A Mesoscopic GTA DTA Multi-Modal Aimsun Model: Recap and Key Points

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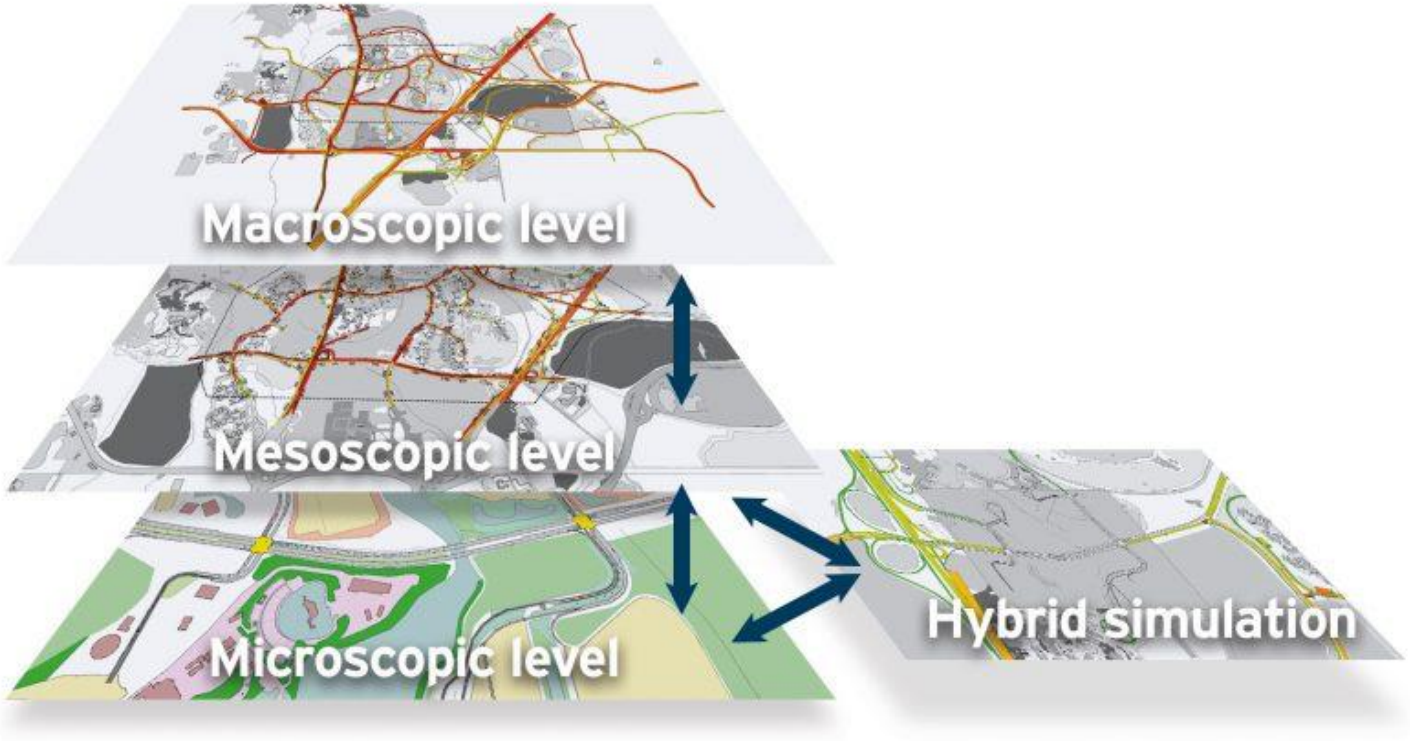
What We are After:

- Mutli-Modal Hybrid DTA Model with AVs



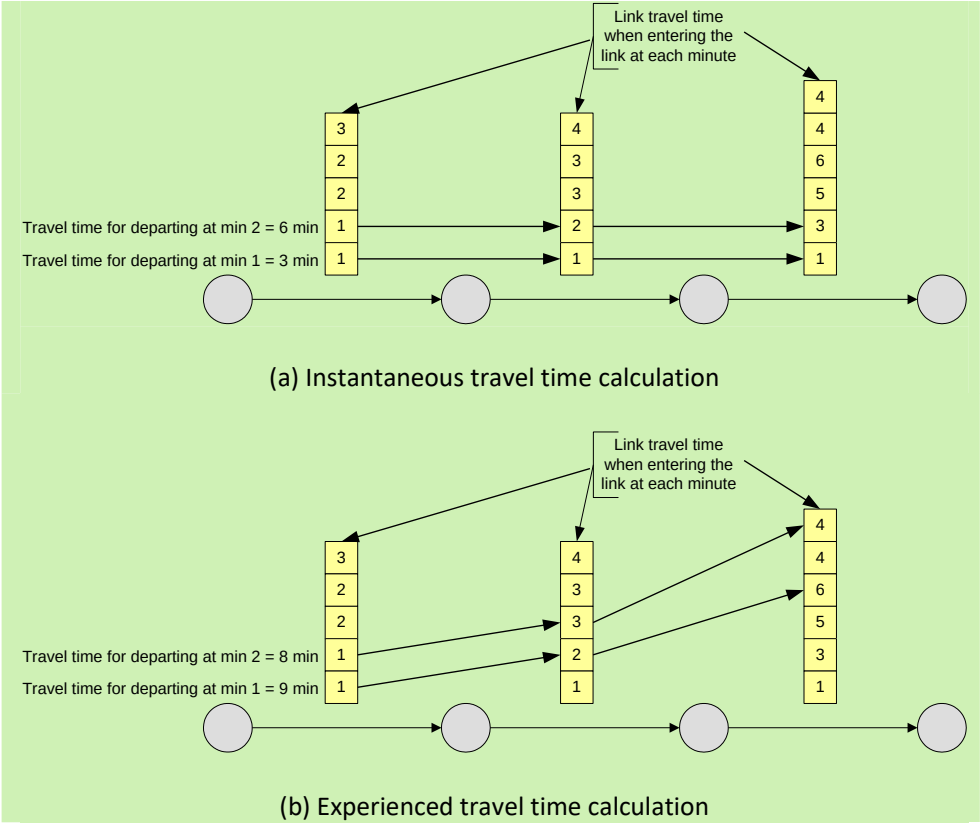
But Why DTA?

- Is DTA fancy STA?
- Are there times when we must use DTA? When?
- What is DTA?
  - Dynamic Traffic Assignment
  - Dynamic Network Analysis and Models
  - Detailed representation of the interaction between travel choices, traffic flows, and time and cost measures in not only spatially (lateral and longitudinal) but also temporally coherent manner.
  - DTA combines time-dependent route choice (lateral) and traffic flow theory (longitudinal)

Limitations of Static Models

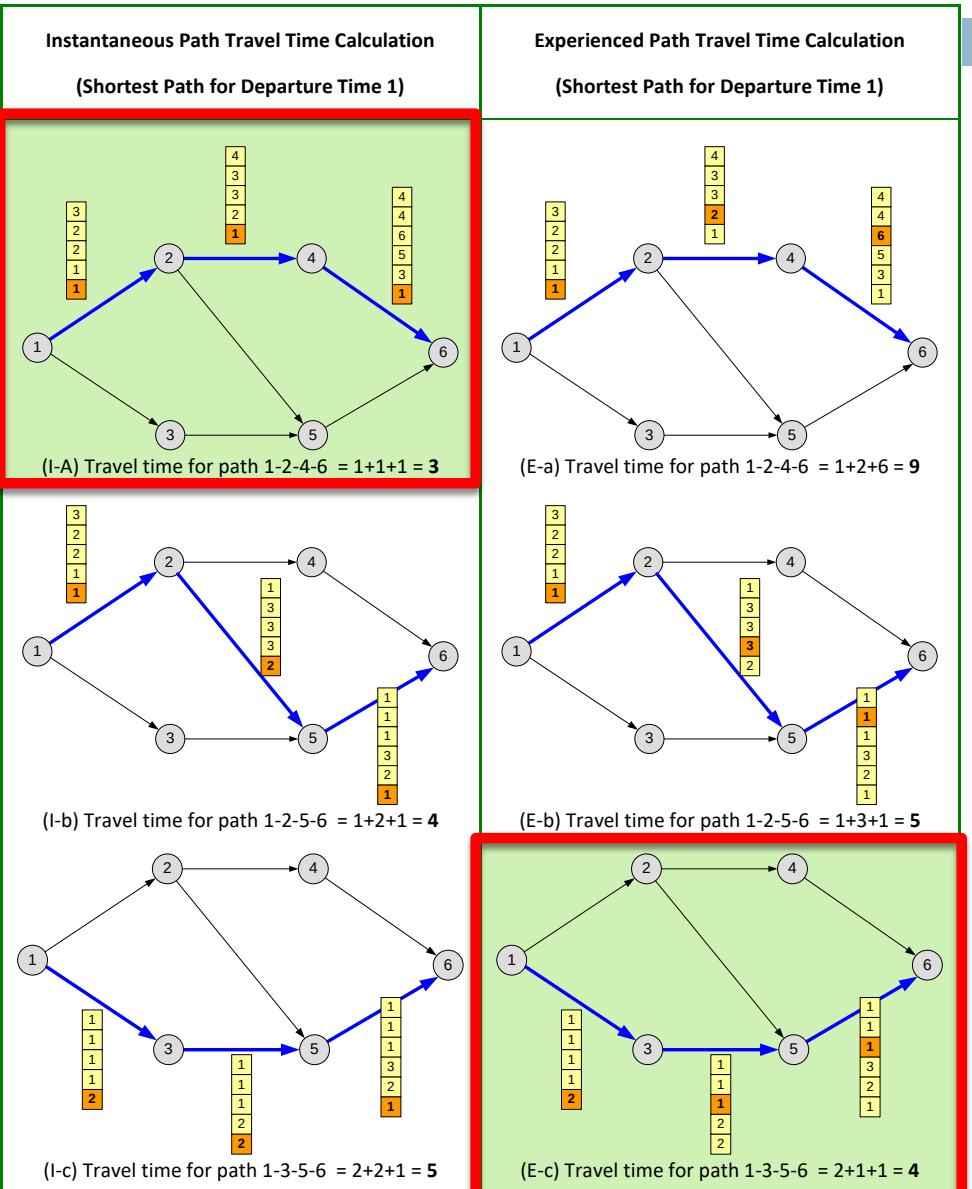
- Key Conceptual Drawbacks
  - Allow V/C >1, has no intuitive meaning, does not correspond to reality or real measurements
  - Inflow = Outflow, i.e.
    - Single value of link flow
    - Steady state representation only
    - Cannot capture temporal congestion spread and spill-back
  - Other..
- Application Limitations: cannot do
  - Signal control
  - HOV and HOT Lanes
  - Evacuation, congestion pricing optimization
  - ITS applications, ATMS, ATIS, RM, Adaptive Control
  - Also questionable in congested networks in general

Time (Temporal Dynamics) Matter to Correctly Capture Travel Times: Experienced vs Instantaneous Travel Time



- Note how the modelling period is sliced into assignment intervals
- Experienced travel time is much different from instantaneous and can only be realized after the fact of going through the trip

Time (Temporal Dynamics) Matter to Correctly Capture Routing:

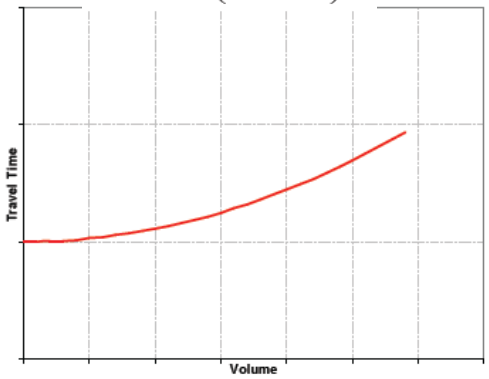


- Different shortest paths obtained by instantaneous travel time and experienced travel time approaches (departure time 1)

Traffic Flow Theory Matters to Capture Spillbacks: v/c must be less than 1.0

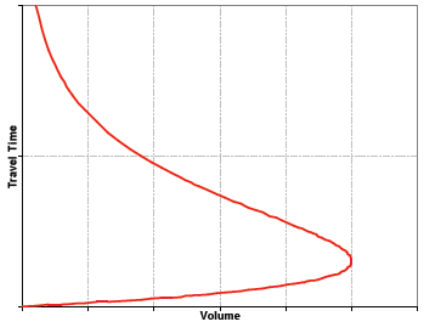
- Typical VDF (BRP)

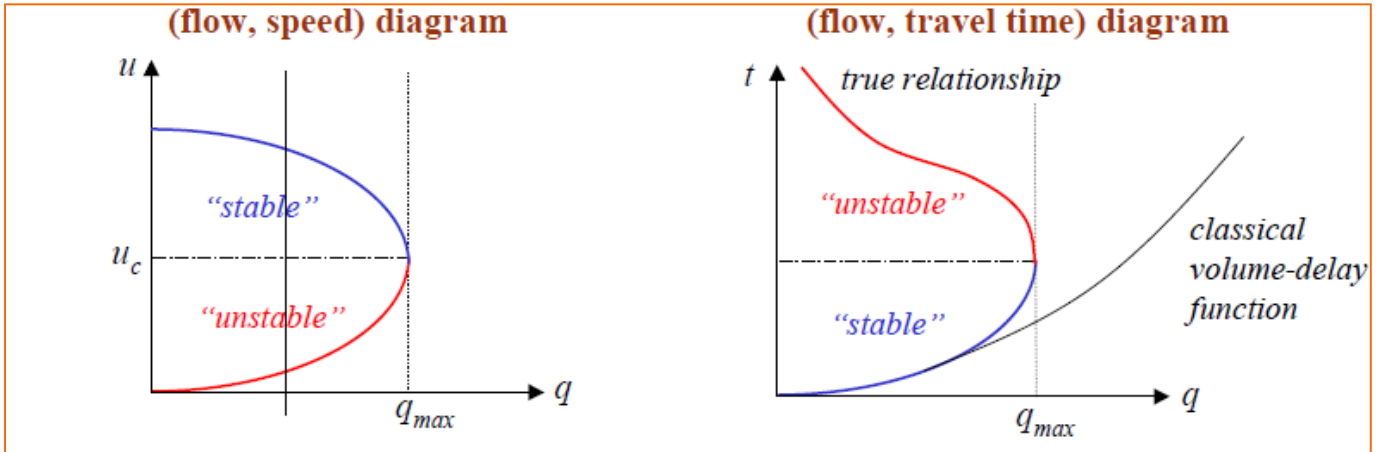
$$t(v) = t_o \cdot \left(1 + \left(\frac{v}{c}\right)^{\alpha}\right)$$



- Simple Traffic Model

$$u(k) = u_f \cdot \left(1 - \frac{k}{k_j}\right) \qquad q = u \cdot k \qquad t(u) = \frac{t_0 \cdot u_f}{u}$$



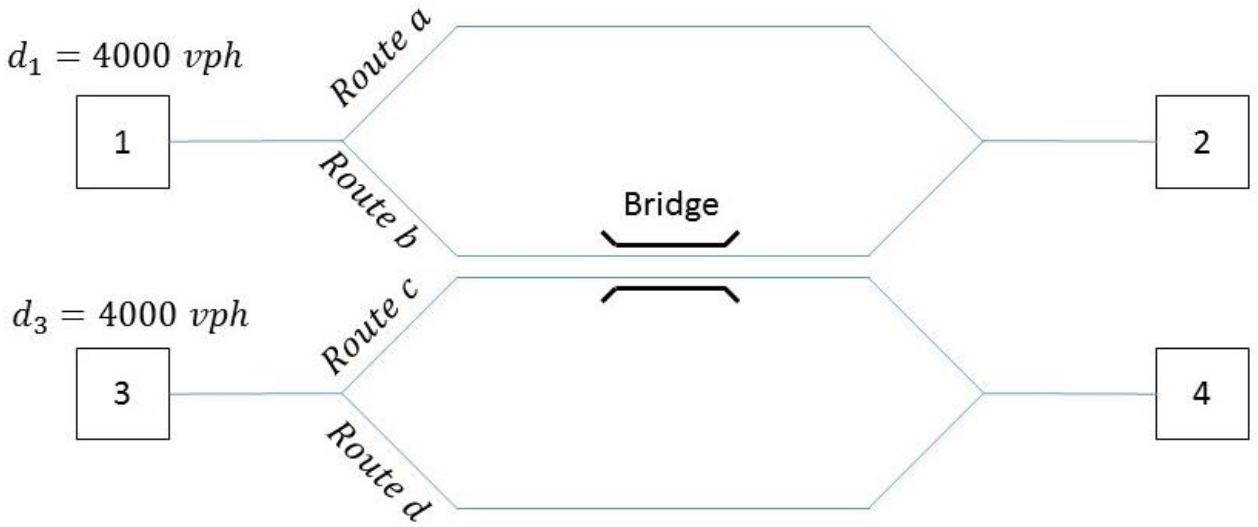


RECAP: When do we must use DTA:

- When we care about spatio-temporal congestion patterns and traffic dynamics
- When we care about congestion spill backs
- When our solutions / policies alter the above:
  - Road pricing
  - Multi-modal pricing
  - Evacuation
  - Dynamic traffic control
- In congested networks in general (i.e. always nowadays)
- And even if demand is not time dependent!– see next

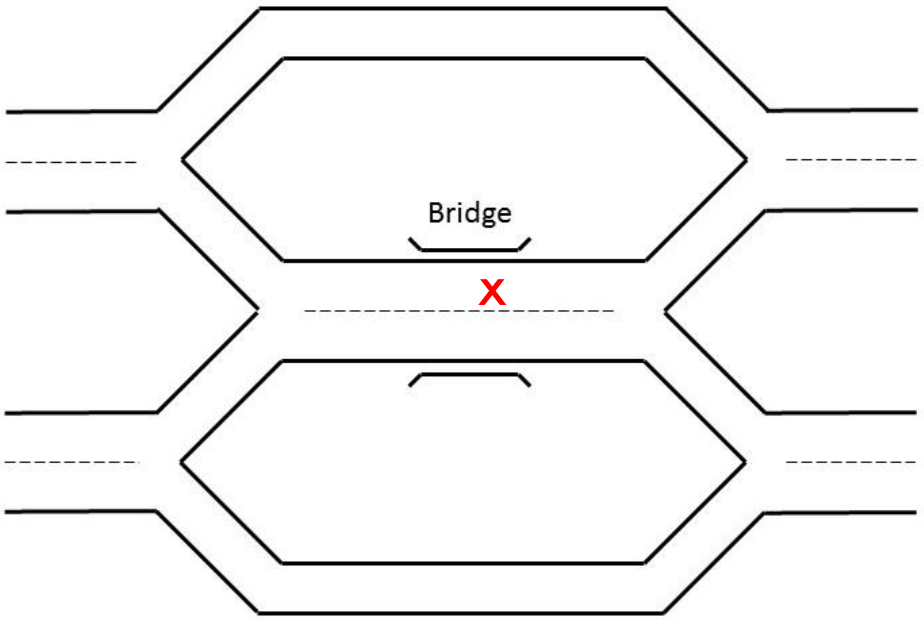
Illustration: Static vs. Dynamic Modelling

- Illustrative Example: consider
  - 2 identical O-D pairs with 4000 vph demand
  - 4 identical routes, each with capacity of 2000 vph
  - Routes b and c pass through a bridge with capacity of 4000 vph



Static vs. Dynamic Modelling

- If the capacity of the bridge is or drops to 2000 vph, evaluate the performance of both static and dynamic modelling during the transient and at steady state?

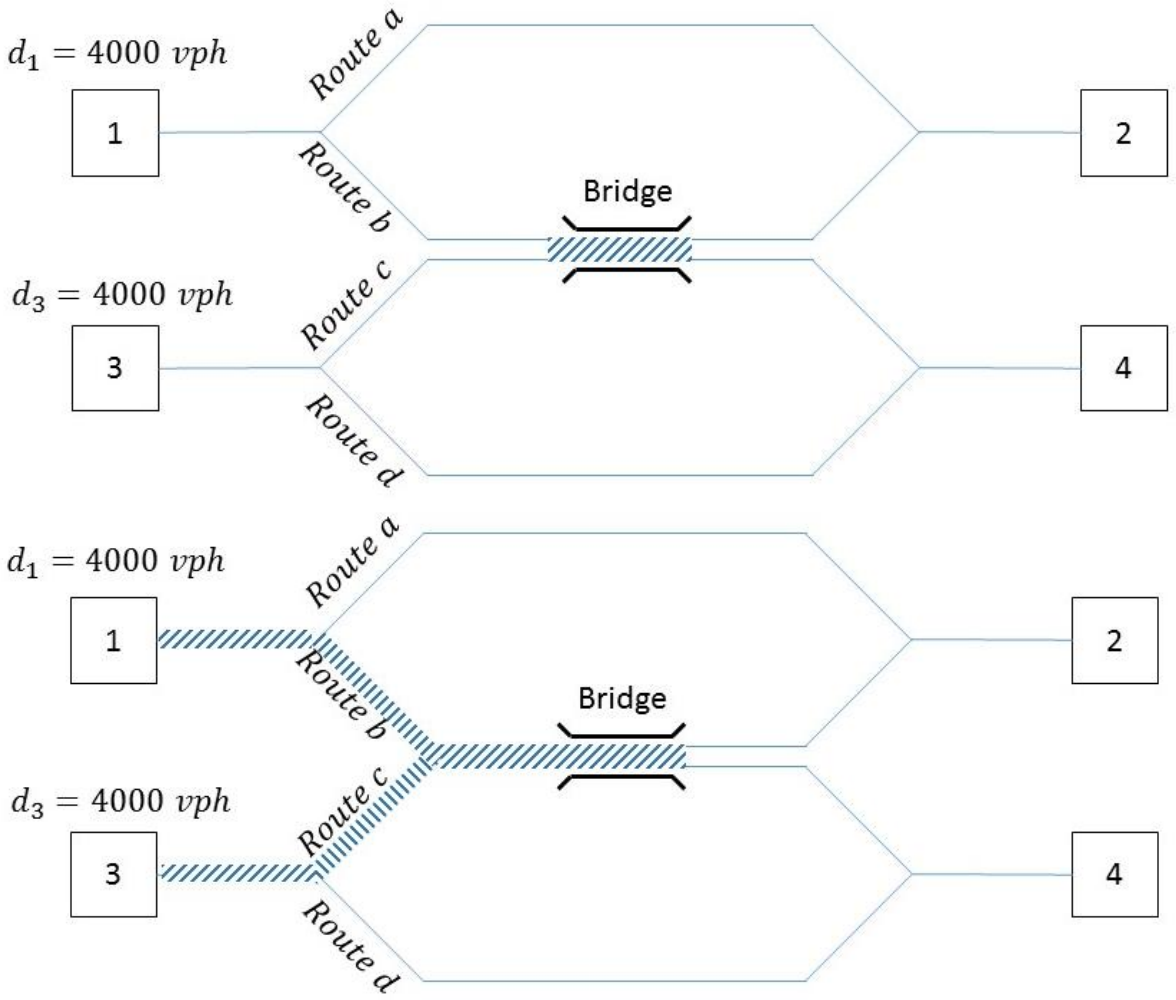


Static vs. Dynamic Modelling

- Transient state after capacity drop: Conges

Static:

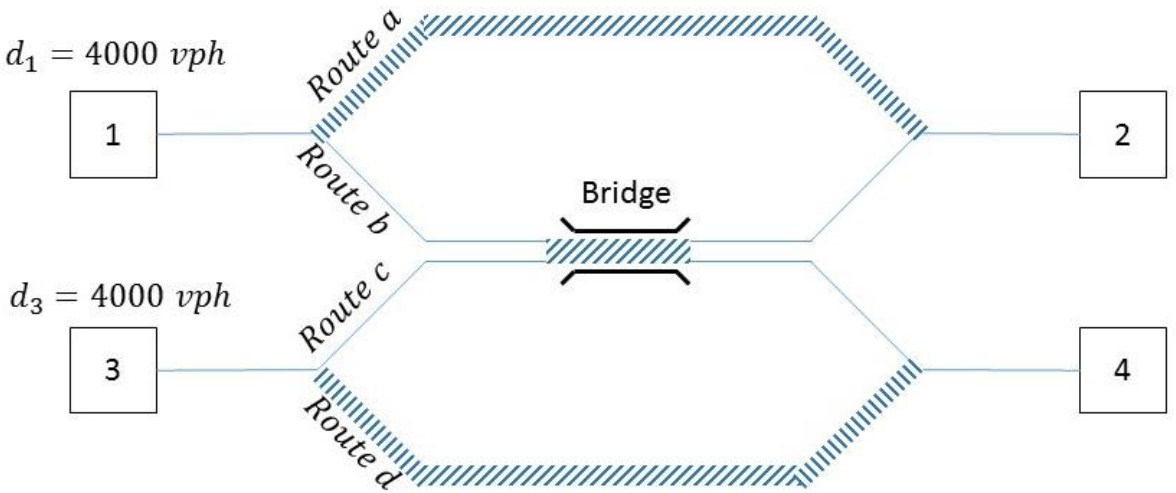
Dynamic:



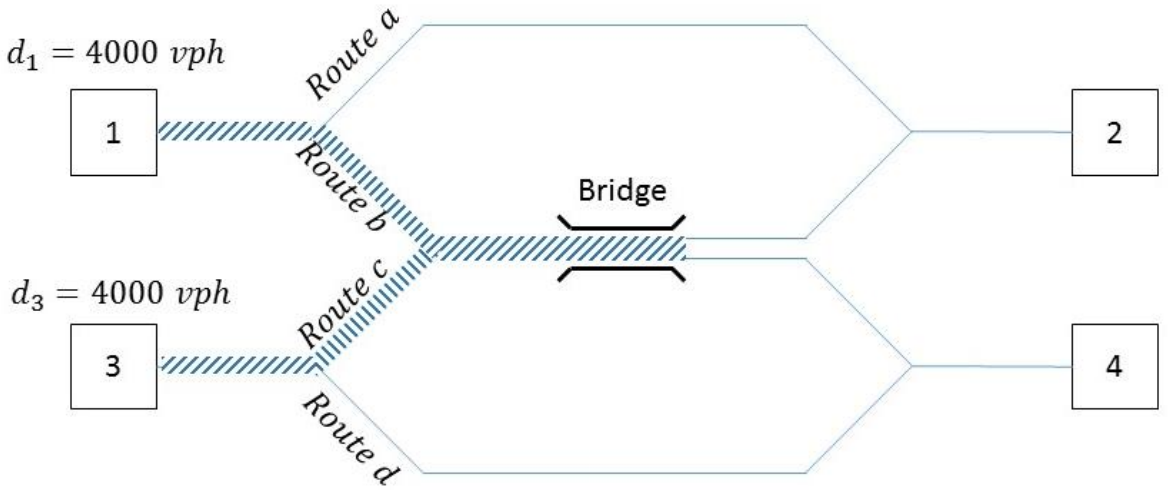
Static vs. Dynamic Modelling

- Steady state after capacity drop: Congesti

Static:



Dynamic:



Policy implications

- If the purpose of the analysis is to identify the bridge for expansion (typical planning), both approaches would somewhat do, despite the misrepresentation of static.

- If the purpose of the analysis is to adjust the spatio temporal patterns of traffic (changes in departure time, route choice etc.), which is typical in over congested networks, only dynamic models should be used, static cannot do and can be misleading or even wrong (tolling the outer routes for instance).