

SFO GLS Demonstration An Airline's Perspective

Chris Osterman
Technical Pilot – Navigation

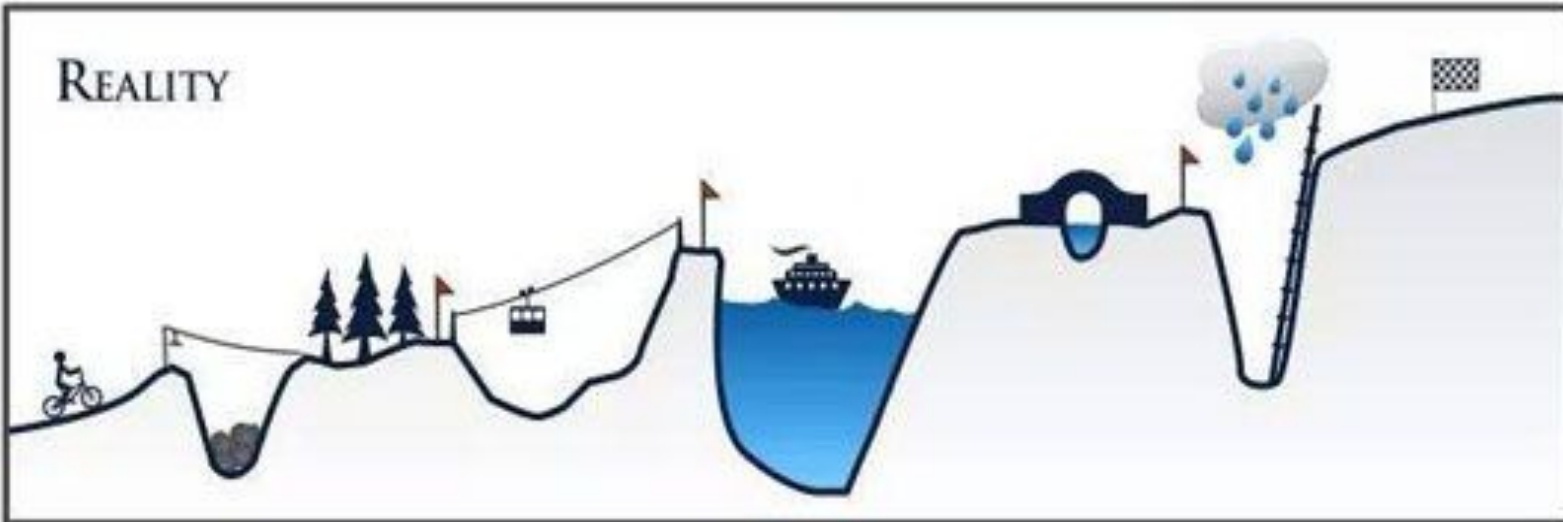
November 29, 2017

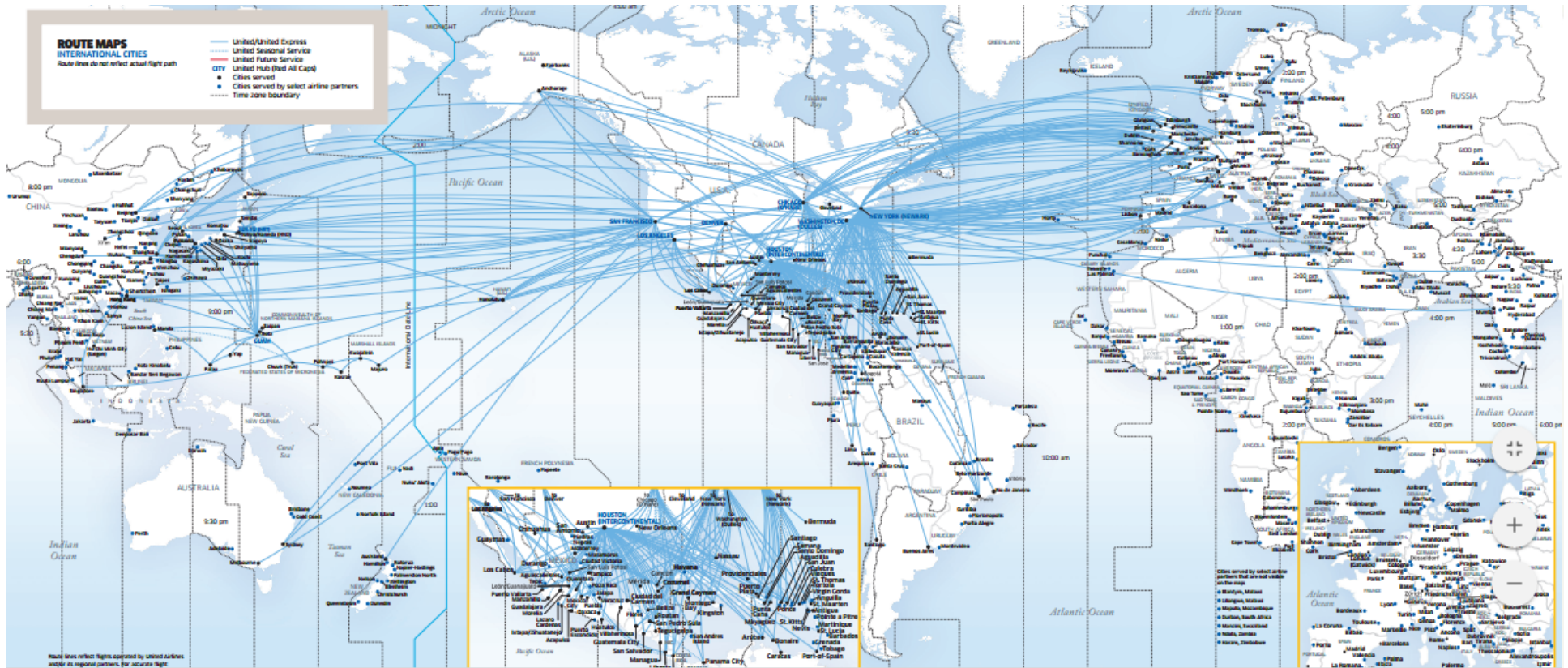


YOUR PLAN



REALITY

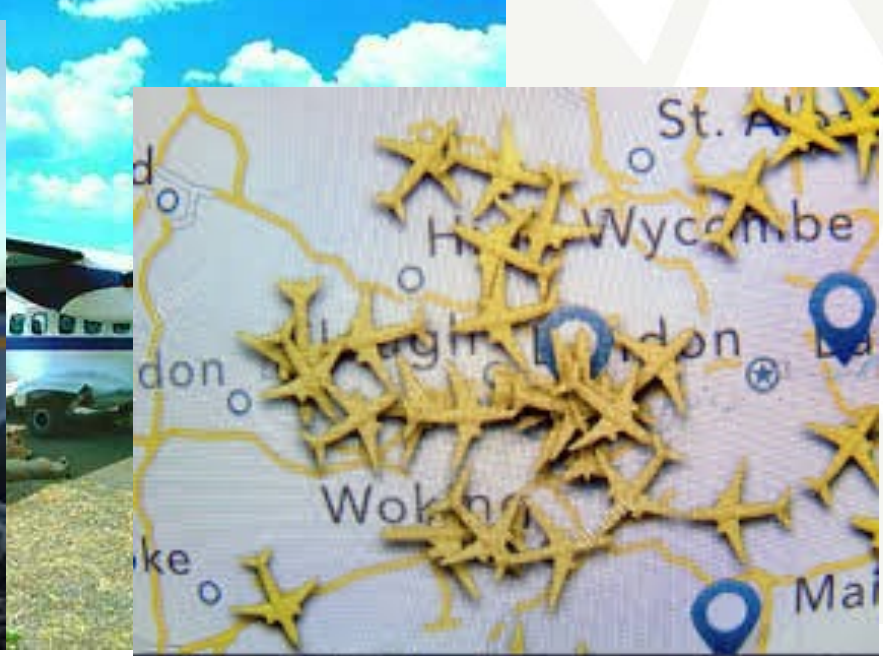




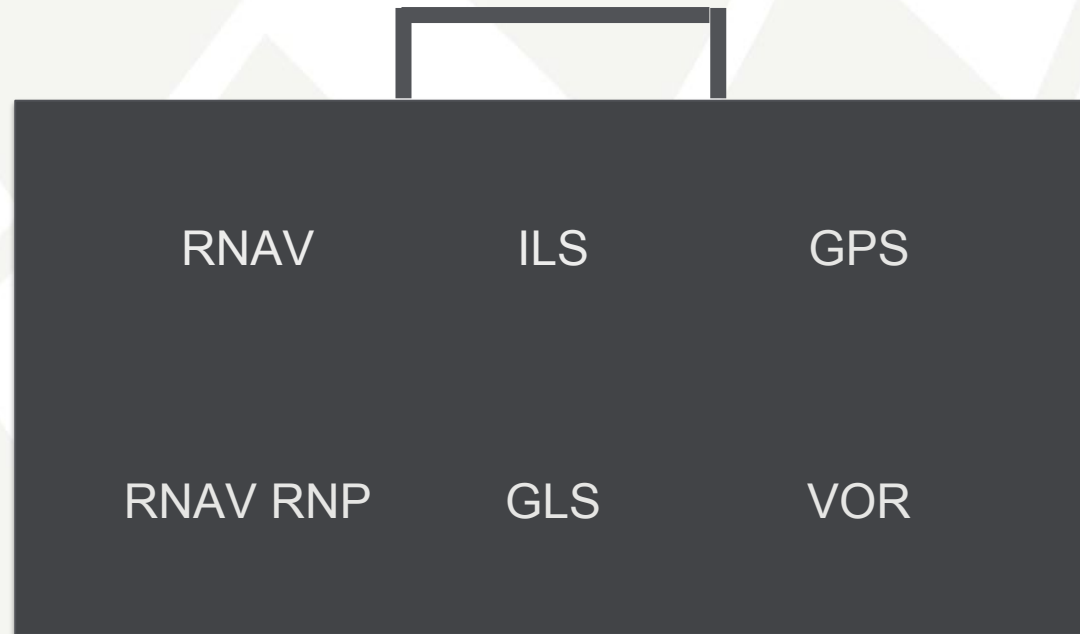
373 Destinations

60 countries





United Airlines Approach Toolbox



United's US Hub Strategy



Newark

GLS Approaches
RNAV RNP Approaches
ILS Approaches

Houston

GLS Approaches
RNAV RNP Approaches
ILS Approaches

San Francisco

ILS Approaches
LDA Approaches
RNAV GPS Approaches

SFO's ROAD BLOCKS TO EFFICIENCY



Top 10 Weather Delayed US Airports for 2015-2016

1. San Francisco International Airport
2. Newark Liberty International Airport
3. Chicago O'Hare International Airport
4. New York La Guardia Airport
5. Denver International Airport
6. Houston – George Bush Intercontinental Airport
7. New York – John F. Kennedy International Airport
8. Boston Logan International Airport
9. Dallas/Ft. Worth International Airport
10. Philadelphia International Airport

Optimized Descents

PBN Based Procedures



Time Based Flow Management



UNITED 

GLS is a non-government supported program in the United States

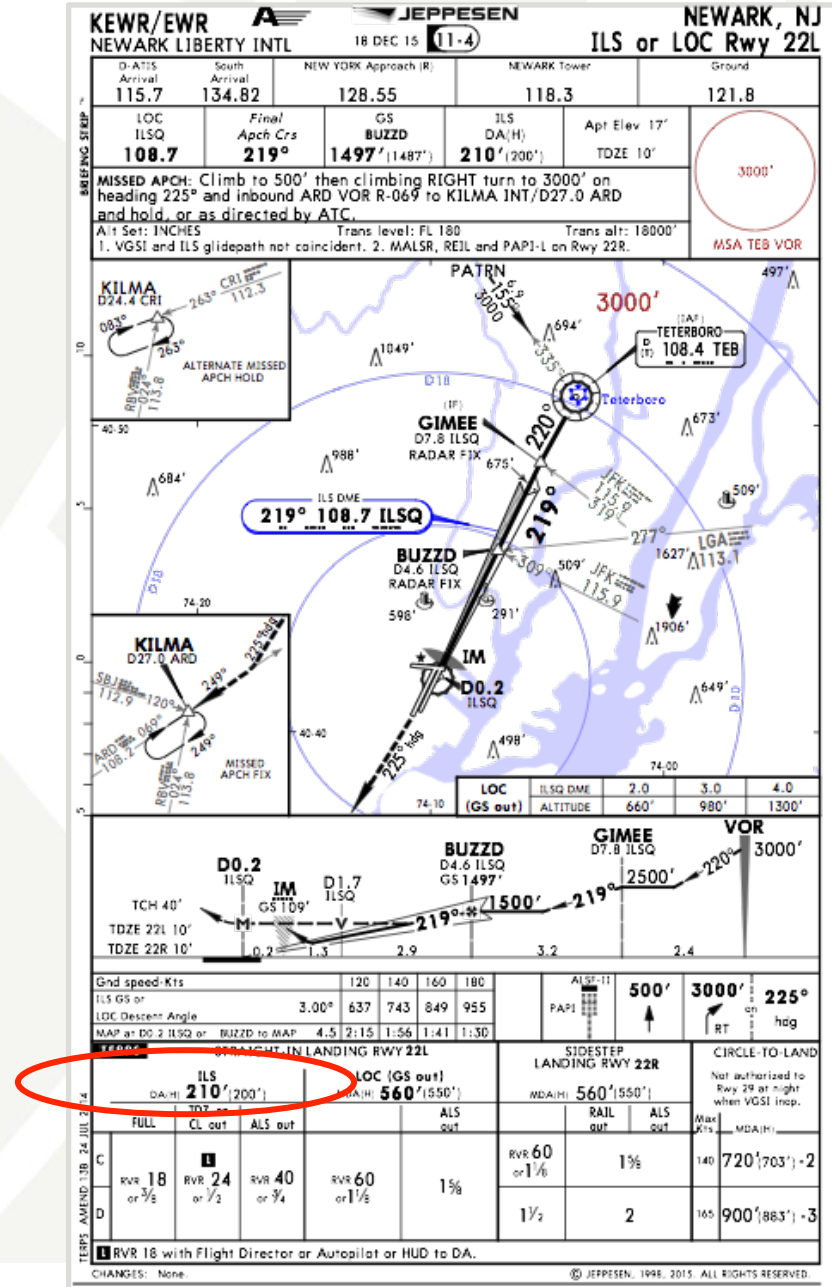
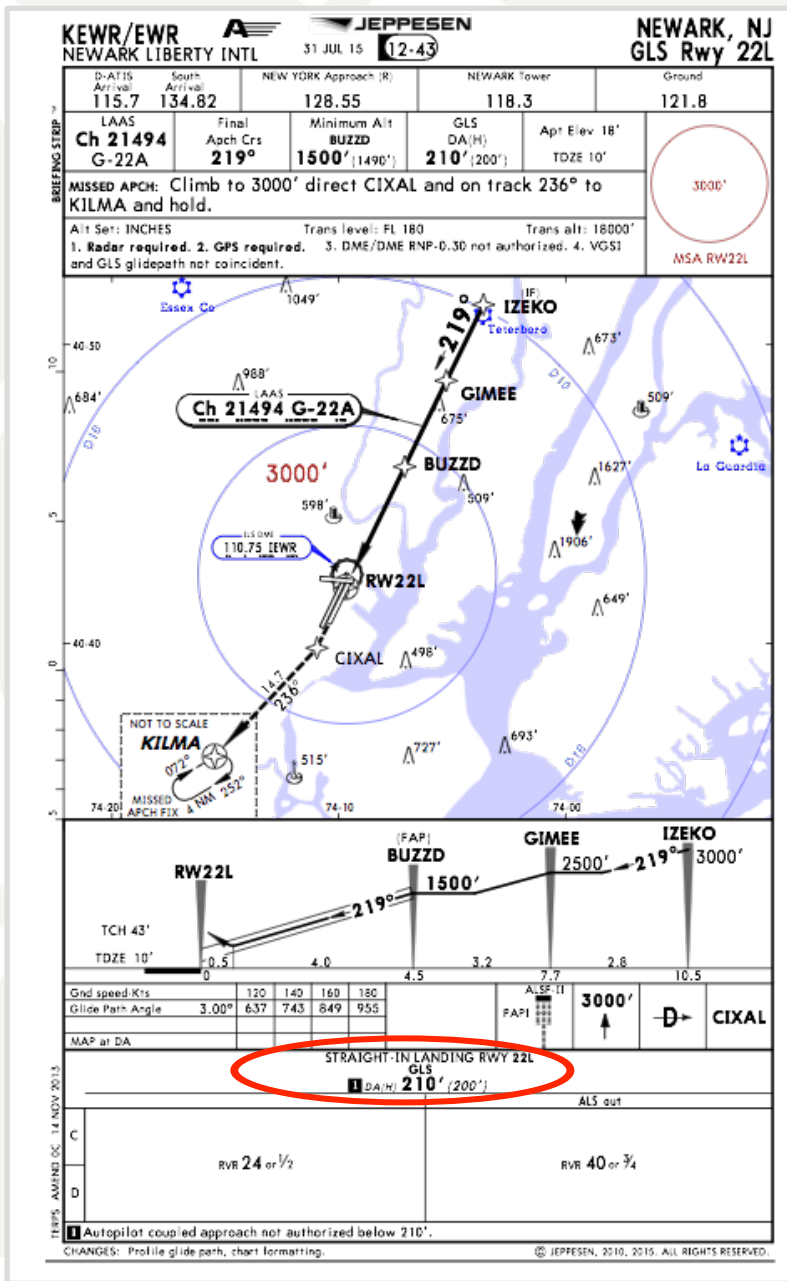


BUILDING THE TEAM



San Francisco
International
Airport

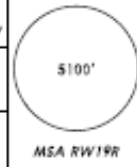




KSFO/SFO
SAN FRANCISCO INTL

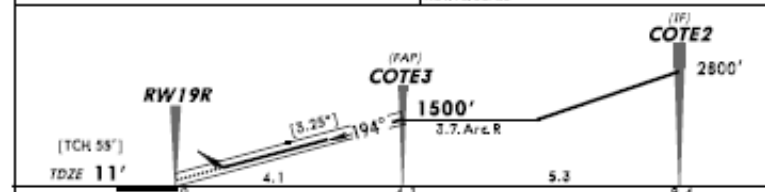
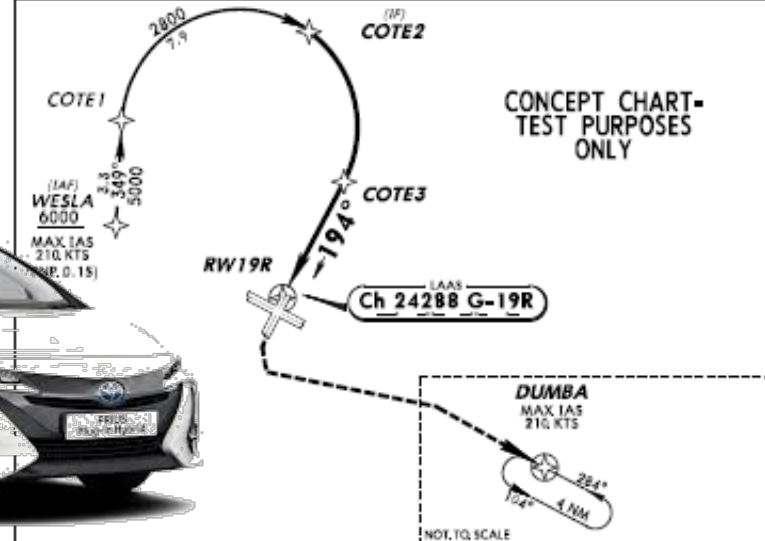
SAN FRANCISCO, CALIF
GLS R RWY 19R

LAAS Ch 24288 G-19R	Final Appch Crz 194°	Minimum Alt COTE2 1200' (1187')	GLS DA(H) XXXX' (XXXX')	Appt Elev 13'
				TDZE 11'



MISSED APCH: C]mb to 400' then c]mb]ng LEFT turn 3000' d]rect DUMBA and hold. Do not exceed 210 KIAS until DUMBA.

- 1. RF and GPS required.
- 2. VGS and GLS glidepath not coincident.



Grd speed-Kts	70	90	160	120	140	160				
GS 3.25°	402	518	575	690	805	920				

STRAIGHT-IN LANDING RWY 19R
GLS
DA(H) **XXXX'** (XXXX')

A	
B	
C	XXXXm
D	

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Oakland Airport Traffic





← Arrival

← Departure



← Arrival

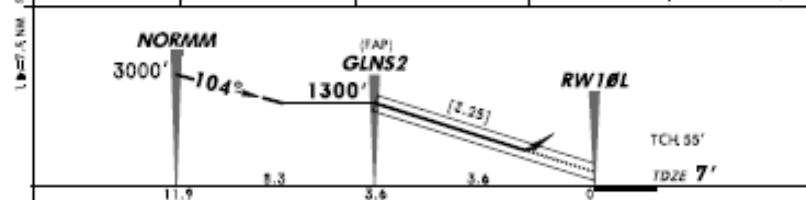
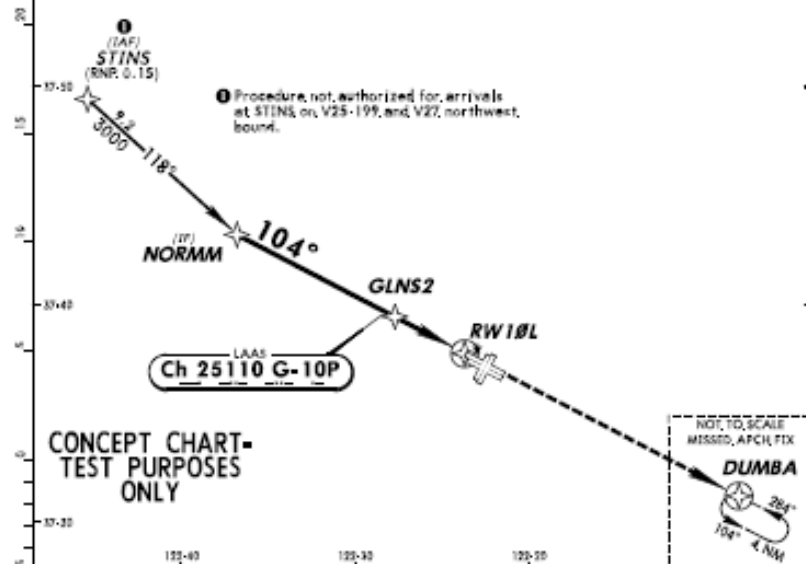
← Departure

KSFO/SFO
SAN FRANCISCO INTL

SAN FRANCISCO, CALIF
GLS P Rwy 10L

D-ATIS 113.7 115.8		NORCAL Approach (R) 118.85 135.45		SAN FRANCISCO Tower 134.5 120.5		Ground 121.8	
LAAS Ch 25110 G-10P		Final Appch Crs 104°		Minimum Alt GLNS2 1300' (1283')		GLS DA(H) XXXX' (XXXX')	
				Apr Elev 13'		TDZE 7'	

MISSED APCH: Climb to 4000', direct DUMBA, and hold.
 Alt Set: INCHES Trans. level: FL 180 Trans alt: 18000'
 1. GPS required.
 2. VGSI and GLS glidepath not coincident.
 MSA RW10L



Grd speed-Kts	70	80	100	120	140	160	REIL PAPI-L	4000'	DUMBA
Glide Path Angle	3.25°	402	518	575	690	805			
MAP at DA									

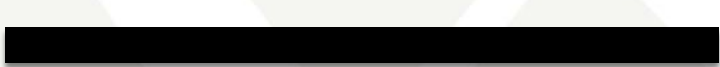
STRAIGHT-IN LANDING RWY 10L
 GLS
 MDA(H) XXXX' (XXXX')

A	X%
B	
C	
D	

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Current SFO Closely Spaced Parallel Runways



28R



28L



KSFO/SFO
SAN FRANCISCO INTL

SAN FRANCISCO, CALIF
GLS W RWY 28R

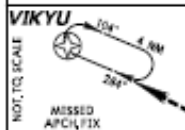
BRIEFING STRIP™

LAAS Ch 22233 G-28W	Final Appch Crs 284°	Minimum Alt RON51 900' (667')	GLS DA(H) XXXX' (XXX')	App Elev 13'	TDZE 13'
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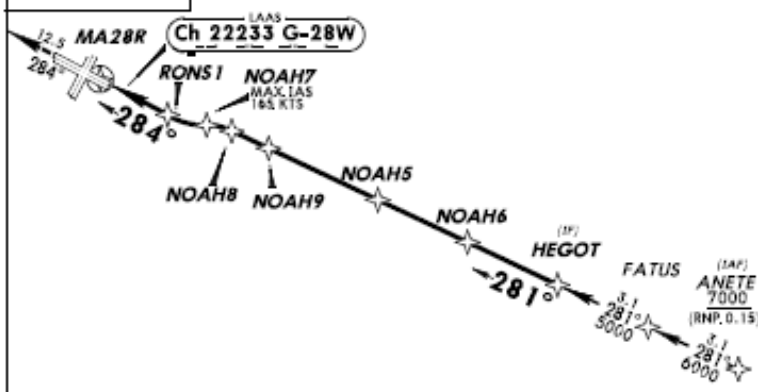


MISSED APCH: Climb to 3000' on track 284° to VIKYU and hold.

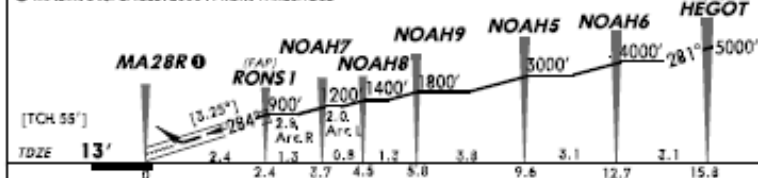
1. RF and GPS required.
2. VGSI and GLS glidepath, not coincident.



CONCEPT CHART-
TEST PURPOSES
ONLY



MA28R DISPLACED 2000' FROM THRESHOLD



Grd speed-Kts	70	90	100	120	140	160
Glide Path Angle 3.25°	403	518	575	690	805	920

STRAIGHT-IN LANDING RWY 28R

GLS

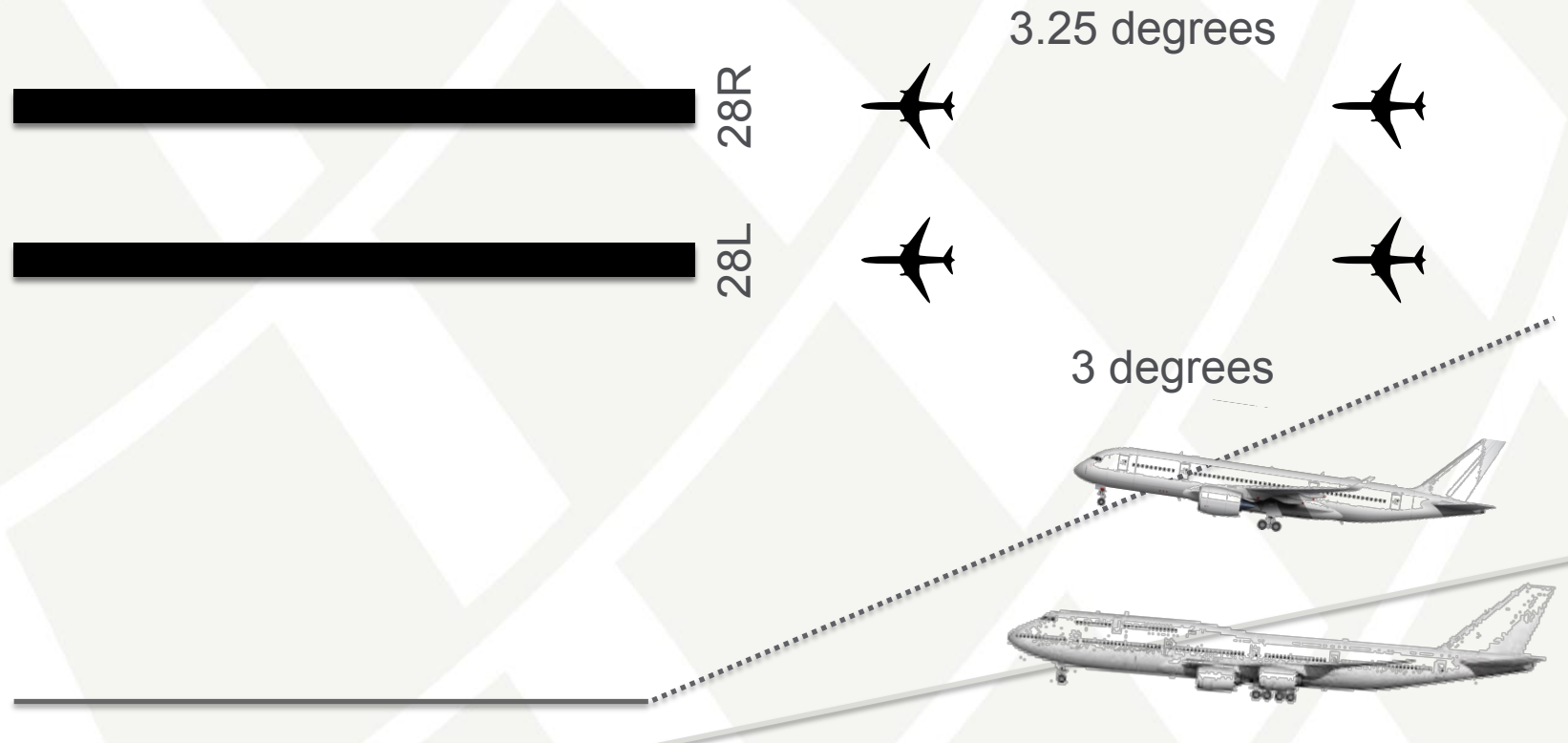
DA(H) **XXXX' (XXX')**

A	XXXXm
B	
C	
D	

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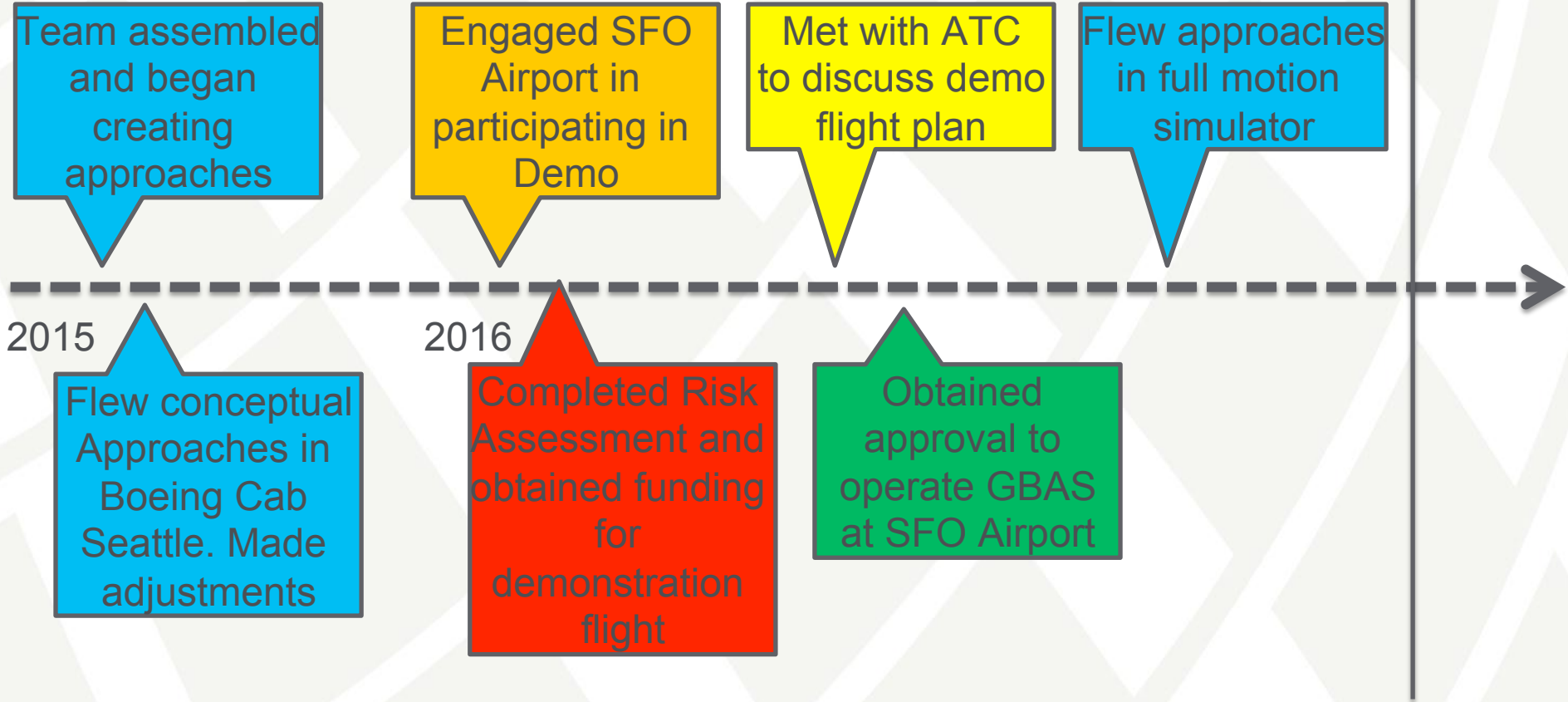


Adjustable GBAS Glide Slope Mitigates Wake Turbulence Issues

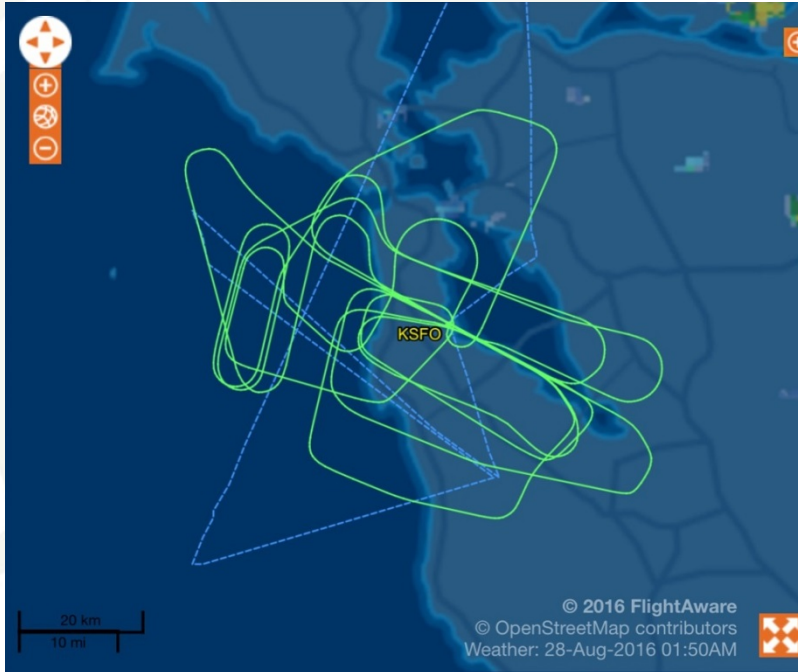




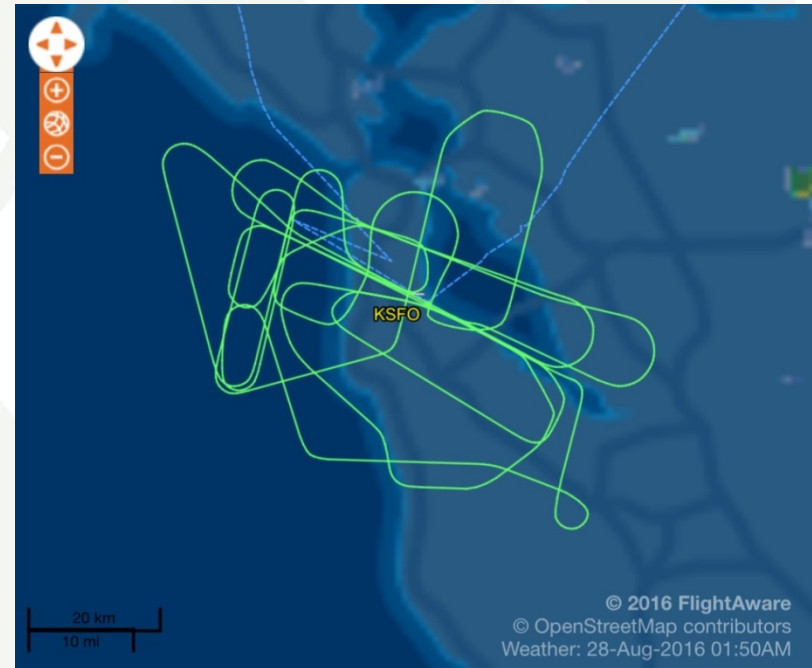
Demonstration Day August 27, 2016



Flight time: 3 hours 30 minutes



UNITED 



 **DELTA**

Total miles flown: 761 nautical miles

UNITED 

Courtesy: Flightaware.com

Post Demonstration



http://laas.tc.faa.gov/documents/Docs/KSFO_RNP_to_GLS_Report_13_Dec_16.pdf



San Francisco
International
Airport



Honeywell



United Airlines is committed to GLS

Largest US carrier equipped with GLS



Over 177 Boeing 737's and 787's equipped with GLS

On a given day over 50% of arrivals to hub airports could be GLS equipped

Fleet Update

Aircraft

Quantity

➤ B737-800	22
➤ B737-900/ER	122
➤ B787-800	13
➤ B787-900	<u>20</u>
	177

- United has 7 GLS capable Level D full motion simulators



- 24% of United's worldwide fleet equipped with GLS.
- With current order book will have 210 GLS equipped aircraft by 2020
- GLS installed on 737Max10 (2018) and Airbus 350 (2022)

What is next for GLS?

Both United and Delta are:

Obtaining permission to fly to Category II minima

Auto land capability

Identifying other hub airports where GLS would increase efficiency

Thank You!

