

Improving data for 21st century information systems and reporting

Leslie Bienenfeld

Transportation Planner & Information System Engineer

Scheduling Unit

San Francisco MTA

San Francisco, California

Presentation Overview

- About SFMTA & Muni
- A Brief History of Timetables
 -from communicating with operators to communicating with customers
- How tech systems recognize the end of the trip and why managers and planners should care
- SFMTA's revised approach to technology systems for schedules changes
- Tips for reconciliation and working with databases

Part 1:

About SFMTA & Muni

SFMTA & the Municipal Railway



- Seventh largest transit system in North America, by ridership
 - 750,000 daily riders
 - 25% of all daily trips in SF by transit
- Service Area:
49 square miles
- Service Area Population:
800,000 residents



Muni Transit Planning and Scheduling

- 85+ regular routes, plus ongoing supplemental service, reroutes, and stop changes for special events and construction
- 5 modes of transit (CC, SR, LR, MC, TC)
- 7 Divisions, 11 Yards
- Planning, Logistics, and Information for Customers and Operations



Beliefs: Organizational responsibilities around transit communications

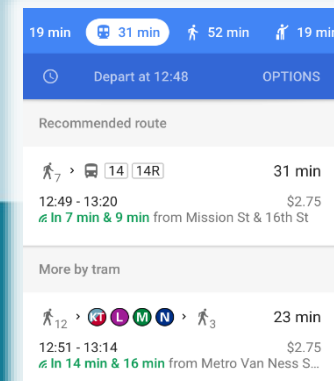
Transit Planning and Communications (TPC):

Responsible for drafting and implementing communications re: transit service and changes

Scheduling:

Largely operational, responsible for planning detailed logistics to communicate for operations.





Part 2:

A Brief History of Timetables

**....from communicating with operators
to communicating with customers**

- Paper-based
- Materials drafted by hand
- Fully authored & formatted by staff

— RUNNING TIME. —

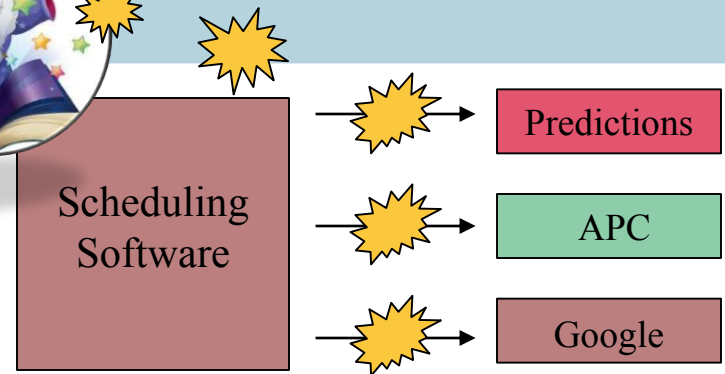
7 A.M. TO 6 P.M. 6 P.M. TO 7 A.M.

FERRY TO POWELL & EDDY	9 MIN.	7 MIN.
POWELL " JONES & M ^c A.	2 "	2 "
JONES " HAYES & LARKIN.	2 "	2 "
HAYES - GOUGH & HIGHT.	3 "	3 "
GOUGH " 28 th & VAL.	11 "	11 "
28 th " 29 th & NOE.	5 "	4 "
	32.	29.

Jeff Moreau Collection
BAERA Archives
Western Railway Museum
#

First Generation Transit Information Systems (1970's – 2000's)

- Database Driven
- Largely 1 way: Schedule system mined to populate other systems
- IT supported: IT Department does magic, reformatting data to fit requirements of other systems
- Results = Different, customized dataset and process for each system
- This works, but limits planner and scheduler ownership over the mediums & creates limitations for connected systems



Examples

Vehicle Predictors

Automatic Passenger Counting

Google Maps/GTFS

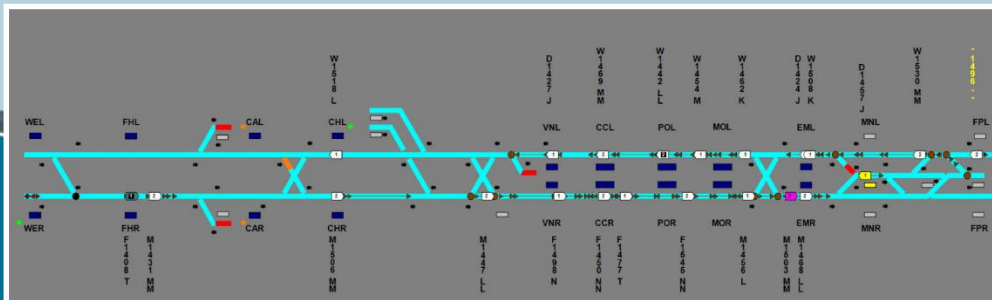
Homegrown Schedule Viewers

Paddles, Rotations, and Run/Bid Report

Data Warehouses & Reporting

Passenger Feedback Systems

Safety Tracking



LN	T	A	EXC	TRAN	RUN	KING	KING	EMBR	EMBR	EMB	VNES	DUBO	CARL	JUDA	JUDA	JUDA	LEAV
NO	T	P		NUM	NUM	6STR	4STR	HARR	FOLS	STAT	STAT	CHUR	HLWY	19AV	SUNS	LAPL	TERM
N	A		F-J	9701	001							433	440	448	453	458	509
N	A		F-KT	9702	005		428	435		439	445	448	455	503	508	514	524
N	A		F-KT	9703	009		441	448		452	458	501	508	517	522	528	538

ALL RUNS WITH STAND-BY TIME ARE SUBJECT TO ORDERS INCLUDING REVENUE WORK

PROCESSED: JUL 06, 2017 8:53AM
SIGN UP : 2017 FALL
SERVICE : WEEKDAY
DIVISION : GREEN

SAN FRANCISCO MUNICIPAL RAILWAY
RANGE
FULL TIME RUN

PAGE: 1
Active Scenario: GRN 144LRV/34F/5E/15NR@6-23-17
EFFECTIVE DATE: 08-12-2017

RUN	ON	TRAIN	OFF	RANGE	PLAT	R/C	TRAV	(SD)	LUN	STRA	STRA	O.T.	O.T.	PAY
					FORM	TIME	ALL.	(SO)	ALL	REG.	NIGHT	REG.	NIGHT	DAYS
											DIFF.		DIFF.	\$ OFF
1	*212 MUNI METRO EAST PULL IN	9701	1031**	8:19	7:44	0:35			1:20	6:05	3:48	0:18		\$372.31 S-S

001

REPORT: 212 OUT: 247 AT GREEN GARAGE

LN	T	A	EXC	RUN	S.J.	CHUR	CHUR	DUBO	V.N.	EMB	LEAV
NO	T	P		NUM	SNCA	30S1	24S1	CHUR	I.B.	STAT	TERM
J	A		*	001	251%	300	304	313			313
J	A			001				313S	317	323	328
J	A			001	411	420	424	433			T-N

% - PULLS OUT A TWO (2) CAR TRAIN. THE FIRST TRAIN TO ENTER THE SUBWAY/TUNNELS, AT ALL PORTALS, (INCLUDING WEST PORTAL, SUNSET IB/OB, MMX-EMB/FOLSOM ENTRY) MUST CONTACT CENTRAL CONTROL FOR PERMISSION TO ENTER. THE FOLLOWING PROCEDURED MUST BE ADHERED TO: 1) BEFORE ENTRY INTO THE SUBWAY, ENSURE THAT YOUR RADIO IS PROGRAMMED & CALL CENTRAL CONTROL FOR CLEARANCE TO ENTER; 2) MAKE SURE THAT GATES ARE OPENED AND SECURED; 3) OPERATE AT NO MORE THAN 27 MPH; 4) CHECK TRACKS, SWITCHES & OVERHEAD LINES.

SWEEPER - NOT IN SERVICE UNTIL SCHEDULED OR INSTRUCTED

LN	T	A	EXC	RUN	JUDA	JUDA	JUDA	CARL	DUBO	V.N.	EMB	EMBR	KING	KING	MTRO	LEAV
NO	T	P		NUM	LAPL	SUNS	19AV	HLWY	CHUR	I.B.	STAT	HARR	4STR	6STR	EAST	TERM
N	A			001	509q	513	519	529	536	540	546	549	556	558		607
N	A			001	716	721	728	739	748	752	758	801	809	811		818
N	A			001	927w	932	939	950	959	1003	1010	1013	1022		1031	**

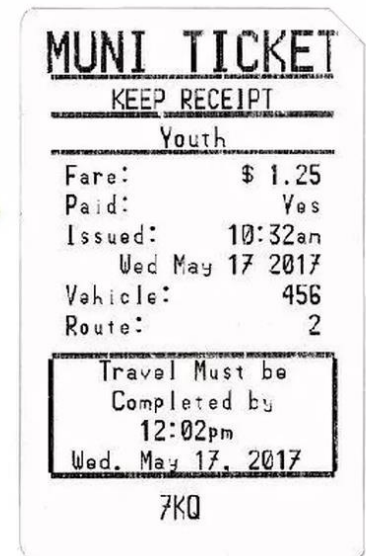
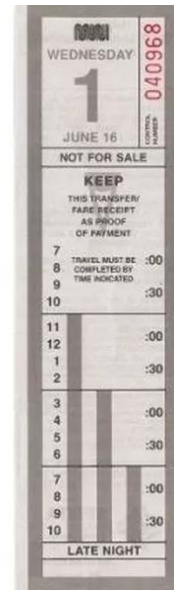
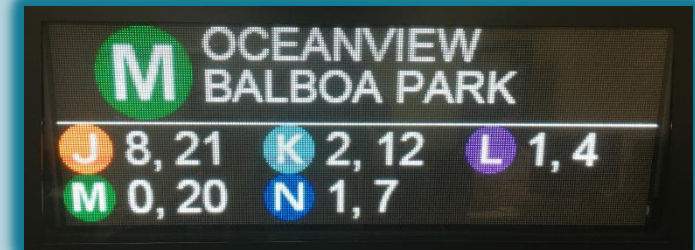
Where we are today: 21st Century Information Systems



- Database Driven
- Digital systems are interconnected rather than independent
- SFMTA must standardize data and move away from data customization for each system
- Transit planners and schedulers are having a more an active role in data development to better meet the needs of customers and operations
- We had to convince our managers to prioritize cleaning up the data. Data cleanup is time consuming.

Muni 2.0: Implementations and Upgrades of Major Transit IT Systems

- Recent accomplishments:
 - Launch of OrbCAD CAD/AVL on bus fleet & cable car
 - Major Upgrades to ATCS
 - Procurement of smart buses and trains
- In progress:
 - Upgrading Customer Information Systems: including prediction services, subway platform signage, and shelter signage
 - Digital Fareboxes, new transfers
 - Schedule-based subway routing
 - Updated public predictions and schedules for non-scheduled service changes and medium-scale special events & construction



Part 2:

**How tech systems
recognize the end of the
trip and why managers
and planners should care**

We all care about data “by trip”

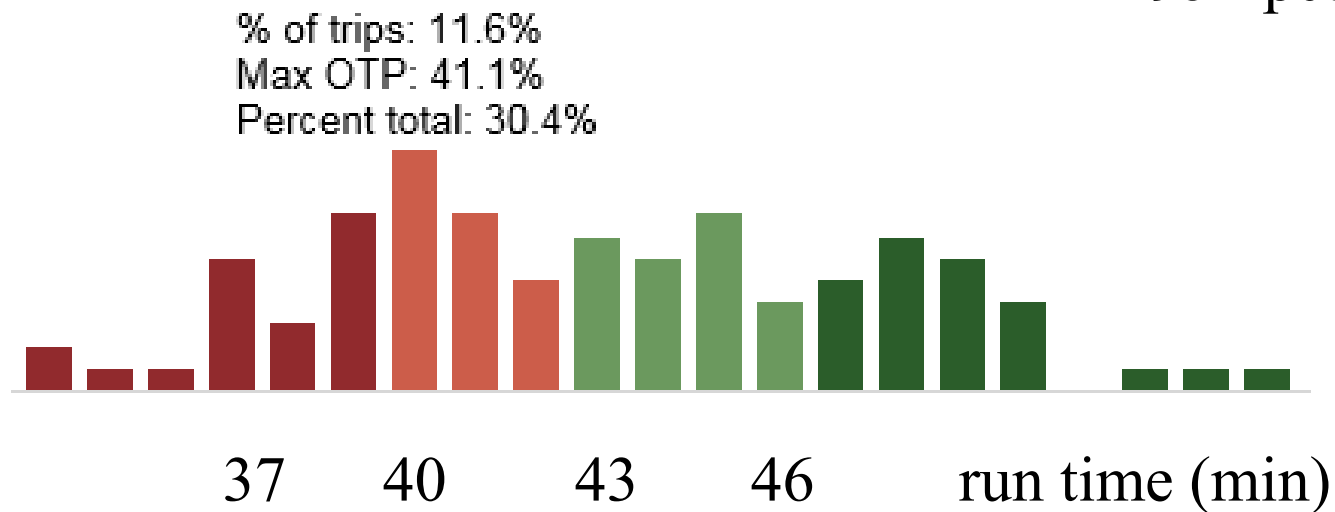
- Examples:
 - APCs = Passengers per trip
 - AVL = Arrival Times -> Historic run times per trip
 - Revenue per trip
 - Head sign auto-configuration by trip

What is the run time?

More Time = More buses

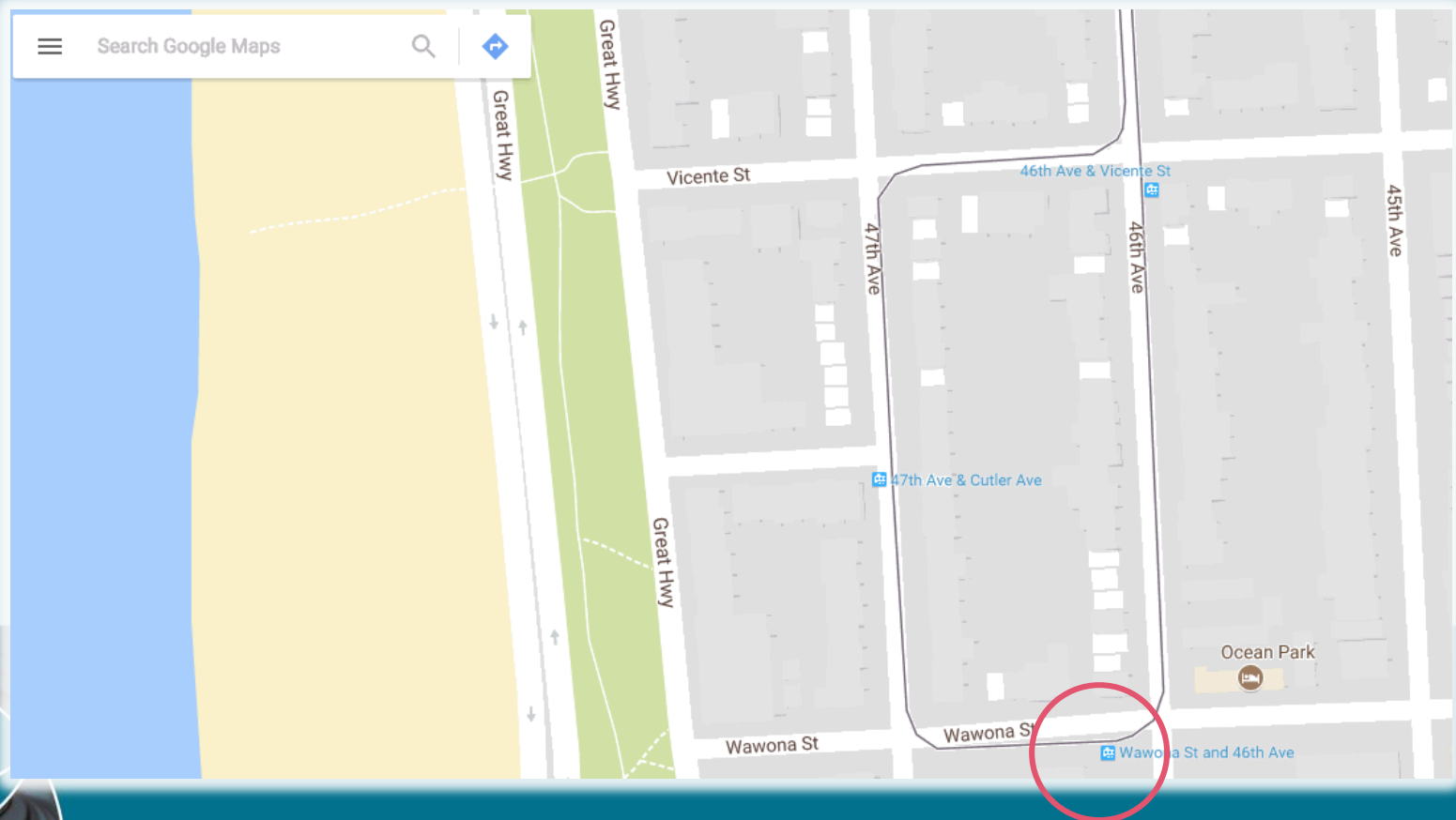
Histogram: Run Time Per Trip
by Line/Direction/Hour

Mode = 40
Median = 43
Mean = 44
90th pctl = 49
95th pctl = 53



How tech systems recognize the end of the trip and why managers and planners should care

- Schedule geocodes affect run times
 - L-Taraval Terminal – Same last & first stop



How tech systems recognize the end of the trip and why managers and planners should care

- Schedule geocodes affect run times
 - Actual run time = 40 minutes



How tech systems recognize the end of the trip and why managers and planners should care

- Schedule geocodes affect run times
 - frequently, # vehicles in layover = 3



How tech systems recognize the end of the trip and why managers and planners should care

- Schedule geocodes affect run times
 - IT System logged run time = 52 min (40 + 6 + 6)



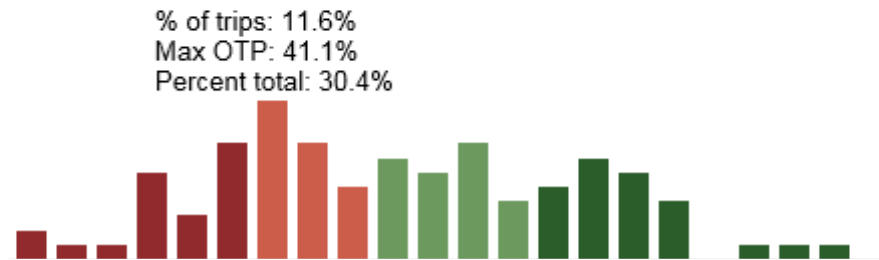
How tech systems recognize the end of the trip and why managers and planners should care

- Schedule geocodes affect run times
 - IT System logged run time = 52 min (40 + 6 + 6)



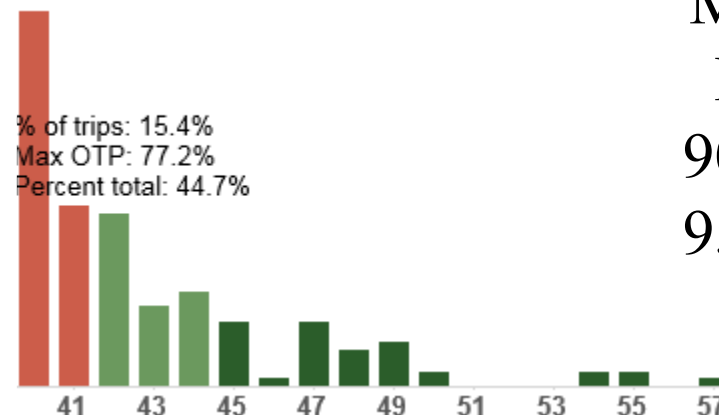
Run Time By Trip With Geocode Improvement

Before



Mode = 40
Median = 43
Mean = 44
90th pctl = 49
95th pctl = 53

After



Mode = 40
Median = 41
Mean = 43
90th pctl = 49
95th pctl = 49

Closing thoughts on terminal geocodes

1. Each system has it's own requirements and optimal location
2. Today, a single geocode locations needs to balance the needs of all systems.
3. Schedulers sometime need to be referees.
4. Terminal geocodes affect automated headsign changes, APC trip ends, run time and more

Part 2:

**SFMTA's revised approach
to technology systems for
schedules changes**

It's not just "Nextbus" Anymore: Realizing how many systems you have

Make a list:

*Communication Systems Affected by Schedule Changes
(Service Additions, Reductions, and Changes)*

Track for each system:

1. *List the owner for each system*
2. *The number of days of advanced notice each system requires for a schedule update*

For each planning project, actively determine which systems will be updated. This is especially valuable for service changes with little notice.

Muni's "Communication Systems Affected by Schedule Changes" List

1. Scheduling software
2. Real Time Prediction System
3. APCs
4. Dispatch system, Pat, 7
5. Payroll system, Alex, 7
6. CAD/AVL system, Leslie, 21
7. Google Trip Planner, Jesse, 9
8. 511, Carter, 9
9. Website GTFS
10. Agency Website
11. Fareboxes
12. Data warehouse
13. Safety tracking software
14. Digital Voice/Announcement System
15. New LRV systems
16. Customer feedback router
17. Spatial Data Store
18. Schedule Viewer
19. OPS custom reports
20. Yard Map
21. Operator website
22. Audio prediction buttons
23. Subway Audio Announcements
24. And more...

It's not just "Nextbus" Anymore: Using the list during planning

IT System	Do we need this to work for Twin Peaks?		
Trapeze FX	Yes	No	Not Sure
Trapeze OPS	Yes	No	Not Sure
Service Changes loaded to Data Warehouse?	Yes	No	Not Sure
Service changes loaded to NextBus?	Yes	No	Not Sure
Service changes loaded to Google Maps?	Yes	No	Not Sure
Service changes loaded to Schedule Viewer?	Yes	No	Not Sure
SFMTA.com GTFS (developers, Apple Maps, MS Maps)	Yes	No	Not Sure
Service Changes loaded to 511? GTFS+	Yes	No	Not Sure
Service Changes loaded to Automatic Passenger Counter (UTA)?	Yes	No	Not Sure
Service Changes loaded to Automatic Passenger Counter (Radio)?	Yes	No	Not Sure
Service Changes loaded to DVAS/AVA (Onboard Digital Information System - headsign, internal signs, voice announcements, door announcements)	Yes	No	Not Sure

It's not just Nextbus Anymore: Planning for service change types

Make a list:

Types of changes for which your agency might change service.

Track for each type of change:

1. *Min/max duration of change*
2. *When and how notice is usually given*
3. *Use a matrix to predetermine whether each of the systems should be updated for each type of change*

Use this matrix to help make decisions about when to schedule service changes of different types.

It's not just Nextbus Anymore: Identify what service change types

#	Planned/ Unplanned	Description of change	Example	Min duration	Max duration	when change/notice typically communicated	how communicated	notes/potential process changes with new radio system	Service Change Built in Trapeze? (7 days needed)
1	Unplanned	Unplanned	Unplanned protest, fire, police activity	<1 day	1 day	After activity begins			No
2	Planned	Stop temporarily relocate, temporarily close	Film event, temporary construction	1 day	<3 or 6 months				No
3	Planned	Stop discontinue, establish	Stop consolidation	Infinite	Infinite				
4	Planned	Caution for protest/disruption	Planned march nearby	<1 day	3 days	Same day or a few days before	Bulletin		No
5	Planned	Motorize trolley line or rail line	special event	<1 day	end of sign up	5-7 days before	Bulletin	Will this affect announcements/	No
6	Planned	Small reroute	Neighborhood festival, Block Party	1 day	3 days	Same day to 1 week before	Bulletin		No
7	Planned	Extra Service (small event)	Sunday Streets, Police Department Shuttle, Special Needs	<1 day	3 days	3-5 days before	Bulletin, paddle, T1	Sometimes only minimal details are put into Trapeze	Yes
8	Planned	Major Reroutes	Market Street Closed for Pride	1 day	3 weeks	5-7 days before	Bulletin		Sometimes
9	Planned	Extra service (Large event)	Hardly Strictly Bluegrass	1 day	3 weeks	5-7 days before	Bulletin, paddle, T1		Yes
10	Planned	Construction project reroute	Rerail, bridge out	1 day	1 + year		Bulletin, paddle, T1		Yes
11	Planned	Holidays - An existing service day	Columbus Day uses Saturday Schedule	1 day	1 day				Yes
12	Planned	Holiday - Something new	Week between Christmas and New Years	1 day	3 weeks				Yes
13	Planned	Regular sign up	Divisional sign ups, General Sign Up (GSU)	>2 months	8 months				Yes

It's not just Nextbus Anymore: Sample of Muni's Matrix

Systems Affected by Schedule Changes (Additions, Reductions, and Changes)

			System Count	1	2	3	4	
			Min Days Advance Notice Req.	7	2	7	7	
			Does it require non-SFMTA staff?				Yes	Yes
			Admin to contact	Pat	Alex	Jesse	Leslie	Carter
#	Planned/ Unplanned	Description of change	Example	Trip Changes in FX	Run changes in OPS	Data Warehouse	Service changes loaded to NextBus?	Service changes k to Google Maps?
1	Unplanned	Unplanned	Unplanned protest, fire, police activity	No	No	No	No	No
2	Planned	Stop temporarily relocate, temporarily close	Building construction	No	No	No	No	No
3	Planned	Stop discontinue, establish		Yes	No	Yes	Yes	Sometimes
4	Planned	Caution for protest/disruption	Planned march nearby	No	No	No	No	No

Chapter 3:

Reconciliation and Checking your work

Get ahead of errors in data uploads: verifying changes using Github.com

The screenshot shows the GitHub interface for the repository 'sfpdev / TSDE'. The repository has 1 watch, 0 stars, and 0 forks. It is currently on the '2017-Summer' branch. The repository contains 37 commits, 2 branches, 0 releases, and 1 contributor. A recent commit by 'sfpdev' is highlighted, showing a merge of pull request #20. The commit history table lists the following files and their commit dates:

File	Commit	Time
README.md	Initial commit	5 months ago
TSDEVVersion.txt	20170512	2 months ago
blk_1.csv	20170607	2 months ago
blk_2.csv	20170607	2 months ago
blk_3.csv	20170607	2 months ago
blk_4.csv	20170601	2 months ago

Get ahead of errors in data uploads: verifying changes using Github.com

 sfpdev / TSDE

Unwatch 1

Star 0

Fork 0

[Code](#) [Issues 0](#) [Pull requests 0](#) [Projects 0](#) [Wiki](#) [Settings](#) [Insights](#)

20170612 #23 [Edit](#)

Merged

sfpdev merged 1 commit into LoopJobs from sfpdev-patch-1 on Jun 12

Conversation 0

Commits 1

Files changed 6

Changes from all commits

Jump to...

+736 -756

Unified Split

Review changes

18

lin.csv

View

@@ -136,11 +136,13 @@	
136 108,12133,N,JUDAH,1,INBOUND,0,113911	136 108,12133,N,JUDAH,1,INBOUND,0,113911
137 108,12134,NX,N EXPRESS,0,OUTBOUND,0,74840	137 108,12134,NX,N EXPRESS,0,OUTBOUND,0,74840
138 108,12134,NX,N EXPRESS,1,INBOUND,0,74841	138 108,12134,NX,N EXPRESS,1,INBOUND,0,74841
139 -108,12488,TP-35,35 EUREKA SPECIAL,0,OUTBOUND,0,124880	139 +108,12284,SWJ,3-CHURCH SWITCHBACKS,0,OUTBOUND,0,116280
140 -108,12488,TP-35,35 EUREKA SPECIAL,1,INBOUND,0,124881	140 +108,12284,SWJ,3-CHURCH SWITCHBACKS,1,INBOUND,0,116281
141 -108,12489,TP-48,48 QUINTARA-24TH STREET SPECIAL,0,OUTBOUND,0,124890	141 +108,12277,SWKT,KT INGSIDE THIRD SWITCHBACKS,0,OUTBOUND,0,122580
142 -108,12489,TP-48,48 QUINTARA-24TH STREET SPECIAL,1,INBOUND,0,124891	142 +108,12277,SWKT,KT INGSIDE THIRD SWITCHBACKS,1,INBOUND,0,122581
143 -108,12490,TP-57,57 PARKHERCED SPECIAL,0,OUTBOUND,0,124900	143 +108,12281,SWL,L TARAVAL SWITCHBACKS,0,OUTBOUND,0,122810
144 -108,12490,TP-57,57 PARKHERCED SPECIAL,1,INBOUND,0,124901	144 +108,12281,SWL,L TARAVAL SWITCHBACKS,1,INBOUND,0,122811
145 -108,12491,TP-94,94 K-L-N OML SPECIAL,0,OUTBOUND,0,124900	145 +108,12276,SWH,M OCEANVIEW SWITCHBACKS,0,OUTBOUND,0,122750
146 -108,12491,TP-94,94 K-L-N OML SPECIAL,1,INBOUND,0,124901	146 +108,12276,SWH,M OCEANVIEW SWITCHBACKS,1,INBOUND,0,122751
	147 +108,12282,SWN,N JUDAH SWITCHBACKS,0,OUTBOUND,0,122820
	148 +108,12282,SWN,N JUDAH SWITCHBACKS,1,INBOUND,0,122821

34

pnt.csv

View

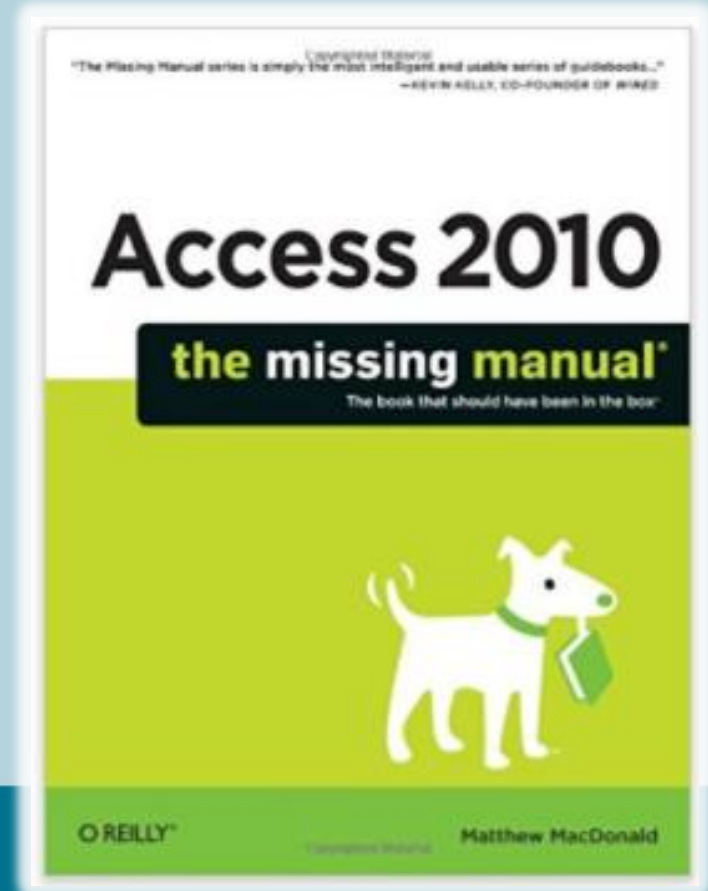
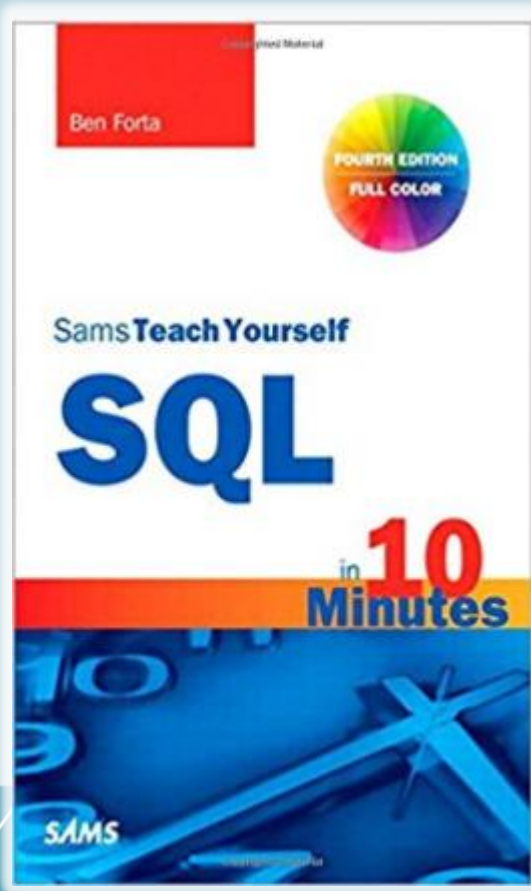
@@ -628,7 +628,6 @@	
628 3020,st,BACHSONW,Bacon St&Somerset St NE-NS,-122407460,37726670,	628 3020,st,BACHSONW,Bacon St&Somerset St NE-NS,-122407460,37726670,
629 3021,st,BACHSONW,Bacon St&Somerset St SW-NS,-122407660,37726540,	629 3021,st,BACHSONW,Bacon St&Somerset St SW-NS,-122407660,37726540,
630 3024,st,BAKRONW,Baker St&Greenwich St SE-NS,-122445693,37797606,	630 3024,st,BAKRONW,Baker St&Greenwich St SE-NS,-122445693,37797606,
631 -7880,st,BARTISS,BART Kissride SE-NS/SE,-122447001,37720694,	
632 3025,st,BATTBOW,Battery St&Broadway SW-FS/BZ,-122401093,37798311,	631 3025,st,BATTBOW,Battery St&Broadway SW-FS/BZ,-122401093,37798311,
633 3026,st,BATTFIL,Battery St&Filbert St SW-FS/BZ,-122401894,37802210,	632 3026,st,BATTFIL,Battery St&Filbert St SW-FS/BZ,-122401894,37802210,
634 7234,st,BATTFILD,Battery Alexander&Field Rd SW-NS,-122530266,37825033,	633 7234,st,BATTFILD,Battery Alexander&Field Rd SW-NS,-122530266,37825033,
@@ -1768,7 +1767,7 @@	
1768 4796,st,GNVA1651,1650 Geneva Ave S-WB/PS,-122428290,37711740,	1767 4796,st,GNVA1651,1650 Geneva Ave S-WB/PS,-122428290,37711740,
1769 4798,st,GNVA1720,1721 Geneva Ave NE-WB/PS,-122426270,37711080,	1768 4798,st,GNVA1720,1721 Geneva Ave NE-WB/PS,-122426270,37711080,
1770 4799,st,GNVA1751,1701 Geneva Ave S-FS/BZ,-122425760,37710720,	1769 4799,st,GNVA1751,1701 Geneva Ave S-FS/BZ,-122425760,37710720,
1771 -4805,st,GNVABAR,Balboa Park BART Station SW-WB/BZ,-122446506,37720756,	1770 +4805,st,GNVABAR,Balboa Park BART Station SW-WB/BZ,-122447379,37720952,
1772 4803,st,GNVABART,Balboa Park BART Station NE-WB/BZ,-122446738,37720801,	1771 4803,st,GNVABART,Balboa Park BART Station NE-WB/BZ,-122446738,37720801,
1773 4808,st,GNVACAS0,Geneva Ave&Castillo St E-NS/PS,-122418230,37707900,	1772 4808,st,GNVACAS0,Geneva Ave&Castillo St E-NS/PS,-122418230,37707900,
1774 4809,st,GNVACAS1,Geneva Ave&Castillo St SW-WI/PS,-122418410,37707700,	1773 4809,st,GNVACAS1,Geneva Ave&Castillo St SW-WI/PS,-122418410,37707700,
@@ -3131,7 +3130,7 @@	
3131 6254,st,RVRELAN0,Revere Ave&Lane St W-NS,-122390290,37731690,	3130 6254,st,RVRELAN0,Revere Ave&Lane St W-NS,-122390290,37731690,
3132 6253,st,RVRELAN1,Revere Ave&Lane St E-NS,-122390040,37731650,	3131 6253,st,RVRELAN1,Revere Ave&Lane St E-NS,-122390040,37731650,
3133 6257,st,S J FAR0,San Jose Ave&Parallones St N-NS/PS,-122452148,37714153,	3132 6257,st,S J FAR0,San Jose Ave&Parallones St N-NS/PS,-122452148,37714153,
3134 -6263,st,S J GNV0,San Jose Ave&Geneva Ave SW-FS/BZ,-122446772,37720885,	3133 +6263,st,S J GNV0,San Jose Ave&Geneva Ave SW-FS/BZ,-122446772,37720885,
3135 6260,st,S J GNV1,San Jose Ave&Geneva Ave E-FS/BZ,-122446474,37720827,	3134 6260,st,S J GNV1,San Jose Ave&Geneva Ave E-FS/BZ,-122446474,37720827,
3136 6262,st,S J GNV3,San Jose Ave&Geneva Ave SW-FS/SI,-122447184,37720007,	3135 6262,st,S J GNV3,San Jose Ave&Geneva Ave SW-FS/SI,-122447184,37720007,

Chapter 4:

Working faster with data and reporting

Increase your knowledge of databases

My favorite books:



Key Take-Aways

1. Today's Transit Technology Systems are highly integrated & require collaboration to get the most value of your investment
2. Much of the automatic data collection used by schedulers and service planning are influenced by small decisions in the schedule data.
Planner, schedulers, and managers all need to contribute to improvements.
3. Learn to use github.com for checking/reconciliation

In case you want to talk specifics...

Muni uses these systems:

- Trapeze FX, Blockbuster, OPS/Comm
- OrbStar CAD/AVL
- Nextbus Real Time Predictions
- Google Trip Planning
- Thales ATCS
- UTA APC's

Leslie.Bienenfeld@sfmta.com

415-701-5661