



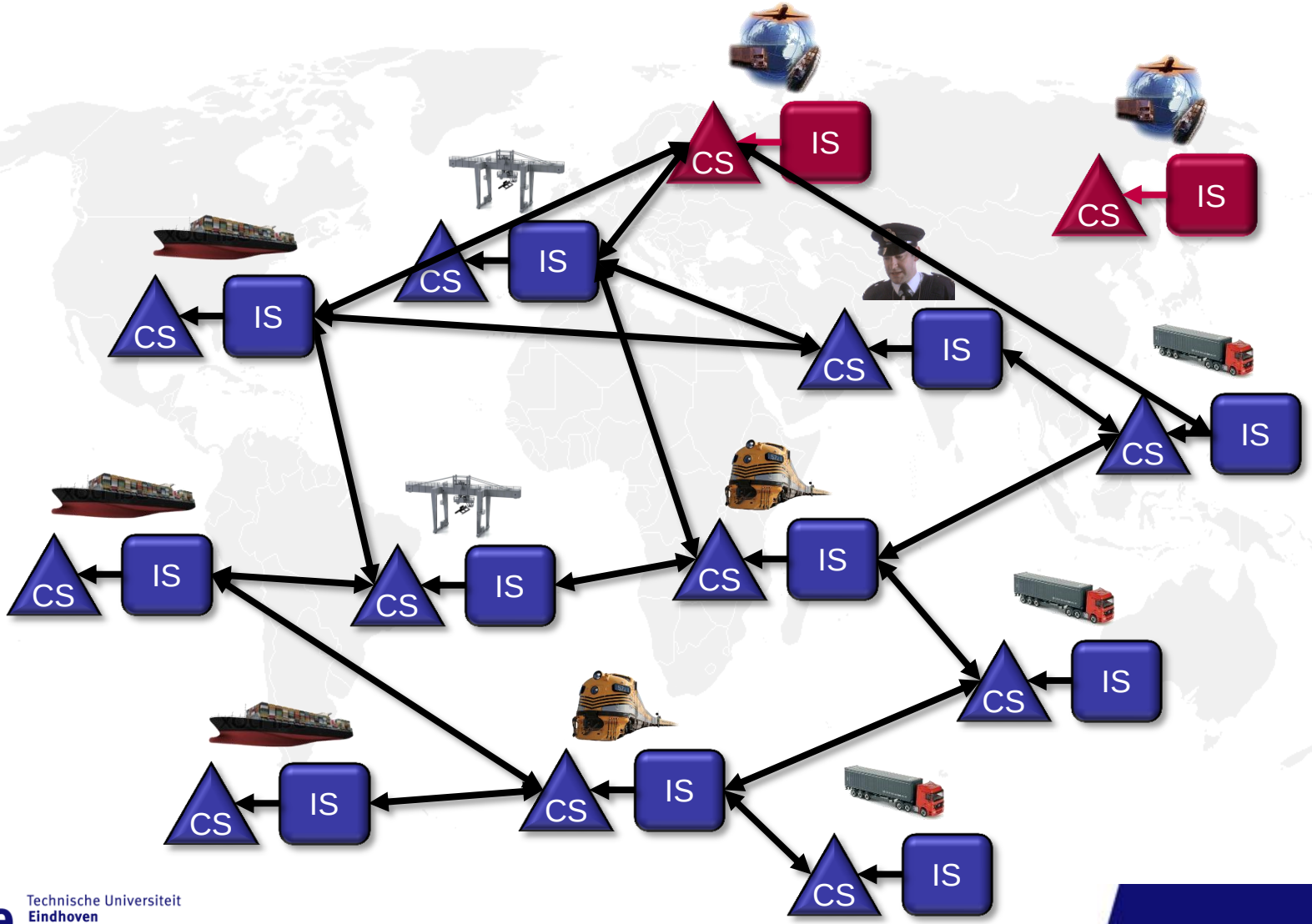
# Limited control

# Limited control

**Example:**

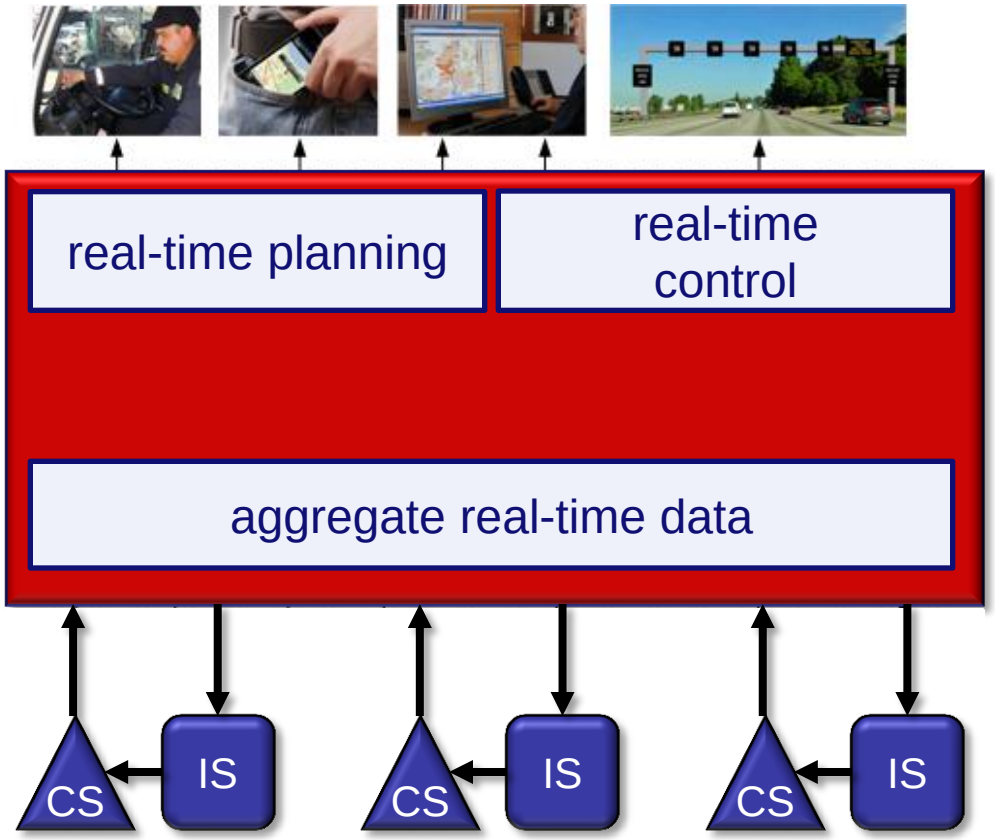
**Multi-modal transport**

# Project goal



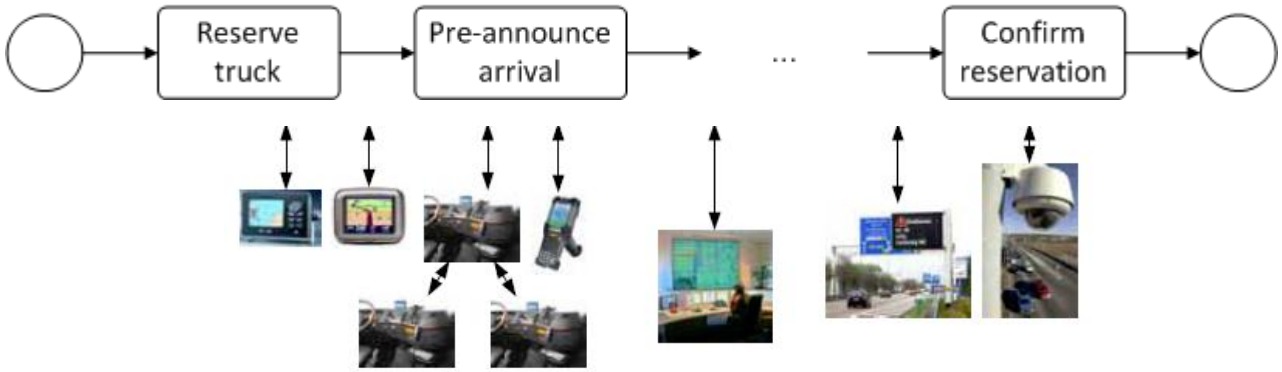
# Project goal

# Challenges


real-time planning
real-time control
aggregate real-time data
CS
IS
CS
IS
CS
IS

# Aggregate real-time data

- aggregate high volume, incomplete, inaccurate data
- to low volume, complete, accurate information
- automatically



# ETD accuracy

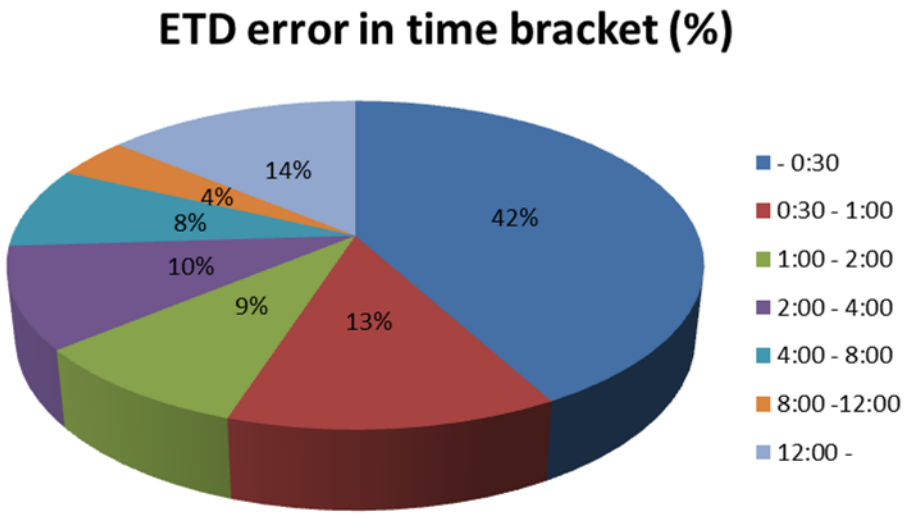
## Error in manual ETD (|ETD – ATD|)

**53 hours**

# ETD accuracy

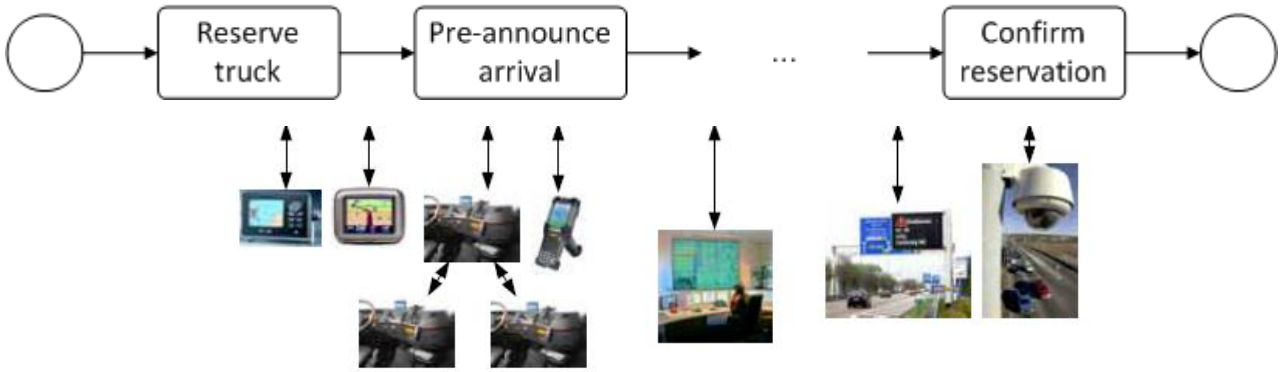
## Error in manual ETD (|ETD – ATD|)

| Error | Ships (%) |
|---|---|
| - 0:30 | 42% |
| 0:30 - 1:00 | 13% |
| 1:00 - 2:00 | 9% |
| 2:00 - 4:00 | 10% |
| 4:00 - 8:00 | 8% |
| 8:00 - 12:00 | 4% |
| 12:00 - | 14% |



# Aggregate real-time data

- aggregate high volume, incomplete, inaccurate data
- to low volume, complete, accurate information
- automatically



# ETD aggregation

## Predict ETD on the basis of available information:

- ETA
- ATA
- Berth
- Cargo
- …

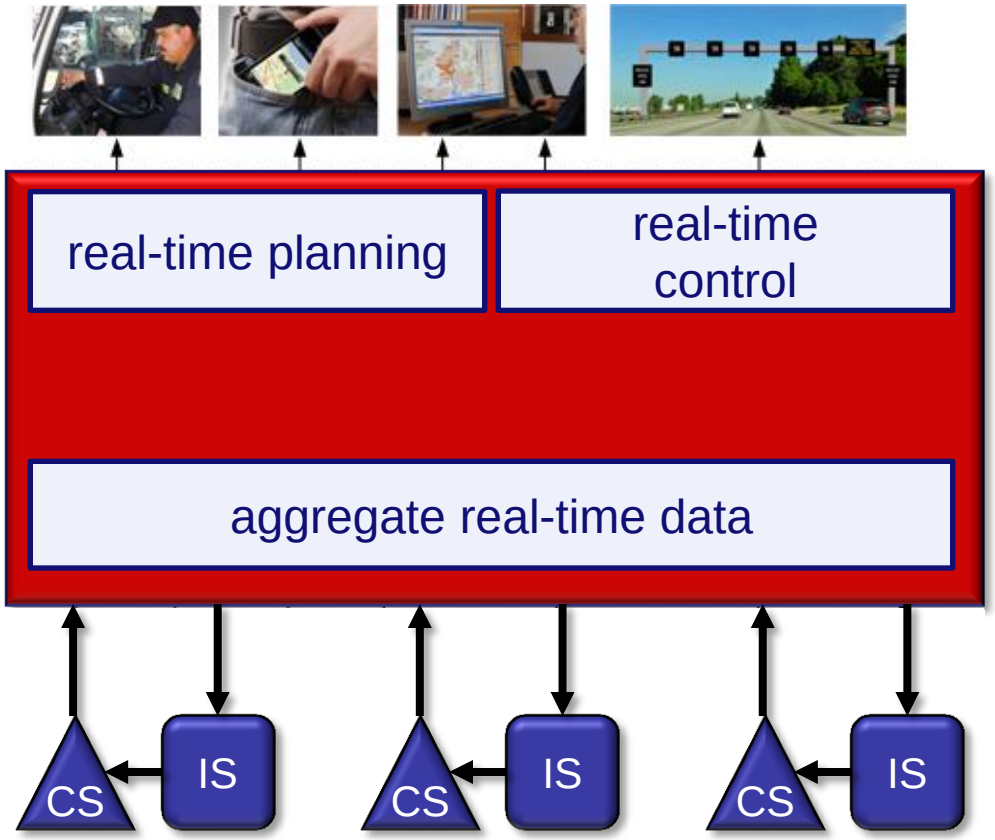
| F | G | H | I | J | K | L | M | N | O | P |
|---|---|---|---|---|---|---|---|---|---|---|
| Berth Code | ETA Berth | ATA Berth | ETD Berth | ATD Berth | Cargo Discharged (tne) | Cargo Loaded (tne) | Totaal Containers Discharged | Waarvan vol gelost | Totaal Containers Loaded | Waarvan vol geladen |
| R8190 | 7-1-2011 15:45 | 7-1-2011 15:50 | | | 8398 | 22969 | 549 | 549 | 1028 | 1028 |
| R2551 | 1-1-2011 15:00 | 1-1-2011 14:50 | 2-1-2011 9:30 | | 5514 | 7928 | 219 | 218 | 323 | 323 |
| R8190 | 4-1-2011 11:30 | 4-1-2011 11:50 | 5-1-2011 0:45 | | 6084 | 7613 | 350 | 290 | 319 | 319 |
| R8150 | 1-1-2011 12:00 | 1-1-2011 13:00 | | | 10066 | 11388 | 565 | 544 | 484 | 484 |
| R2790 | 7-1-2011 22:30 | 7-1-2011 23:15 | | | 8662 | 4051 | 417 | 403 | 204 | 193 |
| R8190 | 1-1-2011 7:00 | 1-1-2011 7:35 | 2-1-2011 19:00 | | 17313 | 19099 | 1181 | 1181 | 1071 | 821 |
| R8150 | 4-1-2011 5:00 | 4-1-2011 7:00 | 5-1-2011 6:00 | | 7500 | 7318 | 606 | 381 | 310 | 309 |
| R8160 | 1-1-2011 23:59 | 2-1-2011 3:18 | | | 16343 | 20341 | 1066 | 1058 | 1294 | 897 |
| R8150 | 11-1-2011 14:00 | 11-1-2011 15:30 | | | 5723 | 6913 | 387 | 281 | 292 | 291 |
| R2790 | 12-1-2011 14:00 | 12-1-2011 14:55 | | | 9141 | 6567 | 489 | 390 | 308 | 301 |
| R2790 | 3-1-2011 4:00 | 3-1-2011 6:30 | | | 4633 | 5249 | 217 | 210 | 239 | 239 |
| R8150 | 5-1-2011 9:30 | 5-1-2011 10:48 | | | 35484 | 26087 | 2210 | 2198 | 1432 | 1168 |
| R8190 | 5-1-2011 16:30 | 5-1-2011 16:35 | 6-1-2011 6:30 | | 12384 | 10046 | 795 | 661 | 558 | 558 |
| R8190 | 6-1-2011 12:00 | 6-1-2011 12:45 | | | 22782 | 15642 | 1857 | 1855 | 1173 | 465 |
| R2550 | 6-1-2011 15:00 | 6-1-2011 15:30 | 7-1-2011 3:00 | | 4409 | 6606 | 210 | 175 | 279 | 279 |
| R8190 | 8-1-2011 4:00 | 8-1-2011 4:36 | | | 1579 | 8680 | 66 | 64 | 322 | 319 |
| R8150 | 9-1-2011 9:00 | 9-1-2011 8:50 | | | 9812 | 17265 | 594 | 584 | 690 | 672 |
| R8150 | 7-1-2011 1:30 | 7-1-2011 2:45 | | | 26824 | 15674 | 1718 | 1718 | 1429 | 486 |
| R2800 | 1-1-2011 10:00 | 1-1-2011 10:15 | | | 4456 | 4507 | 330 | 150 | 237 | 202 |

# ETD aggregation

- **Improvement possible**
- **Error is ‘smeared out’**
- **Real-time updates not taken into account**

| | MAD | MAD* | Verschil | MSE | MSE* | Verschil | MAPE | MAPE* | Verschil |
|---|---|---|---|---|---|---|---|---|---|
| Model 1a | 3,90 | 3,88 | - 0,5% | 36,79 | 26,35 | - 25,4% | 0,13 | 0,14 | + 7,7% |
| Model 1b | 3,90 | 2,90 | - 25,6% | 36,79 | 16,64 | - 54,8% | 0,13 | 0,11 | - 15,4% |
| Model 2 | 3,35 | 2,50 | - 25,4% | 25,22 | 14,00 | - 44,5% | 0,16 | 0,12 | - 25,0% |
| Model 3 | 7,54 | 6,75 | - 10,5% | 185,66 | 115,15 | - 38,0% | 0,20 | 0,23 | + 15,0% |
| Model 4 | 32,50 | 19,95 | - 38,6% | 1644,9 | 916,0 | - 44,3% | 0,81 | 0,45 | - 44,4% |

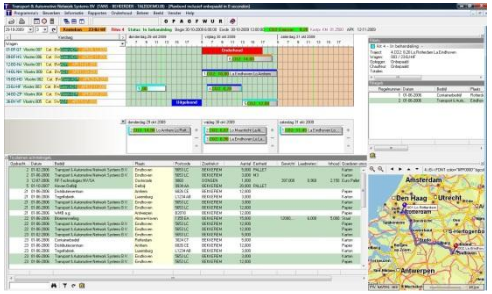
# Challenges


real-time planning
real-time control
aggregate real-time data
CS
IS
CS
IS
CS
IS

# Real-time planning

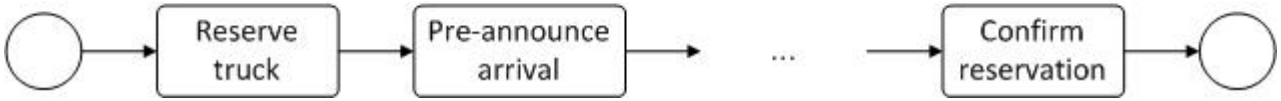
## Transport Planning Algorithms

- real-time planning
- predictive planning



# Real-time control

- execute end-to-end transport plan
- automatically change the plan
  - compute minimum change
  - rollback
  - redo

# Summary

**Facilitate:**

- **provisioning of real-time information**
- **real-time planning**
- **real-time control**

**Thus:**

- **reducing empty-miles**
- **enabling multi-modal transport**