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An overview of onboard computers for monitoring forestry trucks

Contents

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Abstract

FERIC has developed considerable expertise in the use of onboard computers in forestry transportation operations. This report has been prepared in response to member requests for a concise summary of this knowledge. It presents an overview of the technology, the results of case studies, and implementation advice for those who are interested in adopting the technology.

Keywords:

Onboard computers, Asset tracking, Vehicle monitoring, Driver monitoring, Fuel efficiency, Cycle times, GPS, Products, Characteristics.

Introduction

Concern over public safety and vehicle productivity, vehicle maintenance, and operating efficiency have encouraged the use of onboard computers (OBCs) for logging trucks in Canada (Figure 1). Historically, tachograph-based systems were the primary source of information used to monitor logging trucks. However, this technology was cumbersome, it was labor-intensive to analyze the data, and the scope of application of these devices was limited.

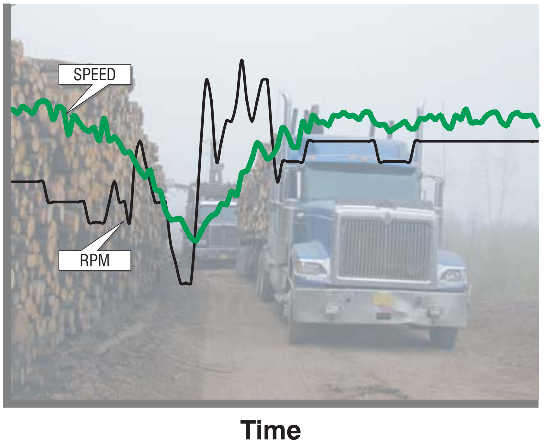

Figure 1. Onboard computers help to increase transportation efficiency.

A number of OBCs with varying capabilities are now available, and are becoming more popular in the trucking industry. FERIC has participated in several trials of these systems and has acquired considerable knowledge of their use. Based on the results of these trials, we believe that OBCs are an appropriate tool for the Canadian forest industry and can help our members to improve the efficiency of their operations. This report was written in response to requests from member companies for a general description of OBCs and their capabilities, along with a comparison of some of the available products. The report also provides some feedback from current users of the technology and guidance on its implementation.

Description of onboard computer systems

OBC systems comprise the following components:

- The onboard computer (i.e., the black box);

- A data-transfer system;
- A base station that includes a data-management and reporting system (i.e., software);
- Optional peripherals (Global Positioning System [GPS], driver identification interface, keypad or terminal, impact sensor, etc.).

Onboard computer

The "black box" is the heart of any OBC system. It gathers information such as engine data (e.g., road and engine speeds, odometer and fuel readings) via an electronic control module (ECM) as well as data from any peripheral devices connected to the OBC's data-input lines, including devices that detect brake usage (including the engine-compression brake); the opening and closing of doors, gates, and hoods; and the status of the power take-off (PTO). All that's required is to hook up one of the data-input lines to the relevant electrical circuit.

It is possible to assign each driver their own identification (ID) number so the OBC can record data separately for each driver. Subsequently, by monitoring various indicators of driving habits (e.g., travel speed, RPM, brake use, fuel consumption, and idling times), reporting software can serve as a driver-management tool by letting managers assign performance scores to each driver. Drivers can identify themselves using one of two methods. The most common method uses an electronic key or driver card that is inserted in the OBC at the beginning of each shift. Alternatively, drivers can use a keypad to enter their personal ID number in the system at the start of each shift.

Data-transfer system

There are various ways to transfer the data recorded by an OBC into the base station's management system. Manual methods are usually based on an electronic card or key, which can be the same as the device used by drivers to identify themselves to the system. Drivers insert their card or key into the OBC, download the data, and then transfer the information into the management system. This must be done regularly (intervals vary by model) so that the storage capacity of the OBC is not exceeded. Manual systems provide the cheapest alternative for smaller fleets, but they have several drawbacks, including the fact that keys and cards can be lost or broken, that drivers have yet another task to perform, and that updating the configuration settings of the OBC can be difficult. Every time an update is required, an updated key or card must be prepared for each vehicle in the fleet and uploaded individually.

Automatic systems offer several advantages, including automated downloads that eliminate manipulation errors, and increase both the frequency of data transfer and configuration updates. Moreover, when the OBC configuration settings are modified, the management system can automatically update all vehicles to use the new configuration. There are two main approaches to automated data transfer:

- Short-range radio: This approach seems to be the best solution in forestry transportation because the transfer occurs automatically whenever the vehicle enters within radio range of the base station. Costs are incurred only once for the hardware (a radio modem plus its antenna)

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and installation. Thereafter, communication is free.

- Cellular or satellite: The data transfer is done at pre-set times or on demand in real-time by means of a cellular network or satellite uploads. This approach involves ongoing fees (monthly plus usage fees). Cellular usage is not a viable solution in many areas, since coverage can be sporadic or absent in the forest environment.

Cellular or satellite systems aren't used solely for data transfer. Their strength lies in their ability to allow real-time management. For example, trucks can be immediately notified of schedule changes, current roadside inventories can be forwarded to the dispatcher, vehicle locations can be tracked by means of a GPS unit, and emergencies can be responded to quickly. Because of the cost of the communications, some OBC manufacturers offer hybrid solutions in which data transfer is manual or by means of short-range radio at the base station, whereas cellular or satellite modems are reserved for instantaneous, real-time communication. Figure 2 illustrates a typical OBC system.

Base station

The base station is typically a desktop computer that hosts the data-management and reporting software and the data-transfer interface, though cellular and satellite solutions may work differently in that data is usually stored on the service provider's server before it is transferred to the customer's management system and/or made accessible via a website.

All data recorded by the OBC is added to a central database, where it can be managed using specialized software. The software that accompanies each OBC system offers a range of possibilities. When you select a product, you should ensure that its software can produce the reports you require and that you can transfer the data into other software

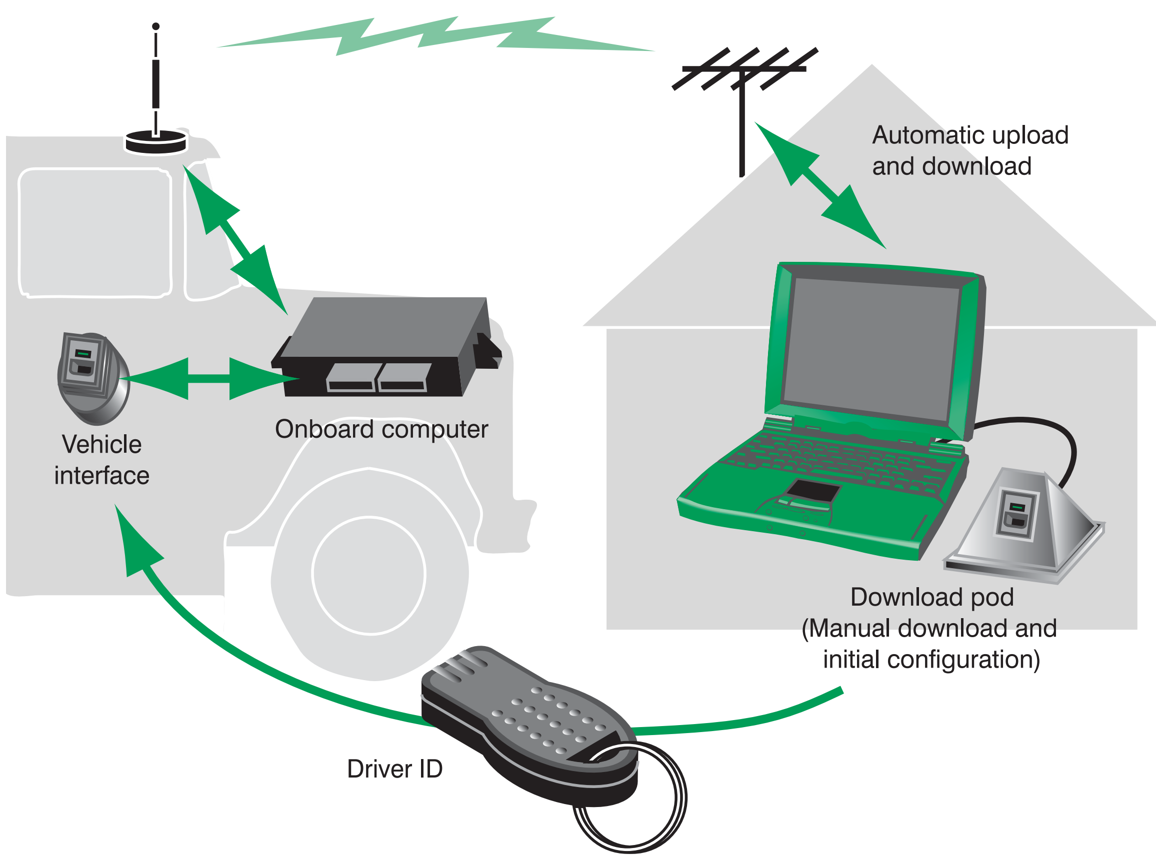

Figure 2. Components of a typical OBC system.

used by your company, such as a Geographic Information System (GIS) or accounting software, if necessary. The importance of this confirmation is echoed by the common statement that "any black box can gather the data, but the software makes the system". It is not possible to describe all the differences between the available software in this report, but we have gathered enough information on various available systems that we can help you understand the key differences and make a more-informed purchase decision.

Optional peripherals

Manufacturers and distributors offer many optional peripherals (devices that add functions to the system), including:

- A keypad or touch-screen (i.e., an in-cab terminal);
- GPS hardware;
- Communications (cellular or satellite);
- An interface to tire pressure control systems (TPCS), also called central tire-inflation systems (CTI);
- An accelerometer (e.g., an impact sensor);
- Onboard printers;
- Onboard weigh scales.

Keypads or touch-screens let drivers enter their ID as well as start and stop codes that explain the cause of any downtime (e.g., maintenance, breakdowns) and other relevant information (e.g., load description, source, and destination). When combined with cellular or satellite communications, the in-cab terminal can also be used for real-time text messaging.

The GPS allows tracking of the locations of assets. This tracking can be passive (e.g., data is transferred after it is collected) or active (real-time data transfer). The GPS gathers time-stamped vehicle coordinates that can be correlated with the OBC's data, which is also time-stamped. This allows information such as date and time, driver and vehicle IDs, engine and travel speed, the vehicle's heading, idling times, and fuel consumption to be referenced geographically.

Some programs can take advantage of this correlation to provide an important feature for forestry operations: *geofencing*. Geofencing refers to the definition of boundaries around key geographic areas so that activity in these areas (e.g., entry and departure, loading) can be monitored. The software can then provide various analyses for those defined areas. For example, a geofence could be created around a mill yard to provide accurate information on a vehicle or fleet's average unloading time without requiring any operator input. Other examples include the monitoring of:

- Compliance with the use of engine-compression brakes in urban areas;
- Compliance with tire pressure guidelines on particular sections of roads;
- Speed limit compliance in specific areas such as school zones;
- Cycle times (by tracking times spent in loading and unloading areas, in identified road systems, etc);
- Activation of self-loader hydraulic system (PTO engagement) within loading areas.

Using geofences, some systems allow an audible alarm to be triggered, warning the driver of a potential non-compliant situation such as excessive travel speed in a school zone.

Types of OBCs and their applications

OBCs can be divided into three main groups:

- Truck and driver performance management: These systems represent a more sophisticated version of the simple tachograph. They gather engine data from the ECM, thereby providing odometer and fuel readings in addition to travel and engine speeds. The software is typically configured to analyze driver behavior by tracking travel speed, braking, idling, and other factors that vary among drivers. This is the cheapest form of OBC and the simplest to use. It is suited for any size and type of fleet.

- Asset tracking: These systems allow for the tracking of assets such as trucks and trailers by means of a GPS. They do not log ECM information, but can still estimate travel speeds using the GPS data. The software may provide geofencing capability and usually includes support for real-time or passive dispatching. Such systems are more suited for freight haulers in areas with cellular coverage, where asset tracking and dispatching are part of the core business.
- Combination: These systems combine the features available in the first two types of OBC with varying degrees of integration. Commonly, engine data can be combined with GPS data. The most comprehensive systems allow complete monitoring of vehicle and driver performance and provide geofencing, varying levels of support for dispatching, and real-time processing of data. They are typically the most expensive systems, but provide the greatest flexibility; the drawback of this capability is that they also require the most management. They can integrate data from other vehicle systems such as TPCS or onboard weigh scales. When cycle times are as important as truck and driver management, combination systems are the tool of choice.

User experience

Three of the several case studies in which FERIC was involved are presented below. The primary goal for the first two case studies was the reduction of fuel consumption, but the primary goal of the third case study was to allow trucks to operate at full weights during the latter part of the spring load-restriction period. Three different brands of OBCs were used for the trials.

Corner Brook Pulp and Paper Ltd., Newfoundland

In this study, five trucks were equipped with OBCs. Each was tracked for 6 weeks to provide benchmark data on fuel consumption and general driving habits. In the fall of 2003, drivers were trained using the *SmartDriver for Forestry Trucks* guidelines, and their performance was tracked for an additional 9 weeks. Figure 3 illustrates how training combined with OBC monitoring can affect driving habits.

is a complete training package for trainers and drivers, designed to teach safer and more fuel-efficient driving habits. For more information, please visit our Web site: http://www.feric.ca.

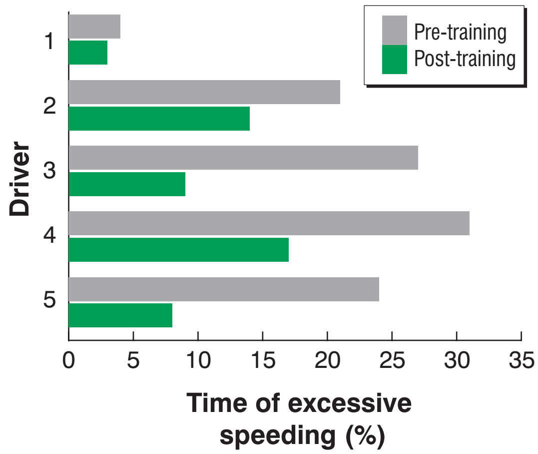

Figure 3. The impact of driver training on excessive travel speeds.

Overall, we did not detect significant differences in fuel consumption after training. However, the training took place between the summer and winter operations, and there is typically an 8% increase in fuel consumption in winter operations. In the absence of this anticipated increase in fuel consumption, the training appears to have generated a comparable reduction in fuel consumption. Our analysis also showed that idling times decreased greatly. The company asked FERIC to analyze cycle times for a particular road system to settle a rate dispute with its contractors, and the OBC data provided the necessary evidence to justify a rate adjustment. The OBCs were also instrumental in settling a fuel rate adjustment dispute based on the difference between winter and summer operations. In light of these benefits, which were attained in less than 1 year of operation, the company decided to phase in OBCs throughout their operations.

Opti-Grade is an integrated system for collecting data on road conditions to support optimized grading interventions, thereby producing the highest road quality at the lowest cost. For more information, please visit our Web site: http://www.feric.ca.

Alberta-Pacific Forest Industries Inc. (AlPac), Alberta

AlPac has been using OBC technology since 2000 to track vehicle and driver performance. It tracks GPS data, fuel taxes (highway vs. off-highway), CTI use, and the use of their *Opti-Grade* system. The company's contract requires all trucking contractors to equip their vehicles with an OBC of a specific brand and specifies that:

- OBCs will be used to monitor speeding violations, especially through school zones and urban areas. Penalties are applicable.
- OBCs will also be used to enforce legal limits on driving hours and weights.

This approach has improved AlPac's standing with small communities and local law enforcement officers. FERIC was told that "if you drive an AlPac truck, you don't get stopped" because travel speeds, legal weights, and legal driving hours are strictly enforced by the company. FERIC asked contractors and drivers what they thought of the system and learned that:

- Contractors were in favor of the system because they had noticed a reduction in their operating costs.
- Drivers were also in favor of the system, as it leveled the playing field for everybody. Cycle times are now known and speed limits are enforced, so there is no incentive to drive unsafely in an attempt to haul one more load or beat fellow truckers to the forest. Drivers claim that their stress levels have thus decreased significantly.

In 2003, eight drivers received *SmartDriver for Forestry Trucks* training. After the training, they were tracked for 5 months and received feedback through monthly progress reports. Because the performance of vehicles and drivers had been tracked before the study, pre-training fuel consumption was already quite good, ranging from 53.4 to 63.4 L/100 km (exclusively B-trains), with idling times ranging from 21.5 to 26.7% (Brown 2004). Even with this good starting point, all but one driver significantly reduced their fuel consumption (by an average of 6.3%) during the first 2 months after training. However, fuel consumption had slipped back to pre-training levels by the third month. The impact on idling time was more significant. Excluding data from the one driver who did not reduce his fuel consumption, idling time decreased by 20.8% during the first 4 months before slipping back to pre-training levels.

Based on these results, AlPac recognizes that OBCs are indispensable for tracking vehicle and driver performance. Since their implementation in 2000, OBCs have become an integral part of its core operations. A consultant now maintains the system and manages the data on AlPac's behalf.

British Columbia

In western Canada, road research by FERIC has led the government of British Columbia to develop a policy to allow trucks equipped with TPCS to operate at their full weight during the latter part of the spring load-restriction period, provided they are equipped with an OBC capable of monitoring certain parameters specified by the regulators.

OBCs of a specific brand collect GPS and TPCS signals to allow monitoring of vehicle speed, route, TPCS setting, and tire inflation pressures. Trip data, encrypted to maintain security, is transferred to the mill scale's computer via a flash card at the end of each trip. Axle-group weights, gathered as the truck moves onto the mill scale, are manually added to the data at that time. The manufacturer of the OBC processes this trip data, posts a compliance report on the Internet within minutes of receiving the data, and provides feedback to drivers before they start the next trip. The format of the compliance report allows regulators to quickly review numerous trip reports for compliance, and gives access to detailed trip data presented in the form of tables and color-coded route maps.

A geofence is defined around weight-restricted portions of the haul route, and only this part of the trip data is reported to government regulators and the forestry company. Data from the entire haul route, compiled in customized reports, is available to truck owners who may find this useful for monitoring driving patterns and cycle times. To expedite data interpretation, out-of-compliance instances are automatically highlighted. The manufacturer of the OBC will be establishing systems to download trip data by short-range radio in 2006.

Manufacturers and product characteristics

Appendix 1 summarizes information from 12 distributors and manufacturers, and represents our best knowledge of the systems' characteristics to the end of 2004. All of the distributors and manufacturers were given an opportunity to review and update these specifications and report on expected future developments, but FERIC cannot guarantee the accuracy of these updates. Moreover, FERIC does not suggest that these systems represent the only options that are available—they are only the options that we found to be most common in the trucking industry.

Although several systems are available, none currently fully satisfies our industry's unique constraints. Experience has shown that although it's easy to identify the need for an OBC, a detailed analysis of the specific requirements that the system must address and how to do so requires considerable understanding of these systems.

FERIC has developed extensive knowledge of six of the systems offered by these distributors and manufacturers: Route Tracker (Cancom Tracking), Silent 1000 (Centrodyne, distributed by Tachographes Québec), Victor (FleetMind), VMU (QA Technologies), FM200+ (Siemens-VDO, distributed by International Road Dynamics Inc.), and Truckbase (Truckbase Corp). Moreover, FERIC has assessed the various existing systems using the following specific criteria and can help you select the best system for your situation based on:

- ECM interface;
- Automatic upload and download of data by short-range radio;
- TPCS monitoring;
- Geofencing capability;
- Web access to the software and database;
- Price;
- Manufacturer credentials (e.g., history of customer support, financial stability).

Upcoming developments

Future developments in which FERIC is involved include:

- Integration of OBCs with onboard weigh scales to integrate vehicle weight with TPCS data and ensure compliance with spring load-restriction guidelines. This will also let FERIC conduct other research projects such as analyses of parasitic weight (mud and snow), more accurate definition of operating costs, and wireless downloading of scale data and inventory updates.
- This integration will also become part of a forestry module that encompasses additional forestry-specific features such as custom report generation for forestry applications.

Appendix 1 provides details on some upcoming developments reported by the OBC manufacturers and distributors.

Implementation

When implementing an OBC system:

- Define the objective for implementing an OBC system and the specific parameters that must be addressed. This will help guide you in identifying the best system to meet these needs.
- Take advantage of FERIC's experience. These systems are complicated, which makes it difficult to take full advantage

of the system without first developing some expertise.

- Appoint a staff member to maintain the system and develop relevant reports. Although this may not be their sole job, it should be a significant portion of their weekly responsibilities.
- Plan a phase-in period. Drivers are understandably reluctant to invite "Big Brother" into their cabs. Thus, you should explain the objectives of the implementation and the advantages, as well as the expected impacts on drivers and vehicles (e.g., ID requirements, entering codes via the keyboard when applicable, modifications to the truck for wiring) and future implications (e.g., modifications of contract obligations).
- Provide regular feedback to the drivers and listen to their feedback.
- If you anticipate reluctance by contractors or drivers, start with a pilot project that will demonstrate the benefits to the rest of the fleet before you attempt a broader implementation.
- All participants must be proactive. OBCs are powerful tools, but they cannot run on their own.
- As shown in the first two case studies, drivers tend to fall back into their old habits. Constant monitoring using the OBCs is essential to identify the need for training updates.

Conclusions

FERIC's OBC projects with member companies have generally been successful. Less-successful projects were characterized by a lack of involvement by the participants. Success stories span a wide range of OBC applications, from purely operational aspects (e.g., monitoring truck and driver performance) to broader issues such as settling labor disputes and mitigating the constraints imposed by spring load restrictions.

Active involvement by all stakeholders is key. Equipping a fleet with onboard computers is expensive (typically on the order of $3000 per vehicle). Because OBCs are not operational tools, but rather monitoring tools, it is easy to underutilize them and waste the investment unless a commitment to continuous improvement is present.

Acknowledgments

FERIC thanks the manufacturers and distributors listed in Appendix 1 for providing information about their products. We also thank our partners in the forest industry who participated in trials of OBC systems for their patience and forward thinking.

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Appendix 1. Product information

A - Readily Available Systems (N/A means the information was not made available)

Manufacturer or distributor (OBC)	Price ($)		Downloading (Y/N)				ECM	CTI	GPS	Geofence	Web hosting	No. of inputs		GIS import
	Hardware	Software	Manual	Radio	Cellular	Satellite	(Y/N)	(Y/N)	(Y/N)	(Y/N)		Freq.	Digital/ analog	
Cancom Tracking (RouteTracker)	950	Monthly	Y	Y	Y	Y	Y	N	Y	N	Y	N/A	N/A	N
Fleetmind Solutions Inc. (Victor)	2300	15 000	Y	Y	Y	Y	Y	N	Y	N	N	3	8-16	N/A
International Road Dynamics Inc. (FM200+)	1300	1300	Y	Y	Y	Y	Y	Y	Y	Y	Y	4	8	N/A
QA Technologies (VMU)	2990	4950	Y	N	N	Y	Y	Y	Y	Y	N	4	6	Y
Tachographes Québec (Silent 1000)	1800	1500	Y	Y	Y	N	Y	N	Y	Y	Y	N/A	6-20	Y
Truckbase Corp. (Truckbase)	2000	Monthly	Y	Y	Y	Y	N	Y	Y	Y	Y	8	16 + 4 RS232	Y
Aldata Software	2500 - 4500	Monthly	Y	N	N	Y	Y	Y	Y	Y	Y	2	10	N
GEOTAB	US$850	US$1150	Y	Y	N	N	N	N	Y	Y	N	N/A	7	Y
GPS Realtime	N/A	N/A	N/A	N/A	N/A	N/A	Y	N	Y	Y	Y	N/A	N/A	N/A
Grey Island Systems International Inc. (Interfleet)	995	Monthly	N/A	N/A	Y	Y	Y	N	Y	Y	Y	17	8	Y
Skyreach Communications Inc.	1950	4000	Y	Y	Y	Y	Y	N	Y	Y	Y	N/A	7	Y
Transcore LinkLogistics	Monthly	Monthly	N	N	Y	Y	N	N	Y	N	Y	N/A	N/A	N

Notes:
- This information was current at the time the report was written.
  "Monthly" refers to a strictly Web-hosted system, in which the software is not offered for local installation. Prices range between $30 and $40 per month for each truck.
- Transcore also offers the hardware for rental at $100 per month for each truck.
- FERIC has good knowledge of the systems shaded in green.

B - Upcoming developments

Company	Developments	Estimated completion date:
1. Truckbase Corp.	1. Reduction in price of onboard hardware 2. Upgrade Web-based data-management and reporting systems 3. More wireless options	New hardware available Ongoing development Ongoing
2. International Road Dynamics Inc.	1. Onboard weigh-scale integration 2. Custom reporting for forestry applications	Fall 2005 Ongoing
3. Centrodyne	Satellite communications	2005

C - Contact information

Manufacturer or Distributor	E-mail	Web site
Aldata Software	info@aldatasoftware.com	www.aldatasoftware.com/tag-overview.htm
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