Crash Data Retrieval System

What it is and what it can do for you

Presented by:
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Who am I?

- Hired on with SPD in 2002
- Assigned to Traffic Section in 2006
- Attended specialty crash schools beginning in 2007
- Obtained ACTAR certification in 2010
- Hired on with Absolute Inv. in 2011
- Became an EDR Analyst in 2012
What is the CDR System?

According to cdr-system.com:

“The CDR Tool is a commercially available tool, allowing you to image crash data directly from all supported vehicles giving you a detailed report of critical data parameters leading up to and during a crash.”
What is the CDR System?

“The Interface”
Event Data Recorders

- The CDR Tool accesses and images information stored in Event Data Recorders (EDR) contained in supported vehicles.
- Event Data Recorders were first supported by the CDR Tool in the 1994 Chevrolet Caprice.
- The EDR was contained inside the Airbag Control Module (ACM).
Event Data Recorders

- The ACM utilized internal software and an accelerometer to monitor the forces at play in a crash to determine if an airbag deployment was needed.
- The software also calculated the severity of the crash—“Delta V”
- The data was recorded to a memory chip—the EDR
- The ACM/EDR combination began to replace mechanical airbag switches.
Event Data Recorders

- GM began reading the EDR data after a crash to determine if the electronics were working properly and making good deployment decisions.
- As technology improved GM began adding communication networks between the ACM and Powertrain Control Module (PCM).
- This allowed the modules to speak to each other and share information such as Speed, Engine RPM, Accelerator Pedal Position, Brake Status and more.
Event Data Recorders

- GM configured their ACMs to record this data every second and began storing 5 seconds of Pre-Crash data.

<table>
<thead>
<tr>
<th>Seconds Before AE</th>
<th>Vehicle Speed (MPH)</th>
<th>Engine Speed (RPM)</th>
<th>Percent Throttle</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>2</td>
<td>832</td>
<td>8</td>
</tr>
<tr>
<td>-4</td>
<td>5</td>
<td>1472</td>
<td>8</td>
</tr>
<tr>
<td>-3</td>
<td>9</td>
<td>1600</td>
<td>8</td>
</tr>
<tr>
<td>-2</td>
<td>12</td>
<td>1792</td>
<td>20</td>
</tr>
<tr>
<td>-1</td>
<td>11</td>
<td>1344</td>
<td>0</td>
</tr>
</tbody>
</table>
Event Data Recorders

- In 2000 Vertronix worked with GM to develop the “CDR Tool” as a commercially available product.
- The tool became the “Bosch CDR Tool” after a merger with Vertronix and Bosch in 2006.
- Vehicles that are equipped with EDRs capable of being imaged by the CDR Tool are known as “supported vehicles.”
- Some vehicles may contain EDRs that are not supported by the Bosch CDR Tool. They may or may not be able to be imaged by the manufacturer.
1st Supported Vehicles

- General Motors
- Ford
- Toyota
- Dodge
- Chrysler
- Foreign motor companies were generally slower to be supported except for Toyota

- 1994 Chevrolet Caprice
- 2001- most models
- 2002 Camry
- 2005 Durango
- 2006 300
- Honda in 2012
- Nissan in 2012
- BMW in 2013

See cdr-system.com for a full list of supported vehicles
What information is available?

- Early models contained very limited information
  - SIR Warning Lamp Status
  - Driver’s seat belt status (Buckled/Unbuckled)
  - Time from algorithm enable to deployment command in msec
  - Delta-V
  - Acceleration graphs
  - No pre-crash
What information is available?

- As technology developed the recorded information got better
  - Pre-crash data
  - Brake switch circuit status
  - Engine RPM
  - Accelerator Pedal Position
  - Throttle Position
  - Vehicle Indicated Speed
  - Longitudinal and Lateral Velocity Change
What information is available?

- Cruise control status
- Steering angle
- ABS system status
- Traction control system status
- Transmission selector position
- Seat occupancy status
- Ignition cycles at time of event and investigation
- Many others depending on vehicle configuration
What information is available?

- The EDRs will typically record 2 types of events
  - Deployment – an event during which airbags were commanded to deploy
  - Non Deployment – an event during which the forces were substantial enough to “wake up” the system but not enough to warrant a deployment
- Different manufacturers name the events differently but the concept is the same
- If a Deployment event is detected the data will write to the EDR and will become locked
  - This data cannot be overwritten by a subsequent event
What information is available?

- If a Non Deployment event is detected, most modules have criteria for the Non Deployment to be overwritten (varies by model)
  - An additional Non Deployment event of any magnitude
  - A more significant Non Deployment event
  - A certain number of ignition cycles
  - A set amount of time

- This necessitates the retrieval of the data ASAP if there was no deployment. Otherwise, it may be permanently lost.
49 CFR “Part 563”

- Required all vehicles manufactured after September 1st, 2012 that were equipped with Event Data Recorders to record specific information.
- Part 563 did not require vehicles to have EDRs.
- Required EDR’s to have a backup power supply in the event of a major crash and subsequent power loss.
- Required manufactures to release a publicly available tool to read the EDR within 90 days of sale.
### Required Info Under Part 563

<table>
<thead>
<tr>
<th>Data element</th>
<th>Recording interval/time (relative to time zero)</th>
<th>Data sample rate (samples per second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta-V, longitudinal</td>
<td>0 to 250 ms or 0 to End of Event Time plus 30 ms, whichever is shorter</td>
<td>100</td>
</tr>
<tr>
<td>Maximum delta-V, longitudinal</td>
<td>0-300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter</td>
<td>N/A</td>
</tr>
<tr>
<td>Time, maximum delta-V</td>
<td>0-300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter</td>
<td>N/A</td>
</tr>
<tr>
<td>Speed, vehicle indicated</td>
<td>-5.0 to 0 sec</td>
<td>2</td>
</tr>
<tr>
<td>Engine throttle, % full (or accelerator pedal, % full)</td>
<td>-5.0 to 0 sec</td>
<td>2</td>
</tr>
<tr>
<td>Service brake, on/off</td>
<td>-5.0 to 0 sec</td>
<td>2</td>
</tr>
<tr>
<td>Ignition cycle, crash</td>
<td>-1.0 sec</td>
<td>N/A</td>
</tr>
<tr>
<td>Ignition cycle, download</td>
<td>At time of download</td>
<td>N/A</td>
</tr>
<tr>
<td>Safety belt status, driver</td>
<td>-1.0 sec</td>
<td>N/A</td>
</tr>
<tr>
<td>Frontal air bag warning lamp, on/off</td>
<td>-1.0 sec</td>
<td>N/A</td>
</tr>
<tr>
<td>Frontal air bag deployment, time to deploy, in the case of a single stage air bag, or time to first stage deployment, in the case of a multi-stage air bag, driver</td>
<td>Event</td>
<td>N/A</td>
</tr>
<tr>
<td>Frontal air bag deployment, time to deploy, in the case of a single stage air bag, or time to first stage deployment, in the case of a multi-stage air bag, right front passenger</td>
<td>Event</td>
<td>N/A</td>
</tr>
<tr>
<td>Multi-event, number of event</td>
<td>Event</td>
<td>N/A</td>
</tr>
<tr>
<td>Time from event 1 to 2</td>
<td>As needed</td>
<td>N/A</td>
</tr>
<tr>
<td>Complete file recorded (yes, no)</td>
<td>Following other data</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Now that you know what information is available, how do we get to it?
Imaging the EDR

- The EDR can be imaged through the vehicle’s electrical system by connecting the CDR Tool to the vehicle’s diagnostic link connector (DLC) under the dash.
Imaging the EDR

- This method requires the vehicles wiring system to be intact.
  - If power is not able to be obtained from the vehicle’s electrical system the module may be “backpowered”
  - Backpowering is done by powering the module through the fuse panel
- DLC imaging is the preferred method so new trouble codes aren’t set
Imaging the EDR

- The less preferred method of imaging the EDR is the Direct to Module or benchtop method
  - This involves removing the ACM from the vehicle and connecting directly to the module
  - This method can cause new trouble codes to be set when power is applied to the module since the vehicle connections are no longer present
Let’s walk through what you should expect to see when an image is performed.
CDR Software Main Screen
Interface Communication Check
## Select Vehicle Make

### Select Brand:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acura</td>
<td>Lexus</td>
<td>Toyota</td>
</tr>
<tr>
<td>BMW</td>
<td>Lincoln</td>
<td>Volkswagen</td>
</tr>
<tr>
<td>Buick</td>
<td>Mazda</td>
<td>Volvo</td>
</tr>
<tr>
<td>Cadillac</td>
<td>Mercedes-Benz</td>
<td></td>
</tr>
<tr>
<td>Chevrolet</td>
<td>Mercury</td>
<td></td>
</tr>
<tr>
<td>Chrysler</td>
<td>MINI</td>
<td></td>
</tr>
<tr>
<td>Dodge</td>
<td>Mitsubishi</td>
<td></td>
</tr>
<tr>
<td>Fiat (US/Canada)</td>
<td>Nissan</td>
<td></td>
</tr>
<tr>
<td>Ford</td>
<td>Oldsmobile</td>
<td></td>
</tr>
<tr>
<td>Geo</td>
<td>Opel</td>
<td></td>
</tr>
<tr>
<td>GMC</td>
<td>Pontiac</td>
<td></td>
</tr>
<tr>
<td>Holden</td>
<td>RAM</td>
<td></td>
</tr>
<tr>
<td>Honda</td>
<td>Rolls-Royce</td>
<td></td>
</tr>
<tr>
<td>HSV</td>
<td>Saab</td>
<td></td>
</tr>
<tr>
<td>Hummer</td>
<td>Saturn</td>
<td></td>
</tr>
<tr>
<td>Infiniti</td>
<td>Scion</td>
<td></td>
</tr>
<tr>
<td>Isuzu</td>
<td>SRT</td>
<td></td>
</tr>
<tr>
<td>Jeep</td>
<td>Sterling</td>
<td></td>
</tr>
<tr>
<td>Lancia</td>
<td>Suzuki</td>
<td></td>
</tr>
</tbody>
</table>
Enter VIN

Brand Selected: Chevrolet

Read VIN from Vehicle

Vehicle Identification Number

Done  Cancel  Clear
Case Information

User

Case Number

Imaging Date (mm/dd/yyyy)  05/13/2014

Crash Date (mm/dd/yyyy)

Done  Cancel  Clear
Case Comments
Ford Written Consent
The Happy Screen

Reading Data From Module

Pass 1  Pass 2  Pass 3
Save recovered data?
REPORT SCREEN

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR FILE INFORMATION

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>Create Custom 2000</td>
</tr>
<tr>
<td>Case Number</td>
<td>14-0001</td>
</tr>
<tr>
<td>EDR Data Imaging Date</td>
<td>09/15/2014</td>
</tr>
<tr>
<td>Event Date</td>
<td>2/07/2014</td>
</tr>
<tr>
<td>Events</td>
<td>Module: SGM 11.12-CDRX</td>
</tr>
<tr>
<td>Saved on</td>
<td>Thursday, May 6 2014 12:20:20</td>
</tr>
<tr>
<td>Touched with CDR version</td>
<td>Crash Data Retrieval Tool 12.0</td>
</tr>
<tr>
<td>Reported with CDR version</td>
<td>Crash Data Retrieval Tool 12.0</td>
</tr>
<tr>
<td>Event Details</td>
<td>Deployment</td>
</tr>
</tbody>
</table>

COMMENTS

Browse and image with AC adapter
Vehicle tire size and sticker tire size match

DATA LIMITATIONS

Recorded Crash Events

There are two types of recorded crash events for front, side, and rear ESR Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the airbags. The minimum SGM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is the VHEP (8 lbs). A Non-Deployment Event contains Pre-Crash and Crash data. The oldest Non-Deployment Event can be overwritten by a Deployment Event. If all three records are full and the Non-Deployment Event is not locked. Non-Deployment Events can be overwritten if approximately 200 ignition cycles. Non-Deployment Event cannot be recorded after the following occurs without the deployment of any of the frontal air bags, side air bags, or rollovers.

Predeployment only Deployment
- Head Rest Deployment
- Window Blowout Deployment

The second type of SGM recorded crash event for ESR Events is the Deployment Event. It also contains Pre-Crash and Crash data. Deployment Events cannot be overwritten or deleted by the SGM. There are also two types of recorded crash events for Rollover Events. The first is the Non-Deployment (Non-rollover) Event. A Non-Deployment Event contains Pre-Crash and Crash data. Non-Deployment Rollover events follow the same rules as ESR Non-Deployment events.

The SGM can store up to three Events.

DATA

For ESR Events, SGM Recorded Vehicle Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SGM Recorded Vehicle Velocity Change is the change in velocity during the recording time and not the speed the vehicle was traveling before the event, and it is not the Barrier Equivalent Velocity. For Deployment Events, the SGM will record 220 milliseconds of data at the Deployment Criteria in full and will use this full record to determine if the event is a deployment event. For Non-Deployment Events, the SGM will record the
What can we do with this data?
Scenario #1

Photo taken from www.aa1car.com
Scenario #1

- A driver is involved in a crash and says he was wearing his seatbelt at the time. The driver complains of a headache but no other injuries.
- The insurance company suspects he was not wearing his seatbelt but has no proof.
- An analyst is hired to image the EDR contained in the crash vehicle.
Scenario #1

- The EDR data is confirmed to be from the crash in question.

- The insurance company now has the proof they were looking for for...
Scenario #2

Photo taken from www.mlive.com
Scenario #2

- A man and a woman were involved in a rollover crash. The woman was ejected from the vehicle and died at the scene.
- The surviving man says the woman was driving at the time because he was highly intoxicated.
- The crash occurred several days ago and family has already been through the vehicle to gather belongings.
Scenario #2

- The police report does not detail the seat positions but it does indicate the man was 6’2” and the female was 5’3”
- An EDR analyst is hired to image the vehicle
## Scenario #2

### Pre-Crash Data -1 sec (First Record)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignition cycle, crash</td>
<td>10,275</td>
</tr>
<tr>
<td>Frontal air bag warning lamp, on/off</td>
<td>Off</td>
</tr>
<tr>
<td>Occupant size classification, front passenger (Child size Yes/No [Hex value])</td>
<td>No [08]</td>
</tr>
<tr>
<td>Safety belt status, driver</td>
<td>Driver Buckled</td>
</tr>
<tr>
<td>Seat track position switch, foremost, status, driver</td>
<td>Not Forward</td>
</tr>
<tr>
<td>Safety belt status, front passenger</td>
<td>Passenger Not Buckled</td>
</tr>
<tr>
<td>Brake Telltale</td>
<td>Off</td>
</tr>
<tr>
<td>ABS Telltale</td>
<td>Off</td>
</tr>
<tr>
<td>Stability Control Telltale</td>
<td>Off</td>
</tr>
<tr>
<td>Speed Control Telltale</td>
<td>Off</td>
</tr>
<tr>
<td>Powertrain Wrench Telltale</td>
<td>Off</td>
</tr>
<tr>
<td>Powertrain Malfunction Indicator Lamp (MIL)Telltale</td>
<td>Off</td>
</tr>
<tr>
<td>HEV Hazard Telltale</td>
<td>Off</td>
</tr>
</tbody>
</table>
Scenario #3
Scenario #3

- A driver is involved in a crash in a 20 mph school zone when a car pulls out of a parking lot into its path.
- The driver claims to have been traveling the speed limit.
- The insurance company notices an unusual amount of damage to both vehicles and hires an EDR analyst to image the striking vehicle.
### Scenario #3

<table>
<thead>
<tr>
<th>Times (sec)</th>
<th>Accelerator Pedal Position (percent)</th>
<th>Brake Switch Circuit State</th>
<th>Engine Speed</th>
<th>Throttle Position (%)</th>
<th>Vehicle Speed (MPH [km/h])</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.5</td>
<td>20</td>
<td>Off</td>
<td>1280</td>
<td>32</td>
<td>54 [87]</td>
</tr>
<tr>
<td>-2.0</td>
<td>18</td>
<td>Off</td>
<td>1280</td>
<td>32</td>
<td>54 [87]</td>
</tr>
<tr>
<td>-1.5</td>
<td>18</td>
<td>Off</td>
<td>1280</td>
<td>31</td>
<td>54 [87]</td>
</tr>
<tr>
<td>-1.0</td>
<td>0</td>
<td>On</td>
<td>1216</td>
<td>16</td>
<td>54 [87]</td>
</tr>
<tr>
<td>-0.5</td>
<td>0</td>
<td>On</td>
<td>1152</td>
<td>12</td>
<td>48 [77]</td>
</tr>
</tbody>
</table>
Scenario #4
Scenario #4

- A vehicle rear ends another vehicle that had stopped for a stop light
- The driver of the striking vehicle claims to have blacked out just prior to the crash
- There was no evidence of any braking prior to the area of impact
- An EDR analyst was hired to image the striking vehicle
## Scenario #4

### Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1)
(\text{the most recent sampled values are recorded prior to the event})

<table>
<thead>
<tr>
<th>Time Stamp (sec)</th>
<th>Speed, Vehicle Indicated (MPH [km/h])</th>
<th>Accelerator Pedal, % full</th>
<th>Engine RPM</th>
<th>Motor RPM</th>
<th>Service Brake (On, Off)</th>
<th>Steering Input (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5.0</td>
<td>42 [ 67]</td>
<td>0</td>
<td>2500</td>
<td>N/A</td>
<td>Off (Brake Not Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-4.5</td>
<td>42 [ 67]</td>
<td>0</td>
<td>2500</td>
<td>N/A</td>
<td>Off (Brake Not Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-4.0</td>
<td>41 [ 66]</td>
<td>0</td>
<td>2500</td>
<td>N/A</td>
<td>Off (Brake Not Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-3.5</td>
<td>40 [ 65]</td>
<td>0</td>
<td>2450</td>
<td>N/A</td>
<td>Off (Brake Not Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-3.0</td>
<td>40 [ 64]</td>
<td>0</td>
<td>2400</td>
<td>N/A</td>
<td>Off (Brake Not Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-2.5</td>
<td>39 [ 63]</td>
<td>0</td>
<td>2350</td>
<td>N/A</td>
<td>On (Brake Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-2.0</td>
<td>39 [ 62]</td>
<td>0</td>
<td>2300</td>
<td>N/A</td>
<td>On (Brake Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-1.5</td>
<td>37 [ 60]</td>
<td>0</td>
<td>2250</td>
<td>N/A</td>
<td>On (Brake Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-1.0</td>
<td>37 [ 59]</td>
<td>0</td>
<td>2200</td>
<td>N/A</td>
<td>On (Brake Activated)</td>
<td>0</td>
</tr>
<tr>
<td>-0.5</td>
<td>35 [ 57]</td>
<td>0</td>
<td>2100</td>
<td>N/A</td>
<td>On (Brake Activated)</td>
<td>0</td>
</tr>
<tr>
<td>0.0</td>
<td>34 [ 55]</td>
<td>0</td>
<td>2050</td>
<td>N/A</td>
<td>On (Brake Activated)</td>
<td>0</td>
</tr>
</tbody>
</table>
“You make the call”
EDR Conclusion

- EDR data should never be used as a substitute for a reconstruction, only a supplement.
- EDR data can be extremely volatile and should be secured as soon as practical following a crash.
  - This is especially true when there is no airbag deployment.
- Always ask if a vehicle may have valuable data even if it’s not a “supported vehicle”.
EDR Conclusion

- Heavy trucks typically have EDRs as well.
- The data is usually accessible by connecting specialized equipment to the Engine Control Module (ECM).
- In many cases a large amount of information can be obtained from a heavy truck ECM.
- Again, don’t hesitate to ask if a vehicle may contain information. We will do our best to get you as much information as possible.
GPS Units and Their Use in Reconstruction

The available data may surprise you

Presented by:
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GPS units can be a wealth of information

- Data is readily accessible with Garmin models through BaseCamp software.
- Data may or not be accessible depending on the brand of the unit.
  - Garmin and Mio are accessible.
- If manufacturer software is not available to access the data, the unit may store log files.
- These log files can be loaded into Google Earth.
Available Information

- Time
- Elevation
- Leg Length
- Leg Time
- Leg Speed (Average)
- Leg Course (Heading)
- Lat/Long Position
Accuracy and Practicality

- Accuracy will depend on several factors:
  - The quality of the satellite signal at the time
  - The time between recorded points
  - The quality of the GPS unit
- Like EDR information, GPS data is not a substitute for a good reconstruction. It should only be used in conjunction with other evidence.
- GPS information can be very useful in determining a vehicle’s path prior to a crash:
  - Which bar the drunk came from
BaseCamp Software

- BaseCamp software is free and is available from Garmin.com
- http://www8.garmin.com/support/mappingsw.jsp
- Simply connect your GPS unit to the computer with a USB cable
- The computer will recognize it like it would a flash drive
- Open the BaseCamp software and navigate to “All Data” in the Library
Google Earth

- If you are using a device other than a Garmin and are able to locate log files on the unit, Google Earth will plot the data for you.
Click on GPS

Select Import from file
And Click Import
Select the appropriate log file and click open.

Note the supported file types.
The plotted path appears as a blue line on the map.
GPS Conclusion

- GPS data can be a valuable tool for investigators to determine where a vehicle came from and possibly pre-crash speed
- Should not be solely relied on for an investigation
- Check for log files BEFORE powering up the GPS unit
- Don’t give up too early on looking for data. It may be buried in the file system
Thank you for listening!

Please feel free to call me anytime with any questions you may have.

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