



FRA's CONNECT Tool

Datapalooza – Session 3

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U.S. Department of Transportation
Federal Railroad Administration

The CONNECT Tool

- Overview
- Inputs/Outputs (Cost and Demand Data)
- Travel Demand Calculations
- Sample of CONNECT Data
- Recent CONNECT Applications

Overview of CONNECT Tool

What is CONNECT?

- **CON**ceptual **NE**twork **C**onnections **T**ool
- Sketch planning tool for estimating performance of passenger rail corridors and networks
- Estimates order of magnitude ridership, revenue, and costs
- Intended for use during initial stages of a planning process, primarily in a regional network context
- Broad market based (MSA – MSA) level of detail

Overview of CONNECT Tool

Features of CONNECT:

- **Excel-based:** Broad-based platform
- **User-defined:** Network customized by user
- **Fully integrated:** A single action by user runs ridership, revenue, and cost calculations
- **Flexible:** Advanced users can adjust assumptions
- **Complete:** National database
- **Costs and benefits linked:** Evaluates costs associated with achieving higher levels of service and ridership

Provides Data not Answers

Overview of CONNECT Tool

When to use CONNECT:

- Provide an analytic base to decision making process in early phases of planning
- Provide relative comparisons between corridors and networks
- Act as a coarse screen to identify most compelling visions for further study
- Analyze importance of connecting corridors in the context of a more detailed study
- Estimate existing travel market between metro regions and develop estimates for future travel

Overview of CONNECT Tool

Limitations of CONNECT:

- Not a substitute for detailed corridor and network planning
- Not a corridor ridership tool
- Not GIS enabled – market based analysis limits ability to account for station locations, alternative alignments which may have large impact on ridership and costs
- Intercity markets only – will miss short distance trips (less than 50 miles) and commute trips
- Costs driven from generalized assumptions, not detailed operating plan

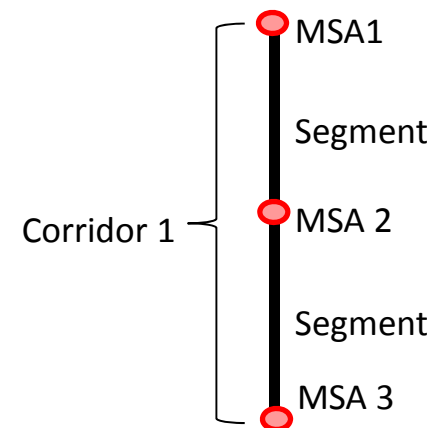
Corridor: A corridor is defined as a series of MSAs connected with direct rail service. Up to ten MSAs can define a corridor.

Segment: A segment is a subset of a corridor defined by two consecutive MSAs.

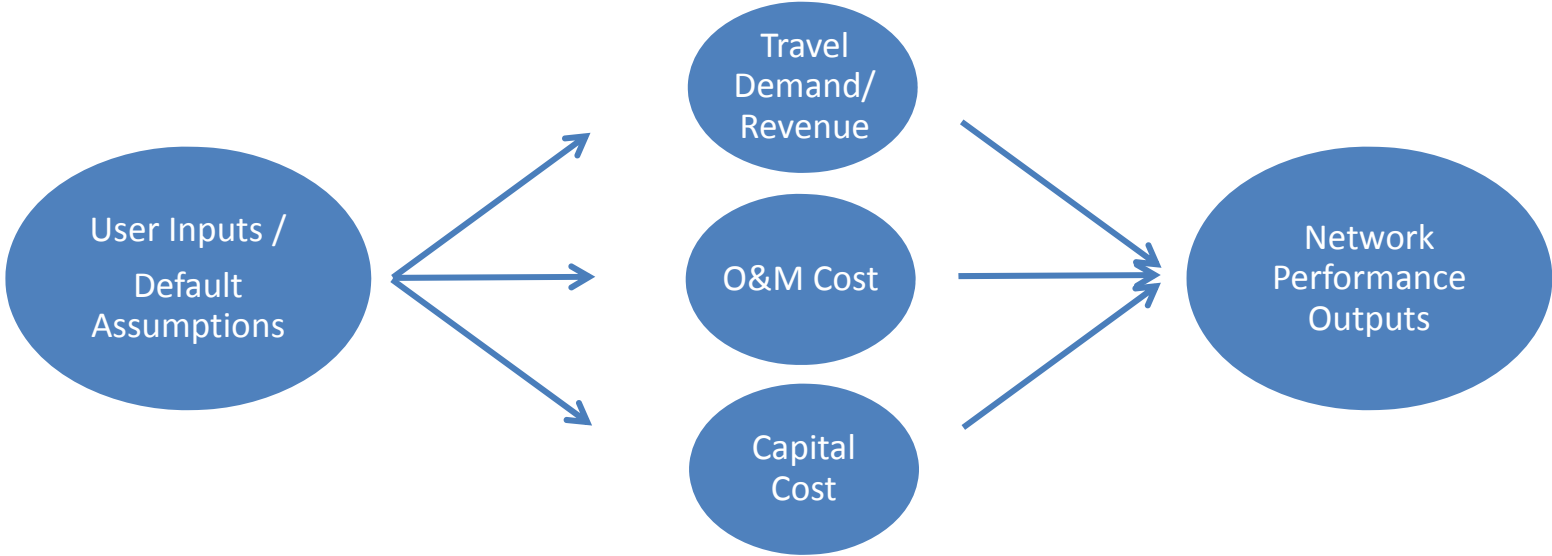
Network: A network is the full set of corridors entered into CONNECT and can consist of as few as one corridor to as many as 10 corridors.

Primary Corridor: The primary corridor is evaluated to the full extent of CONNECT. A user can test a range of frequency on all three service tiers (Emerging, Regional, and Core Express) with a single run. The “network effects” can also be analyzed on the primary corridor.

Secondary Corridor: All other corridors (up to nine) are secondary corridors. These corridors play a supporting role in the analysis. Corridors can be rotated into the “primary slot” to fully evaluate of multiple corridors in a network.



Inputs / Outputs



	MSA Pair	Segment	Corridor	Network
Ridership / Revenue	X	X	X	X
O&M Costs			X	X
Capital Costs			X	X

Inputs/Outputs

Stage 1
Demand Models

Intercity Auto
Demand Model

Local Air
Demand Model

Connect Air
Demand Model

Stage 2
Mode Choice Models

Auto Diversion
Model

Local Air
Diversion Model

Connect Air
Diversion Model

Rail

Auto

Rail

Air

Rail

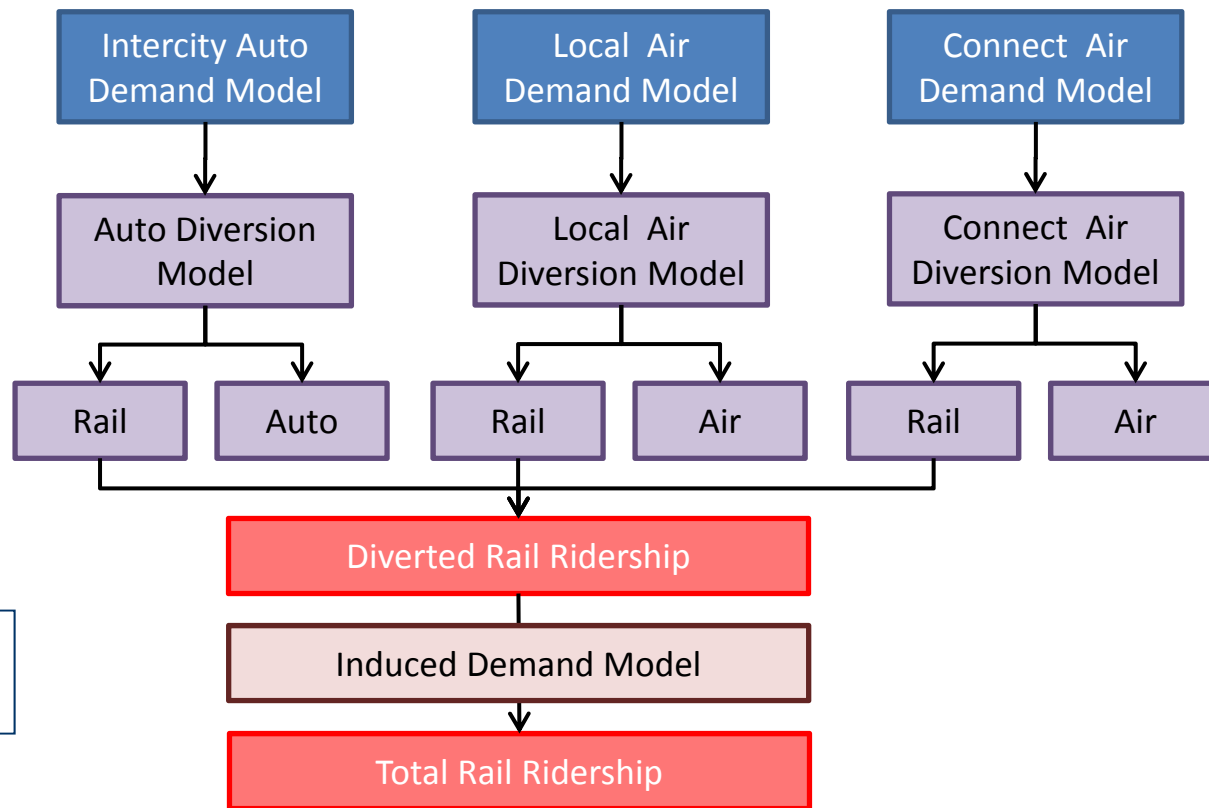
Air

Stage 3
Induced Demand Model

Diverted Rail Ridership

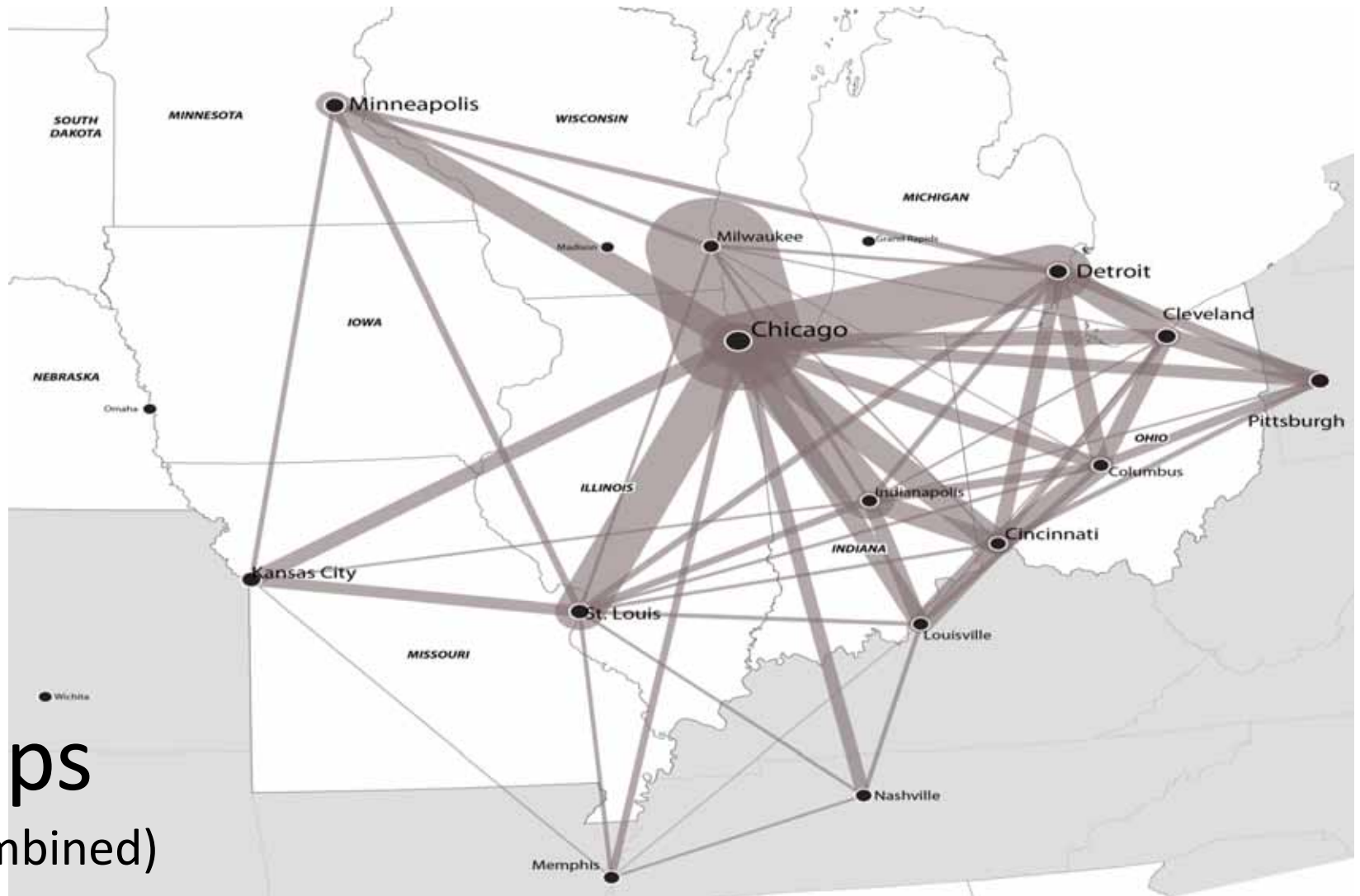
Induced Demand Model

Total Rail Ridership

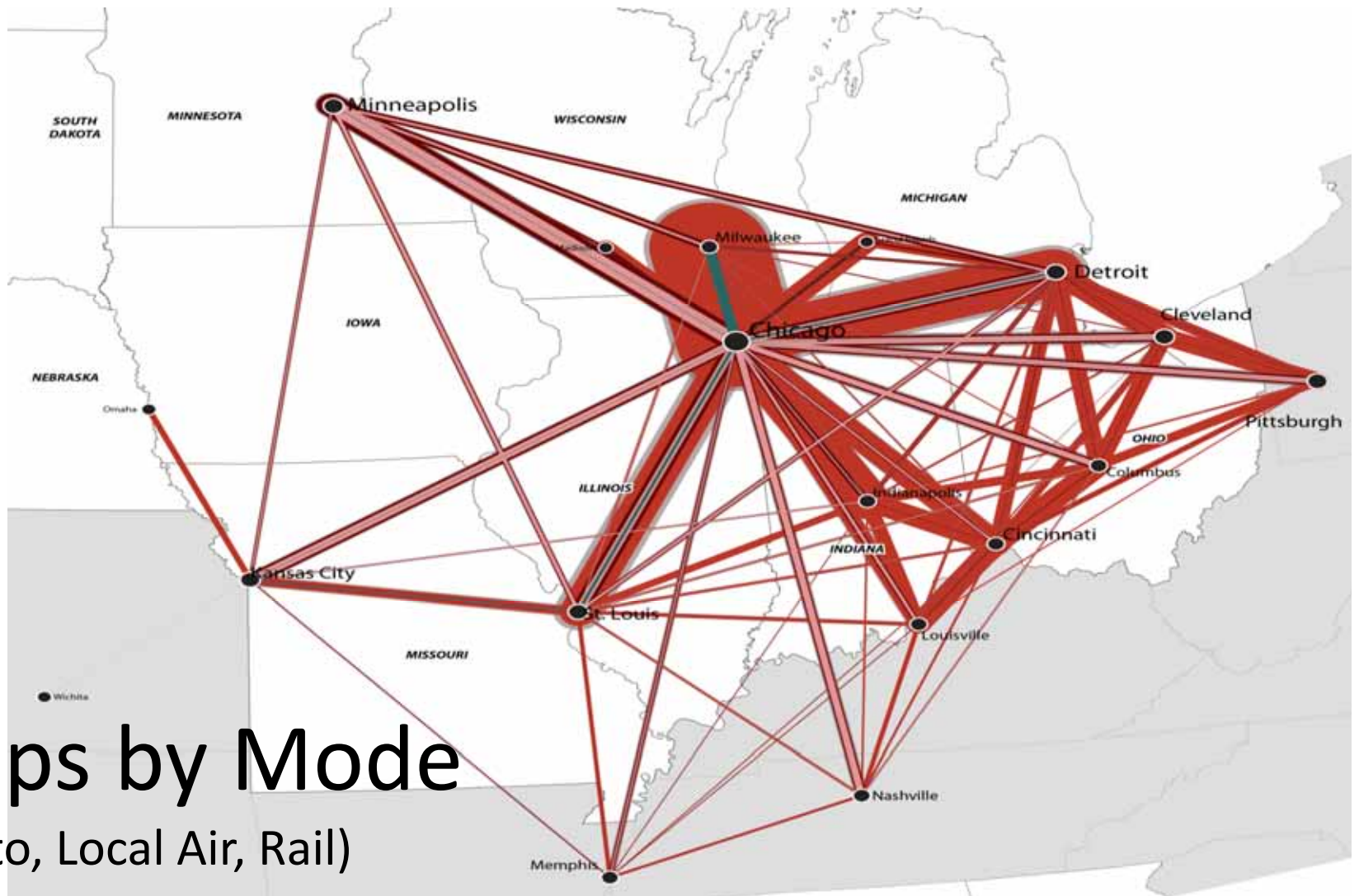


Sample of CONNECT Demand Data

- A sample of 2010 travel flows from the CONNECT database showing:
 - Rail Trips
 - Auto Trips
 - Air Trips
 - Local Air (Trips Between Sampled MSA Pair Only)
 - Connect Air (Multi-State Air Trips With One Leg on Sampled MSA Pair)



All Trips
(Local Combined)



All Trips by Mode

(Total, Auto, Local Air, Rail)

CONNECT Inputs

Advanced Inputs Include:

- Unit Costs (Capital, O&M)
- Operating Characteristics (avg. speeds, transfer times)
- Fleet Characteristics, Facility Assumptions
- Ridership Factors (value of time, congestion, fares, rail access time)

	Input Value Used	User Input	User Override	Default Settings
ADVANCED SETTINGS - Network				
OPERATING CHARACTERISTICS				
1				
2				
3				
4	Circuitry Factor (CircFac)			
5	Emerging			1.2 X Straight Line Distance
6	Regional			1.15 X Straight Line Distance
7	Core Express			1.1 X Straight Line Distance
8	Running Speed before Station Penalty (OpSpeed)			
9	Emerging			60 MPH
10	Regional			90 MPH
11	Core Express	Y	150	186 MPH
12	Station Penalty			5 Min.
13	Transfer			
14	Transfer Time			25 Min.
15	Transfer Penalty	Y	15	30 Min.
16	Misc. Operating Characteristics			
17	Daily Operating Time			16 Hours
18	Layover Time			40 Min. of Dwell
19	PHYSICAL Network / FLEET CHARACTERISTICS			
20	Network Data			
21	Network Wide Maintenance Facility	Y		Y
22	Corridor Data			
23	Number of terminal layover yards	2		2
24	Number of intermediate maintenance	2		2
25	Fleet Characteristics			
26	Seats - Emerging	300		300

Running speed before station penalty for Core Express reduced to 150 MPH from default value of 186 MPH

Transfer penalty reduced to 15 minutes from default value of 30 minutes

CONNECT Inputs

Capital Costs:

CAPITAL COST INPUTS	
<u>Unit Costs</u>	
<u>New Construction</u>	
Average ROW Acquisition Costs - Urban (low)	\$ 4,000,000
Average ROW Acquisition Costs - Urban (high)	\$ 32,000,000
Average ROW Acquisition Costs - Rural (low)	\$ 2,000,000
Average ROW Acquisition Costs - Rural (high)	\$ 14,000,000
Cost per route Mile - At Grade (low)	\$ 15,000,000
Cost per route Mile - At Grade (high)	\$ 35,000,000
Cost per route Mile - Tunnel (220mph)	\$325,000,000
Cost per route Mile - Tunnel (180mph)	\$275,000,000
Cost per route Mile - Tunnel (150mph)	\$250,000,000
Cost per route Mile - Tunnel (120mph)	\$200,000,000
Cost per route Mile - Tunnel (90mph)	\$150,000,000
Cost per route Mile - Tunnel (60mph)	\$125,000,000
Cost per route Mile - Aerial (low)	\$ 60,000,000
Cost per route Mile - Aerial (high)	\$100,000,000
Major Station - Core Express	\$200,000,000
Major Station - Regional	\$100,000,000
Major Station - Emerging	\$ 50,000,000
Minor Station - Core Express	\$ 40,000,000
Minor Station - Regional	\$ 20,000,000
Minor Station - Emerging	\$ 10,000,000
Trainset (low)	\$ 35,000,000
Trainset (high)	\$ 35,000,000
<u>Emerging Adjustment from Core for new track</u>	60%
<u>Regional Adjustment from Core for new track</u>	80%
<u>For All Corridors</u>	

O&M Costs:

OPERATING AND MAINTENANCE COSTS	
<u>Unit Costs</u>	
Fixed Costs	\$ 5,000,000
Major Stations - Core Express	\$ 10,000,000
Minor Station - Core Express	\$ 2,500,000
Major Stations - Regional	\$ 4,000,000
Minor Station - Regional	\$ 1,000,000
Major Stations - Emerging	\$ 1,000,000
Minor Station - Emerging	\$ 500,000
Annual Seat Miles - Low	\$ 0.040
Annual Seat Miles - High	\$ 0.060
Route Miles - Low	\$ 200,000
Route Miles - High	\$ 300,000

CONNECT Outputs

	Forecast year:		2050
	CORE EXPRESS		
	Low	Medium	High
Performance of Primary Corridor in Stand-Alone Context			
Frequency - All Stop		16	
Frequency - Limited Stop		28	
Ridership (Annual Passengers)	7,400,000	7,800,000	8,100,000
O&M Cost Recovery Ratio	1.64	2.03	2.58
Initial Capital Investment	\$2,200,000,000	\$2,200,000,000	\$2,200,000,000
Annual Ticket Revenue	\$725,000,000	\$762,000,000	\$797,000,000
Annual O&M Cost	\$309,000,000	\$375,000,000	\$441,000,000
Annual O&M Profit/(Subsidy)	\$284,000,000	\$387,000,000	\$488,000,000
Annual O&M Subsidy/Passenger-Mile	-	-	-
Rail Share of Total Intercity Travel Market	34%	36%	35%
Performance of Primary Corridor in Network Context (Infrastructure Corridor)			
Ridership (Annual Passengers)	13,600,000	16,900,000	20,000,000
O&M Cost Recovery Ratio	1.86	2.40	3.17
Initial Capital Investment	\$2,200,000,000	\$2,200,000,000	\$2,200,000,000
Annual Ticket Revenue	\$818,000,000	\$900,000,000	\$978,000,000
Annual O&M Cost	\$309,000,000	\$375,000,000	\$440,000,000
Annual O&M Profit/(Subsidy)	\$378,000,000	\$525,000,000	\$669,000,000
Annual O&M Subsidy/Passenger-Mile	-	-	-
Rail Share of Total Intercity Travel Market	34%	36%	35%
Performance of Full Network			
Annual Ridership	14,000,000	17,000,000	20,000,000
Annual Ticket Revenue	\$996,000,000	\$1,160,000,000	\$1,317,000,000
Initial Capital Investment	\$3,200,000,000	\$3,200,000,000	\$3,200,000,000
Annual O&M Cost	\$381,000,000	\$466,000,000	\$552,000,000
Max Segment Load Factor			
	CORE EXPRESS		
Primary Corridor - Stand-Alone Context	0.40		
Primary Corridor - Network Context (Infrastructure Corridor)	0.77		
Full Network	0.88		

CONNECT Outputs

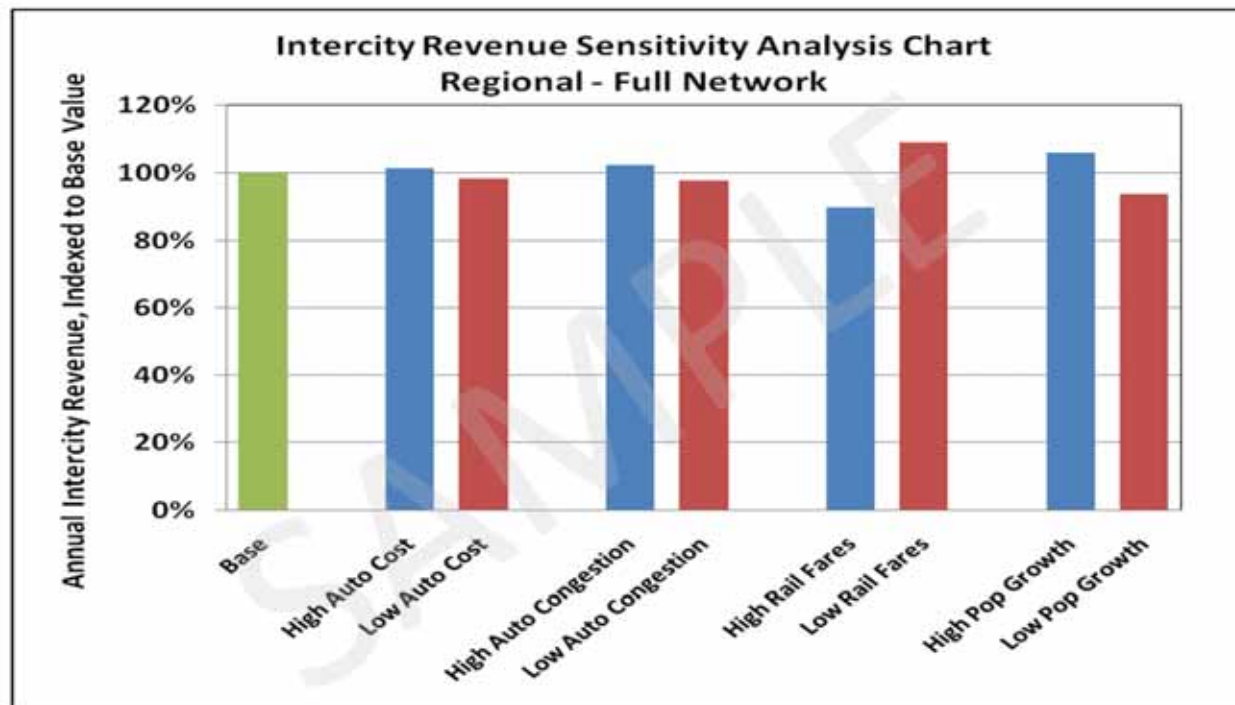
MSA Pair Ridership

A		B	E	K	Q	W	AC	AI	AO	AU	BA
1 Annual Intercity Ridership by MSA Pair - Tentative and Preliminary - For Discussion Purposes Only											
2 All MSA Pairs on Full Network											
3 MSA Code	4 MSA Pair	5 Emerging			6 Regional			7 Core Express			
		Low	Medium	High	Low	Medium	High	Low	Medium	High	
		Total	Total	Total	Total	Total	Total	Total	Total	Total	Total
6 31100-38060	Los Angeles-Phoenix	0	0	0	0	0	0	0	3,520,258	3,685,044	3,863,407
7 31100-40140	Los Angeles-Riverside	0	0	0	0	0	0	0	5,695,847	6,059,412	6,442,226
8 31100-41740	Los Angeles-San Diego	0	0	0	0	0	0	0	2,232,461	2,378,174	2,529,972
9 38060-40140	Phoenix-Riverside	0	0	0	0	0	0	0	818,512	866,377	914,873
10 38060-41740	Phoenix-San Diego	0	0	0	0	0	0	0	1,334,298	1,394,074	1,455,064
11 40140-41740	Riverside-San Diego	0	0	0	0	0	0	0	931,524	981,990	1,035,976
12 -	-										

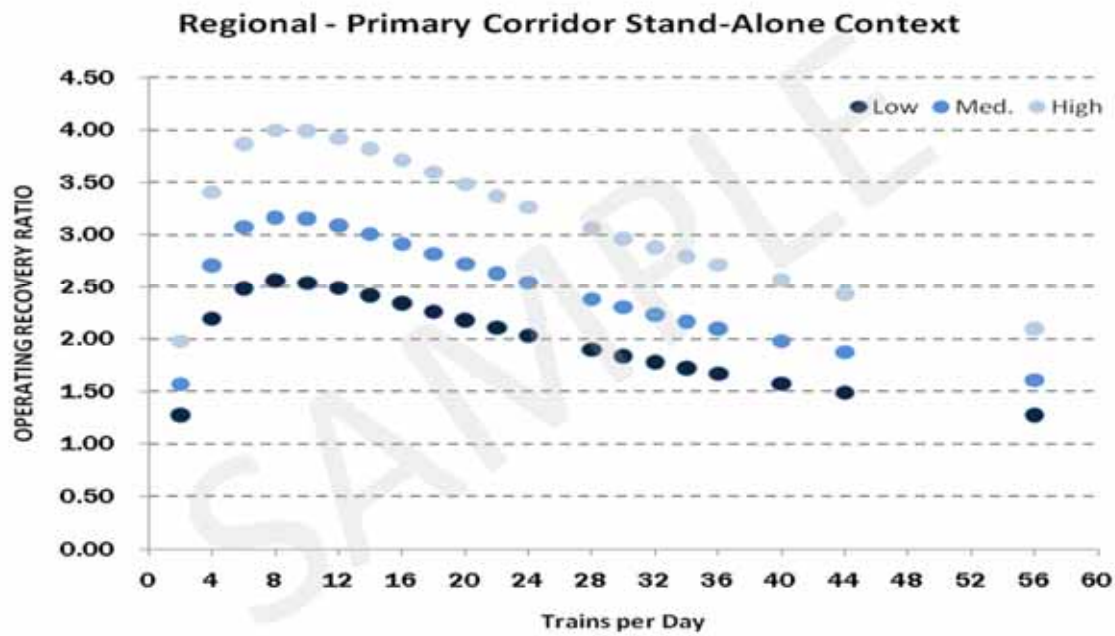
O&M Costs by Corridor

A	B	C	D	E	F
1	Stand-Alone Context			Network Context (Service Corridor)	
2	Low	High		Low	High
3	Emerging	\$ -	\$ -	Emerging	\$ - \$ -
4	Regional	\$ -	\$ -	Regional	\$ - \$ -
5	Core Express	\$ 182,380,000	\$ 256,069,000	Core Express	\$ 156,880,000 \$ 227,819,000
6					
7	Stand-Alone Context		Service Tier on	Network Context (Service Corridor)	
8	Low	High	Primary Corridor	Low	High
9	Core Express	\$ 302,124,000	\$ 450,686,000	Emerging	\$ - \$ -
10			Regional	\$ - \$ -	
11			Core Express	\$ 224,000,000	\$ 333,499,000
12					

CONNECT Outputs



CONNECT Outputs



Recent CONNECT Applications

- Southwest
- Texas

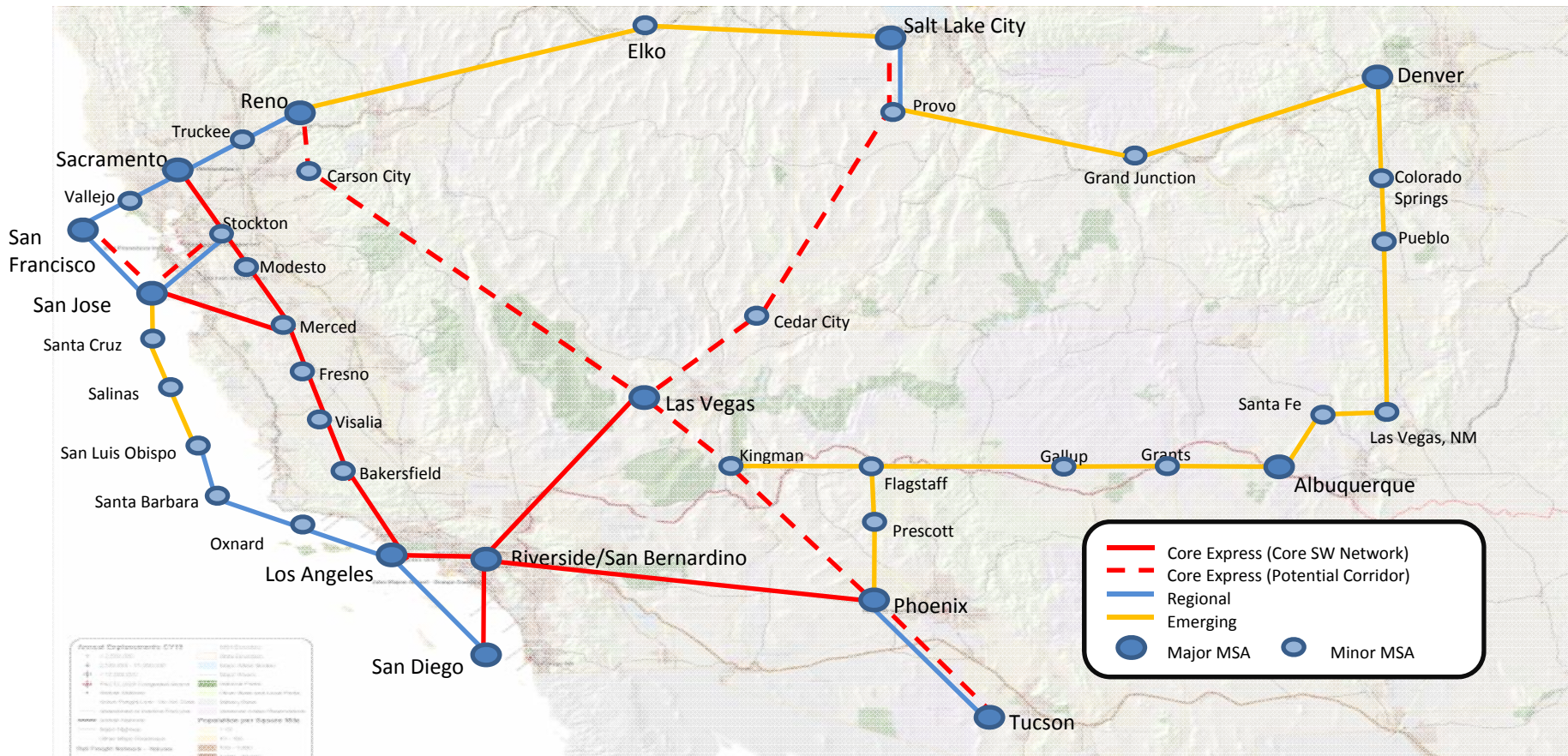
Southwest

Southwest Multi-State Rail Plan

- The first multi-state network planning study led by the FRA.
- Convened stakeholders to develop regional vision and provide input for analysis.
- Used CONNECT to generate data for conceptual planning of intercity corridors.
- Worked with stakeholders to assess how planning decisions may change when corridors are analyzed in a network context.



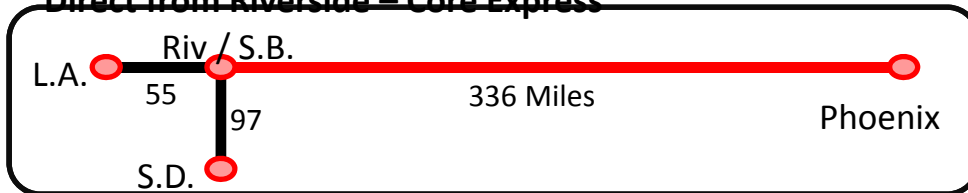
Southwest



Southwest

Tested Alternative Network Configurations:

Direct from Riverside – Core Express



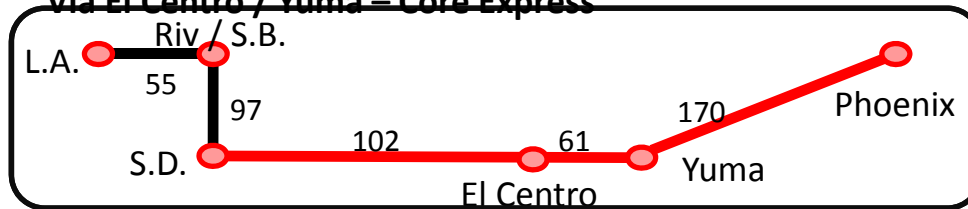
Initial Capital Investment	\$12 – \$16 B
Annual Ridership	10.7 – 14.2 M
Annual Ticket Revenue	\$1,000 – 1,280 M
Annual O&M Cost	\$480 – 690 M
O&M Cost Recovery Ratio	1.5 – 2.7

Riverside via Yuma – Core Express



Initial Capital Investment	\$13 – 18 B	Dif from Opt 1 \$1.1 – 1.7 B
Annual Ridership	10.6 – 14.2 M	--
Annual Ticket Revenue	\$1,010 – 1,310 M	\$10 – 30 M
Annual O&M Cost	\$500 – 730 M	\$20 – 40 M
O&M Cost Recovery Ratio	1.4 – 2.6	(0.1)

Via El Centro / Yuma – Core Express



Initial Capital Investment	\$14 – 20 B	Dif from Opt 1 \$2.5 – 4.5 B
Annual Ridership	9.4 – 13.7 M	(0.5 – 1.3 M)
Annual Ticket Revenue	\$770 – 1,070 M	(\$210 – 230 M)
Annual O&M Cost	\$440 – \$650	(\$40 M)
O&M Cost Recovery Ratio	1.2 – 2.4	(0.3)

Southwest

Phoenix - Tucson:

Primary Corridor	Stand-Alone	Network Context (Inf. Corridor)
Service Tier	Regional	
Daily Frequencies (All Stop, Limited Stop)	(8,8)	
Ridership (Annual Passengers)	600,000	2,000,000
O&M Cost Recovery Ratio	0.42	1.03
Initial Capital Investment	\$3,200,000,000	\$3,200,000,000
O&M Profit/(Subsidy)	(\$37,000,000)	\$200,000,000
Rail Share of Total Intercity Travel Market	15%	15%

Southwest

Used data to analyze total impact of network connectivity:

	Markets Served ¹	Annual Ridership ²	Annual Ticket Revenue	O&M Cost	Capital Cost ³
Sum of Stand Alone	87	53 - 61 M	\$5.2 - \$6.0 B	\$3.6 - \$5.2 B	\$180 - \$250 B
Network	197	69 - 84 M	\$7.4 - \$9.3 B	\$3.2 - \$4.7 B	\$150 - \$200 B
Difference	+ 126%	+ 30 - 38%	+ 42 - 55%	- 10 - 11%	- 17 - 20%

All costs in 2010 \$

1. Total number of market pairs on network with maximum of one transfer
2. Year 2050 intercity demand
3. Capital figure excludes land costs

Texas Network

ZA)

DFW-HOU

Total Network Capital:

\$22.5 Billion

Additional Capital for non-OKC to SAN:

\$7.6 Billion

Total Network Ridership:

24.9 Million

HOU-DFW Ridership:

10,630,075

DFW-AUS/SAN Ridership:

8,509,322

HOU-AUS/SAN Ridership:

3,442,897

Total Small Market Boardings:

291,158

Network Rail Mode Share:

32.3%



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Texas Network

4B) AUS-CST-HOU, DFW-WAC-CST-HOU

Total Network Capital:

\$23.3 Billion

Additional Capital for non-OKC to SAN:

\$8.4 Billion

Total Network Ridership:

25.7 Million

HOU-DFW Ridership:

10,400,109

DFW-AUS/SAN Ridership:

8,509,322

HOU-AUS/SAN Ridership:

4,221,887

Total Small Market Boardings:

425,286

Network Rail Mode Share:

33.4%



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Illustrative Analysis of TX Networks

- Summary – Relative Values

Network Option	Total Network Capital	Additional Capital for non OKC-SAN	Total Network Ridership	HOU-DFW Ridership	DFW- AUS/SAN Ridership	HOU- AUS/SAN Ridership	Small Market Total Boardings	Rail Mode Share
2A DFW-HOU	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2B DFW-CST-HOU	1.01	1.03	1.00	0.99	1.00	0.99	1.39	1.00
2C WAC-CST-HOU	0.91	0.74	1.01	0.98	1.00	1.05	1.45	1.01
2D AUS-CST-HOU	0.91	0.74	1.00	0.90	1.01	1.23	1.40	1.02
2E AUS-HOU	0.88	0.63	1.00	0.91	1.00	1.25	1.05	1.00
2F SAN-HOU	0.92	0.78	0.94	0.81	1.02	1.16	1.01	0.95
3A SAN-HOU, DFW-HOU	1.24	1.71	1.02	1.00	1.00	1.11	1.00	1.00
3B SAN-HOU, DFW-CST-HOU	1.25	1.76	1.03	0.99	1.00	1.16	1.40	1.02
3C AUS-HOU, DFW-HOU	1.20	1.59	1.04	1.00	1.00	1.25	1.03	1.06
3D AUS-HOU, DFW-CST-HOU	1.21	1.62	1.04	0.99	1.00	1.25	1.42	1.05
3E AUS-HOU, WAC-CST-HOU	1.11	1.33	1.04	0.98	1.00	1.25	1.45	1.05
3F SAN-HOU, WAC-CST-HOU	1.16	1.49	1.02	0.98	1.00	1.10	1.45	1.02
4A AUS-CST-HOU, DFW-CST-HOU	1.13	1.39	1.04	0.99	1.00	1.23	1.43	1.04
4B AUS-CST-HOU, WAC-CST-HOU	1.04	1.11	1.03	0.98	1.00	1.23	1.46	1.03

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Questions?

Thank you!