



Western Coalfields Limited  
(A Subsidiary of Coal India Limited)

## Coal mining industry major implements RFID-enabled TRUCK ACCESS CONTROL SYSTEM

Efficient automated tracking of thousands of trucks

Real-time automated truck verification and prevention of unauthorized entry through boom barriers and cameras

Automated operation of entry/exit, trip logging and alarms

Complete server architecture integration as well as remote area operations through GIS mapping



INSIDE:

Key Requirements  
Solution  
Implementation  
Working  
Benefits  
Links



### TECHNOLOGY

**Solution:**

EPC Gen2 compliant vehicle tracking solution

**Tag Type:**

Parka™ UHF Passive

**Reader/Antenna:**

Xtenna™  
Xtenna Proximity™  
Wi-Fi Radio Masts

**Method:**

Multiple Tracking via Integrated Reader/Antenna modules

**Integration Platform:**

**RFID Middleware:**

Xtenna™ WebToolkit  
Xtenna™ Studio

**Application:** Essen RFID's

Truck Access Control System

**Database:** SQL Server 2005 Exp. ed.

**Tag Manufacturer/Supplier:**

EsSEN RFID, with US based chip inlay

**Reader/Antenna Manufacturer:**

EsSEN RFID, with US based module

**Systems Integrator:**

EsSEN RFID

For further details contact:

**EsSEN RFID**

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Nariman Point  
Mumbai 400021 India  
[www.essenrfid.com](http://www.essenrfid.com)





## CASE STUDY

### KEY REQUIREMENTS:

Western Coalfields Limited (WCL), based in Nagpur, is a subsidiary of Coal India Limited, the country's monopoly coal mining company and one of the largest in the world. At WCL, coal is mined and transported daily in huge quantities. The company also deploys trucks belonging to contracted vendors and truck operators for coal transport. These trucks need to be tracked and also verified at entry/exit to prevent theft taking place when coal is transported out from vast open coalfields.

Since the existing manual system was inadequate in coping with a large flow of thousands of trucks, an automated system was required that would monitor truck movement to and from the mines.

Main challenges in implementation:

- Identify authorized trucks automatically without human intervention.
- Validate each truck trip and ascertain valid truck registration and vendor.
- Automated alarm in case of blacklisted truck/vendor.
- Maintain an automated record of truck movement into and out of the mines.

### SOLUTION:

Essen RFID offered a RFID-based Truck Access Control System that identified trucks at each entry/exit gate, automated the operation of a boom barrier at the entry gate that allowed entry, and logged individual truck movement and trips into and out of the mining area, with details updated to the central server and reports generated for the management. Essen RFID's total coverage included 11 sub-headquarters of WCL, apart from the main headquarters at Nagpur.

### IMPLEMENTATION:

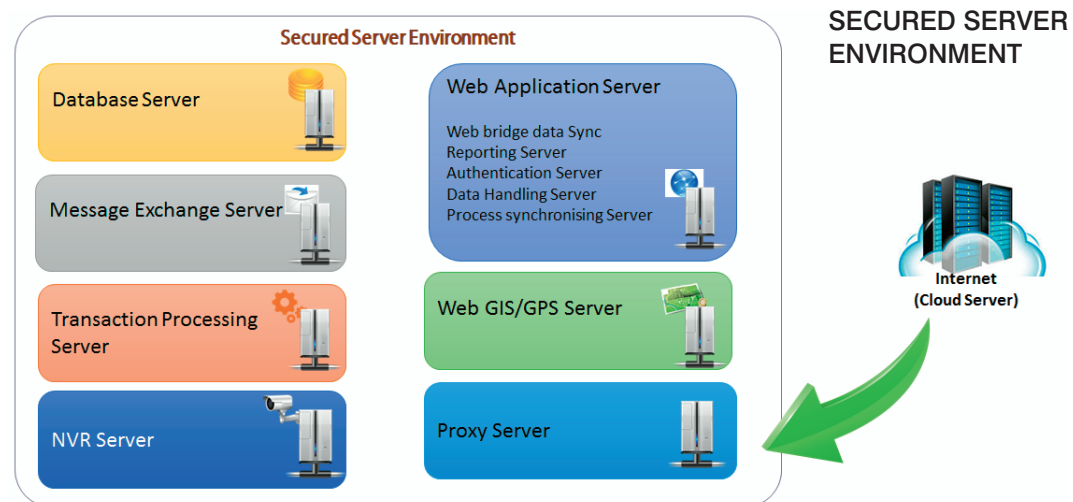
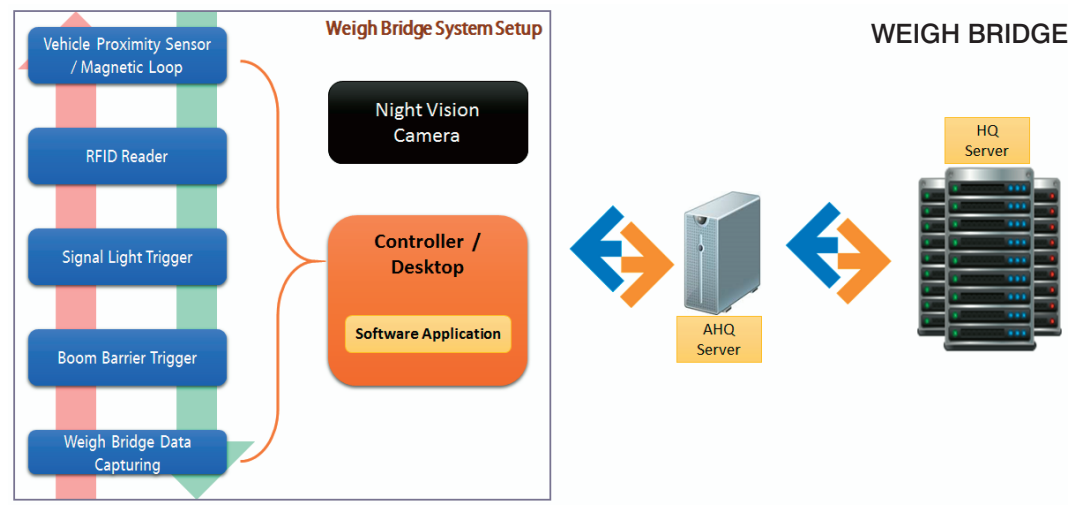
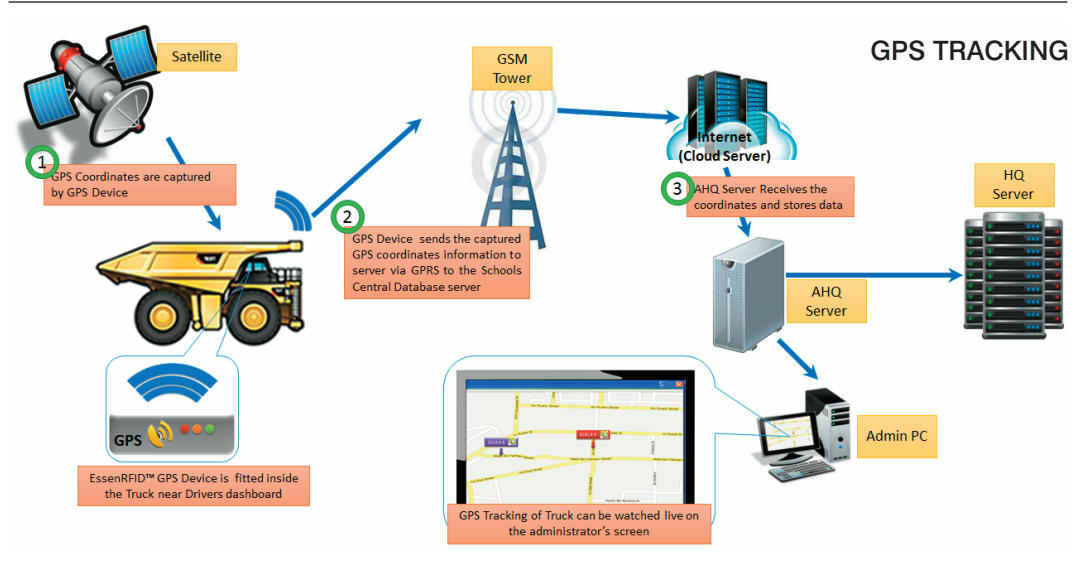
The complete implementation by Essen RFID at WCL includes the entire Server Architecture Integration of Main Server (fail safe RAID with mirroring) along with DBase Server, Proxy Server, Network Server, Web Server, Application Server, Cluster Server, Transactions Server, Mail Server, SMS Server, Cloud Server, NVMS, Anti Virus, VTS Application for GPS Server (developed by Essen RFID along with GIS), Workstations (containing Essen RFID's Application Software), Weighbridge readings, Radio Masts and Boom Barrier.

Xtenna™ RFID Antenna-Readers are installed at the IN and OUT gates in the target areas. In all, 316 Xtenna™ antenna-readers are deployed at various remote locations within the mining area. Wi-Fi Radio Masts are utilized to provide wi-fi connectivity and link these remote locations to the network. Xtenna Proximity™ Reader is installed for tag registration at the registration counter.



## CASE STUDY

### Implementation Flow Diagrams





## CASE STUDY

A PARKA™ RFID tag is issued to each authorized truck and affixed to its windshield. These tags have been affixed to over 2,500 trucks. Each tag is registered into the database for the respective vehicle, using a Xtenna Proximity™ reader. Essen RFID's Truck Access Control System software is installed at each location, along with night-vision cameras, signal lights and boom barriers for granting access to valid trucks. In all, 432 cameras have been deployed, across these locations within the mines. SQL Server is deployed as the local database and network connectivity is installed between the locations and the central server. The number of workstations deployed is 164.

The system also utilizes GPS where available within the mines. Trips to/from remote mining areas are mapped through routes created by GIS mapping generated by Essen RFID.

### WORKING:

Truck details such as registration number, name of the contractor/vendor, destination, etc. are entered into the Truck Access Control System and a PARKA™ RFID tag is assigned to the truck.

A truck entering the mining area approaches the IN gate. The Xtenna™ antenna-reader mounted at the IN gate reads the PARKA™ tag affixed to the windshield of the truck and sends the tag details to the server.

The system checks if the truck is registered in the database and the current trip is valid. If it finds the truck registered and the trip is validated, it sends a command to the trigger switch that controls the boom barrier. The signal light flashes 'Green', the truck's photo is captured and the boom barrier is lifted. The truck enters and its entry time is automatically logged into the system.

If the truck has been blocked or blacklisted in the database, or the truck's trip is not found valid, then the system will sound an alert and the boom barrier stays shut, thereby not allowing entry to the truck.

At the OUT gate, the Xtenna™ mounted there reads the tag of the truck exiting the gate and logs the exit time into the system. The security administrator can view detailed reports of entry and exit timings of each truck.

The system tracks two types of trucks:

- Permanent Vehicles
- Temporary Vehicles

### Permanent Vehicles:

These vehicles are issued a permanent PARKA™ RFID tag that is affixed to the truck's windshield when the truck is registered into the database. When the truck enters the mining area, the Xtenna™ reader-antenna at the IN gate reads the tag and the Truck Access Control System validates the trip.

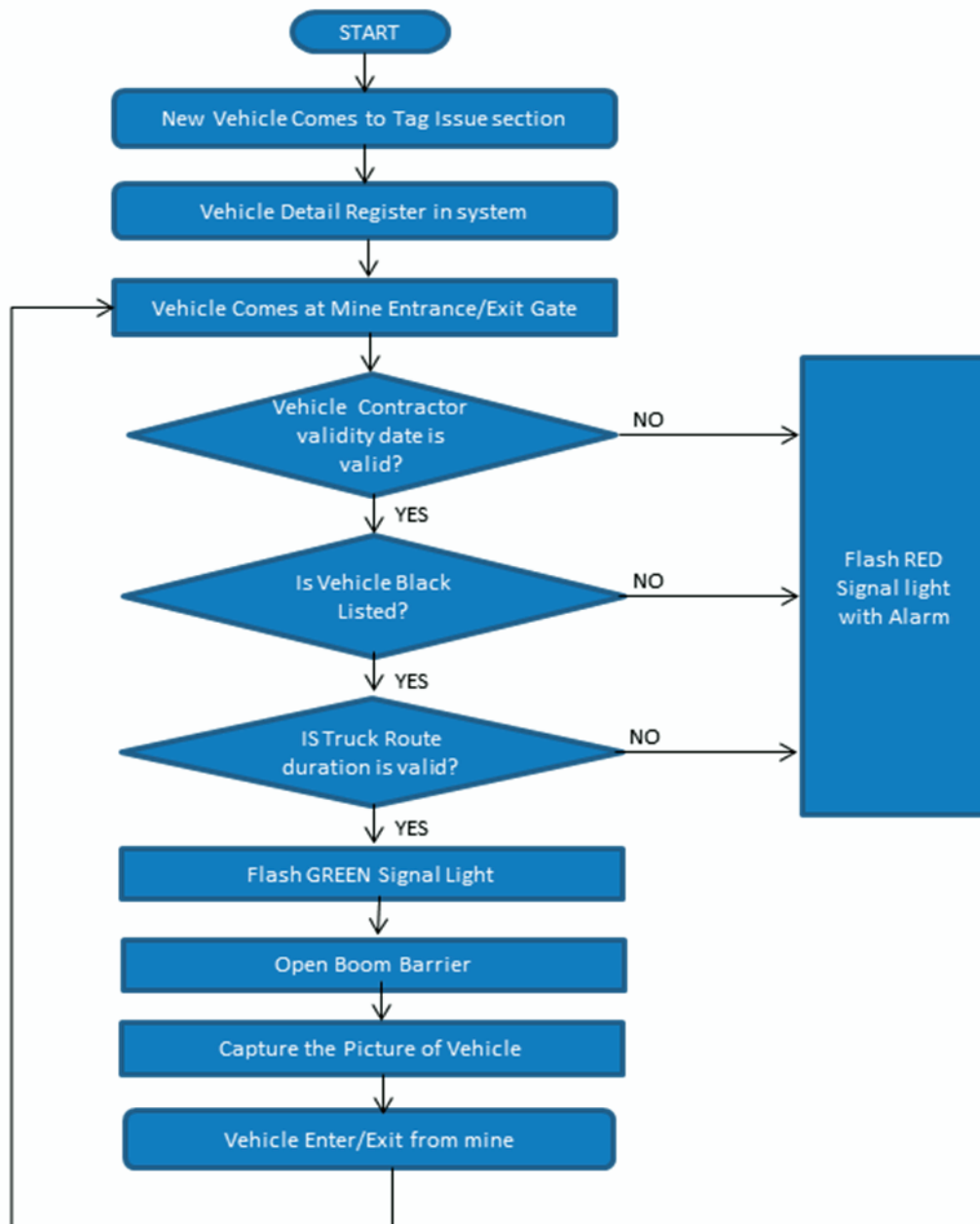


### CASE STUDY

The following validations are carried out:

- Checking if the truck is registered.
- Checking if the truck owner/vendor's contract validity is expired.
- Checking if the truck has been black-listed.
- Checking the truck's previous trip duration.

If the truck passes these validations, the signal light flashes 'Green', the night-vision camera mounted at the gate captures the truck's photo and the boom barrier opens to allow the truck inside. If any of the above conditions are not fulfilled, the boom barrier does not open and the signal light flashes 'Red' along with a loud alarm.





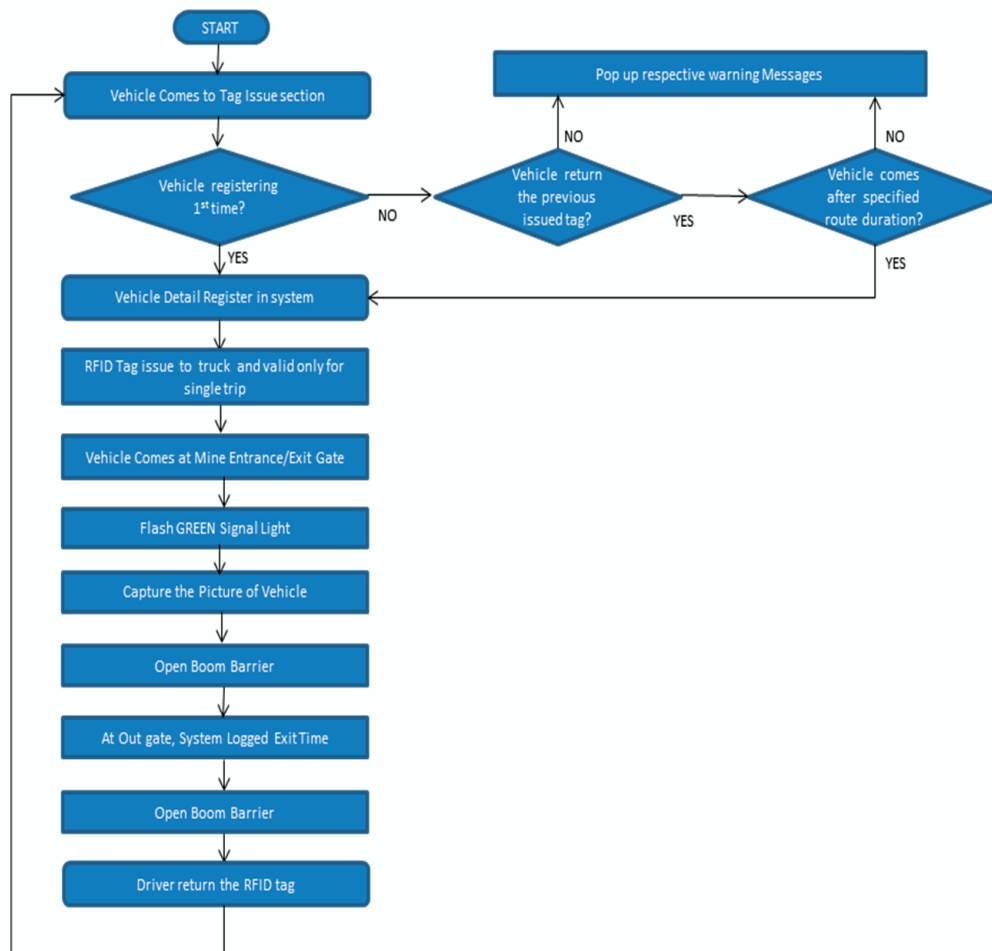
## CASE STUDY

### Temporary Vehicles:

These are trucks that are temporarily hired whenever there is additional requirement for transporting coal. To maintain details of temporary vehicles, the system issues temporary PARKA™ RFID tags that are valid only for a single trip. The truck is registered before the trip and the tag is issued to the truck. After the tag is assigned, the reader at the gate detects the tag and performs validations. If the necessary conditions are fulfilled, the signal light flashes 'Green' and the boom barrier opens to allow the truck to enter.

Temporary vehicles are checked by the system to verify if the truck has been previously registered and that any temporary tag previously issued has been returned.

When the trip is completed, the tag is read at the OUT gate and the time logged into the system. The tag is then returned and de-assigned in the system. After de-assigning, the same tag can be reused for by another temporary vehicle on its next trip.





## CASE STUDY

### Application Flow:

The Truck Access Control System contains the following modules:

- Mine Master
- Party (Vendor) Master
- Route Master
- Product Master
- Vehicle Master
- Delivery Master
- IN Trip Details
- OUT Trip Details

**Mine Master:** Details of each mining area, such as Mine Name, Location, Code, etc. are entered in this module. This location data is used during truck trips. The administrator can ascertain which trips have been made from a particular mine.

**Party (Vendor) Master:** This module contains vendor/contractor details such as their name, address and contact details, as also their contract validity period. If a vendor's contract date has expired, his trucks are not allowed any further trips by the Truck Access Control System.

**Route Master:** Here, route details such as source and destination locations are entered, along with the estimated travel duration for the route. The route can then be mapped to the trucks in the Vehicle Master module and the transaction (trip) time can be validated against the estimated travel time.

The screenshot displays the 'TRUCK ACCESS CONTROL SYSTEM' interface. At the top, it shows 'Version: 1.0.0.54' and 'User: admin'. The main window is divided into several sections:

- Actions:** A sidebar menu with categories like Masters (Mine Master, Party Master, Route Master, Product Master, Vehicle Master, Delivery Order), Transactions (Post Good Issue, Viewer), and User Management (User Master, Role Master, Role Mapping).
- Table:** A table with columns: ROUTE\_ID, ROUTE\_CODE, ROUTE\_NAME, ROUTE\_SOURCE, ROUTE\_DESTINATION, ROUTE\_TRAVEL\_DURATION, IS\_DELETED, and CREATED\_BY. It contains two rows of data.
- Data Entry Form:** A form for 'Route Code' with fields for Route Code (R001), Route Name (Source 1 - Destination 1), Route Source (Source 1), Route Destination (Destination 1), Travel Duration (5.02), and System ID (1). Buttons for OK, Cancel, Clear, and Export To Excel are visible.
- Device Status:** A window showing 'DeviceIP: 192.168.123.147', 'Status Time: 16:16:0', and 'Tags read: 1'. A tag ID '0a0500024a30313000000000' is displayed in green.
- Route Details:** A section for 'Log' with a table for recording trip details.

The Xtenna logo is visible at the bottom left of the interface.



### CASE STUDY

**Product Master:** Various types and grades of coal that are mined are entered into the Product Master.

**Delivery Master:** Delivery orders are generated at the central server and downloaded to the local server. When trucks arrive at the IN gate, the operator selects a particular delivery order and allots it to the trip.

**Vehicle Master:** Each truck is registered into the database along with its details, such as license plate number, driver's name and contact number, truck's tare weight, etc. in this module. The vehicle owner/vendor's name is mapped to the vehicle from the Party Master. A PARKA™ RFID tag is then assigned to the truck using the Xtenna Proximity™ reader. A route is then allotted to the vehicle.

The screenshot shows a 'Data Entry Form' for a vehicle. It contains the following fields and values:

Vehicle No	6AP-05-TBA-8765	Vehicle Max Capacity	25000
Vehicle Code	V-002	Vehicle Status	IS_Active
Driver Name	RAJU SATANKAR	Number of Axle	4
Tare weight	14000	Current Route	Source 2 - Destination 2
Party Name	Mokal Transporter	Device IP	192.168.123.148
Tare Date	Saturday, August 24, 2013	Tag ID	0162805324813899000000
System ID	2		

Buttons at the bottom: OK, Cancel, Clear, Export To Excel.

**IN Trip Details:** Xtenna™ antenna-readers are installed at each IN and OUT gate of the mine location. Xtenna™ reads the truck's RFID tag and sends this information to the system. The system retrieves the truck's details from the database and displays them to the operator.

The screenshot shows the 'TRUCK ACCESS CONTROL SYSTEM' interface. It includes a navigation menu on the left and a main data entry area. The main area displays the following information:

- Version: 1.0.0.54, User: admin
- License Plate No: MP-03-MG-2784
- Delivery ID No: L1133
- Gate: IN
- Delivery Order No: 00-0001
- Delivery Order Date: 20-08-2013 00:00:00
- Product Name: [Empty]
- Vehicle Information:
  - Vendor Name: Sharma Transporter
  - Driver Name: Ja'raj
  - Number of Axle: 7
  - Route Name: [Empty]
  - Route Source: [Empty]
  - Route Destination: Destination 1

Buttons: Save (F2), Cancel, Clear.

Bottom left: Xtenna™ logo and device status: Device IP: 192.168.123.147, Status Time: 16:16:0, Tags read: 1, 0a0500024a30313000000000.





## CASE STUDY

The Truck Access Control System displays alerts on screen to validate the vehicle and prevent unauthorized trips. Some of these alerts are:

1. If the tag is non-registered, or the truck has been black-listed.
2. If the vehicle owner's contract has expired.
3. If the trip time is valid, i.e. if the vehicle arrives for the next trip within the time allocated for the previous trip, then it is likely that the truck has not completed the previous trip correctly.

**OUT Trip Details:** When a truck arrives at the OUT gate, the Xtenna™ antenna-reader mounted there reads the truck's RFID tag and logs its OUT time into the system. If the truck is a temporary vehicle, its tag is returned at the OUT gate for de-assigning and reuse.

The screenshot shows the 'TRUCK ACCESS CONTROL SYSTEM' interface. At the top, it displays 'Version: 1.0.0.54' and 'User: admin'. The main form is titled 'TRUCK ACCESS CONTROL SYSTEM' and includes a 'License Plate No' field with the value 'MP-03-MG-2784' and a 'Delivery ID No' field with the value 'L1133'. A red 'OUT' button is visible. Below these fields are sections for 'Delivery Order Information' and 'Vehicle Information'. The 'Delivery Order Information' section includes fields for 'Delivery Order No' (00-0001), 'Delivery Order Date' (20-09-2013 00:00:00), and 'Product Name'. The 'Vehicle Information' section includes fields for 'Vendor Name' (Sharma Transporter), 'Route Name' (Source 1 - Destination 1), 'Driver Name' (Jain), 'Route Source' (Source 1), and 'Number of Axle' (7). At the bottom of the form, there are buttons for 'Save (F2)', 'Cancel', 'Clear', and 'Return'. A 'Trip Details' section is also visible, showing a 'Log' table with one entry: '0a0500024a3031300000000000'. The Xtenna logo is visible in the bottom left corner.

### Reports:

The Truck Access Control System saves daily trip details into the database. Trip reports are available to authorized persons such as shift supervisors. These reports can be viewed, printed and filtered for specific data. Examples of reports are Vendor Master Report, Vehicle Master Report, Total Trip Details, Summary Report, etc.

**Vendor Master Report:** This report allows the user to view vendor details such as the vendor's name, address and contact details, and the vendor's contract expiry date.



## CASE STUDY

**Vehicle Master Report:** This report displays details of trucks registered in the Truck Access Control System database, along with their details, status and owner/vendor's name.

VEH_NO	VENDOR_NAME	STATUS	ROUTE NAME	Max Capacity
MP-03-MG-2784	Sharma Transport	ACTIVE	Source1-Destination1	30000
MP-13-JG-2884	Sharma Transport	ACTIVE	Source1-Destination1	30000
MP-34-JJ-5674	Gupta Transport	BLACKLISTED	Source2-Destination2	35000
MP-14-KJ-2374	Gupta Transport	ACTIVE	Source2-Destination2	35000
MP-34-JJ-5254	Gupta Transport	ACTIVE	Source2-Destination2	35000
MP-01-MJ-5786	Gupta Transport	ACTIVE	Source2-Destination2	35000

**Total Trip Details:** This report provides vendor-wise details of trips including truck IN and OUT times, product type, delivery order, etc.

**Summary Report:** This report provides a vendor-wise summary of the trip count.

### BENEFITS:

- Verification of each truck entering the mining area.
- Prevents unauthorized entry of trucks.
- Automated identification of truck contractor and validation of contract period in the database for each truck.
- Manual entry of trucks is not required due to automated RFID detection.
- Automated logging of entry/exit at IN and OUT gates.
- Automated entry/exit logging enables automated calculation of trips made.
- Allows tracking of temporary vehicles.
- Enables correct payments to be made for trips by each truck.
- Brings transparency in truck trip operations.
- Ease of use and saves time.
- Improved efficiency through automated processes.
- Provides management with report generation and analysis in real time.



## CASE STUDY

### LINKS:

#### Hardware:



#### Tags:



#### Software:



#### Reference Example:

<http://www.essenfid.com/Mailer/accessparking-flash-demo.pdf>

<http://www.essenfid.com/Mailer/mining-flash-demo.pdf>