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Hyperloop Modelling & Appraisal in Sweden/Finland

Modelling World conference, Dubai

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Modelling the Demand for Hyperloop

or

Market Segments and Uncertainty

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1 Background

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The Problem

"In a world characterised by uncertainty, it is almost certain that traffic forecasts will be wrong."

(Robert Bain, 2009)

How do we reconcile this with the reasonable desire of the Hyperloop project sponsors to know if a particular scheme is commercially-viable?

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Background to Hyperloop

RCL is not an engineering consultancy, but planners of fixed-track systems

Hyperloop is ‘a thing in a tube which goes *very* fast’

Technical details (whilst world-beating) not important to us

Instead, our questions are:

How much demand will it generate?

Will it make any money?

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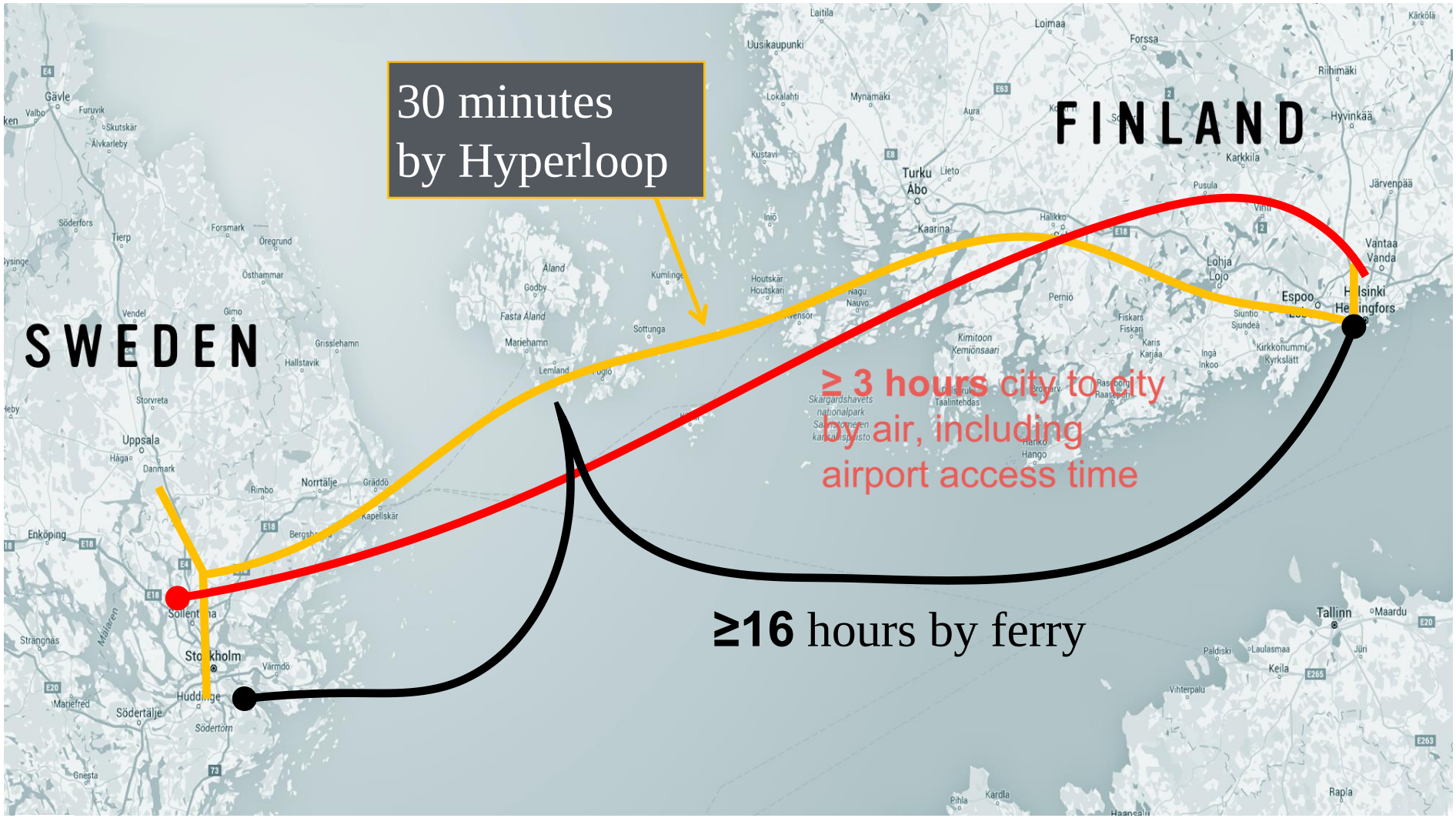
Background to this Corridor



2 Transport Modelling Issues

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Modelling Approaches

- Collect lots of trip data & stick it in a big computer
  problem: we haven't got lots of data
- Interview lots of passengers & extrapolate
  problem: there aren't any passengers yet
- Understand existing preferences & extrapolate
  problem: there isn't a public Hyperloop anywhere yet
- *Another problem: Hyperloop is an economic game-changer*

- So: what do we know?
- *People travel for a purpose, and that determines many of their travel characteristics*

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Key Issues

- Small changes to transport networks → we know a lot about how people respond
- Big changes → we know less
- Changes in economic geography → we know even less
  - Will people move house? Change jobs?
  - Will businesses move? Which ones? Where?
  - Will this attract more investment? From whom?
  - Will people change how they spend their free time?
  - How much they'll be willing to pay?

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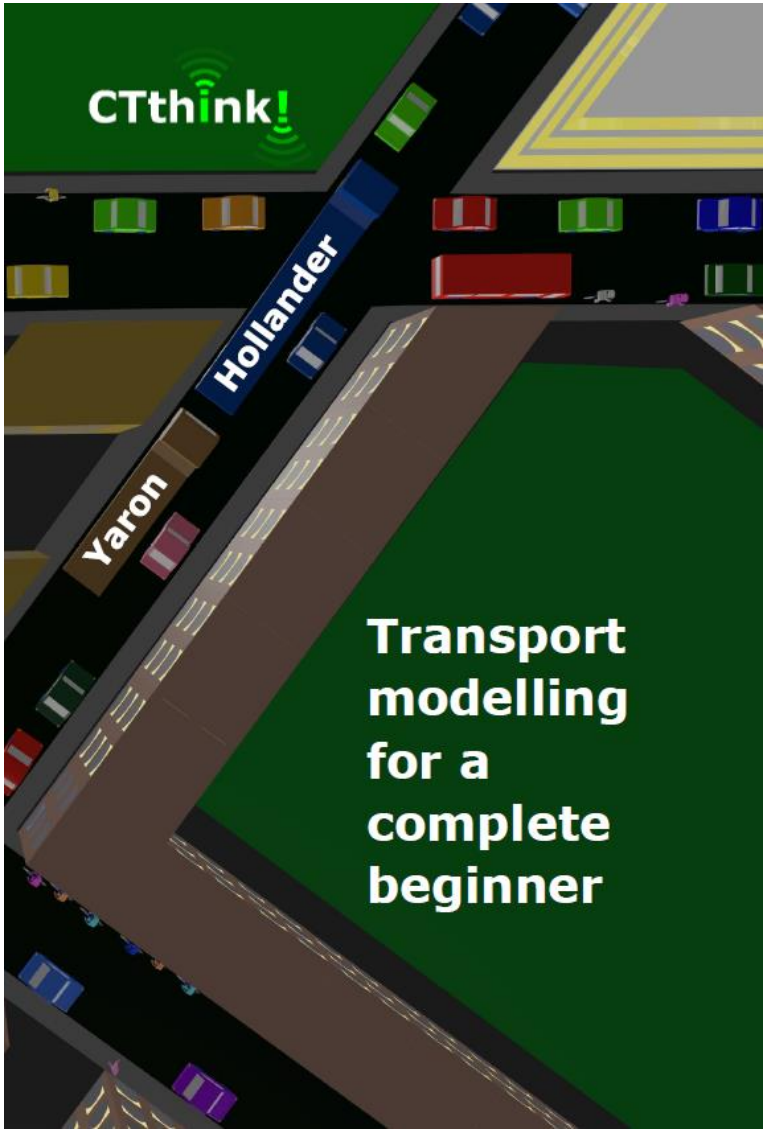
Hyperloop and Best Modelling Practice



- An acknowledgement:
- The Hyperloop model was developed while my colleague Dr Yaron Hollander was writing the latest guide for transport modellers
- The project influenced the guide and vice versa
- Both reflect state-of-the-art thinking on forecasting challenges and modelling best practice

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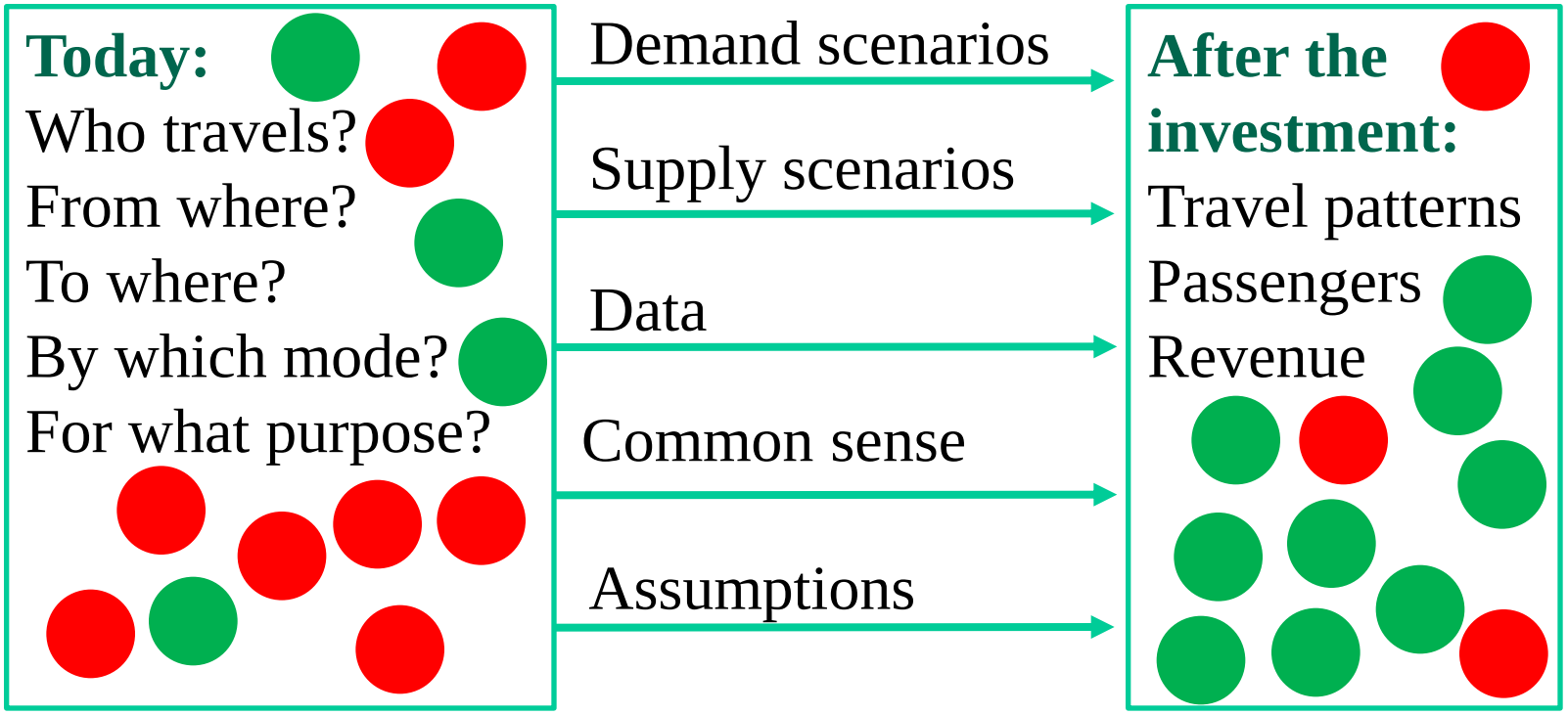
How Transport Models work



Things we have good information about

Things that are uncertain / unknown

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Model Structure

- 10 demand segments
- Some conventional, some unique to this project
- Segments reflect:
  - trip type
  - trip purpose
  - traveller type
  - where to/from
- Markets within each segment
- Demand scenarios
- Supply scenarios
- Demand & revenue estimated separately for each

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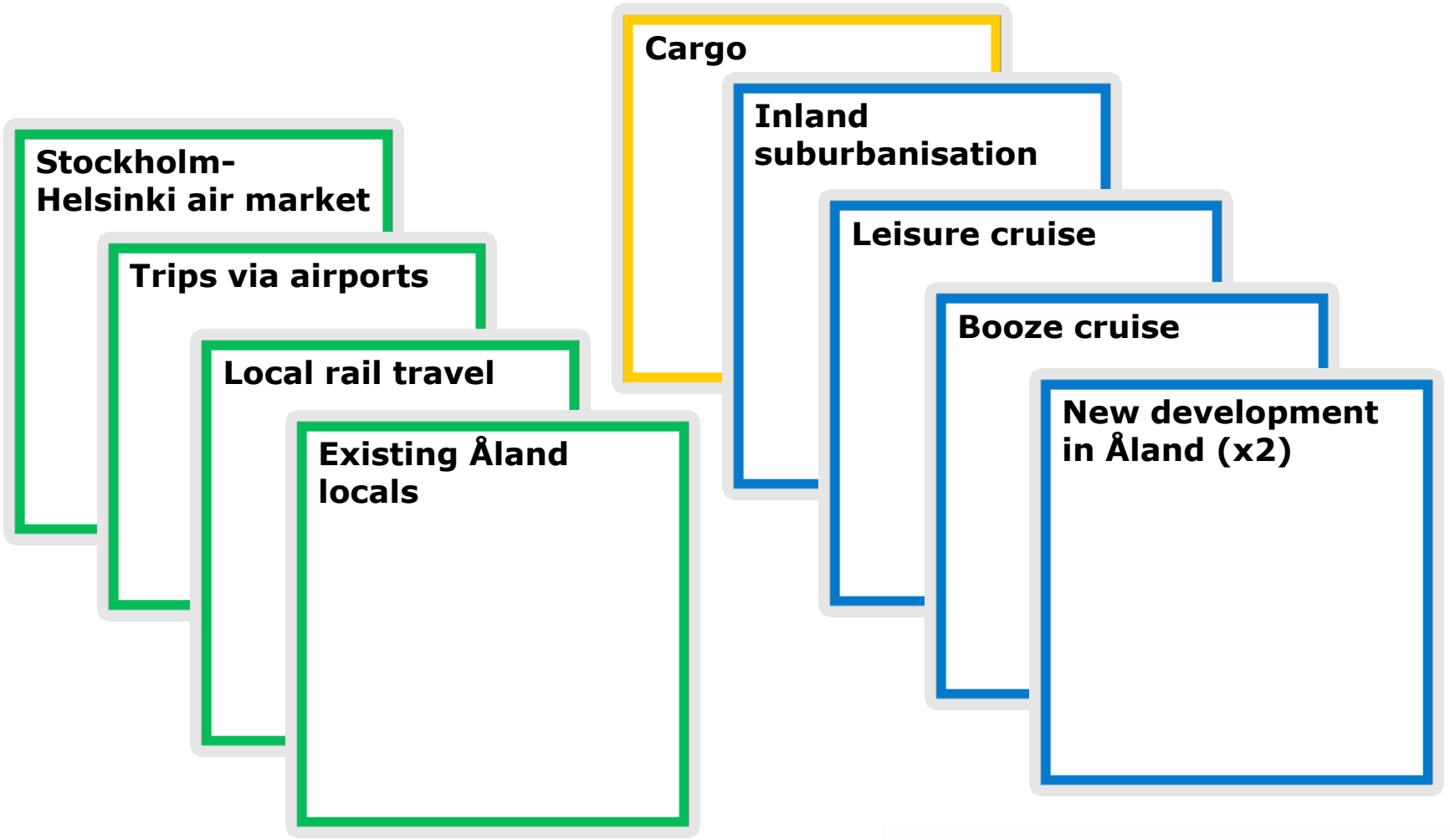
Demand segments in our model



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Conventional Model Segments

- Concept of “generalised cost” = time + money + pain + …
- Describes how people make transport choices
- Typical response parameters for typical parts of the cost
- Easy to use parameters from one place in another
- So demand estimation follows a standard process

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Unique Model Segments

- We still use “generalised costs”
- Still describes how people make choices
- But these are unusual choices
- So the costs include unusual variables
- We cannot use parameters from anywhere else
- Initial work has not yet included local data collection (☹)

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Why we need Scenarios

- Supply scenarios – because:
  - the Hyperloop technology is still being developed
  - also travel times, comfort, capacity, security process, costs…
- Demand scenarios – because:
  - maybe Government will encourage people/businesses moving from one place to another – but maybe not
  - maybe Government only supports specific sectors
  - there is uncertainty about general growth
  - there is uncertainty about competition from other services
  - there is uncertainty about competition from other locations
- Ongoing work will continue to refine these

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Model Structure (for each segment)

		Hyperloop			Competing option		
Gen cost element	No Hyperloop	Hyperloop - supply scenario 1	Hyperloop - supply scenario 2	Hyperloop - supply scenario 3	Hyperloop - supply scenario 1	Hyperloop - supply scenario 2	Hyperloop - supply scenario 3
Time							
Cost			⟷			⟷	
Hassle							
Experience							
…							

- Similar table for each demand scenario in this segment

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3 Description of Selected Model Segments

Conventional Commuting

- Many people already commute into either Stockholm or Helsinki
  - Either by car or train
- Hyperloop will significantly reduce journey times
  - e.g. Turku – Helsinki: 113 to 20 minutes
- This will increase demand *but*
- The scale of this reduction makes demand forecasting difficult
  - Can use arc elasticities, but results can only be indicative

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Distant Airport Access (2)

- Hyperloop is potentially sufficiently fast/flexible to enable passengers in one country to access flights from another e.g.
  - Live in Salo, use Hyperloop to catch flights from Stockholm
  - Live in Stockholm, use Hyperloop to catch flights from Helsinki
- This is high-yield but small market segment

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Inland Decentralisation

- Continuing to work in the capitals but living much further away
- Travel from Uppsala, Turku or Salo to Stockholm / Helsinki and back every day
- The choice is between moving to these cities (without changing jobs) or continuing to live near the Capitals

Markets:

- Stockholm to Uppsala
- Helsinki to Turku
- Helsinki to Salo

Demand scenarios (from Volterra):

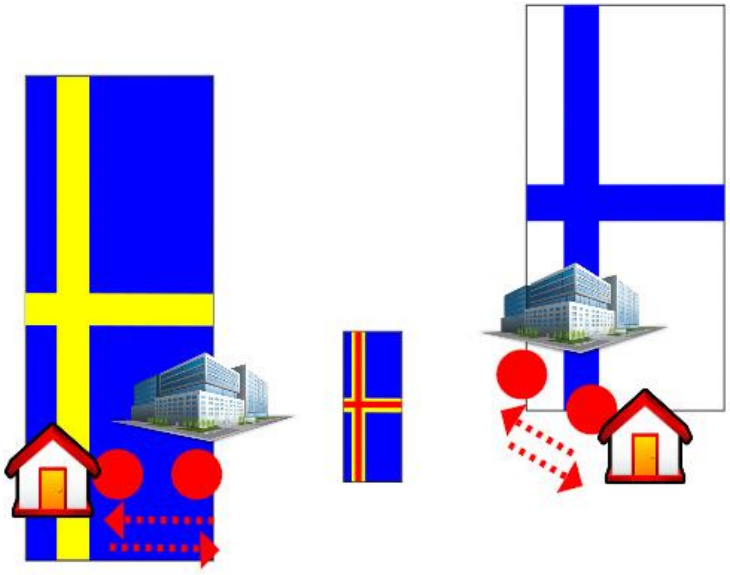
- People travel same time as today
- People spend less time travelling
- Capitals get less attractive

Special items in generalised cost:

- Cost of housing
- Quality of housing and neighbourhood

Supply scenarios:

- Hyperloop frequency / Journey experience / Security hassle



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Leisure Cruise

- Cruise to port cities with a 1-way Hyperloop trip
- The choice is between travelling one-way on Hyperloop or continuing by boat only

Markets:

- Shorter cruise (3-day)
- Longer cruise (7-day)

Demand scenarios:

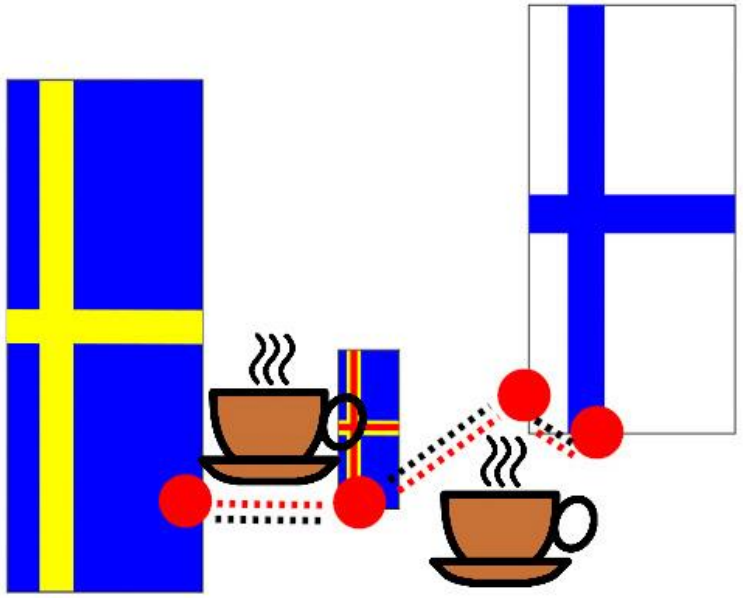
- As today
- Cruise culture declines
- People get wealthier

Special items in generalised cost:

- Having a good time on the boat
- Saving time by Hyperloop
- Getting to the boat vs Hyperloop
- Price of boat vs Hyperloop

Supply scenarios:

- Journey experience
- Security hassle



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Initial Findings

- People will probably travel more between Stockholm and Helsinki
- Likely diversion from air, for travel between the capitals
- Within each country, some diversion from cheaper rail is likely
- Significant decentralisation from Stockholm & Helsinki is possible
- New developments in Åland seem very likely
- Possible extended reach of one-day cruises: but low yield
- Low rail fares impact on potential Hyperloop pricing
- Dependency on local behavioural insight is high. Reducing project uncertainty will need local data collection

Results & Interpretation

- (Not surprisingly!) we are unable to provide financial results here
- Plausible orders of magnitude from bottom-up analysis
- Our ‘bottom-up’ approach provides an understanding of which markets are more important – and which are more uncertain
- Single estimates have been given for ‘conventional’ market segments (although it must be stressed that there is a considerable range around these)
  - The end-to-end air market is the largest of these
- Results from three different scenarios are shown for the other market segments
  - The decentralisation market is the largest (and most variable) of these
- Cargo has been estimated separately

Conclusions

- Demand & revenue forecasting for something as new and different as Hyperloop cannot be undertaken using conventional models
- Local competitive transport conditions are important
- Potential behaviours must be understood, by market segment
- A range of results must be presented

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