SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

Modeling Task Force Meeting

SCAG's Transit Network Development

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Outline

- Background
- Objectives
- Data
- Methods
- Results

Background

- **Existing Transit Service in the Region**
  - 130 Operators
  - 2.7 M daily boardings

Objectives

For 2016-2040 RTP/SCS, to build 2012 Base year transit networks with:

- Details
  - By time of day (AM, MD, PM, EV, NT) and day of week (Mon-Fri, Sat, Sun)
- Accuracy
  - Headways, service hours, patterns
- Good Coverage
  - Most fixed routes in the region
- More model years
  - 2012, 2020, 2035, 2040….

Objectives: Challenges

- Traditionally transit networks coded manually
- Each planning cycle, network attributes need updates
  - new services, service cut, service change
  - route alignments, stops, schedules...
- For the SCAG region, extremely difficult to go through each route to update the changes manually
  - 8 modes, 1,000+ routes, 130 transit operators, 3,000+ route patterns, 160,000+ route stops

Objectives: Solutions

Automate the updating process as much as possible

Steps:

- Transit LOS data collection
- Make full use of existing transit database from local transit operators
  - TripMaster database well maintained by LACMTA
    - Frequently updated
    - Good coverage
- Compose a comprehensive transit database
- Programming to automate the updating process
  - Separate out patterns and calculate headways
  - Develop a database conversion tool

Data: Data Collection

- Transit LOS Data Collection:
  - Base year: 2012
  - Consultant: AECOM
- From NTD, obtained data on Vehicles by Mode and Service Type, Cost/Revenue, Passenger Miles, etc.
- From TripMaster, obtained data on Lines, Stops, Schedules, and VRM/VRH
- Customized a spreadsheet for each transit operator
  - No duplicate questions asked if available in NTD or TripMaster
  - Individualized route listing included for each agency
  - Relieve the burden of operators to provide data to greatest extent
- Contacted 79 transit operators with fixed routes
  - 24 report to National Transit Database (NTD)
  - 58 included in Trip Master (TM) Database
  - Received responses from 57 agencies

Data: Data Collection

- Data collected include:
  - Boarding (by peak/offpeak, by line)
  - Service (freq., route miles, pass. miles, stops, schedules, fares, VRM, VRH)
  - Operation (cost/revenue, subsidy, vehicles by mode and service type)
  - Performance (accident/road call rates, on-time rate)
  - Operator contact info
  - Other (on-board surveys, transfers, PNR)
- The goal is to build a complete transit database that covers key attributes of NTD and TripMaster for most fixed routes in the region

Data: TM

- Maintained by LACMTA for transit scheduling, Trip Planner web application
- Covers 68 operators, nearly 1,800 routes/patterns in the region as of fall 2012
- Major shake-ups twice a year
- Consists of six types of data tables
  - Carriers, Lines, Signs, Stops, Times, and Trips

Data: TM

Number of Routes by Carrier in TripMaster Database

No. of Routes	%	Carrier	CODE	No. of Routes	%	Carrier	CODE
481	27.11%	MTA	MT	8	0.45%	Beach Cities	CN
198	11.16%	Orange County Transit	OC	8	0.45%	Flyaway	FA
111	6.26%	Riverside Transit Authority	RA	8	0.45%	Irvine Shuttle	IR
92	5.19%	Vista	VS	7	0.39%	Monterey Park	MP
81	4.57%	Foothill Transit Zone	FZ	6	0.34%	Baldwin Park Shuttle	BP
76	4.28%	Long Beach Transit	LB	6	0.34%	Max	MX
69	3.89%	Omnitrans	OM	6	0.34%	Commerce	CM
65	3.66%	Santa Monica	SM	6	0.34%	Catalina Express	CE
59	3.33%	Dash (Community Lines)	DA	5	0.28%	Thousand Oaks Transit (TOT)	TH
43	2.42%	Santa Clarita	SC	5	0.28%	Burbank Media Shuttle	BU
32	1.80%	Commuter Express	CX	5	0.28%	Compton Renaissance	CR
28	1.58%	Antelope Valley	AV	4	0.23%	Alhambra Community Transit	AT
26	1.47%	Victor Valley (VVTA)	VV	4	0.23%	Lynwood Trolley	LY
25	1.41%	Metrolink	ML	4	0.23%	West Covina	WC
25	1.41%	SunLine Transit	ST	3	0.17%	Camarillo Area Transit	CL
24	1.35%	Glendale Beeline	GB	3	0.17%	Duarte Transit	DT
24	1.35%	Los Angeles County Shuttles	CO	3	0.17%	Sierra Madre Gateway	SG
23	1.30%	Gold Coast Transit	GC	3	0.17%	Rosemead Shuttle	RS
22	1.24%	Culver City Bus	CC	2	0.11%	Bellflower Bus	BF
21	1.18%	Montebello Transit	MB	2	0.11%	Airport Shuttle	AS
18	1.01%	Torrance Transit	TO	2	0.11%	Cerritos On Wheels	CW
18	1.01%	Pasadena Arts	PA	2	0.11%	La Puente Link	LL
15	0.85%	Amtrak	AM	2	0.11%	Lawndale Trolley	LT
13	0.73%	Norwalk Transit	NT	2	0.11%	Moorpark City Transit	MR
12	0.68%	Gardena Transit	GA	2	0.11%	Palos Verdes Peninsula Transit Authority	PP
12	0.68%	Mountain Area Rapid Transit Ag	MA	2	0.11%	West Hollywood	WH
11	0.62%	Palo Verde Valley Transit Ag	PV	1	0.06%	Ojai Trolley	OT
10	0.56%	Simi Valley Transit	SV	1	0.06%	Bell Gardens Town Trolley	BG
9	0.51%	Carson Circuit	CA	1	0.06%	Cudahy Transit	CH
9	0.51%	El Monte Trolley	EM	1	0.06%	Inglewood I-Line	IN
8	0.45%	Corona Cruiser	CK				
				1774		Total	

Data: TM

- The **Carriers** table contains records with attribute information for each transit agency

Field	Type	Length	Description
Carrier_ID	Integer	2	Unique carrier ID
Name	String	40	Carrier name
Carrier	String	2	Carrier code
Contact	String	19	Carrier contact telephone number
Notes	String	129	Notes about the carrier
Status_ID	Integer	1	Carrier status
Effective	String	19	Effective date and time
User_ID	Integer	1	User ID
TS	String	19	Timestamp

- The **Signs** table relates a headsign ID in a Times table to the actual headsign displayed at the front of most buses and the sides of most trains.

Field	Type	Length	Description
hdsgnID	Integer	5	Headsign ID number
hdsgn	String	48	Headsign display on transit vehicle

Data: TM

- The **Lines** table contains a record for each transit route pattern, including attribute information for each route

Field	Type	Length	Description
ilin	Integer	5	Trip Master internal line number
parent	Integer	5	Parent of sequential line number (route group) as defined by the scheduling department
xtline	String	7	Route pattern: CCLLLAD (same as rte):
			CC=carrier code
			LLL=line code
			A=blank or alternate pattern number
			D=direction code
mode	String	3	Mode:
			1CR=Commuter rail
			2LR=Local rail (subway/light rail)
			3EX=Express bus
			4RB=Rapid bus
			5LB=Local bus
			6TW=Transit way
name	String	48	Name of line (not unique)
sistername	String	48	Name of sister line (interline)
longname	String	60	Long name of line
skedtype	String	1	Schedule type
sister_code	String	7	Route pattern (xtline) of sister line: CCLLLAD
method_number	Integer	1	Method number
calc_type	String	1	Calculation type

Data: TM

- The **Stops** table: some are only intermediate shape points; stop locations are not unique

Field	Type	Length	Description
ilin	Integer	5	Trip Master internal line number
dist	Integer	5	Distance along route (hectofeet)
xcoord	Integer	10	X Coordinate 1983 SPCS Zone 405 (feet)
ycoord	Integer	10	Y Coordinate 1983 SPCS Zone 405 (feet)
att	String	2	Stop attribute
loc	String	100	Cross street or landmark name
parent	Integer	5	Parent of sequential line number (route group) as defined by the scheduling department
xtline	String	7	Route pattern: CCLLLAD (same as rte):
			CC=carrier code
			LLL=line code
			A=blank or alternate pattern number
			D=direction code
mode	String	3	Mode:
			1CR=Commuter rail
			2LR=Local rail (subway/light rail)
			3EX=Express bus
			4RB=Rapid bus
			5LB=Local bus
			6TW=Transit way
geton	String	1	Flag for boarding permitted
getoff	String	1	Flag for alighting permitted
alight_zone	Integer	1	Alighting fare zone
board_zone	Integer	1	Boarding fare zone

Data: TM

- The **Times** table contains records representing a bus or train arrival at a time point for a given day
- A separate table for each day of the week

Field	Type	Length	Description
day	String	2	Day of the week
hr	Integer	5	Hour of the day
ilin	Integer	5	Trip Master internal line number
trip	Integer	5	Trip number
dist	Integer	5	Distance along route (hectofeet)
timex	String	8	Time (HH:MM:SS)
hdsgn1	Integer	5	Primary headsign number
hdsgn2	Integer	5	Sister headsign number
div	String	2	Metro operating division
busrun	String	10	Bus run number

Data: TM

- The **Trips** table contains a record for each trip a given route pattern makes.
- A separate table for each day of the week.

Field	Type	Length	Description
day	String	2	Day of the week
hr	Integer	5	Hour of the day
ilin	Integer	5	TripMaster internal line number
trip	Integer	5	Trip sequence number (within a given hour)
hdsgn1	Integer	5	Primary headsign number
hdsgn2	Integer	5	Sister headsign number
firstdist	Integer	5	Beginning point along the route (values > 0 indicate shortline schedule) (hectofeet)
firsttime	Integer	10	Beginning time along the route (sec)
lastdist	Integer	5	Ending point along the route (hectofeet)
lasttime	Integer	10	Ending time along the route (sec)
ups	Real	11	Speed (units per second)
freqx	Integer	3	Frequency (discontinued)
div	String	2	Metro operating division
busrun	String	10	Bus run number

Data: Database

- To create a transit database based on the data collection
  - Routes, Stops, Fares, Boardings, etc.
- Data cleaning/QC

Data: Database

- Before the database can be used to create the transit network, a program was developed to:
  - Automate the process of separating out shortlines/interlines based on unique start-end of bus run
  - Keep the correspondence for pattern/line conversion
  - Calculate more accurate headways and detailed service hours (start time and end time) by 5 times of day and 3 days of week
  - Compare the changes between 2008 and 2012
  - Consultant: M.E. Consulting

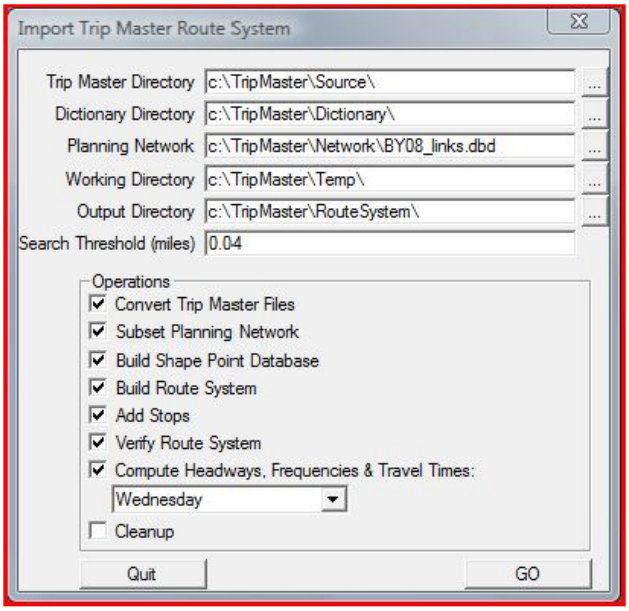
Methods

To Convert the Transit Database to TransCAD format

- A GISDK script developed by Caliper to create a transit route system including physical stops for the actual physical locations of stops and stations

- Routes with the geography of the transit routes are based on the street or rail links in the SCAG planning network, and route stops for each place that a given route stops at physical stops were created

TransCAD Add-In



Methods: Steps

1. Subset the SCAG planning network into: rail, ferry, local road and all road geographic databases. Build TransCAD networks for the rail and full road subsets, on top of the complete planning network database

2. Convert stops based on the x, y coordinates in the database, create a geographic database of stops and intermediate shape points

3. For each successive pair of points for a bus route, the shortest path is computed using the full road network

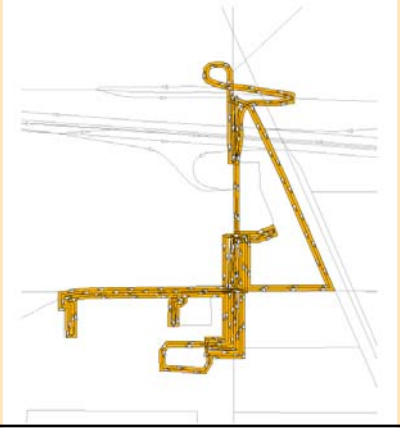
4. Connect the stops and the intermediate shape points to be routes with the planning network

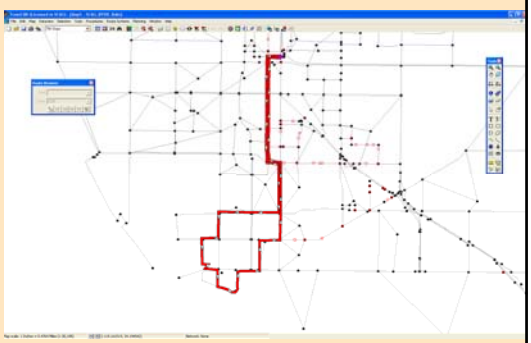
Methods: QC

- Stops farther from the route than a certain search threshold are reported
- Calculate the route length and compare against the database definition. Significant differences are reported
- Check each route is connected and syntactically correct
- Manually check reported routes and stops

Methods: Issues

- Transit data quality
- Planning network quality
- Looping
- Stop allocation (routes with many stops assigned to the same milepost)



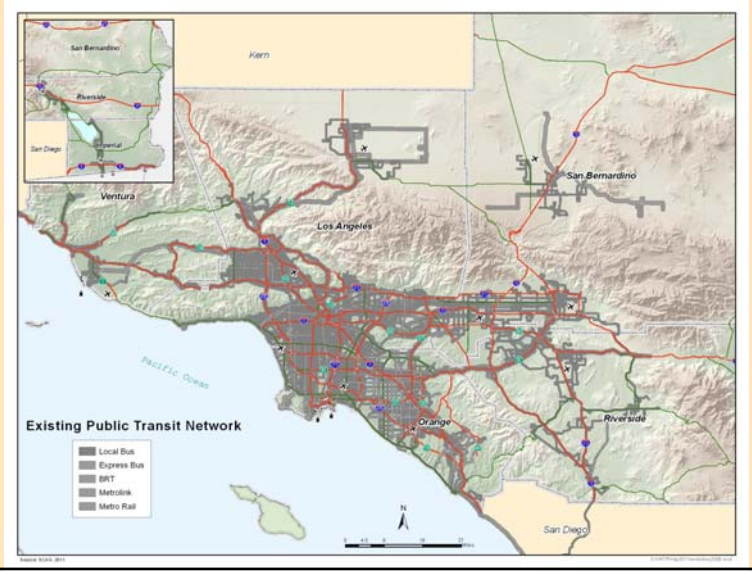


Results

- 2008 Base year network
  - Built transit database
  - Separated shortlines/interlines to calculate correct headways
  - Developed base year 2008 transit networks
    - over 3,400 routes and 160,000 stops
    - 15 transit networks by time of day (AM, MD, PM, EV, NT) and day of week (Mon-Fri, Sat, Sun)
- 2012 Base year network: in working progress

Results

2012-2035 RTP/SCS 2008 Base Year Transit Network



Fares (1)

- 3 types of transit fares (route level)
  - base boarding fares
  - transfer fares
  - zones fare matrix
- 3 types of fare factors (carrier level)
  - base fare factor
  - transfer fare factor
  - fare factor matrix
- Fares collected through the transit data collection program in 2012 dollars
- To use CPI factor to adjust to 2009 dollars

Fares (2)

- Considering the complex fare structure for most carriers, the published full cash fares for initial boarding and transfers are used to represent the base fare and transfer fare
- To account for the revenue composition of different fare types, such as one-way walkup fares, daily/weekly/monthly passes etc., base fare factors and transfer fare factors are estimated from the boarding and revenue data provided by transit operators

Network Attributes

Routes Layer

- Route ID, route name, route head sign, transit operator, route distance, direction, transit modes, and fares
- Detailed headway, frequency, start time and end time of the service for each of the five time periods

Stops Layer

- Route ID, stop coordinates, milepost, corresponding highway node ID, etc.
- For rail transit: station-to-station rail time, rail station information, and Amtrak/Metrolink's fare zone

Transit Modes

7 Transit Modes
(based on service characteristics and fare structures):

- Commuter rail: Metrolink, Amtrak
- Local rail: subway, light rail
- Local bus
- Rapid bus: limited stops, local streets
- Express bus: limited stops, freeways
- Transitway : semi-dedicated guideway (El Monte Busway and Harbor Transitway)
- BRT: dedicatetd guideway (Orange Line)

Non-Transit Modes

2 Non-transit modes (transit access links):

- Walk access, egress, and transfer links
  - coded as two-way links between a zone centroid and a transit stop location
- Park-and-ride lot to stop and transfers between stations links
  - coded as two-way walk links between a park-and-ride lot and a transit stop location, and connections between stations

Go Transit!

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Thank you!

Questions?