

**Highway Collision Warning Technology:
Determination of Criteria for Detecting and Logging
Hazardous Events in Tractor-Trailer Safety and
Training Programs**

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ABSTRACT

Advanced electronic safety systems have been increasingly deployed on passenger and commercial vehicles ([1]-[2]). Most recently, radar-based systems have been introduced for detecting and warning of impending collision. These warning systems are particularly significant for large trucks and tractor-trailers due to the severity and occurrence of rear-end collisions resulting in death and serious injury. Fleet operators are presently able to remotely monitor and record hazardous conditions for evaluating driver skills and assessing the safety and reliability of highway routes. However, the criteria for logging hazardous conditions from the available data and the basis for subsequent corrective actions are not well understood. This research seeks to develop a safety-management system through remote monitoring of large truck operating conditions, thereby providing an environment to more effectively use real-time fleet operating data to improve highway safety and driver training.

I. PROBLEM DESCRIPTION

This research developed a method of integrating radar-based highway collision warning systems into existing remote monitoring systems as a means of improving highway safety and driver training. The following are the objectives of this research:

- Demonstrate a configuration for real-time data acquisition and reporting of vehicle and traffic conditions to fleet operational centers. This includes the remote monitoring and logging of variables such as tractor-trailer speed, location, brake apply status, and forward object following time.
- Analyze the results of a fleet deployment of the remote monitoring system to develop criteria for safety monitoring. As an example, this may include tractor following-times with correlation to hard braking (rapid deceleration) events. The results of this analysis would be employed in driver training and management planning.
- From the fleet deployment data, assess the cost/benefit ratio for adoption of radar-based safety monitoring systems. That is, determine the effectiveness of radar-technology in reducing accident related loses compared to conventional safety training and monitoring methods.

In conclusion, the results of this study would make recommendations regarding decisions for fleet-wide deployment of radar-based safety systems for real-time fleet operations.

II. METHODOLOGY

This research evaluated the effectiveness of radar based collision warning systems and developed new methods for improved warning capability and increasing the effectiveness of management oversight. The principle steps to achieve these objectives are summarized in the following:

- Working with the associated enterprises (JBHT, Eaton-VORAD, Qualcomm, Freightliner) a real-time data acquisition system was developed that remotely records information from the tractor-trailer SAE-J1939 network bus. This includes operating variables such as speed/acceleration, steering angle, brake apply, forward vehicle clearance and relative velocity. This has been accomplished by expanding the existing system that collects basic usage information such as location, fuel usage and hard-braking event logging.
- Deployed the data acquisition system on a set of fleet vehicles.
- Develop data analysis software to process the large amount of data from the fleet data acquisition system. This enables the deployment of systems that determine the relationship and correlation between the severity of hazardous conditions and the associated information gathered from the radar system of driver behavior.
- Draw conclusions regarding the use of radar-based vehicle systems and how it should be incorporated into driver evaluation and safety training.

The configuration of the developed fleet vehicle monitoring system is shown in Fig. 1. Vehicle data such as velocity, acceleration, weight, forward object distance and relatively velocity (range-rate) is communicated to the central tractor microprocessor over a digital communication network (SAE-J1939 protocol). This information is configured for transmission to a central communication network through a wireless (satellite) system. The vehicle data is then sent to the fleet operations center. The transmitted data is collected and logged for rapid decelerations along with other in-vehicle data to obtain a comprehensive view of the driver and traffic operating conditions. From this operational data conclusions and recommendations for improved highway safety and driver training can be derived.

In April of 2005 there were a total of five Eaton-VORAD radar equipped trucks [4] received at JB Hunt Transport (Lowell, AR). The class-8 tractors were configured for continuously recording data (tractor ID 312054, 312055, 312056, 312057 and 312058) from EVIMS Message 21 data [4]. The operation of the system was verified May 12, 2005 by deliberately inducing EVIMS Message 13 exception conditions while driving the tractors under controlled test conditions (rapid deceleration, close following times of various time intervals, etc.).

The resulting radar-based collision warning system developed in this research is shown in Fig. 1. Through the on-board tractor communication system, data acquired from the radar unit for following distance and closing rate is also made available to tractor velocity, deceleration, brake pedal apply status, turn-signals, etc. This information is then configured to be communicated through a satellite link (Qualcomm provider) to the fleet management center for analysis.

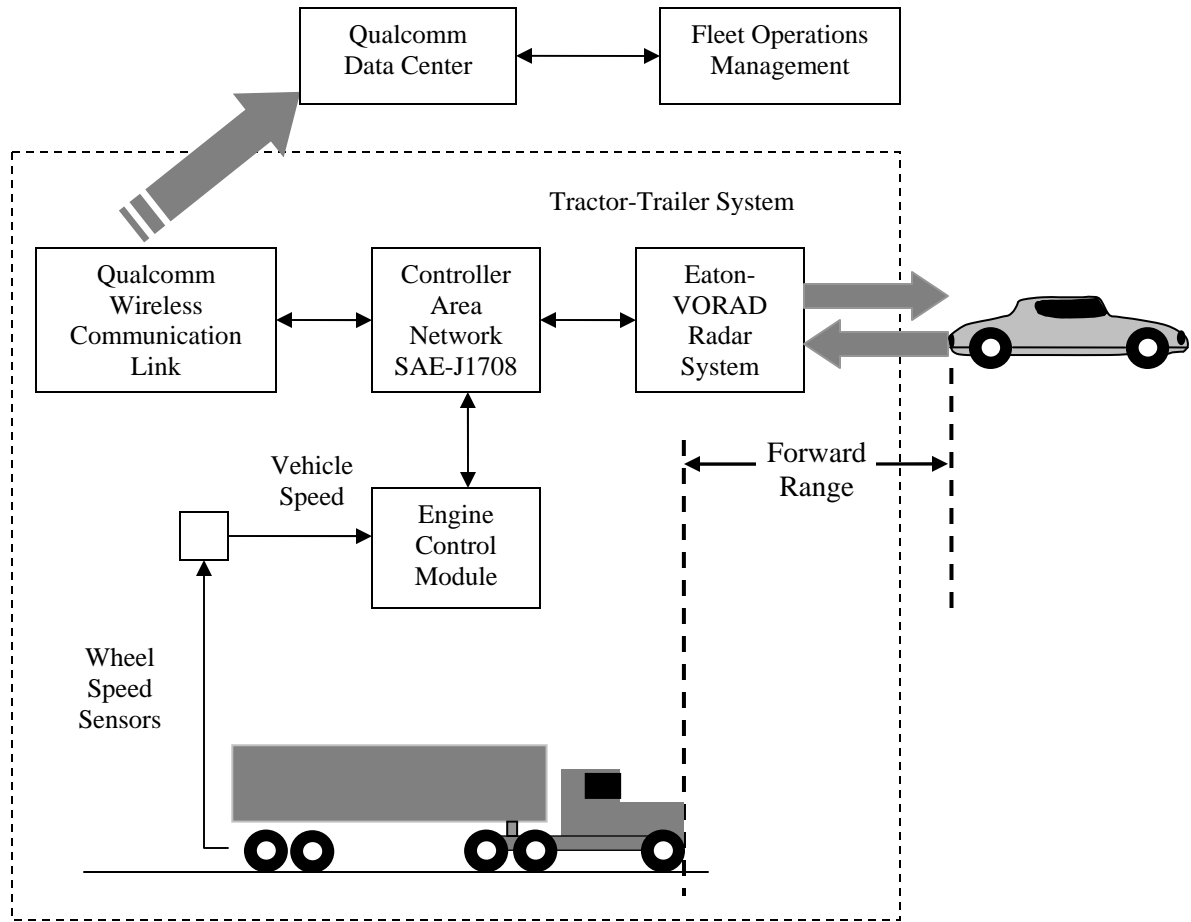


Fig. 1: Data acquisition system for remote monitoring and analysis of vehicle operating data.

Configuration: Five tractors equipped with VORAD forward and right-side collision warning. Operating conditions are remotely monitored through Qualcomm system for the following:

- 1, 2, 3 second following time
- 0.50g and 0.25g deceleration
- percent time in over-speed (summary data only)
- Slow vehicle detection

Detection of 1, 2, 3 second following time and 0.50g and 0.25g deceleration are referred to in this memo as a “hazard event.” Each of the monitored parameter was configured for one of the following:

- Immediate notification (exception report VIMS message type 13) to fleet manager for 1 second following time and 0.50g deceleration.
- Weekly summary report (VIMS message type 21) of the entire event history is also communicated whenever a message type 13 is generated.

In this report, “VORAD system” refers to the combined in-cab warning with reporting of data to fleet managers and JBHT mainframe computer data collection.

Tractor Control Group: Tractors selected as equivalent to those in test group and were be located at the same terminal locations as the test group. The control group tractors are are not directly monitored other than accident summaries are available for evaluating collision rates in comparison to the test group.

Although the data is available with each subsystem given in Fig. 1, a significant engineering effort was required to develop software interfaces in order to have a useable data format available at the fleet management center. An overview of the software development need to support this research activity is given in the Appendix.

III. APPROACH

Specifications and Requirements: This research project developed a data acquisition system that collects real-time information on vehicle and driver conditions during hazardous conditions. The first phase of the project systematically defined the requirements for the data acquisition system to achieve the research objectives. A top-down structured approach was taken. Sample size and test duration were determined from incident reports on record at JBHT. Data requirements were determined based upon existing knowledge of highway traffic conditions and the most frequently encountered hazardous conditions. From this, requirements for the number of vehicles, location, time-of-day, and duration were derived. A new sensor and communication network was created for the data acquisition system. The software requirements were developed based upon the system level data collection requirements.

Data acquisition Development: Product samples were obtained from the respective sponsors (Freightliner, Eaton-VORAD and Qualcomm) for verifying conformance to the design requirements. This was accomplished with the 5 radar units obtained in Task 1. A block diagram is shown in Fig. 1 for the overall data acquisition system. To summarize, data from the tractor SAE-J1939 communication network is used to broadcast data to a remote monitoring center. The data is then made available in real-time to the fleet management center for assessing traffic and logistic conditions.

Analysis Software Development: The primary purpose of the research is the development of a radar-based collision warning system in conjunction with other vehicle data for developing improved safety monitoring and training processes for tractor-trailer drivers. The software analysis tools will be developed to automate the process of assessing the conditions under which a hazardous event is recorded (refer to the Appendix).

Fleet Deployment: The data acquisition system was deployed in fleet vehicles. Initial evaluation is directed towards J.B. Hunt tractor-trailers equipped with the Eaton-VORAD

radar collision warning system. The data was collected for the forward object range and range-rate and vehicle velocity. In addition, other variables of interest were monitored such as brake apply status and steering wheel angle. To summarize, when a condition such as a hard braking event is detected based upon exceeding a threshold, for example 7 mph/s, the data acquisition system will automatically begin storing the complete set of vehicle data. After a predetermined acquisition period, for example 10 seconds, the data acquisition system will stop recording and return to a monitoring state until the next time that a threshold is exceeded.

Data Analysis: Concurrently to the fleet deployment, the acquired data is analyzed on a continuing basis. The data analysis phase of the project will then use the analysis software to systematically determine the conditions under which hard-braking and collision warning events are logged and their correlation to resultant accident levels and the severity of near misses.

Complete Overall Evaluation: At the conclusion of the fleet deployment stage, the complete set of processed data is available for analysis for statistical trends and correlations. The primary interest is the relationship between radar based warning set-points and resulting hard-braking events with respect to actual collision incidents and/or near misses. From this, recommendations will be made for best implementation of radar warning systems and hard braking event data, and how the real-time processing of this data from fleet operations can be used for improved driver training and remediation.

IV. FINDINGS

For the VORAD equipped trucks, audible and visual alerts were active for the forward and right side radar units. Set-points for rapid braking and following time are were set to avoid nuisance trips. No driver was involved in an accident during the evaluation period. Example data from fourteen anonymous driver exception reports is summarized in Table I for the number of exception events extracted from Message 21 (summaries) generated and the time interval for which the respective driver operated the truck. This example summary data has all types of events lumped together so that the proportion of “1 Sec. Following Time” versus “3 Sec. Following Time” is not detailed, but is available when needed for the analysis software.

TABLE I: Sample Driver Data Summary

Driver ID	Total Number of Events	Number of Days Operating	Average Events per Day
JBHT-1	90	66	1.36
JBHT-2	129	44	2.93
JBHT-3	206	105	1.96
JBHT-4	84	35	2.40
JBHT-5	28	11	2.55
JBHT-6	38	15	2.53
JBHT-7	120	69	1.74
JBHT-8	21	11	1.91
JBHT-9	24	8	3.00
JBHT-10	54	27	2.00
JBHT-11	302	125	2.42
JBHT-12	84	37	2.27
JBHT-13	25	13	1.92
JBHT-14	42	11	3.82

Instructions and training in the operation of the VORAD system was provided. No incentives were given to the drivers for minimizing the number of alert events.

TABLE II: Statistics of Driver Data–Number of Days Operating

Average number of days operating	41.2
Standard deviation of days operating	35.9
Minimum no. of days	8
Maximum no. of days	125

Note that the standard deviation of the operating days for each driver is almost the same as the mean number. This indicates a large variation in the exposure level to those using the VORAD system. This is a normalized variance of 87% (std. deviation divided by mean). The statistics for the average events per day for each driver as listed in Table I is listed in Table III.

TABLE III: Statistics of Driver Data–Average Events Per Day

Average number of events per day	2.34
Std. deviation of ave. events per day	0.36
Minimum average events per day	1.36
Maximum average events per day	3.82
Correlation events/day to operating days	-0.35

It is noted that the standard deviation of the average number of events per day is relatively low (normalized variance 25.6%) compared to the variation in the number of operating days for each driver.

The rate of occurrence in exception reports was examined. There is a correlation factor of -0.35 with respect to the number of operating days and the average number of events per day. This indicates a trend of reduced event rates as number of operating days increases. This could also be influenced by factors that were not accounted for in this analysis. This includes the tenure or cumulative experience level of the driver and the corresponding reinforcement level of previously acquired driving habits. In addition, no incentives were offered in reducing the number of recorded exceptions. As an example, the histogram of the driving with the largest number of days driving the VORAD truck (105 days) for which a written survey was obtained is given below (Figure 2). There were two periods where this particular truck was not in use (vicinity of day 45 and day 90). Otherwise, during each operational period the truck acquired exception reports at an approximately

constant rate. As an example, in the written survey the driver responded in a manner favorable towards the technology:

- Strongly agree with “I would recommend the VORAD system to another driver.”
- Strongly agree with “Overall, I am quite impressed with the Eaton VORAD system.”

However, this driver also indicated

- Neither agree/disagree with “Eaton VORAD system helps me to keep a safe following distance.”
- Neither agree/disagree with “The Eaton VORAD system makes driving at night safer.”

It is important to not draw conclusions from a single driver. However, we may observe that for a driver with more extensive exposure to the VORAD system that the technology was reliable and useful but did not result in a modification in driving behavior. The trend of no significant modifications in the driving behavior (no incentives) was observed with all driver data sets.

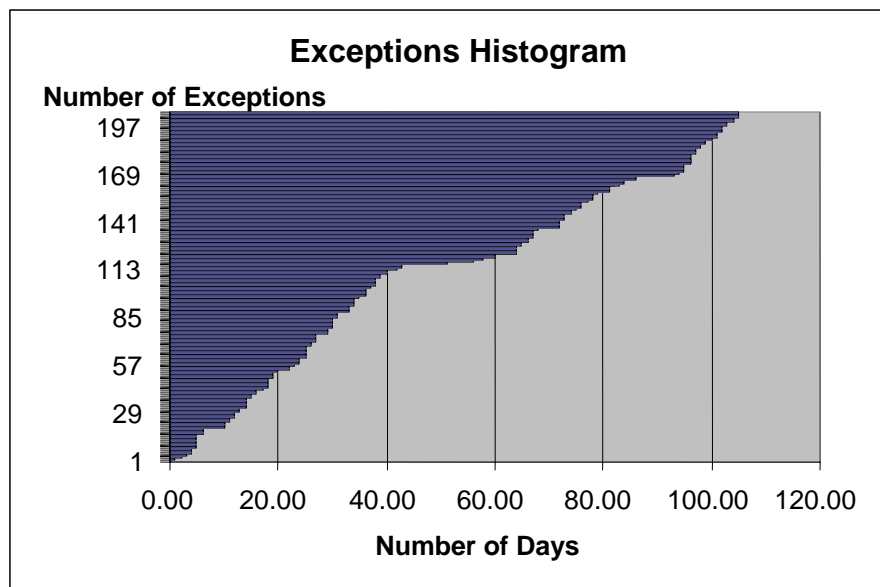


Figure 2: Histogram of exception reports recorded.

Table IV: Summary of Driver Survey Results

Survey Question	Average Response: Rating 1 to 7 increasing agreement: 4.0 is neutral.	Std. Deviation of Responses:
The Eaton VORAD system has helped me to avoid dangerous Situations	4.50	2.06
The Eaton VORAD system makes me a better driver	5.25	2.49
The Eaton VORAD system helps me to keep a safe following Distance	4.25	1.48
The Eaton VORAD system makes driving at night safer	5.00	1.58
Driving in bad weather is safer when there is an Eaton VORAD system in the tractor	5.75	1.09
Overall, I am quite impressed with the Eaton VORAD system	5.25	2.49

Responses to the survey regarding questions about false alarms, nuisance trips and distraction levels indicated that this was not a problem for the drivers. From this survey, there was a strong consensus that the radar system improved safety in adverse weather conditions with somewhat less support for the other safety related condition.

Safety Monitoring: Driver of Fleet Sampling Requirements

For the five active trucks taken over the 209 day period there were 34 drivers. Of these drivers, five were evaluated for less than two weeks (14 days) and five were evaluated for more than 45 days. It is reasonable to require approximately six weeks (45 days) to reliably evaluate the behavior of a driver without bias introduced by circumstantial conditions. This assertion is valid given the narrow deviation in the event rates observed for all drivers regardless of cumulative days operating with the VORAD system. Therefore, each truck on average would provide

$$\left(\frac{363 \text{ operating days per year}}{209 \text{ sample days}} \right) \left(\frac{5 \text{ Drivers}}{3 \text{ Tractors}} \right) = 2.894 \text{ Drivers / Tractor - Year}$$

with a 45 day minimum driver acceptance data criteria.

Conclusion: Drivers for a full fleet deployment can be selected at random (no pre-selection criteria for experience level) from the available driver pool, with a yield of approximately three drivers per tractor-year that will provide at least 45 days of operating data for fleet-wide evaluation.

Sample Size Recommendations for Large Fleet Monitoring

If fleet safety is determined by the occurrence of unsafe behaviors relating to targeted incident types (i.e., rear end collisions with respect to following times and lane change maneuvers), then the real-time fleet sampling/monitoring requirements can be determined while maintaining adequate confidence levels regarding the fleet as a whole. Under this evaluation criteria, it is sufficient to determine the mean and variance levels of the fleet drivers under evaluation. Consequently, the sample size required for determining mean and variance to a give accuracy and confidence level are independent of the fleet size if a normal distribution is present. However, moderately increasing the sample size (number of drivers monitored) allows for good mean and variance estimation even if there is not a normal distribution. The results of the small fleet study are included in the determination of the number of drivers needed for estimating the mean value of events/day:

Pilot Sample Size	14
Current Estimate	2.34
Current Variance Estimate	0.36
Acceptable Significant Level (alpha)	0.05 (customary)
Acceptable Absolute Error	0.20
Required Sample Size (no. of drivers with >45 days operating with VORAD radar)	35
Number of equipped tractors	12

It is also necessary to estimate the variance in the events/day rates when accessing the impact on settlement costs. That is, if the average number of events/day rate is reduced by 50% then some conclusion could be drawn regarding a reduction in settlement costs if the events/day variance levels among the drivers remain the same. As a simple example, we may initially have 100 drivers where each one averages two events per day. After introducing the VORAD system with incentives, suppose the 100 drivers now averages

one event per day. If the variance remains the same (every driver has an average of one event per day) then a conclusion could be drawn about the improved safety behavior of the fleet and have some degree of confidence in reduced settlement costs. However, if the variance instead increases to 0.5 for the driver pool, then some drivers have actually decreased safety behaviors (from the zero variance initial condition) even though most have improved. In this case there is little ability to draw conclusions about the expected reduction in settlement costs.

Acceptable Significant Level (alpha parameter)	0.05
Acceptable absolute Error	0.325
Required Sample Size (number of drivers at >45 days of VORAD use)	47
Number of equipped tractors	16

Example of ROI Computation

An example of the return on investment (ROI) was computed based on several assumptions that are for illustration only, and are not intended to reflect current commercial conditions. The accident categories considered are rear-end collisions and right side lane changes. Although the VORAD system may also reduce jackknife, turnover, etc., the forward and right side radar system primarily influence driver behavior for the two types specified. Accordingly, an expected percentage reduction in collision rates can be estimated for rear-end collisions and right side lane changes, whereas considering other types is more speculative. Values used in the ROI computation are detailed below:

- Trade cycle: 3 years
- Discount rate: 5%
- Radar unit purchase price: \$1500 (budget example, not actual price)
- Driver Experience: Medium
- Accident rate per million miles: 0.18 (example)
- Direct costs per million miles: \$5,000 (example)

- Indirect cost % of direct: 50%
- Annual mileage per tractor: 100,000
- % reduction in accident costs: 50%
- Three year residual value: \$750

Resulting ROI values:

- Net Present Value: \$250
- Internal Rate of Return: 12%
- Payback in Years: 3.6 (which may be greater than trade interval)

Evaluation Criteria Example

The ROI is based on a 50% reduction in the number of rear end and right lane change collisions. The premise for this study is that a reduction in event occurrences (following time and hard braking) correlates to improved driving behavior which in turn correlates to reduced collision rates, which in turn yields reduced settlement costs.

X% Reduction in Hazard Warnings => Y% Reduction in Settlement Costs

This X|Y correlation will be determined based on safety analysis and performance data gathered from fleet data obtained from the monitoring system developed in this research. This determination of X|Y also includes a weighted contribution of the event types (1.0 sec. following time versus 3.0 sec. following times).

Once the X|Y correlation has been determined, data is collected for a control and test group. The mean and standard deviation (and statistical variance) can be computed from number of occurrences of hazard events in the test and control groups. The evaluation then considers if the mean value of the hazard occurrence rate in the test group has been reduced by a percentage X compared to the control group that corresponds to a 50%

reduction in Y (ROI calculation). To be valid, the statistical variance for the test and control will be compared and should be equal to the accuracy limits of the variance estimation (0.325) based on the sample size.

V. SUMMARY AND CONCLUSIONS

The following items were achieved with this research:

- Demonstration of a integrated large truck safety monitoring system for real-time data acquisition and reporting of vehicle and traffic conditions to fleet operational centers. This included the remote monitoring and logging of variables such as tractor-trailer speed, location, brake apply status, and forward object following time.
- A software environment where the remote monitoring on fleet conditions can be used to develop and continuously revise criteria for safety thresholds.
- A safety monitoring system where the fleet analysis results can be employed in driver training and management planning.

In addition, an example of using fleet deployment data was used to assess the cost/benefit ratio for adoption of radar-based safety monitoring systems. That is, the safety monitoring environment enables the determination the effectiveness of radar-technology in reducing accident related loses compared to conventional safety training and monitoring methods.

In conclusion from the particular test fleet under consideration, the following conclusions were drawn:

- Driver exceptions were acquired at almost a constant rate after an initial period of operating the radar system (noting that there were no incentives to minimize occurrences).
- Driver surveys indicated a slightly positive approval of the benefits of the radar system, with particular benefit noted during adverse weather conditions.

- Because of factors such as driver turnover rates, variability in the duration of time for each driver to become familiar with the radar technology, and the limited sample size, the results are inconclusive regarding the cost-benefit analysis of the radar system.

References

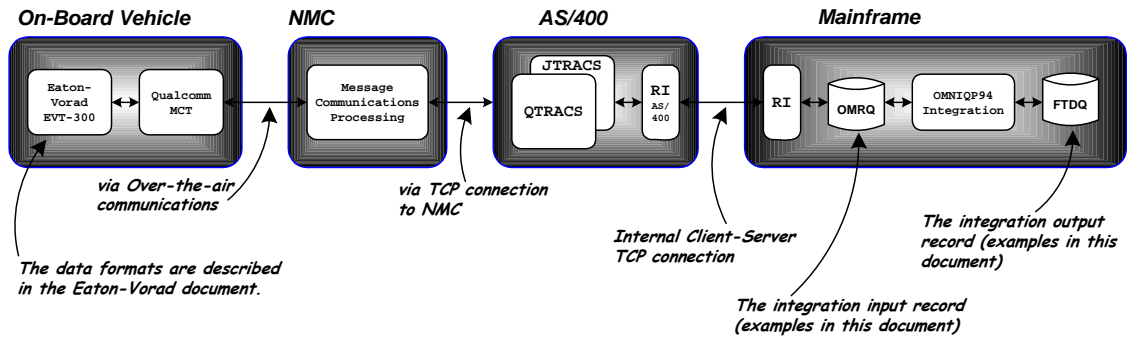
- [1] B. Akinici, C. Hendrickson, and I. Karaesmen, "Exploiting motor vehicle information and communications technology for transportation engineering," *ASCE Journal of Transportation Engineering*, vol. 129, no. 5, pp. 469-474, Sept./Oct. 2003.
- [2] R. Murray, K. Astrom, S. Boyd, R. Brockett and G. Stein, "Future directions in control in an information-rich world," *Control Systems Magazine, IEEE* , vol. 23, no. 2 , pp. 20 -33, April 2003.
- [3] P. Hancock and S. DeRidder, "Behavioral accident avoidance science: understanding response in collision incipient conditions," *Ergonomics*, 2003, vol. 46, no. 12, pp. 1111-1135.
- [4] EVT-300 Collision Warning System: Operator Manual and Service Guide, Eaton VORAD Technologies, L.L.C., 13100E. Michigan Ave., Galesburg, MI 49053, 2003.

APPENDIX: Tractor Data Software Conversion

Overview:

The Eaton-Vorad unit (EVT-300) formats fault messages and data messages in response to events it senses on the tractor. These faults are then communicated as a JTRACS MID and forwarded to the host software. The host JTRACS software then identifies specific faults and passes them on to the integration data queue on a mainframe computer such as an IBM AS/400 where overall safety assessment and monitoring is automatically executed. The fleet conditions in this sample study would be processed by JB Hunt mainframe integration software. The following diagram shows these relationships.

Relative Components of Eaton-Vorad Integration



Integration Output Record - Exception Violation Record:

Following is an example of the Exception Violation Record.

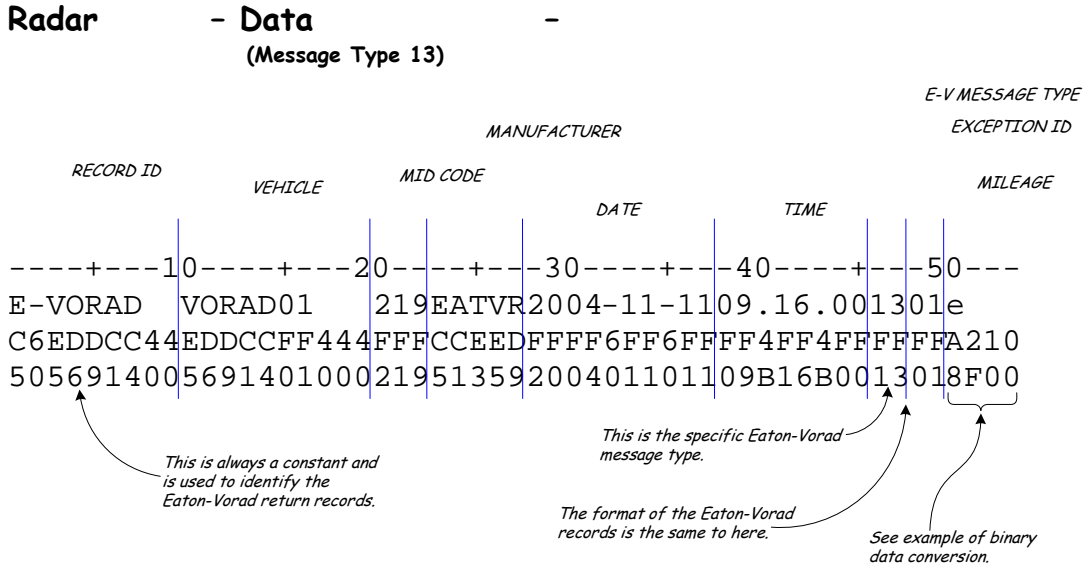


Figure 2. Eaton Vorad Exception Violation record.

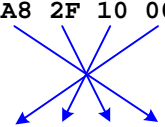
Binary data that is two or more bytes has to undergo a position conversion before it can be converted to decimal. The example illustrates that process.

An example of binary data conversion:

Data as received: **A8 2F 10 00**

Convert positions

Data as converted: **00 10 2F A8 = 1,060,776₁₀**



Host Software Configuration:

QTRACS/400:

QTRACS on the AS/400 is configured to pass data to the JTRACS application. This is accomplished by entering option 19 (External Applications). An entry is created with a configuration as shown below:

```
QTRACS/400 v5.3(0329)      RI-5 Test System      11/18/04 16:56:04 PSI
-----
Display External Application Detail

Definition
Application Identifier . : JTRACS
Application Name . . . . : JTRACS Server App.
Fwd Msg Acknowledgement : *ALL      *ALL, *NEG
Send GL Events . . . . . : *NO        *YES, *NO

EAL Interface Characteristics
Input Queue Type . . . . : *DTAQ      *DTAQ, *FILE
Input Queue Name . . . . : JTRCVQ     Name
Library . . . . .       : RISDATA    Name, *LIBL, *CURLIB
Error Handling . . . . . : *RETRY     *IGNORE, *RETRY
Number of Retries . . . . : 10        Count (2-99)
Wait Between Retries . . : 10        Seconds (10-300)

Transmission Counts
Messages Sent . . . . . :      27
Characters Sent . . . . . :     704
Last Reset . . . . .    : UNKNOWN

F3=Exit      F5=Refresh      F12=Cancel      More...
```

JTRACS Pro:

There are several settings in JTRACS: These include the Monitoring Definitions, the Vehicle Definitions, and the Message Routing.

A. Monitoring definitions - There are four sets of monitoring definitions.

1. Monitoring Group Definition – This is the first of four monitoring screens. Begin by going to option 4 (Work with Monitoring Groups). Next, is the ‘Work With Monitoring Groups’ screen. The initial fields required for the test are circled in the example.

```

JTRACS Pro v2.3(0108)      RI-5 Test System      11/18/04 16:57:44 PST
Monitoring Group Definition

Monitoring Group ID.....: VORAD
Monitoring Group Name.....: Vorad Group

Query for VIN & Engine Info?: N (Y/N)

Automatic Monitoring Group Assignment Criteria:

Matched With Vehicle Query Response:
Engine Manufacturer.....: EATVR Eaton Vorad
Engine Model.....:
Default Group if Tie?...: Y

Matched With Vehicle Definition:
Vehicle Manufacturer....: EATVR Eaton Vorad
Model Year Range.....: 1990 to 2004

F1=Help  F3=Exit  F5=Refresh  F12=Cancel
1 of 4...

```

2. Fault Monitoring Definition

```

JTRACS Pro v2.3(0108)      RI-5 Test System      11/18/04 16:58:19 PST
Fault Monitoring Definition

Monitoring Group....: VORAD      Vorad Group

Type options, press Enter.
5=Display

MID  PID  SID  FMI  Filter  Level
- 1.  219  *    *    *MCT  DEFAULTS
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

MID  PID  SID  FMI  Filter  Level
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.
- 20.

Enter 219 for the MID as shown.

F1=Help  F3=Exit  F5=Refresh  F12=Cancel
2 of 4...

```

3. Device Monitoring Definition – after the Fault Monitoring Definition is entered with new device definitions.

```

JTRACS Pro v2.3(0108)      RI-5 Test System      11/18/04 16:59:34 PST
Device Monitoring Definition

Monitoring Group....: VORAD      Vorad Group

Type options, press enter.
5=Display

Dev  MID  Description
- 1.  219  Collision Avoidance Sys
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.

Enable Device Data Messages | Enable Keyboard | Max Transmit
Forward  Return  Display  Rate
- 1.  Y      Y      00001
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.

Enter the fields as shown.
The blank fields should have a 'N' entered.

F1=Help  F3=Exit  F5=Refresh  F12=Cancel
3 of 4...

```

- Parameter Monitoring Definition – Page down one page after the Device Monitoring Definition and enter F6 to create a new parameter definition.

```

JTRACS Pro v2.3(0108)      RI-5 Test System      11/18/04 17:00:20 PST
Parameter Monitoring Definition
Monitoring Group....: VORAD      Vorad Group
5=Display

MTD/PTD Description                      Frequency  Qry  Exp  Date
                |                |                |  Trig  Val?  Expected
1.  219/234 Collision Avoidance Sys/Software Ide Eng-Start N/A
2.  219/243 Collision Avoidance Sys/Component Id Eng-Start N/A
3.                                     Eng-Start N/A
4.                                     Eng-Start N/A
5.                                     Eng-Start N/A
6.                                     Eng-Start N/A
7.                                     Eng-Start N/A
8.                                     Eng-Start N/A
9.                                     Eng-Start N/A
10.                                   
11.                                   
12.                                   
13.                                   
14.                                   
15.                                   

F1=Help  F3=Exit  F5=Refresh  F12=Cancel
4 of 4
  
```

Make sure both entries are added.

B. The truck implementation is defined:

- The trucks are defined as JTRACS enabled.
- The two follow-on screens that contain the ‘Confirmed Vehicle Devices Monitored’ and the ‘Confirmed Vehicle Parameters Monitored’ are filled in when the vehicle has received a ‘SUCCESS’ status for the monitoring.

```

JTRACS Pro v2.3(0108)      RI-5 Test System      11/18/04 17:05:17 PST
Vehicle Definition

Vehicle Identifier.....: VORAD01
Vehicle Name.....: Test Vorad System Van
Vehicle VIN.....: NONE
Vehicle Manufacturer.....: EATVR Eaton Vorad
Vehicle Model Year.....: 0000

Monitoring Group.....: VORAD      Vorad Group
No monitoring override exists for this vehicle.

Returned Engine Manufacturer.....: NONE
Returned Engine Model.....: NONE
Returned Engine Serial Number.....: NONE
Returned Engine Software Version..: NONE

Fault Monitoring Status.....: SUCCESS 10/27/04 14:11:15
Device Monitoring Status.....: SUCCESS 10/27/04 15:11:29
Parameter Monitoring Status.....: SUCCESS 10/27/04 14:11:15
Last manual Query Status.....: SUCCESS 10/27/04 14:01:20

Confirmed Devices...

F1=Help  F3=Exit  F5=Refresh  F12=Cancel
  
```

First, need to set up vehicle, manufacturer, and monitoring group.

Second, need to make sure all parameters are successfully updated (via Option 1 on the Vehicle Directory if needed)

C. Message Routing is defined after the Remote Integration configuration is completed.

```
JTRACS Pro v2.3(0108)      RI-5 Test System      11/18/04 17:02:29 PST
-----
Message Routing Entry Detail

Application ID.....: VORADAPPL
Application Name.....: Vorad Avoidance System
Routing Manufacturer...: EATVR Eaton Vorad
Routing Device MID.....: 219 Collision Avoidance Sys
Application Input Queue: JTVORADQ
Library.....: RI5SITE
Status.....: Normal

Total Messages Sent....: Forward Messages      Return Messages
000000000              000000037
Total Characters Sent...: 000000000              000004442
Totals Last Reset at...: (none)              (none)
Last Message Date.....: (none)              11/11/04 08:12:38
Vehicle ID.....: VORAD01
Device.....: Collision Avoidance Sys
Manufacturer.....: Eaton Vorad
Message Size.....: 000000000
Message Status.....: Normal

F1=Help  F3=Exit  F5=Refresh  F12=Cancel
```

This is the destination for any data that is related to the 219 MID. It is also defined in the RI Proxy.

Remote Integration/400:

The Remote Integration can be configured to capture the data found in the queue that is created by JTRACS. This is done as an option. An entry must be set up to receive the data put in the queue defined in JTRACS.

```
RI/400 v1.1(0054)      RI-5 Test System      11/19/04 16:39:52 PST
-----
Work With Proxy Applications

Type options, press Enter.
 2=Edit  4=Delete  5=Display

-----Proxy Application-----  ---Input Data Queue---
Opt Name      Description      Name      Library
-  INTGJT      JTRACS Integration for Vorad  JTVORADQ  RI5SITE
-  INTGQT      RIS Dispatch Integration  DISPATCHQ  RI5BATA

F1=Help  F3=Exit  F5=Refresh  F6=Create  F12=Cancel  F17=Top  F18=Bottom
```

This corresponds to the JTRACS Message Routing entry.