



FAF²

The Second Generation of Freight Analysis Framework


Part 1 of 2

Office of Freight Management and Operations
Federal Highway Administration



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Part 1 Outline

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- 1) FAF Objective
 - 2) Deliverables
 - 3) Approaches
 - 4) CFS Contribution TO FAF²
 - 5) FAF¹ vs. FAF²
 - 6) Current Status





FAF² - Objective

- 1) To answer freight shipment volume and congestion questions on the highway system
- 2) To answer freight shipment route/corridor questions
- 3) To provide state DOTs and MPOs control freight traffic data
- 4) To answer freight shipment modal questions
- 5) To provide disaster scenario analyses as related to freight movements





FAF² - Objective

- 1) To answer freight shipment volume and congestion questions on the highway system
- 2) To answer freight shipment route/corridor
 - 1: FHWA Policy and investment analyses
 - 2: State DOTs and local MPOs control data
 - 3: Other derivative usages
- 5) To provide disaster scenario analyses as related to freight movements





FAF is not ..

a computer model in the traditional sense of computer software modeling and programming

FAF consists of :

- 1: Customized loglinear and iterative proportional fitting programs to deal with O-D matrix data
- 2: Economic models to deal with future economic growth projections
- 3: Customized programs to convert tonnage to # of trucks
- 4: Commercial available traffic modeling programs to assign truck/passenger vehicles on to a highway network.



FAF² - Products and Deliverables

- 1) freight flow databases
- 2) highway freight truck movement databases and flow networks
- 3) waterway freight shipment databases
- 4) rail freight shipment databases





FAF² - Products and Deliverables

(time series products)

- 1) 2002 base year
- 2) Annual provisional estimates starting with year 2005
- 3) Projections for years between 2010 to 2035 with a 5-year increment



FAF² - Approach

- 1) Data Sources – public data
- 2) Methods and Models – transparent and duplicable
- 3) Deliverables – data, methods, and results are publicly available

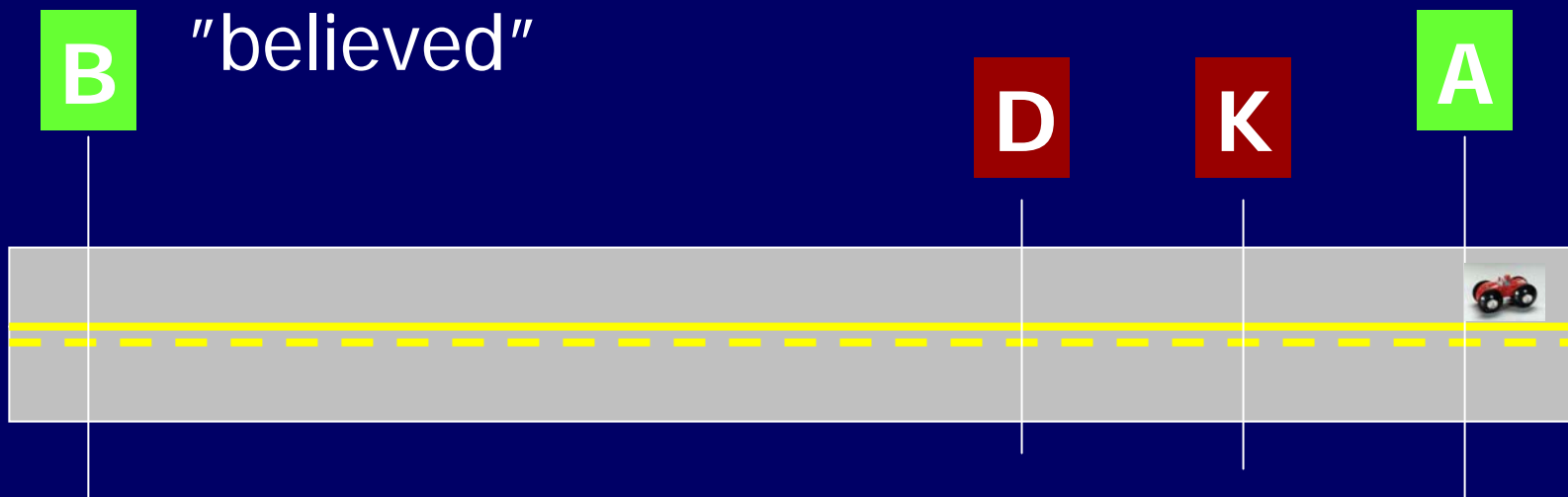
Commodity Geographical Resolution ...

- 1) Observed data -- "truth"
- 2) Synthesized data – "trusted" or "believed"

...geographic resolution is referring to the scale of an area where "observed data" are available

Commodity Geographical Resolution ...

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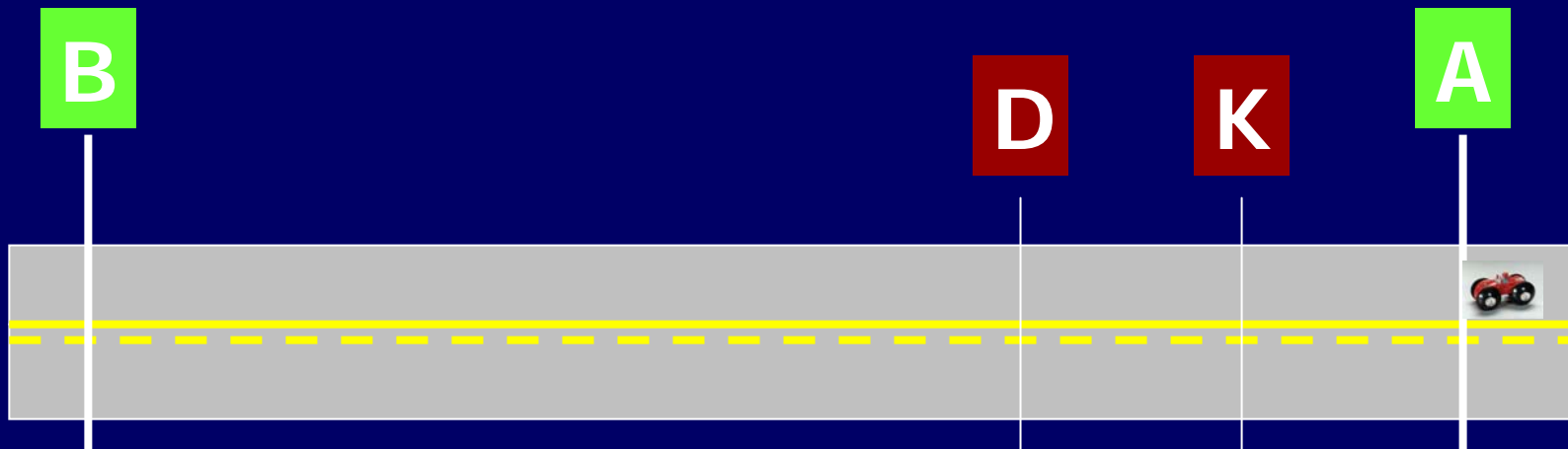
OBSERVED
DATA

Distance (from A to B) = 80 miles
Car SPEEDY travels from A to B in exactly 1 hour, the
average speed is 80 miles/hour between A and B

Commodity Geographical Resolution ...

- 1) Observed "truth" – 80 mi/hr between A and B
- 2) Speeds between A and K, K and D, D and B can be "synthesized" based on the above "truth" and information gathered not related to the present travel.

The geographic resolution here is the length of AB and not anything shorter than AB



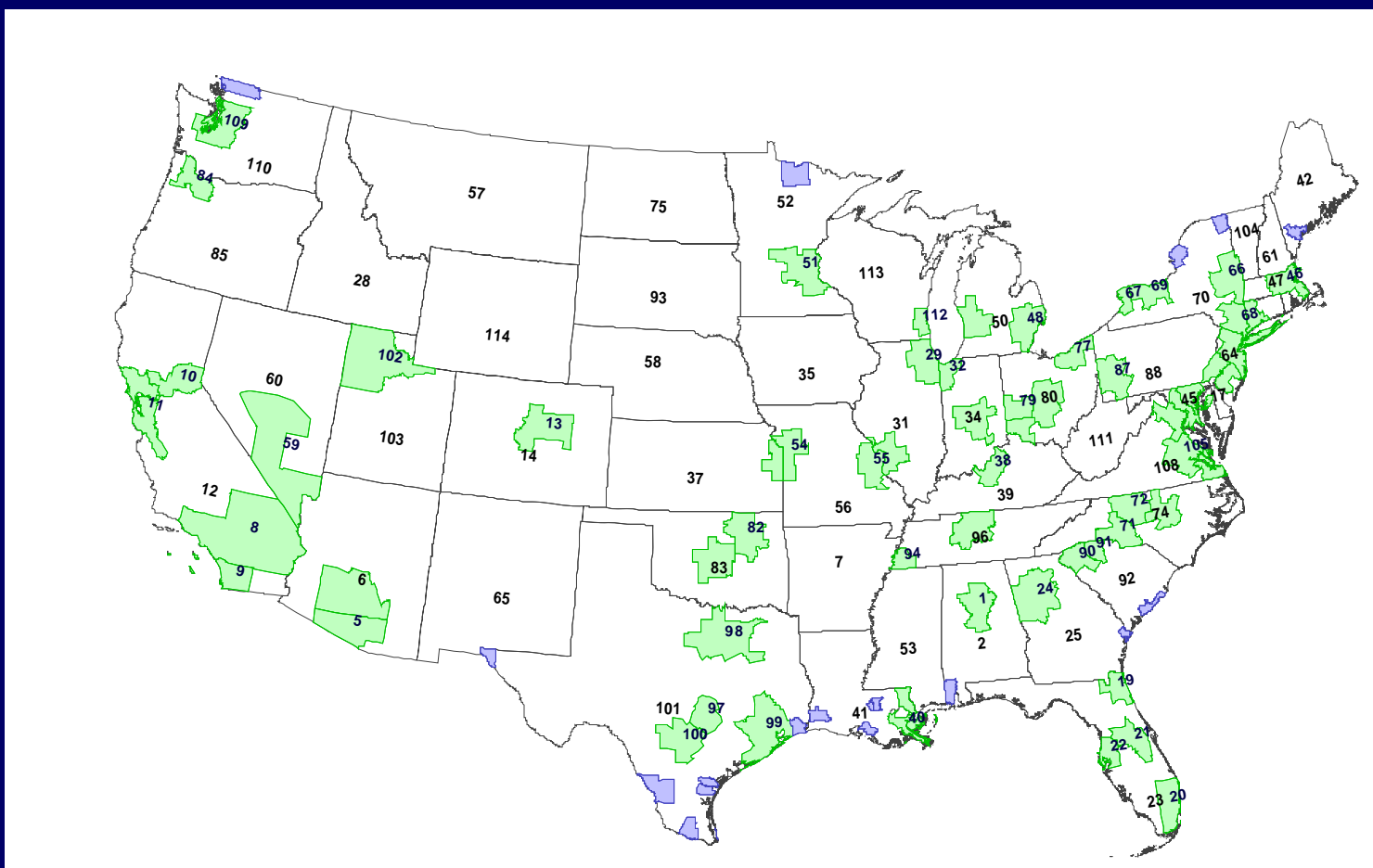


FAF² : Commodity Geographical Resolution...

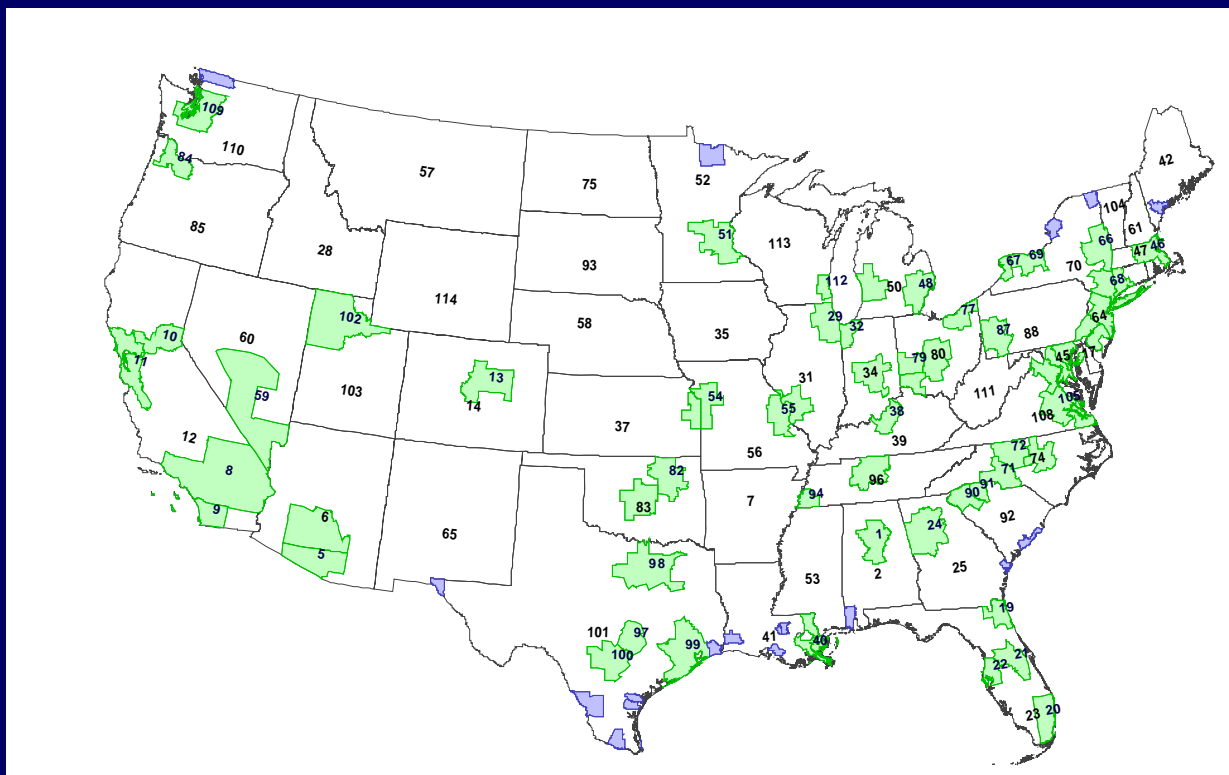
- 1) 114 Commodity Flow Survey (CFS) regions
- 2) 17 additional international gateways (AIG)
- 3) 7 International trade regions

A Total of 17,196,732 Matrix Cell Values
for a given time period

114 CFS Zones (Green and White)



FAF² - 13 AIG (Magenta)



Land Crossings: Laredo TX; Blaine WA; International Falls MN; Champlain/Rouses Point NY; Alexandria Bay NY; El Paso TX; Brownsville/Hidalgo, TX.

Ports: Beaumont TX; Charleston SC; Portland ME; Savannah GA; Morgan City LA; Corpus Christi TX; Lake Charles LA; Baton Rouge LA; Mobile AL;




FAF² - 7 International Trade Regions

- 
- 1) Canada
 - 2) Mexico
 - 3) Latin and South America
 - 4) Asia
 - 5) Europe
 - 6) Middle East
 - 7) Rest of the World



FAF² – Transportation Mode

- 
- 1) Truck
 - 2) Rail
 - 3) Water
 - 4) Air
 - 5) Pipeline
 - 6) Intermodal
 - 7) Others



FAF² – Commodity Classification

Categories Outside CFS

- 1) Farm based agricultural
- 2) Fishery
- 3) Crude petroleum
- 4) Natural gas
- 5) Municipal solid waste

continued ...



FAF² – Commodity Classification

Categories Outside CFS

Continued

- 6) Construction
- 7) logging
- 8) Services
- 9) Publishing
- 10) Retail
- 11) Household & Business Moves
- 12) Imports





FAF² – Commodity Classification

Standard Classification for Transported Goods (SCTG)

At 2-digit level, there are 42 commodities + 1 unknown.



FAF² – Regional OD Database

Example – for a given commodity and given mode with the unit of tonnage...

		From Region (I)							
		1	2	3	4	5	6	7	8
To Region (J)	1	0	0	128	256	256	12	23	45
	2	12	0	0		3	5	6	125
	3	0			0	5	12		
	4	20		0	0	6	11		
	5		9	0	0	7	10	15	23
	6	15	2	0	0	9	2		
	7			12	0	7	0		25
	8	0	0	14	0	6		14	
	9	2	5	0	12	3	2	26	
	10		50		25	8	0	25	
	11	0			63	25		12	
	12			0	2	2		5	12



FAF² – Regional OD Database

Example – for a given commodity and given mode with the unit of tonnage...

		From Region (I)							
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	3	0			0	5	12		
	4	20		0	0	6	11		
	5								23
	6								
	7			12	0	7	0		25
	8	0	0	14	0	6		14	
	9	2	5	0	12	3	2	26	
	10		50		25	8	0	25	
	11	0			63	25		12	
	12			0	2	2		5	12

missing values and zero cell entries



FAF² – Regional OD Database

The Method adopted in handling missing values

If a matrix entry is blank and it is not zero, then a value is estimated. The estimated value is then plugged back into the matrix. The method adopted here is

loglinear method



FAF² – Regional OD Database

The Method adopted in handling control total

In order to maintain the control total (marginal total) of a matrix after estimated values are plugged in, a mathematical method is needed to readjust all cell values with certain relationships, the method adopted here is

iterative proportional fitting (IPF) method

FAF² – Regional OD Database Final Database

		From Region (I)							
		1	2	3	4	5	6	7	8
To Region (J)	1	0	0	120	256	265	12	21	45
	2	1) Unit: Tonnage and \$					5	6	125
	3	2) Mode: 7					2	2	1
	4	3) Commodity: 43					1	3	2
	5	4) Geographic Areas: 138					0	15	9
	6						2	24	1
	7						0	2	25
	8						4	14	2
	9						2	23	0
	10	1	50	0	25	8	0	25	0
	11	0	2	0	63	25	0	12	3
	12	12	23	0	2	2	34	5	12



FAF² – Future Goods Movement

The regional economic growth projections for years between 2010 and 2035 are analyzed through economic models for three different scenarios – normal growth, low growth, and high growth. These growth data are commodity specific.



FAF² – Routing Future Goods Movement

For a given commodity, the modal split remains constant unless information indicates otherwise.

This does not guarantee that total modal share is constant. If commodity shares are changed, then total modal share will be changed, too.



FAF² – Routing of Future Goods Movement

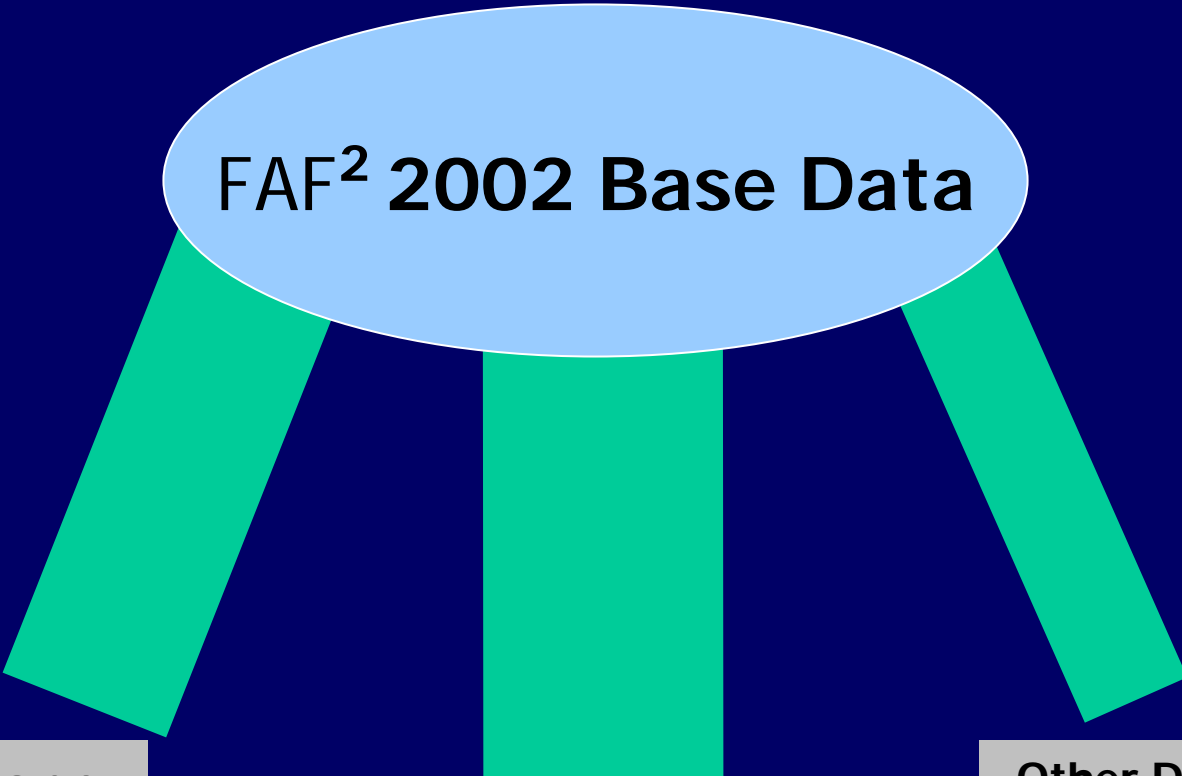
For the highway mode, routing is developed based on both truck and passenger vehicles through the least resistance assignment algorithm.

This task is carried out through commercially available traffic modeling software

FAF1 vs. FAF²

- 1) Data Sources: private proprietary vs. public
- 2) Input Data Resolution: county vs. regional/state level
- 3) Output Data Resolution:
 - Within USDOT: County vs. County
 - Outside USDOT: State vs. Sub state
- 1) State DOTs and Local MPOs Applications:
 - FAF¹: limited usage in modeling application
 - FAF² : control total in statewide and MPO modeling
- 4) Results and deliverables:
 - FAF¹ : Limited O-D data
 - FAF² : At a minimal, regional and sub-state OD data.

CFS Contribution to FAF²



FAF² 2002 Base Data

**Out of Scope
Studies**

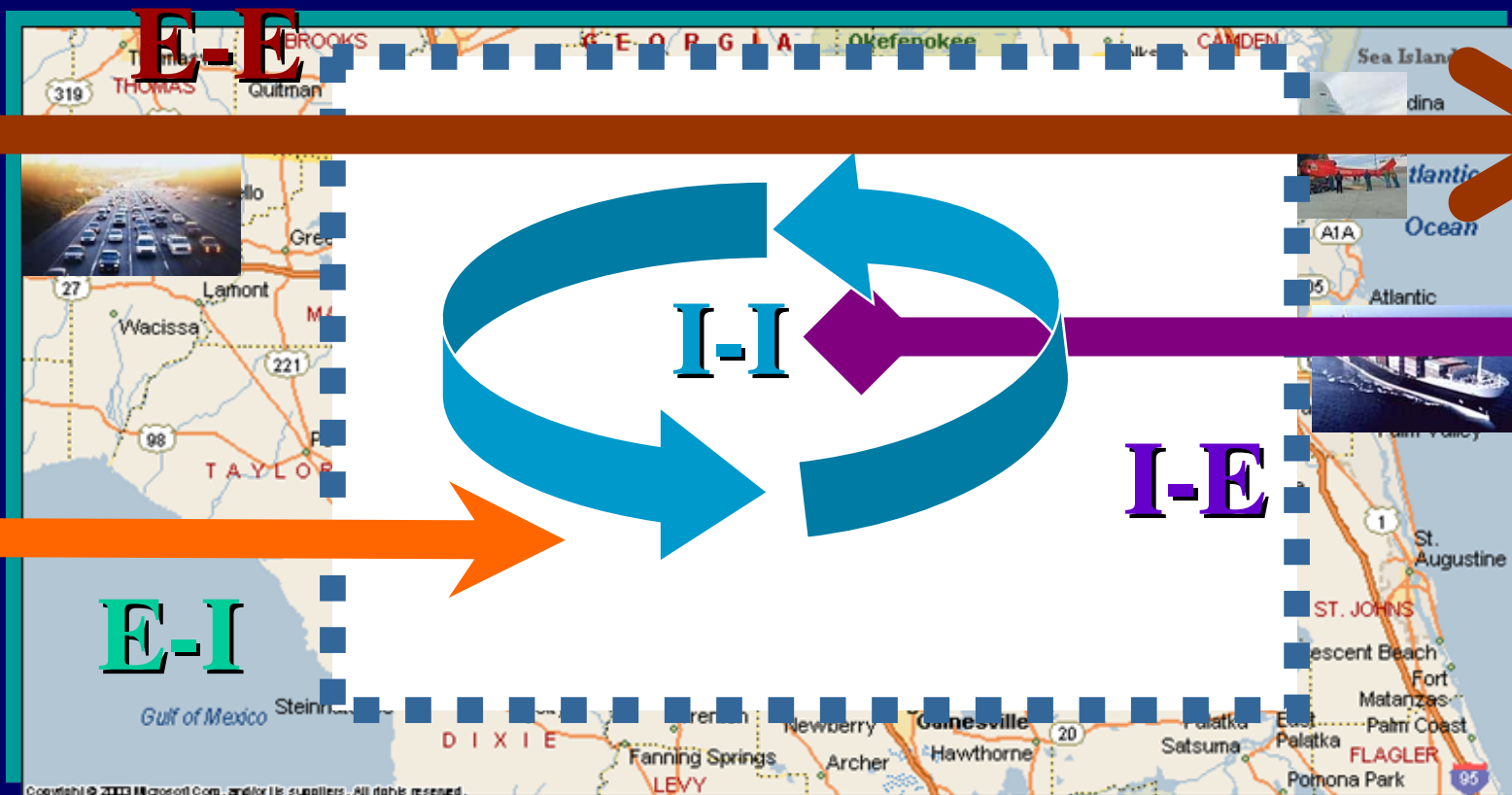
**2002 Commodity
Flow Survey**

**Other Data: Waybill,
Waterborne
Commerce...**

CFS Contribution to FAF²

- 1) CFS accounts for about 60% of total FAF² in tonnage
- 2) CFS accounts for about 65% of total FAF² in value
- 3) CFS accounts for about 71% of total FAF² in ton-mile

FAF² - State and MPO Application Illustration



FAF² – Application Illustration (daily Truck Volume)





FAF² – Application Illustration (Route Freight Burden)

Inter-State Highway #	No of Segs	Miles	FAF Trk ADT	FAF Trk ADT per Mile	FAF Trk Share of Total ADT
5	1,304	1,383	14,989	10.8	22.7%
8	149	348	14,270	40.9	69.4%
10	1,465	2,460	11,408	4.6	29.5%
15	610	1,436	7,014	4.9	23.8%
20	956	1,539	6,844	4.4	20.4%
24	173	308	6,797	22.0	19.3%
25	556	1,062	6,108	5.8	30.4%
26	168	259	6,071	23.5	16.0%
29	373	752	6,061	8.1	45.4%
30	286	365	5,629	15.4	13.3%
35	897	1,425	5,386	3.8	16.8%
40	1,218	2,493	5,129	2.1	18.0%
44	390	630	4,978	7.9	18.5%

FAF² – Application Illustration (Disaster Impact on Freight)

Detail Summary of Characteristics Associated with the Total Tonnage of Freight Involving the Scenario 2 Impact Area in 2005

2005 Annual Tonnage by Shipment Mode	Shipment Direction Relative to Impact Area			Total Tonnage
	Into	Out Of	Within	
Air	99,131	58,232	0	157,363
Highway	147,086,500	173,853,913	68,117,299	389,057,713
Other	60,819,561	31,044,424	21,322,997	113,186,982
Rail	65,154,962	34,086,432	4,304,313	103,545,707
Water	113,574,497	84,250,706	22,292,179	220,117,382
All Mode	386,734,651	323,293,707	116,036,788	826,065,146



FAF Truck Flows - 1998
15000 7500 3750
Map of the Region - 2004

FAF² - Status

- 1) 2002 base case database – January 2006
- 2) 2005 annual provisional estimate – March 2006
- 3) Annual provisional estimate – March of the following year
- 4) Flow database – Fall 2006
- 5) Projections of 2010-2035 – Fall 2006



End