Enhancing Intermodal Passenger Travel in Canada

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Research Areas

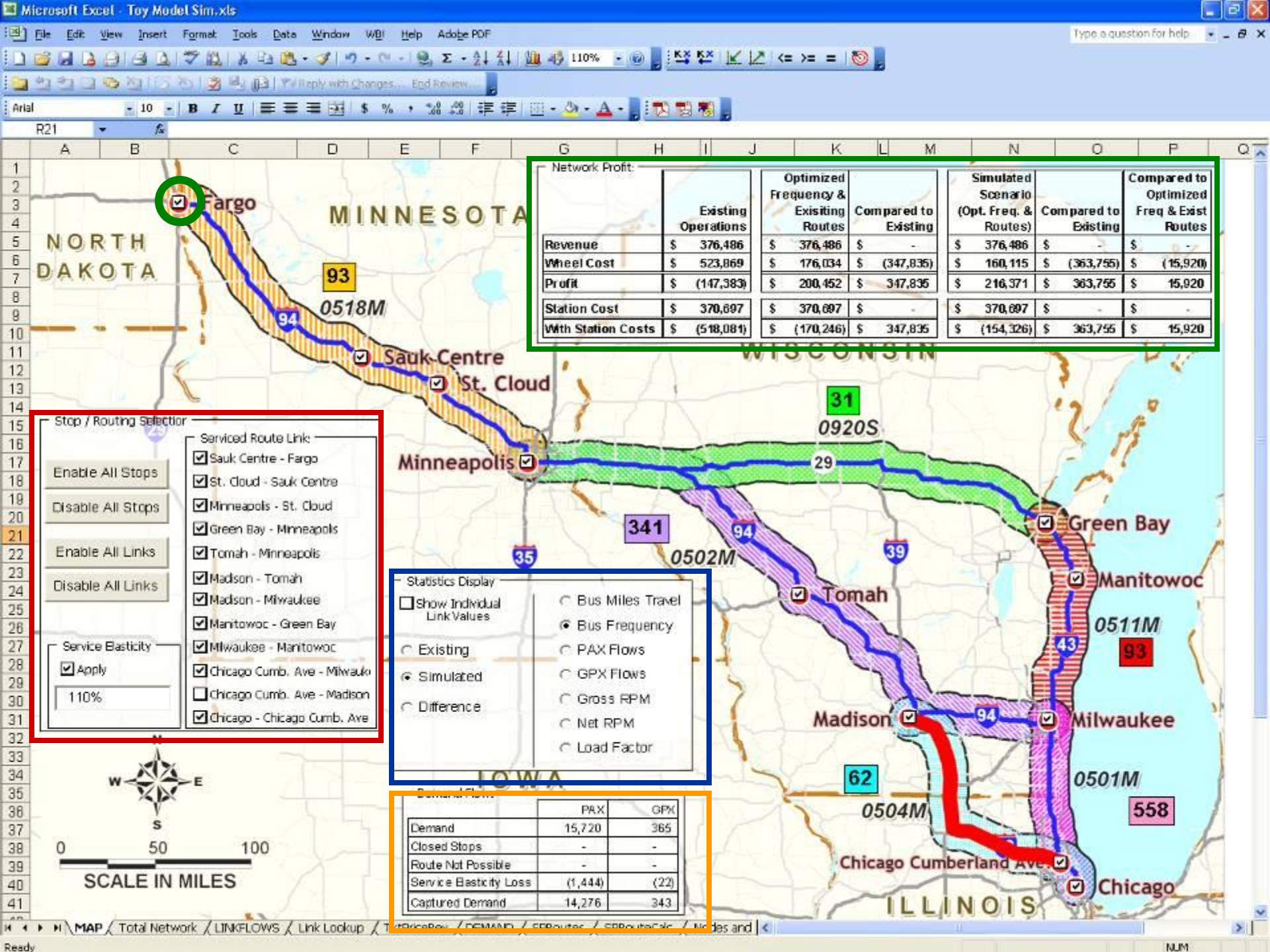
- **Intermodal Passenger Transport Systems**
- Intelligent Transportation Systems
- Transportation Systems Analysis
- Traffic/Transit Simulation
- Operations Research

Intermodal Passenger Transport

- Goal:
  - To Improve modal connectivity by moving people with greater efficiency. The more **seamless the connection** between transportation modes, the greater the operating **efficiency and productivity**.
- Focused Areas
  - Network design & optimization
  - Vehicle scheduling & routing
  - Service planning
  - System coordination
  - Travel time estimation & prediction

Network Design & Optimization

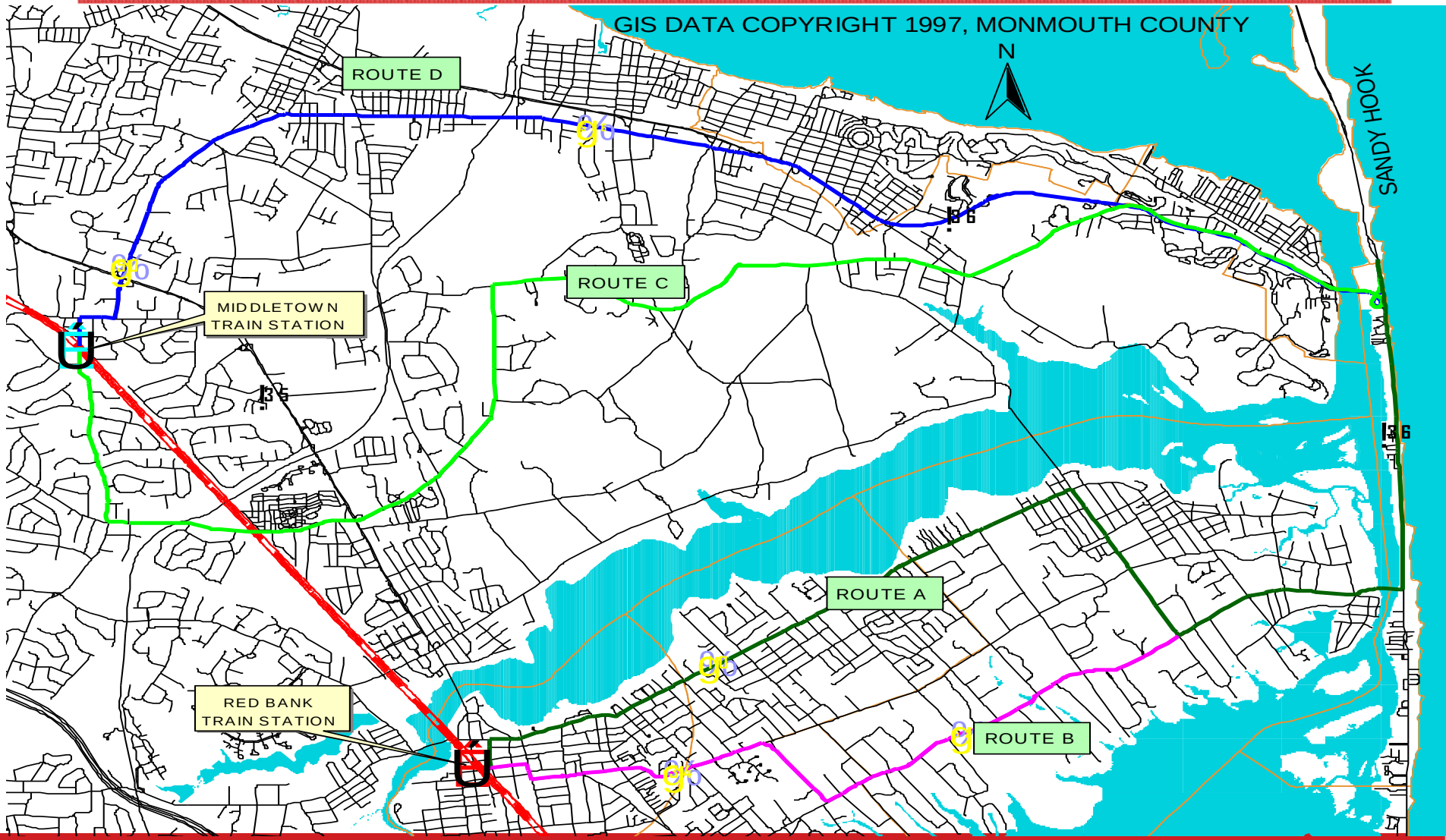
- Optimize Intermodal Networks
- Max. Profit, Ridership; Min. Cost Operation
  - Developing new vs. enhance existing networks
  - Selection of routes and transfer hubs
  - Competitive vs. complementary service
- Constraints
  - Demand vs. capacity
  - Operating cost
  - Fleet size
  - others


Microsoft Excel - Toy Model Sim.xls
Network Profit:
Existing Operations
Optimized Frequency & Exisiting Routes
Compared to Existing
Simulated Scenario (Opt. Freq. & Routes)
Compared to Existing
Compared to Optimized Freq & Exist Routes
Revenue $ 376,486 $ 376,486 $ - $ 376,486 $ - $ -
Wheel Cost $ 523,869 $ 176,034 $ (347,835) $ 160,115 $ (363,755) $ (15,920)
Profit $ (147,383) $ 200,452 $ 347,835 $ 216,371 $ 363,755 $ 15,920
Station Cost $ 370,697 $ 370,697 $ - $ 370,697 $ - $ -
With Station Costs $ (518,081) $ (170,246) $ 347,835 $ (154,326) $ 363,755 $ 15,920
Stop / Routing Selection
Enable All Stops
Disable All Stops
Enable All Links
Disable All Links
Service Elasticity
Apply
110%
Serviced Route Link:
Sauk Centre - Fargo
St. Cloud - Sauk Centre
Minneapolis - St. Cloud
Green Bay - Minneapolis
Tomah - Minneapolis
Madison - Tomah
Madison - Milwaukee
Manitowoc - Green Bay
Milwaukee - Manitowoc
Chicago Cumb. Ave - Milwauk
Chicago Cumb. Ave - Madison
Chicago - Chicago Cumb. Ave
Statistics Display
Show Individual Link Values
Existing
Simulated
Difference
Bus Miles Travel
Bus Frequency
PAX Flows
GPX Flows
Gross RPM
Net RPM
Load Factor
PAX GPX
Demand 15,720 365
Closed Stops - -
Route Not Possible - -
Service Elasticity Loss (1,444) (22)
Captured Demand 14,276 343
Fargo
Sauk Centre
St. Cloud
Minneapolis
Tomah
Green Bay
Manitowoc
Madison
Milwaukee
Chicago Cumberland Ave.
Chicago
0518M
0920S
0502M
0511M
0501M
0504M
93
94
29
341
31
43
62
558
35
39
MINNESOTA
NORTH DAKOTA
WISCONSIN
IOWA
ILLINOIS
N
W
E
S
0 50 100
SCALE IN MILES
MAP
Total Network
LINKFLOWS
Link Lookup
Ready

Vehicle Scheduling & Routing

- Optimize Routes, Stops, Service Frequency and Vehicle Size
- Max Profit, Ridership; Min Cost
  - Regular vs. irregular network
  - Homogenous vs. heterogeneous demand
  - timetable
- Constraints

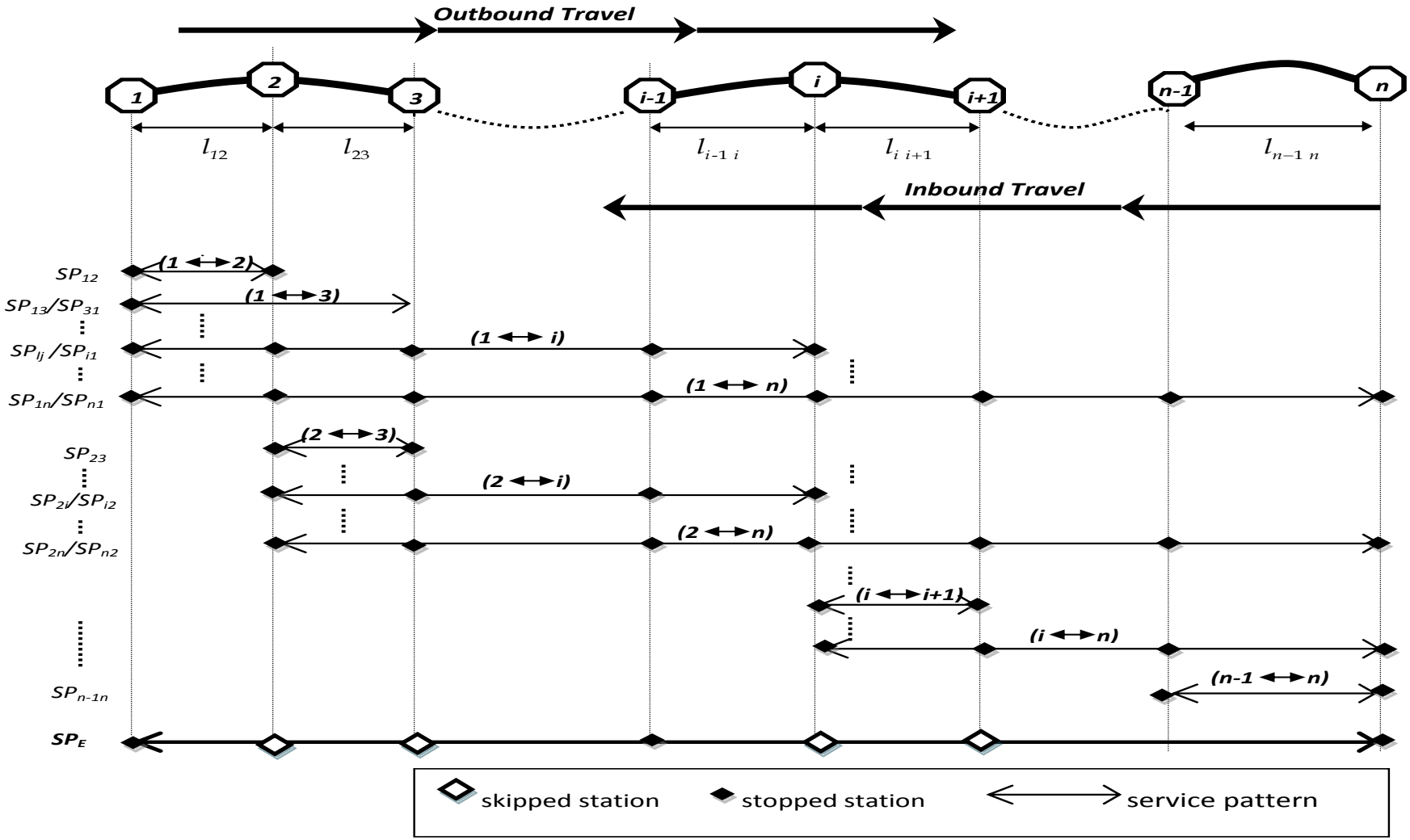
Sandy Hook Transit Service



Service Planning

- Optimize Service Patterns Frequency and Fare
- Max. Profit, Ridership; Min. Cost
  - Local, short-turn, accelerated, express, and integrated
  - Feeder service
  - Stop/station selection
  - Demand elasticity
  - Willingness to pay for transfer among modes
- Constraints

Integrated Service Patterns

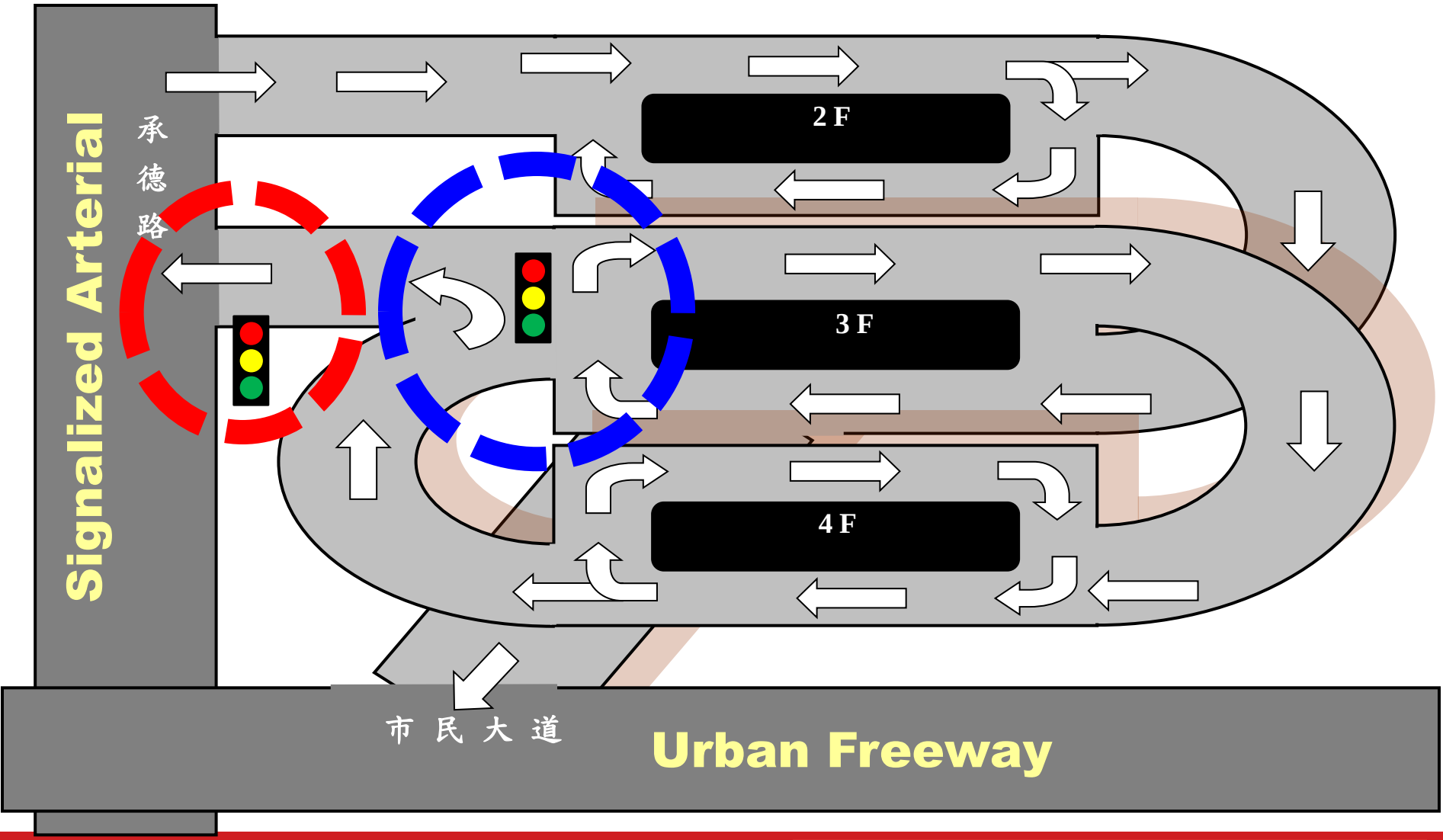


System Coordination

- Optimize Headway, Slack Time, Vehicle Size
- Max. Profit, Ridership; Min. Cost, Travel Time
  - Deterministic vs. probabilistic conditions
  - Demand elasticity
  - Transfer incentive
  - Dynamic control (Signal, Holding vs. Speeding)
- Constraints

Taipei Intermodal Terminal

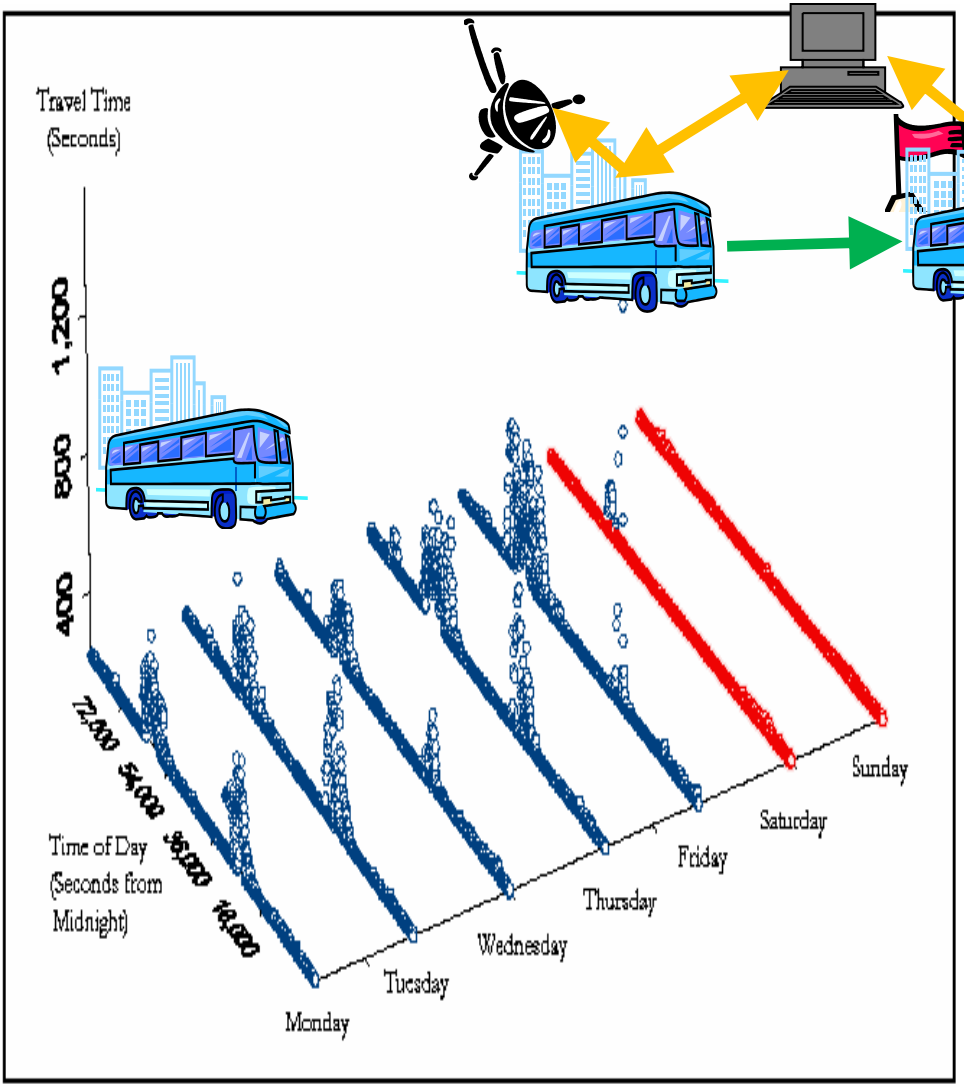
Dynamic Bus Traffic Control

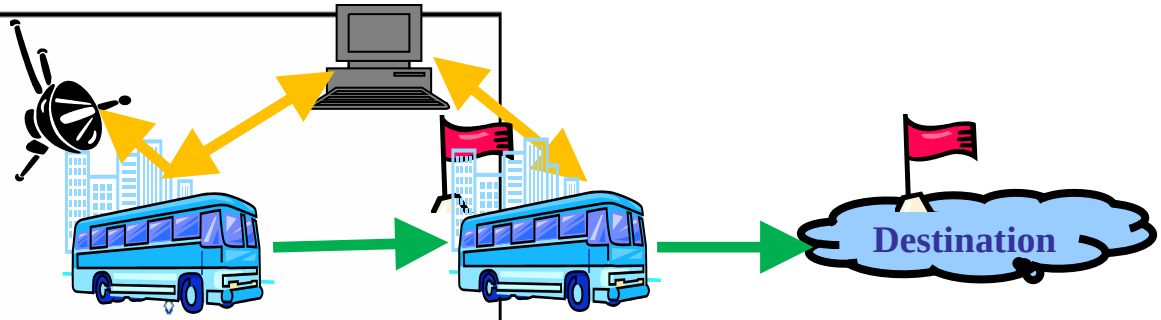


Travel Time Estimation & Prediction

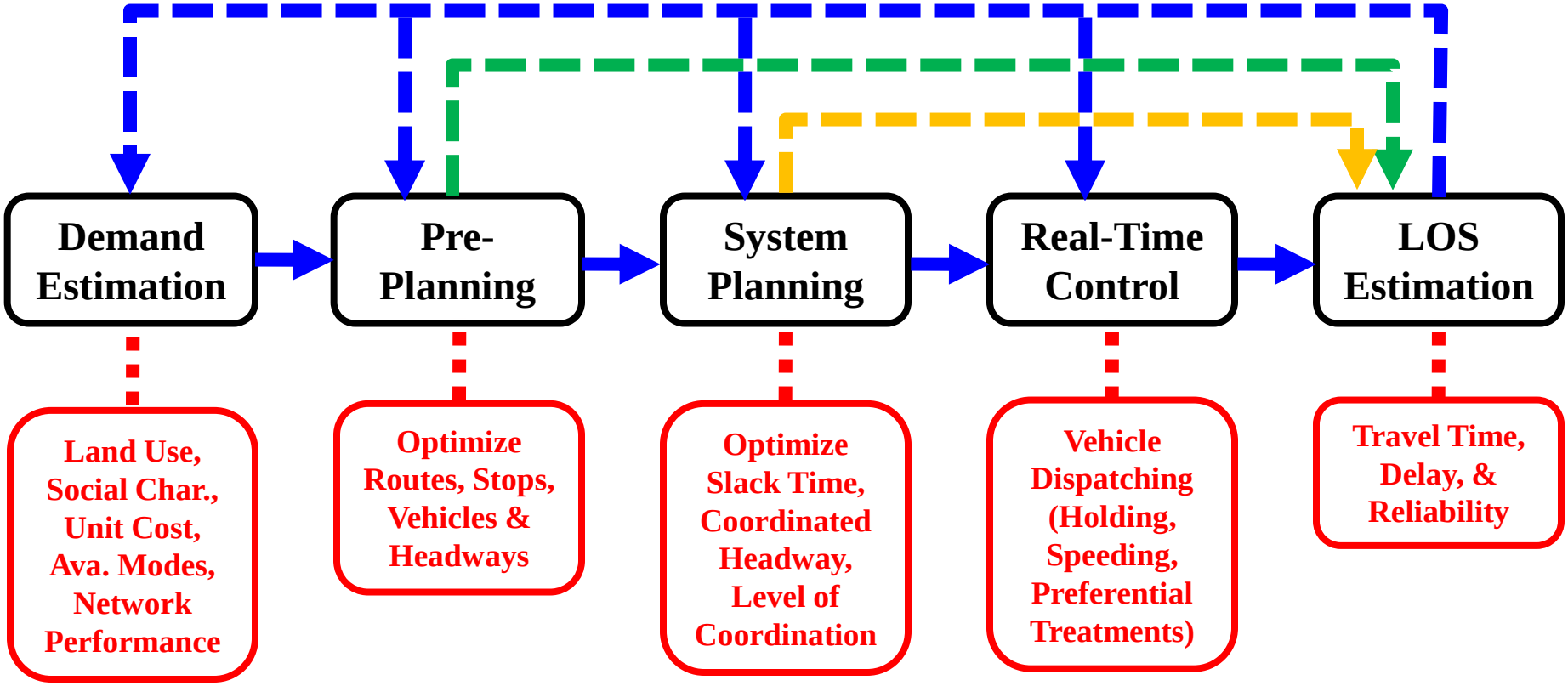
- Optimize Prediction Accuracy
- Travel Time under Various Conditions
  - Normal condition
  - Recurring congestion
  - Non-recurring congestion
  - Adverse weather
- Data
- Traveler Information
  - Kiosk
  - En-route
  - Pre-trip

Historic/Real-Time Data





Coordinated Intermodal System



Seamless Public Transportation

Urgency

Information: pre-trip, en-route, kiosk

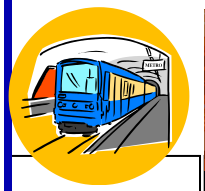
Service: frequent, coordination

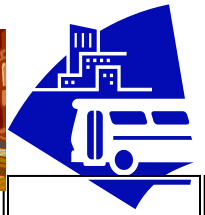
Accessibility: short walk dist., parking

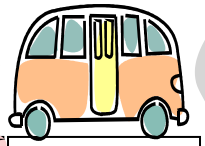
Accessibility: maintain service

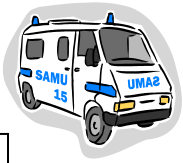
Information: on-time, reliability

Service: frequency meets need









Rail | LRT | BRT | Bus lane | Bus | Rural Bus | DRT | Community Bus

Demand (High to Low)

Urban | Suburban | Rural

Research Agenda

- How does coordination apply to public transport?
- What are coordination techniques?
- How can technology get us there faster?
- What are costs and benefits?
- Who benefits & pays?
- What investments must be made?
- How to justify investments and measure success?
- How to apply and to adapt existing successful practices?
- How to move towards implementation?