Location

Location

your partners in safety & security... OnStar®
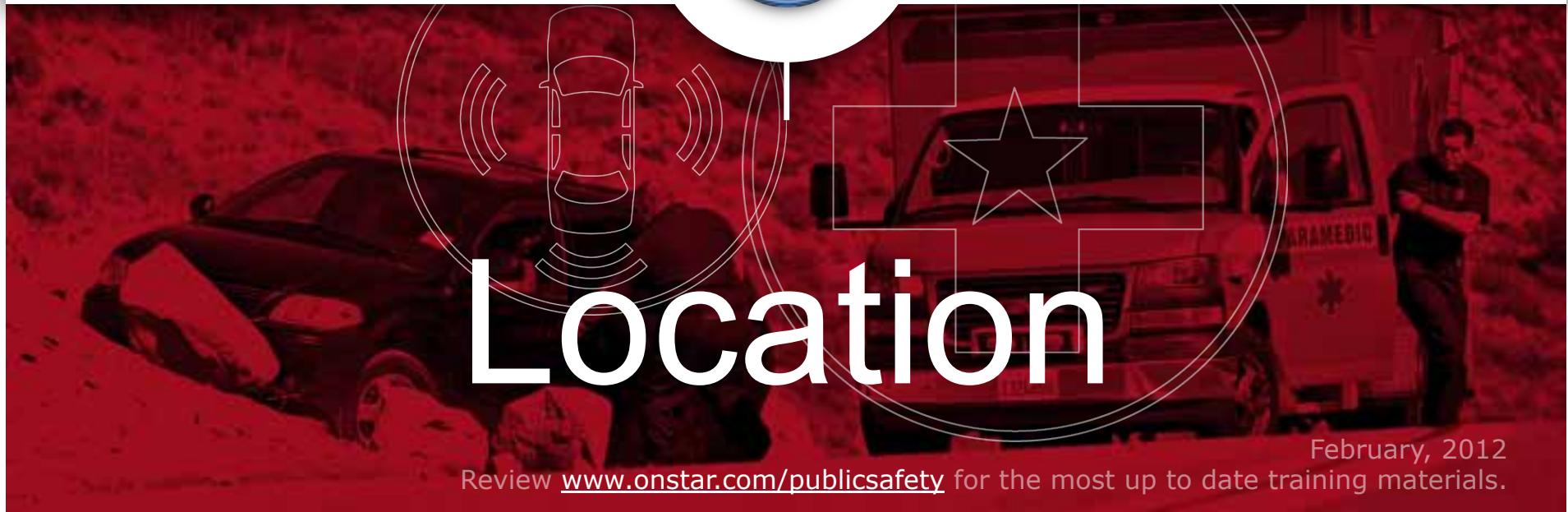
Location

Project Beacon

Started in 1996

- **Offered on Cadillac models**
- **Dealer Installed**
- **About 1,000 subscribers by year end**
- **9 calls per day**

Factory installed began in 2000

- **On Cadillac models**
- **About 630,000 subscribers by year end**
- **Over 5,000 calls per day**

In 2005 began OnStar Monthly Vehicle Diagnostics Emails (OVD)

Expansion

Opened in China in 2009

- **About 250,000 subscribers**

Deployed Injury Severity Prediction (ISP)

- **In 2010**
- **Determines the probability of a severe injury**
- **Based on the data from the vehicle**

In 2011 rolled out mobile applications

- **Allows the subscriber to connect to their vehicle**

OnStar® FMV

For My Vehicle

- **Available for a broad range of vehicles (>90 M)**
- **Extends OnStar services outside GM family of vehicles**
- **Professional installation at consumer electronics stores**
- **Features accelerometer, GPS, OnStar services, Bluetooth, embedded cell phone**

4

6million+

global subscribers

2011

Over 43 million calls

- **About 118,000 calls per day**
- **Around 2 calls per second**

47 million OVD Emails

Over 7 million mobile app interactions

Total Interactions

- **Over 97 million**
- **Over 270,000 per day**
- **Around 4 interactions per second**

Technical Stuff

ESRI Mapping

Oracle Virtual Private Database
- **Restrict access to personal information**

Real Application Clusters (RAC)
- **Provides failover and high availability**

Oracle Service Oriented Architecture
- **Front end application**
- **Load balancer between available servers**

Technical Stuff

Oracle Goldengate

- **Replication for real time data access**

Oracle Spatial

- **Geography based reporting and analytics**

I/O Stats for one 24 hour period

- **Total Logical Reads – 8 billion**
- **Total Physical Reads – 550 million**
- **Total Physical Writes – 4.8 million**

2000+ Advisors

160+ Emergency advisors

80+ Stolen Vehicle advisors

H O W   O N S T A R   W O R K S

GPS satellites orbit earth at 12,000 miles continuously streaming navigational data…

Upon OnStar button press or automatically in a crash, vehicle data is sent via wireless connection…

The OnStar receiver calculates data from at least 3 of those satellites…

Cellular transmission connects Subscriber to one of our Call Centers…

HOW ONSTAR WORKS

OnStar Call Centers answer a call for assistance every second of every day — 24/7/365...

Cellular transmission connects Subscriber to one of our Call Centers…
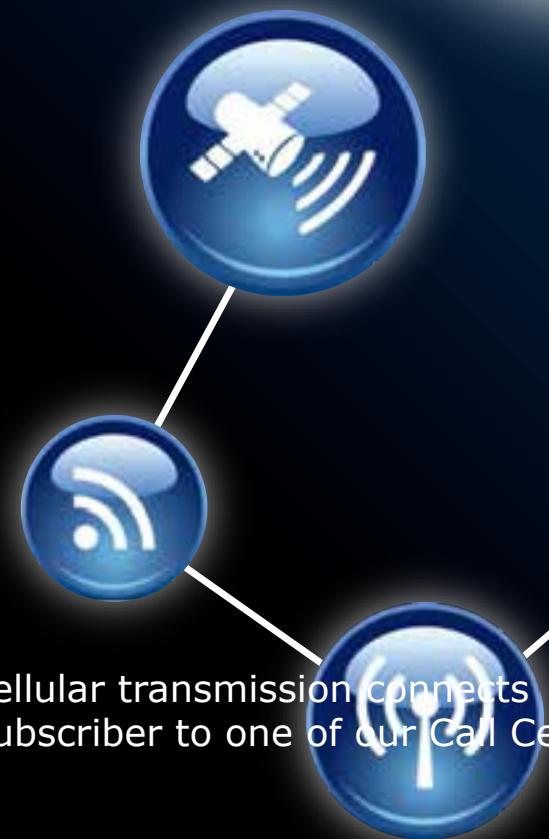
Trained Advisors work in special teams (Emergency Services, Stolen Vehicle Assistance, Crisis Assist, etc.) to better handle subscriber requests…

In an emergency, Advisor contacts Public Safety with location, crash data and injury status for emergency responders.

11

a day in the life of OnStar...

how OnStar helps…
emergency services

Emergency Services by the numbers...

2,500 monthly automatic crash responses

5,600 monthly emergency services

7,000 monthly Good Samaritan calls

...as of December, 2011

With a *human* connection...

- **Live Advisors**
  - o Able to assess the situation
  - o Specifically trained for emergency calls

- **Extensive Training**
  - o General OnStar training (4 wks)
  - o Non emergency assignment (3 months)
  - o Emergency training including APCO (6 wks)
  - o ALL Emergency Advisors are EMD certified
  - o Stolen Vehicle Assistance training (4 wks)
  - o Ongoing education

At the push of a button...

- **Personal in-vehicle emergencies**
  - Similar to 9-1-1 Calls
  - Understanding of medical problems
  - Knowing routes to hospitals & service

- **Good Samaritan calls**
  - Vehicle crashes
  - Road hazards
  - Criminal/suspicious activity
  - Amber Alert information

With *advanced* tools & training...

- **Sophisticated support**
  - Data / Voice link to vehicle
  - GPS location / Aerial imagery
  - Priority access to Public Safety
  - Real-time info (weather, Amber Alerts)
  - Bilingual Advisors / Language Line support
  - TTY
  - Command Center
  - Poison Control
  - Suicide Prevention Hotline
  - Emergency Medical Dispatch

automatic crash response

when every second counts...

you can count on OnStar.

Comprehensive, Continuous Safety:
Protection Before, During, and After Vehicle Collisions

BEFORE | DURING | AFTER

Available Crash Avoidance & Driver Assistance Technologies

- Stabilitrak
- Rear Video Monitor
- Lane Departure Warning
- Side Blind Zone Alert
- Adaptive Cruise Control
- Anti-Lock Braking System
- Daytime Running Lights

Hands-Free Calling
Vehicle Diagnostics

Systems Help Absorb Energy from Impact

- Automatic Crash Response
- Automatic Fuel Sender Shutoff
- Automatic High-Voltage Shutoff
- Automatic Door Unlock
- Automatic Flashers

Post-Crash Occupant Protection

19

Air bag inflation can cause severe injury or death to anyone too close to the bag when it deploys. Be sure every occupant is properly restrained.

AUTOMATIC CRASH RESPONSE STATUS

Air Bag Status	Airbag Deployed
Maximum Reported Delta V	28 mph from the left
Direction of Impact	Left Side (30˚)
Multiple Impacts	No
Rollover	No

INJURY SEVERITY PREDICTION	HIGH
	Advisor Crash Input
Female	YES
Over 55 Years Old	YES
UPDATE PREDICTION	UPDATE

VEHICLE INFORMATION

Owner's Name	Patty Smith
Make	Chevrolet
Model	Malibu Hybrid
Manuf. Year	2009
Color	Imperial Blue
License Plate	AKL3890
Emergency Contact	Jim Smith
Emergency Contact Phone Number	313-555-0001

PSAP LOCATION

Name	Type	Connect/Transmit Data
District of Columbia	Primary Emergency No.	TRANSMIT
Comments		

Secondary emergency no. is (202) 555-5556. This value is plotted from the latitude 28.2172 and the longitude -81.6883.
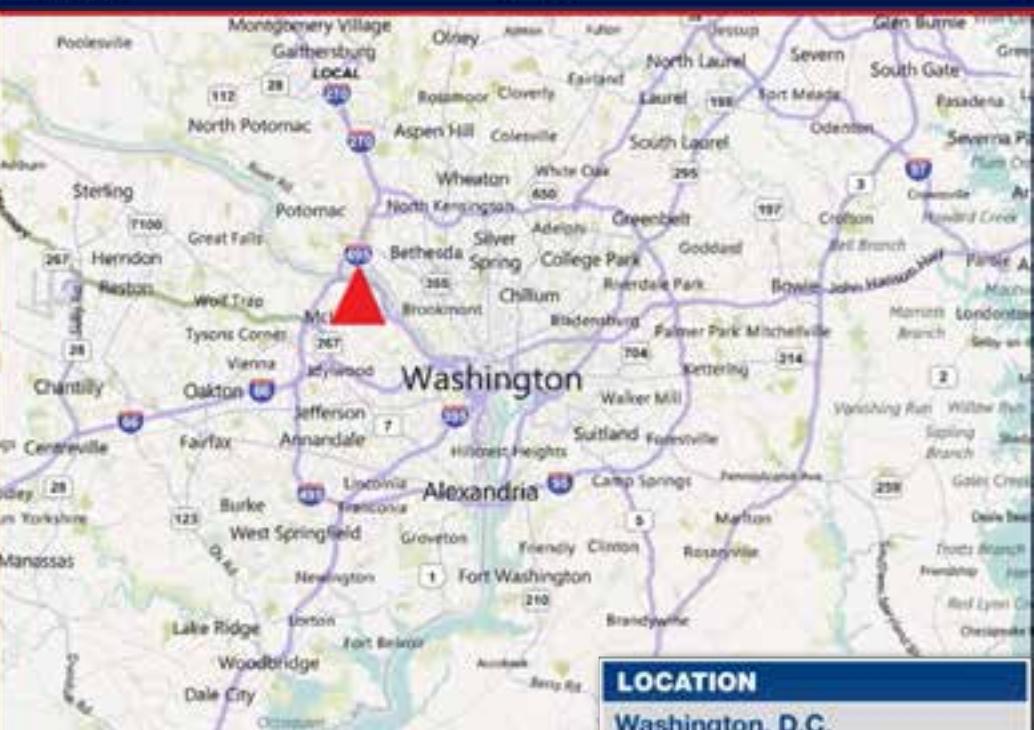
LOCATION

Washington, D.C.

Georgetown Pike	Ridge Dr
Latitude	Longitude
38˚ 53' 9" N	77˚ 02' 51" W

Crash Notification Events

Analysis using Oracle Spatial

- **Where are the higher volume areas**

- **How far from home do ACR events occur**
  - **Used to be thought of as occurring within 5 miles from home**
  - **OnStar events exceed a certain collision threshold or airbag deployment**
  - **On average these events occur 86 miles from the garaged address**

Finding Location and Distance

Analysis using Oracle Spatial

```sql
SELECT              /*+ ordered
use_nl(uss,mdl) */
                mdl.aacn_case_sak,
                    mdl.rds_case_sak,
                    mdl.case_xsak,
                    mdl.TIMESTAMP,

mdl.rds_account_sak,

mdl.rds_vehicle_sak,

mdl.service_event_xsak1,
                    mdl.lat,
                    mdl.lng,
                    uss.state inc_state
            FROM    mdl,
reds3.us_states uss
            WHERE   sdo_anyinteract (
                    uss.geom,
                    SDO_GEOMETRY (2001,
                    8307,
                    sdo_point_type
(mdl.lng, mdl.lat, NULL),

NULL,

NULL)
                        ) = 'TRUE'
            UNION ALL
……..
```

```sql
SELECT                  /*+ ordered use_nl(usc,st) */
        DISTINCT st.aacn_case_sak,
            st.rds_case_sak,
            st.case_xsak,
            st.TIMESTAMP,
            st.rds_account_sak,
            st.rds_vehicle_sak,
            st.service_event_xsak1,
            st.lat,
            st.lng,
            st.inc_state,
            usc.NAME inc_county
    FROM   st, reds3.us_county usc
    WHERE   sdo_anyinteract (
        usc.geom,
        SDO_GEOMETRY (
        2001,
        8307,
        sdo_point_type (TO_NUMBER (st.lng),
                TO_NUMBER (st.lat),
                NULL),
        NULL,
        NULL
        )
        ) = 'TRUE'
    UNION ALL
```

Finding Location and Distance

Analysis using Oracle Spatial

```
ROUND (
      (sdo_geom.sdo_distance (
        SDO_GCDR.GEOCODE_AS_GEOMETRY (
          'ODF_NA_Q210',
          SDO_KEYWORDARRAY (
            addr.address_line1,
            addr.city || ' ' || addr.state || ' ' || addr.zip_code
          ),
          addr.country
        ),
        SDO_GEOMETRY (2001,
              8307,
              sdo_point_type (addr.lng, addr.lat, NULL),
              NULL,
              NULL),
        0.005
      )
      * 0.0006214),
      2
    ) dist_from_home_miles
```

Injury Severity Prediction

Injury Severity Prediction

Data Points (in order of importance) include:

- Delta V
- Principal Direction of Force
- Seatbelt use
- Age
- Multiple events (impacts)
- Vehicle type
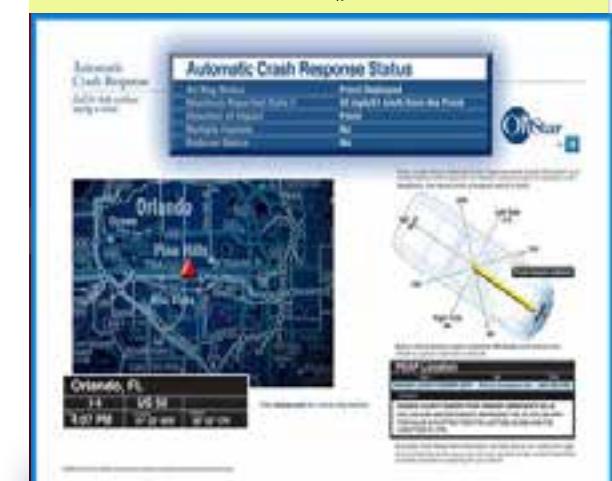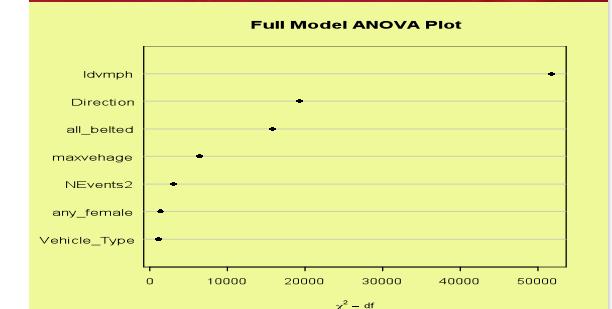
Full Model ANOVA Plot

Automatic Crash Response Status

AUTOMATIC CRASH RESPONSE STATUS

| Air Bag Status	Airbag Deployed
Maximum Reported Delta V	28 mph from the left
Direction of Impact	Left Side (30°)
Multiple Impacts	No
Rollover	No

Injury Severity

Research Activity

Use Oracle Spatial to find all events that occur in a specific geographic area

Identify counties and roadways to match up Police reports
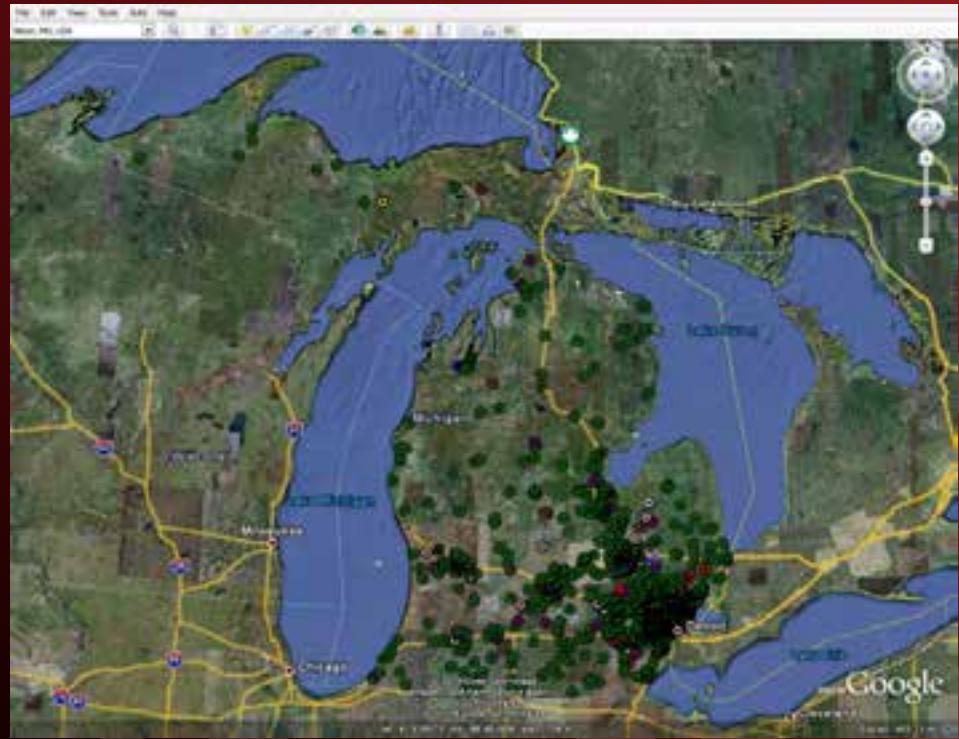
Injury Severity

Analysis using Oracle Spatial

```
mdl
    AS (SELECT   kvp9.aacn_case_sak,
            kvp9.rds_case_sak,
            kvp9.case_xsak,
            kvp9.TIMESTAMP,
            kvp9.rds_account_sak,
            kvp9.rds_vehicle_sak,
            kvp9.service_event_xsak1,
            TO_NUMBER (kvp9.lat) lat,
            TO_NUMBER (kvp9.lng) lng
      FROM   kvp9
     WHERE kvp9.lat BETWEEN 41.454273
AND 47.792508
            AND kvp9.lng BETWEEN -92.324258
AND -82.378677),
```

```
md AS (SELECT                      /*+ ordered use_nl(usc,st) */
        DISTINCT st.aacn_case_sak,
            st.rds_case_sak,
            st.case_xsak,
            st.TIMESTAMP,
            st.rds_account_sak,
            st.rds_vehicle_sak,
            st.service_event_xsak1,
            st.lat,
            st.lng,
            st.inc_state,
            usc.NAME inc_county
     FROM   st, reds3.us_county usc
    WHERE   sdo_anyinteract (
          usc.geom,
          SDO_GEOMETRY (
            2001,
            8307,
            sdo_point_type (TO_NUMBER (st.lng),
                    TO_NUMBER (st.lat),
                    NULL),
            NULL,
            NULL
          )
        ) = 'TRUE'
        AND st.inc_state = 'MI'),
```

An example of the mechanics of the calculation is shown in the chart below

Injury Severity

	A	B	C	D	
	Factor	Model Coefficient	Variable Input from OnStar	B * C	
1					
2	Intercept	-15.0327	n/a	-15.0327	
3					MUST USE NATURAL LOG HERE:
4	Delta-V (mph)	3.5991	40	13.276646	
5					$D4 = B4 * Ln(C4)$
6	IMPACT DIRECTION				
7	FRONT (1="YES")	0.9559	1	0.9559	
8	LEFT (1="YES")	2.7857	0	0	
9	RIGHT (1="YES")	2.0008	0	0	
10	Rear = 0 (base case)				
11					
12	MULTIPLE EVENTS				
13	MULTIPLE (1="YES")	0.3825	0	0	
14	SINGLE = 0 (base case)				
15					
16	BELT USE				
17	USED (1="YES")	-1.4737	1	-1.4737	
18	NOT USED/UNK = 0 (base case)				
19					
20	OLDOCCUPANT				
21	YES (1="YES")	0.9878	1	0.9878	
22	NO = 0 (base case)				
23					
24	GENDER				
25	FEMALE (1="YES")	0.4668	1	0.4668	
26	MALE = 0 (base case)				
27					
28	VEHICLE TYPE				
29	UTILITY (1="YES")	-0.2057	1	-0.2057	
30	PICKUP (1="YES")	0.1412	0	0	
31	VAN (1="YES")	-1.1465	0	0	
32	CAR = 0 (base case)				
33					= Sum of Column D
34	AIRBAG				
35	DEPLOYED (1="YES")	0	1	0	
36	NOT DEPLOYED / UNKNOWN = 0				
37				+	
38				-1.024954	Pr(ISS 15+) =
39					$1 / [1 + exp(-w)] =$
40					$1 / [1 + exp(-1.024954)]$
41					
42					NOTE THE SIGN
43			Urgency Algorith	0.2641	
44			"The probability of ISS 15+ is 0.2641 or 26%"		

Injury Severity Prediction

Crash	
Delta V, Mph	35
Impact Direction	Front
Multiple Events	No
Seatbelt Use	No
Age (over 55)	Unk
Gender	Unk
Vehicle Type	Car

Probability?

24%
HIGH

Injury Severity Prediction

Crash	
Delta V, Mph	35
Impact Direction	Front
Multiple Events	No
Seatbelt Use	Yes
Age (over 55)	Unk
Gender	Unk
Vehicle Type	Car

Probability?
7%

Injury Severity Prediction

Crash	
Delta V, Mph	35
Impact Direction	Front
Multiple Events	No
Seatbelt Use	No
Age (over 55)	Yes
Gender	Unk
Vehicle Type	Car

Probability?

38%

HIGH

crisis assist

when every second counts...   **you can count on OnStar.**

Central point of contact, assistance & information for subscribers...

Emergency Services plus:

- o Evacuation routes
- o Connection to loved ones
- o Real-time hotel reservations
- o Food, water & medical supply sites
- o Targeted crisis messaging
- o Hospital directions
- o Fuel availability
- o Special needs assistance
- o Utility up-time information

Helping people during a crisis:

Real Time Assessment of traffic conditions
with Oracle Spatial

GPS Based
Speed (mph)

➢ = 60 GREEN

➢ 50 < 40 BLUE

➢ 40 < 50 PURPLE

➢ 30 < 40   ORANGE

➢ 20 < 30   YELLOW

➢ < 20 RED

Helping people during a crisis:

Near real time assessment of incoming calls from disaster areas (counties) to conduct situational qualitative analysis

Crisis team listens to calls to get a ground view of what is happening and what subscribers are requesting

Listening to the quality of service being provided by the Advisors.

Helping people during a crisis:

			Near Real Time Calls for Call Monitoring - Carolinas								
						List					
Inc State	Inc County	Case Number	Case Date	Longitude	Latitude	Call Type	STID	Advisor Name	Advisor Team	Call Rating	Reason for Call
NC	Beaufort	#########	Aug 28, 2011 11:45:24 AM	-77.00721	35.51368	OnStar Button	#######				
NC	Carteret	#########	Aug 28, 2011 11:58:34 AM	-76.82190	34.73202	Emergency Button	#######				
NC	Carteret	#########	Aug 28, 2011 11:52:21 AM	-76.80954	34.73419	Emergency Button	#######				
NC	Columbus	#########	Aug 28, 2011 11:35:58 AM	-78.38591	34.27780	OnStar Button	#######				
NC	Craven	#########	Aug 28, 2011 11:29:45 AM	-77.15516	35.08246	OnStar Button	#######				
NC	Duplin	#########	Aug 28, 2011 11:12:39 AM	-78.13303	34.98738	OnStar Button	#######				
NC	Halifax	#########	Aug 28, 2011 11:19:56 AM	-77.67260	36.46932	OnStar Button	#######				
NC	Lenoir	#########	Aug 28, 2011 11:17:53 AM	-77.53861	35.29716	OnStar Button	#######				
NC	Lenoir	#########	Aug 28, 2011 11:21:26 AM	-77.53568	35.29660	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:04:02 AM	-77.80683	36.09453	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:13:27 AM	-77.80801	35.96428	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:19:12 AM	-77.83238	35.86231	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:22:44 AM	-77.82018	36.06176	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:22:24 AM	-77.84446	35.97273	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:28:10 AM	-77.84112	35.97655	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:43:58 AM	-77.93884	36.04507	OnStar Button	#######				
NC	Nash	#########	Aug 28, 2011 11:56:41 AM	-77.84881	35.95480	OnStar Button	#######				
NC	New Hanover	#########	Aug 28, 2011 11:29:58 AM	-77.89852	34.14587	OnStar Button	#######				
NC	New Hanover	#########	Aug 28, 2011 11:51:57 AM	-77.94103	34.23594	OnStar Button	#######				
NC	Onslow	#########	Aug 28, 2011 11:03:45 AM	-77.36865	34.74340	OnStar Button	#######				
NC	Onslow	#########	Aug 28, 2011 11:27:39 AM	-77.35293	34.66905	OnStar Button	#######				

Helping people during a crisis:

Louisiana Roadways on a Normal Day in 2008

Helping people during a crisis:

Louisiana Roadways one Day Before Hurricane Gustav After Call for Evacuation
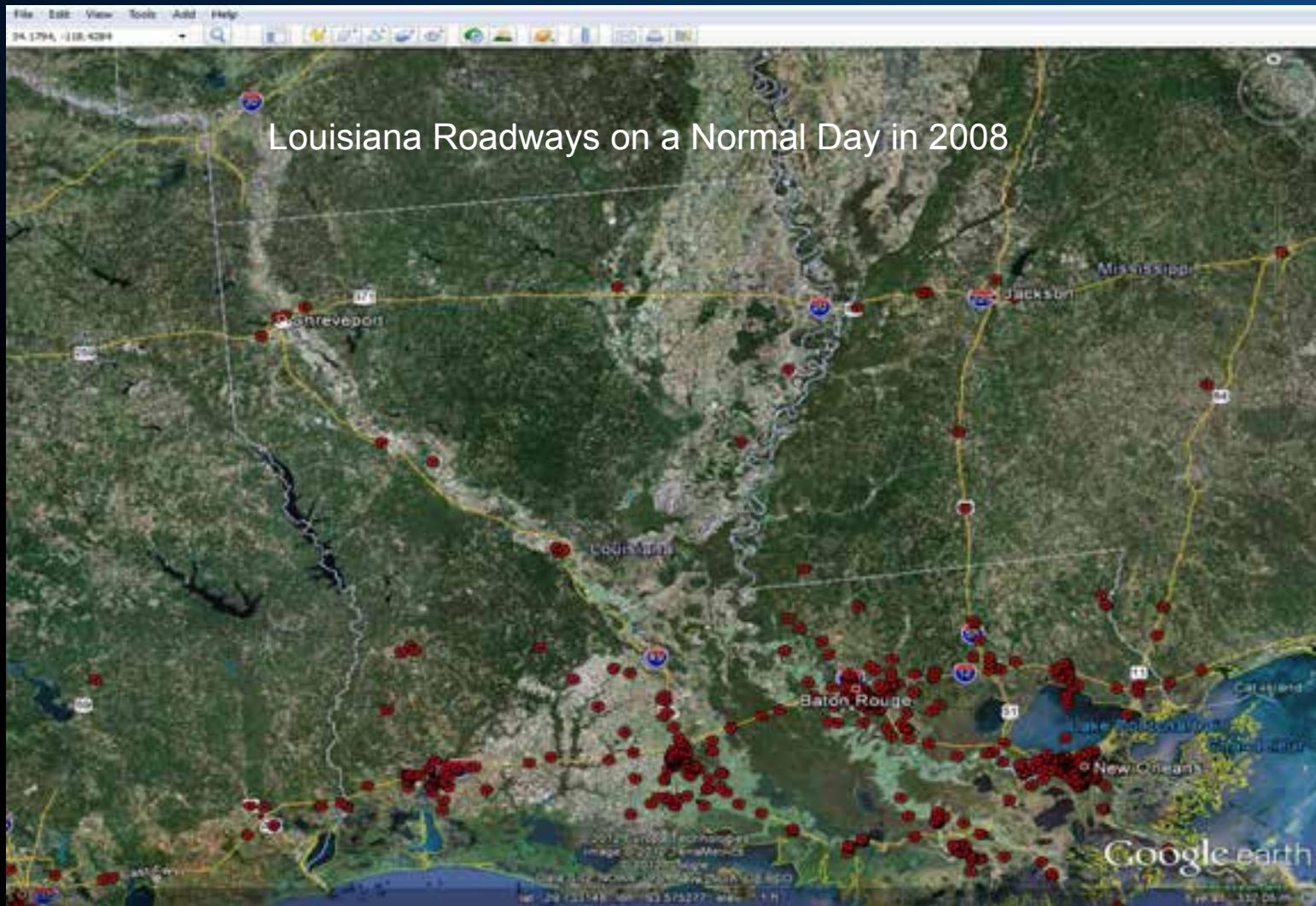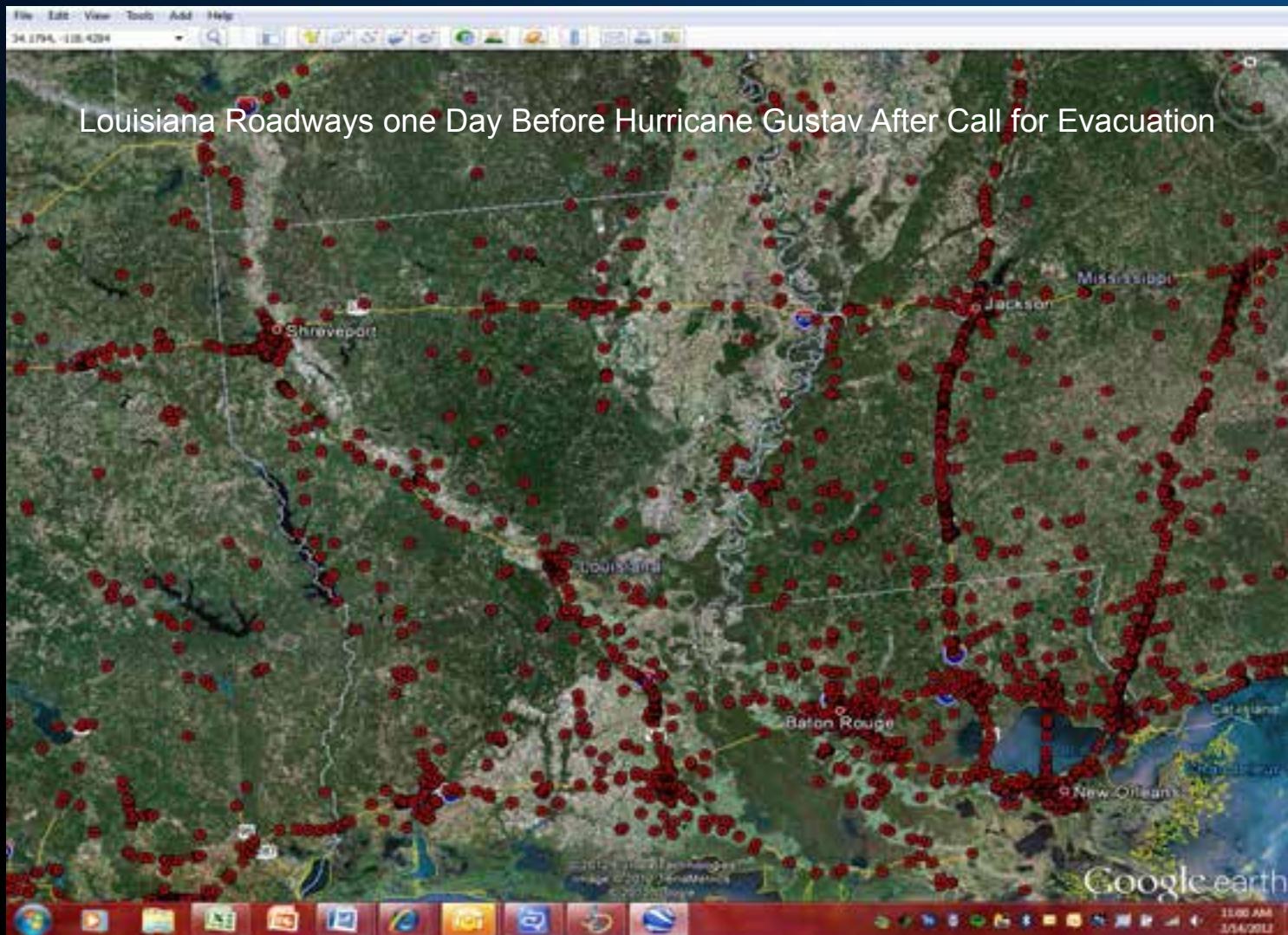
Helping people during a crisis:

Analysis of subscriber activity during a crisis
- **What kinds of calls**
    - **Routes**
    - **Points of Interest**
        - **Gas stations**
        - **Lodging**

- **How far do they travel or do they stay put**
    - **Different for cat 2 through cat 5 hurricanes**
    - **Regional differences**

- **Establish call center staffing levels for different kinds of crisis**

Calls from Mexico

Using Spatial as exclusion to create KML file


```
SELECT   " "name",
      'Case Reference: '
      || mdl.rds_case_sak
      || '<br>'
      || 'Call Type: '
      || mdl.call_type
      || '<br>'
      || 'Case Type: '
      || mdl.case_type
      || '<br>'
      || 'Date/Time: '
      || TO_CHAR (mdl.open_date, 'mm-dd-yyyy hh:mi:ss AM')
      || '<br>'
      || 'Garaged Country: '
      || mdl.country
      || '<br>'
      || 'Garaged State: '
      || mdl.state
        "description",
      mdl.lat "latitude",
      mdl.lng "longitude",
      DECODE (mdl.call_type,
          'OnStar Button', 'circle',
          'Emergency Button', 'circle',
          'Collision Notification', 'triangle',
          'Collision Sensor', 'triangle',
          'Airbag Deployment', 'triangle',
          'circle')
        "icon",
      DECODE (mdl.call_type,
          'OnStar Button', 'BLUE',
          'Emergency Button', 'RED',
          'Collision Notification', 'RED',
          'Collision Sensor', 'RED',
          'Airbag Deployment', 'RED',
          'BLUE')
        "color"
  FROM   mdl
 WHERE   mdl.rds_case_sak NOT IN (SELECT         /*+ ordered use_nl(uss, mdl */
                       mdl.rds_case_sak
                   FROM   mdl, reds3.us_states uss
                  WHERE   sdo_anyinteract (
                      uss.geom,
                      SDO_GEOMETRY (
                        2001,
                        8307,
                        sdo_point_type (mdl.lng,
                                mdl.lat,
                                NULL),
                        NULL,
                        NULL
                      )
                    ) = 'TRUE')
```

safely connecting you...
in ways you never thought possible...