

## Connected Corridors Face-to-Face Meeting

Tuesday, Jan 31st, 2017 – 1:30 – 3:30 pm Caltrans D7 HQ





## New Faces at Caltrans HQ

### HQ

- Amarjeet Benipal Acting Division Chief for Traffic Ops
- Robert Peterson Acting Assistant Division Chief for the Traffic Ops Operations Program
- D7
  - Sarah Horn New Corridor Manager Corridors TRB
  - Richard Hung System Modeling, Data Collection and Analysis



## Agenda

- Introductions
- Schedule Review
- Outreach
- Data Quality and Estimation
- Corridor Model Update
- High Level Design and Implementation
- Call for Projects Update
- Action Items and Closing



## Our Corridor: The I-210

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## Systems Engineering Next Steps

- 5
- Design Documents How will the requirements be met
- Hardware and Software Building the system



## Transitioning

- We are transitioning to a phase where we will be more involved again with the stakeholders
  - Model Reviews
  - Response Plan Generation
  - Call for Projects Installation details
  - Data Quality
  - Demonstrations of functionality
  - Software Installations
  - Communications upgrades
  - Memorandum of Understanding
  - Roles and Responsibilities
  - Outreach, demonstrations and presentations
- We are moving from design to doing





## Schedule







## Outreach

- Project Charter Amendment
  - Awaiting signature from Duarte
- Winter Connected Newsletter distributed
- Connected Corridors and the I-210 at TRB
- Connected Corridors Program at Berkeley selected by USDOT as an Innovation Center
- **CC Statewide Rollout website continuing to add content**



## Winter Connected Newsletter Distributed



A Quarterly Newsletter for Connected Corridors Stakeholders

#### How to Manage an Incident: Response Plans

morning. Can this type of situation occur? It did, on alternate routes. Monday, December 7, 2016. Regrettably, the Connected A response plan is not limited to just a traffic reroute. Corridors program had not yet been launched, and there Signal and metering light timing changes, equipment was no way for a fully coordinated traffic management and personnel requests, and communication plans response plan to be put in place to safely route travelers could also be deployed as a part of a response plan.

city streets. two years ago, the stakeholders began focusing on de- many rules and determine the best response plans. as these. What should a response plan do? What ITS in- conditions to account for the complexity of incidents, frastructure is needed to implement the response plans? considering factors such as time of day, day of the week, How do we decide- in real time-which response plan expected duration, location of the incident, and possible

do we know when to end a response plan?

A package is thrown from a car on the I-210 corridor and west directions. The 2015 Call for Projects funding In LA County. It lands near the Gold Line transit tracks. approved by Metro and Caltrans SHOPP project funds It could be a bomb or worse. The authorities shut down are being used to purchase and install the traffic signals, the I-210 and the Gold Line transit service, bringing traffic sensors, and the necessary changeable message transportation to a standstill at 9:00 on a Monday signs needed to guide travelers along the designated

around the scene and reduce the chaos that resulted on Stakeholders are currently defining all of these response plan components and when and where they will be used Understanding how the I-210 stakeholders can most Rules are being developed in the form of: "If an event effectively respond to serious traffic incidents is what occurs at location X, do Y and notify Z." These rules the Connected Corridors program is all about. Over will be processed by a rules engine, which will evaluate

signing corridor-wide response plans for incidents such The rules engine must support a complex set of to use? What approval mechanisms are needed and how issues with alternate routes such as an active school zone. A response plan can also be scaled depending on

Step one in the definition of response plans was the the severity and length of the incident. For example, if identification of approximately 300 preliminary alternate two lanes of the freeway are expected to be closed for routes within the corridor. This list went through several one hour, that would warrant a different response plan Iterations to refine the number of options and match than if the two lanes were expected to be closed for ten them with available ITS element resources. The list is hours or if the closure were to occur at 3am versus 3pm. now at approximately 60 alternate routes for both the east O Continued on page 2





## **ITS California**

 Would like to partner with stakeholders on presentations and demonstration

#### Submitting 5 abstracts

- I-210 Update (and statewide rollout?)
- Detailed Roles and Responsibilities for ICM
- Operational Data Hub with new technologies
- Use of the cloud for operations management
- Modeling and estimation
- Your ideas?
- Requesting a demonstration of the data and modeling flow
  - Data Quality
  - Estimation for the corridor
  - I-210 Model running a scenario



## Data Quality and Estimation

## Sensor Availability

Weekly Average		Eastbo	und I-210 F	PM 25 to Pl	M 43.25		Westbound I-210 PM 25 to PM 43.25						
Data Quality	Fwy-Fwy	HOV	Mainline	Off Ramp	On Ramp	Total		Fwy-Fwy	HOV	Mainline	Off Ramp	On Ramp	Total
Dec04 - Dec10	52.4%	91.0%	90.7%	83.7%	90.9%	89.0%		100.0%	78.2%	80.1%	83.3%	79.1%	80.4%
Dec11 - Dec17	66.7%	91.4%	92.7%	91.6%	92.6%	91.7%		100.0%	75.2%	78.6%	74.8%	77.0%	77.9%
Dec18 - Dec24	100.0%	90.0%	91.0%	93.1%	95.8%	91.7%		100.0%	71.8%	81.8%	82.4%	83.7%	80.9%
Dec25 - Dec31	100.0%	91.8%	93.5%	93.1%	95.8%	93.5%		100.0%	74.4%	84.3%	86.2%	85.7%	83.4%
Jan01-Jan07	100.0%	89.2%	91.1%	93.1%	95.8%	91.7%		100.0%	71.4%	81.7%	86.2%	85.2%	81.4%
Jan08-Jan14	42.9%	62.8%	65.7%	79.3%	69.6%	67.2%		42.9%	53.0%	63.1%	71.4%	66.8%	62.1%
Jan15-Jan21	42.9%	60.6%	63.7%	79.3%	69.6%	65.7%		42.9%	50.4%	60.1%	70.5%	65.8%	59.7%
Jan22-Jan28	100.0%	88.7%	88.6%	95.6%	95.8%	90.4%		100.0%	73.3%	82.8%	90.0%	91.3%	83.3%
Loops in Category	2	33	140	29	24	228		8	38	164	30	28	269

- Serious problems resulting in temporary loss of data
- Most configuration changes for basic corridor are now completed
- There are now fwy-fwy loops registered on Westbound I-210 PM 22.6 to PM 25 and on Eastbound SR-134 PM 11.4 to PM 13.5.



## Sensor Availability Report

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Freeway	Sensor Health	Art	erial	Sensor	Health	3					
Wee	ekly Average Data Q	uality					I-210 · E	Eastbound PM	25 - PM 43.25	•	
Hover ov	ver cells to view units in det	ector-day	<b>s</b> .	CD	СН	Fwy-Fwy	HOV	Mainline	Off Ramp	On Ramp	Total
	27 28 29 30	31	1 2			57.1%	78.4%	88.4%	73.3%	95.8%	85.1%
January	3 4 5 6	7	89			66.7%	75.1%	83.1%	71.4%	86.3%	80.4%
	10 11 12 13	14	15 16	5		66.7%	68.6%	76.4%	72.4%	84.5%	75.4%
	17 18 19 20	21	22 23	}		66.7%	73.9%	81.9%	73.3%	89.9%	80.1%
	24 25 26 27	28	29 30	)		66.7%	77.6%	87.5%	73.3%	92.3%	84.3%
	31 1 2 3	4	56			57.1%	59.2%	68.9%	61.4%	75.0%	66.9%
February	7 8 9 10	11	12 13	3		38.1%	37.6%	42.1%	31.4%	42.9%	40.1%
	14 15 16 17	18	19 20	)		66.7%	67.8%	73.6%	53.3%	75.0%	70.2%
	21 22 23 24	25	26 27	7		66.7%	71.8%	81.2%	61.9%	85.7%	77.5%
	28 29 1 2	3	4 5			66.7%	75.5%	87.4%	70.0%	95.8%	83.8%
March	6789	10	11 12	2		66.7%	70.2%	80.2%	69.0%	95.2%	78.5%
	13 14 15 16	17	18 19	>		66.7%	68.6%	77.1%	67.6%	92.9%	76.0%
	20 21 22 23	24	25 26	5		66.7%	69.8%	77.9%	69.0%	92.3%	76.8%
	27 28 29 30	31	1 2			57.1%	58.4%	67.1%	56.7%	75.0%	65.1%
April	3 4 5 6	7	89			90.5%	64.1%	73.0%	61.0%	76.8%	71.0%
	10 11 12 13	14	15 16	5		100.0%	75.5%	83.4%	72.4%	88.7%	81.8%
	17 18 19 20	21	22 23	3		100.0%	81.6%	91.0%	72.9%	90.5%	87.6%
	24 25 26 27	28	29 30	)		100.0%	75.9%	84.9%	73.3%	86.3%	82.7%
May	1 2 3 4	5	6 7			100.0%	69.4%	78.4%	73.3%	86.3%	77.8%
	8 9 10 11	12	13 14	ł		100.0%	81.6%	87.9%	73.3%	82.1%	85.0%
	15 16 17 18	19	20 21			100.0%	83.3%	87.4%	72.4%	83.9%	84.9%



## Arcadia

	Arcadia										
Weekly Data Quality (%)	D	etour Rout	es	Not	Detour Ro	outes	All Detectors				
	Good	Bad	No Data	Good	Bad	No Data	Good	Bad	No Data		
04-Dec-2016 To 10-Dec-2016	62.86	31.35	5.79	27.29	17.54	55.17	53.92	27.88	18.20		
11-Dec-2016 To 17-Dec-2016	61.64	32.57	5.79	26.70	18.13	55.17	52.86	28.94	18.20		
18-Dec-2016 To 24-Dec-2016	62.93	31.28	5.79	28.47	16.35	55.17	54.27	27.53	18.20		
25-Dec-2016 To 31-Dec-2016	64.05	30.16	5.79	28.77	16.06	55.17	55.19	26.62	18.20		
01-Jan-2017 To 07-Jan-2017	63.29	30.92	5.79	28.57	16.26	55.17	54.57	27.23	18.20		
08-Jan-2017 To 14-Jan-2017	62.76	31.45	5.79	28.28	16.55	55.17	54.10	27.70	18.20		
15-Jan-2017 To 21-Jan-2017	62.86	31.35	5.79	29.16	15.67	55.17	54.39	27.41	18.20		

- Now that we are receiving County, Monrovia and Duarte data we should be able to start looking at the quality of that data also
- Looking forward to Pasadena data



## **Estimation**

### □ As a reminder data quality ultimately is used to:

- Indicate where data is missing
- Indicate bad data for removal

#### Estimation fills in:

- Where there are no sensors
- Where the data is missing
- Where the data was bad

#### Progress on Estimation

- Expanding arterial estimation to entire corridor
- Work reviewed by TSS
- Simplifying freeway estimation



# Next Steps: City Data Quality Review and Estimation Reviews

- March: Stakeholders review model in detail
- April: Modifications are made as needed
- April: Stakeholders review model and accept
- May: Response plan development begins
- June: First detailed response plans including signal timing are modeled and reviewed with stakeholders
- July: Modifications are made
- July: First approved response plan is completed
- August and forward: Response plans for remainder of corridor are generated, modeled and approved



# Corridor Model update

## Outline for Aimsun model discussion

Road geometry

#### Traffic control elements

- School zones
- Conflicting flows at intersections

#### Driver behavior

- Secondary stop lines at intersections
- Forced turns
- Trip cost calculations
  - Travel costs formulas

### Demand modeling

- Origin-destination matrix adjustments based on traffic counts
- Manual flow adjustment
- Model Calibration
- Next Steps



## **Geometrical Elements**

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Addition of U-turns where permitted





## **Traffic Control Elements**

#### Mapping of schools affecting traffic operations

#### Coding of school zone speed limits

- Forced speed reduction to 25 mph by all vehicles
- Active from 10 min before bell to 30 min after bell
- Coding of regular bell schedule only Too much variability with alternative schedules (short days, etc.)







## **Traffic Control Elements**

#### Conflicting flows at intersections

- Identification of conflicting volumes for permitted left turns and right turn on red at signalized and 2-way stop intersections
- Information used by Aimsun to calculate conflicting traffic volumes for each movement
- Conflicting volume information input to user-defined formulas to estimate travel cost associated with gapseeking movements





## **Driver Behavior**

#### Secondary intersection stop lines

 Coding of "in-intersection" stop lines to replicate vehicles pulling into the intersection waiting for a gap in opposing traffic





## **Trip Cost Calculations**

#### Updates to formulas used to calculate travel costs during a simulation

- Dynamic cost function per vehicle type (DCFVT) Travel costs during simulation based on current travel time
- Initial dynamic cost function per vehicle type (ICFVT) Travel costs at start of simulation based on free-flow conditions
- Updates to formulas used to calculate travel costs during static traffic assignments
  - Volume-density functions (VDF) Travel time along roadway segment based of volume-to-capacity ratio
  - Junction delay functions (JDF) Additional 0.10 to 2.00 min of perceived travel time to factor difficulty of seeking gap against opposing flow
  - Turn penalty functions (TPF) Additional 0.375 to 1.25 min of perceived travel time (higher values for trucks) to account signs and signals along path

Functions ノDCF DCFVT ICF ICFVT JDF - Gap Acceptance Cost - Signal JDF - Gap Acceptance Cost - Signal - Reduced JDF - Gap Acceptance Cost - Stop K-Initials VT TPF - Base Function ノ TPF - High Cost TPF - Signalized Turn TPF - Signalized Turn - Reduced Cost J TPF - Stop Turn (2-way) TPF - Stop Turn (4-way) VDF - (Example) PT Connection Walking 5 km/h ノ VDF - Arterial VDF - Arterial Segment VDF - Arterial with Signal VDF - Centroid Connector Default VDF - Centroid Connector Extra Cost VDF - Freeway - HOV VDF - Freeway - Mainline VDF - Freeway - On/Off Ramp VDF - Ringroad VDF - Road VDF - Street VDF - Street with Signal VDF - Street with Stop



## **Demand Modeling**

- Development of base origindestination matrices from SCAG data
  - Obtained 2016 estimated trip pattern for corridor from SCAG
  - Used the SCAG data to developed O-D matrices matching the specific origindestination layout of the Aimsun model
  - Matrices developed for:
    - Cars
    - HOV
    - Medium trucks
    - Heavy trucks





## **Demand Modeling**

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#### Matrix adjustment to reflect observed traffic data

- Developed a multi-step process to "adjust" the base O-D matrices derived from SCAG data into matrices better reflecting observed traffic counts
- Reference data
  - Traffic counts from continuous traffic monitoring systems
  - Intersection turning counts
  - Traffic counts from traffic impact studies
- Current focus has been on adjusting matrices for passenger cars





## **Demand Modeling**

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### Manual adjustment to developed origin-destination matrices

- Automated process used by Aimsun to adjust O-D matrices to observed traffic data can lead to too much/ too little flow associated to specific ODs
- Example: Do we really have 750 vehicles per hour going to the Double Tree in Monrovia?
- Manual corrections are made where necessary to ensure realistic traffic patterns

Main	Cent	roids and Sect	ions	Outputs to Genera	te Variables	s Pa	arameter	s	Attribute	s	
Name:	ODME	- AM 07-09			External ID:						
Times	3							_			
Date	:	1/1/2000						÷			
Initia	al Time:	7:00:00 AM						*	Duration:	02:00:00	*
Traffi	c					Geom	etry Con	figura	ations		
Traff	fic Dema	and: 🗐 7	995143	: SCAG 2016 AM	•	🗆 s	elect All	Not	ning Selec	ted Filter	
Publi	c Transi	it Plan: 🗳 7	633948	: Weekdav	•						
		~		,							
Deteo	ction Da	ita									
Real	Data S	et: RDS 7996	390: RE	S AM 07-09 - Nov 1	4 🔻						
Group	ping Op	tions									
Use	Centroi	d Groupings:	None		•						
Use I	Detectio	on Groupings:	None		•						



## **Model Calibration**

- Simulation runs with modeled demands have been executed to ensure no unusual problems affect the simulation
  - 2-hour test runs
  - Tests for both AM and PM peak periods
  - Constant traffic demand within each period





## Next Steps

#### Updates to traffic signal control elements

- Available timing sheets used to model corridor reflect existing situation at end of 2015 / early 2016
- Evidence of some signal operational changes on Google Street View
  - Example: new protected left turn at California @ Pasadena

#### Development of typical traffic demand profiles

- AM peak
- Midday
- PM peak
- Adjustments of driver behavior and O-D trips to ensure adequate replication of
  - HOV movements on freeway
  - Bottlenecks on freeways
  - Congestion on arterial segments



## Next Steps: Generation and Acceptance of Model and Response Plans

- March: Stakeholders review model in detail
- April: Modifications are made as needed
- April: Stakeholders review model and accept
- May: Response plan development begins
- June: First detailed response plans including signal timing are modeled and reviewed with stakeholders
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## High Level Design





## Architecture - Systems within and connecting to the Amazon Cloud (Not network arch)

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## Major Components Within the Cloud





## Subcomponents - Software

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			20	17	2018				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Quart	4th Quart
	ATMS	Design	Contract	Build	Build	Test/Int	Deploy	Release	Run
	τα ας	Design	Build	Build	Build	Test/Int	Deploy	Release	Run
	Trailblazer Software	Design	Purchase	Purchase	Install	Test/Int	Complete	Release	Run
	TSMSS	Build	Build	Test/int			Deploy	Release	Run
	Data Hub	Build	Build	Load	Build	Test/Int	Deploy	Release	Run
	Corridor Mgmt Sys	Contract	Select	Build	Build	Test/Int	Deploy	Release	Run
6 oftwara	Loop Interface	Design	Design	Build	Te/Int				
SUILWAIE	511 Integration	Design	Build	Build	Build	Test/Int	Deploy	Release	Run
	RIITS (Transit, Rail)	Design	Build	Build	Build	Test/Int	Deploy	Release	Run
	RIITS (Video)	Design	Design	Build	Build	Test/Int	Deploy	Release	Run
	RIITS (Environ)	Design	Purchase	Purchase	Install	Test/Int	Complete	Release	Run
	PEMS	Design	Contract	Build	Build	Build	Test	Release	Run
	Arterial Lane Closure	Deploy	Test	Choose	Test	Test/Int		Release	Run
	Travel Time	Design	Purchase	Purchase	Build	Test/Int			



## Subcomponents - Other

			2	017			20	18	
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Quart	4th Quarte
Org and Derconnel	Personnel	Design	Assign	Assign	Assign	Ready	Deploy	Release	Run
Olg allu Persollier	Training	Design	Build	Build	Build	Train	Train		
Hardwara	Call for Projects (HW)	Design	Build	Build	Build	Done	Test/Int	Release	Run
naiuwaie	I-210 Project	Build	Build	Build	Test/Int	Deploy		Release	Run
Data	City Data	Pasadena	Quality	Quality	Ready			Release	Run
Dala	210 Data	Quality	Quality	Ready					
	Modeling	Build	Review	Update	Release				
	Rules Engine	Design	Build	Build	Build	Test/Int	Deply	Release	Run
AMS	Rules	Build	Build	Build	Build	Test	Deploy	Release	Run
	Response Plans	Design	Design	Design	Test	Test/Int	Deploy	Release	Run
	Response Plan Gen	Design	Design	Design	Test	Test/Int	Deploy	Release	Run
System Integration	System Integration	Build	Build	Build	Build	Build	Test	Release	Run



## **Highest Risks**

### Metro Call for Projects – (High Priority, High Risk)

- Starting later than expected
- Procurement approach being developed
- Many components are part of this call
- Inclusion of COTS Corridor Management systems (High Priority, High Risk )
  - Plan to release request for participation in pilot
  - Uncertain of number of responses
  - Need to refine final purchase plans
- C2C Connections (High Priority, High Risk)
  - Unexpected change, involves 3 systems and 4 (6) organizations
  - Unclear if C2C exists for all systems



# Call for Projects Update

## **Call for Projects Update**

- The draft Funding Agreement and attachments have been submitted and reviewed by Metro
- □ There are a few remaining comments that need to be addressed
- □ Then the agreement will be sent to Metro and CT legal for review.

- Procurement Plan:
  - Status of using a Service Contract to deliver the project
  - Awaiting word from DPAC



## I-210 East Reroutes

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## I-210 West Reroutes







## Job Descriptions and Duties/Tasks

PARTNERS FOR ADVANCED TRANSPORTATION TECHNOLOGY INSTITUTE OF TRANSPORTATION STUDIES UNIVERSITY OF CALIFORNIA, BERKELEY
I-210 Pilot System Requirements:
Job Descriptions and Duties/Tasks
CALLER THA Caltrans
Partners for Advanced Transportation Technology works with researchers, practitioners, and industry to implement transportation research and innovation, including products and services that improve the efficiency, safety, and security of the transportation system.

- Corridor Champions
- Corridor Manager
- Corridor Technical Manager
- Corridor Data Analyst
- Traffic Engineers
- Data Analysts
- Software Éngineers
- Electrical Engineers
- Database Administrators
- Stakeholders
- Maintenance Staff
- Information Technology Support
- Information Technology Security
- TMS/TCS Operators
- Transit Field Supervisors
- Public Information Officers
- First Responders
- Outreach and Communications Manager



## Job Roles and Responsibilities

- Caltrans has completed assigning roles/personnel to the job roles and responsibilities
- Next steps
  - Review Caltrans' assignments
  - Implementation and training plan
  - Transition plan for PATH roles to Caltrans



## Data Hub and DSS within the cloud







### Internals of Amazon Cloud





## Data Hub Streaming Progress



## Heterogeneous Sources Progress





## Proof Of Concept

- Continued engagement with possible corridor management system (purple box) partners
  - Met with Parsons
  - Met with Telegra
  - Met with Kapsch
  - All have indicated interest in working with us
- We are tailoring requirements based on feedback. Requirements requiring custom development will be minimized
- How to advertise POC
  - ITS American and ITS California



## **Proof of Concept Dates**

The anticipated schedule for the COTS pilot is: - Release of this document February 17 17 - Receive responses April - Choose vendors 17 May July 17 - Complete agreements 17 - Begin integration planning August - Begin integration 17 Sept - Launch with first vendor Oct 18 - launch with next vendor Jan 19 - Launch with next vendor April 19 The anticipated schedule for Caltrans procurement is: - Begin internal procurement process April 18 - Procurement RFP Released 19 Oct - Vendor Chosen March 20 20 - Complete negotiations June - Install production software 20 Sept 20 - Complete pilot Dec 



## I-210 SHOPP Construction Project Update

- Partnering meeting held on Jan 10<sup>th</sup> with all corridor stakeholders
- Construction progress, issues resolution and communication plan were discussed
- The project is on schedule to deliver Phase 1 (CC area) by end of 2017
- Next partnering meeting is scheduled for May



## Items of Note

- Rules Engine Going with Drools
- RIITS account setup and able to request data
- Iteris providing CC ITS Architecture for internal review
- Receiving data from Arcadia, County, Monrovia and Duarte from IEN. Awaiting Pasadena.
- Awaiting install of communication line from TMC to Amazon cloud
- Data hub design presented to Kapsch, Telegra, Parsons, Iteris and in summary to USDOT. Next to Irvine Consulting



## **RIITS Interface**

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## RIITS Services – Basic info available

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- Rail- Real Time Location (Text and Map)
- Travel Time Travel time values between nodes (Text)
- Bus Real Time Location (Text and Map)
- Congestion PEMS, LA Sensors (Text and Map)
- Ramp Meter Basic Info (Text and Map)
- Cctv Basic Info (Text and Map, but no video)
- Cms Info (Text and Map)
- Event Info (Text and Map)
- Signal Unable to access and not on map



# Thank You and Next Meeting