



Road User Charges Review Group



## Road User Charges Review: Expert Technological Advice – Report 3

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# Road User Charges Review: Expert Technological Advice – Report 3

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# 1 INTRODUCTION

Hyder Consulting prepared an Expert Technical Advice report for the Road User Charges (RUC) Review Group in late 2008. In response to questions from the group Hyder Consulting prepared a further brief report in January 2009. This document accompanies, and should be read in conjunction with, the “Expert Technical Advice” documents previously provided to the Road User Charges Review Group. It contains further clarification and advice around the following points requested by the Group:

- 1 The (unconfirmed) business drivers and business requirements of the various RUC “actors” to use an automated technology based system as proposed by the sample diagram:
  - (i) RUC administration
  - (ii) Transport Operators
  - (iii) Police
  - (iv) Commercial tracking providersIt is understood that the RUC review group will confirm the accuracy of this section with each of the groups prior to publication.
- 2 The estimated time requirement of the RUC inspection component during an enforcement stop.
- 3 A high level desktop based list of possible strategic sites for automated audit/ enforcement gantries and high level principles and dependencies. This has been developed using the heavy traffic volumes indicated by NZTA<sup>1</sup>'s GIS<sup>2</sup> viewer. It is recommended that further development of this list of sites would require close consultation with local CVIU<sup>3</sup> staff to confirm optimum positioning, including the availability/ elimination of viable bypass routes.
- 4 A high level benefit cost ratio for implementing strategic sites for automated audit/ enforcement gantries.
- 5 Proposed benchmarks for a trial of GNSS<sup>4</sup> based positioning systems.
- 6 Other Services a Transport Sector Data Pool Might Offer Small, Medium and Large Enterprises.
- 7 High level description and high level estimate of costs for the proposed transport sector standard web service interface.
- 8 Availability and cost of OBU<sup>5</sup> components and digital tachygraphs.

The high level benefit cost ratio concludes that the inclusion of automated audit sites in a GNSS based RUC system strongly aligns with the objectives of Government to improve productivity and attain greater value for money:

- it will increase net revenue to the Government accounts now and in the future
- it will improve the productivity of industry and enforcement agencies now and in the future
- It will improve the productivity of the economy as a whole by funding more construction and maintenance of transport infrastructure now and in the future, and in particular improving the wealth of taxpayers to help bring Crown debt down to prudent levels.

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<sup>1</sup> New Zealand Transport Agency

<sup>2</sup> Geographic Information System

<sup>3</sup> New Zealand Police Commercial Vehicle Investigations Unit

<sup>4</sup> Global Navigation Satellite Systems

<sup>5</sup> On Board Unit

## 2 Draft RUC System Business Drivers and Requirements

It is recognised that any alternative RUC system should address (as far as possible) the strategic business drivers and requirements of all parties to the system. This section lists indicative strategic business drivers (relating to RUC) that are readily identified for each of the key stakeholders, along with strategic business requirements. **This is on a best assessment basis, that may not be conclusive, and it is subject to consultation and confirmation (or otherwise) with each of the key stakeholders. It is understood that the Road User Charges Review Group will undertake the required consultation.**

### 2.1 RUC Administration

RUC administration is currently carried out by the NZTA ECU (Economic Compliance Unit) on behalf of the Ministry of Transport. The key business drivers and requirements are outlined.

#### Key business drivers are:

- Maximising the percentage collection of RUC revenue that is due.
- Providing refunds accurately and efficiently when they are due.
- Minimising credit risk.
- Meeting the Government's requirements for RUC with a sound administrative system that matches those requirements.
- Operating effective and accurate business systems that readily withstand evidential tests to both criminal and civil standards.

#### Key requirements from Government:

- Clear definition of the strategic objectives of a fair and equitable RUC system that accounts for the actual and potential inter relationships with other Government strategic objectives.
- Clear definition of the parameters that are to be measured to meet the strategic RUC objectives. i.e. the current system varies by nominated weight, axle configuration, motive power, distance, on and off road.
- Legislation to address any changes or improvements required in the RUC environment

#### Strategic business requirements are:

- Simplification of business process to reduce overhead costs.
- Elimination of unnecessary system elements and legal defences that are required to support the current IT system.
- A business system that minimises opportunity for evasion, enhances audit capabilities and maximises detection of evasion when it occurs.
- A business system supported by simple, cost effective and agile information systems, designed to meet changing business requirements and readily supporting web services.

- A RUC system that automatically updates with changes to records in other services, for example change of company name (Companies Office web service) or a change in registration number (motor vehicle register).

## 2.2 Vehicle Operators

Vehicle operators that are subject to RUC fall into two main groups (heavy and light) the heavy group can be further split into those that are primarily engaged in transportation and those that use heavy vehicles for other purposes. The business drivers are slightly different due to the cost of RUC and the influence on the overall business.

### 2.2.1 Commercial transport operators

Key business drivers are:

- Maximising profit.
- Competitive advantage.
- Customer service.
- Balancing willing compliance with transport law against associated costs of compliance.
- Optional use of automated electronic systems for many purposes, collecting each type of data once only (including road user charging), to gain commercial advantage.

Strategic business requirements are:

- Simplifying business process to minimise RUC administrative costs and overheads.
- Continuously available, real time, electronic RUC purchasing potentially with electronic evidence of purchase replacing the requirement to display a RUC licence and potentially charging for actual weight carried.
- Choice of hubodometer or electronic tracking system based road user charging as a commercial decision.

### 2.2.2 Operators of other heavy vehicles

Key business drivers are:

- Maximising profit in a non-transport business requiring trucks e.g. farming, trades, support vehicles etc.
- Minimising administrative costs while ensuring RUC requirements are met.

Strategic business requirements are:

- A simple to use readily available system, enabling compliance with RUC requirements and minimum intervention.

## 2.2.3 Private owners of light diesel vehicles

Key business drivers are:

- Minimising administrative costs.

Strategic business requirements are:

- A simple to use readily available system, enabling compliance with RUC requirements and minimum intervention.

## 2.3 Enforcement

The majority of RUC enforcement is carried out by the New Zealand Police Commercial Vehicle Investigations Unit as part of their wider role enforcing commercial vehicle legislation.

### 2.3.1 Police CVIU

Key business drivers are:

- Maximising compliance with RUC legal requirements.
- Maximising detection of non-compliance with RUC legal requirements.
- Minimising time spent collecting, processing and proving offences.

Strategic business requirements are:

- A simple, fair RUC system, with no (or minimum) legal defences available.
- Continuously available access to real time RUC data with printed results of any query being legislated as primary evidence of compliance or non-compliance.
- Automated system generation of infringement notices, wherever possible.
- Automated collection of highly accurate data using appropriate hand held electronic devices.
- Minimising the range of traffic offence notices (increased infringement range).
- Accurate, evidence based, intelligence gained from the largest possible pool of data about vehicle movements and compliance. This may include data from:
  - enforcement checks
  - automated audit systems
  - mobile ANPR
  - exception reports from commercial tracking providers,

All this information may be electronically collected and collated real time then analysed in conjunction with other relevant information to minimise enforcement of compliant operators and provide an evidence base for targeted enforcement of non compliant operators.



- Near real time (within 4-5 seconds) electronic assessment of vehicle compliance enabling automated decisions about whether to stop a particular vehicle for an enforcement check.
- Allowing judges to reduce RUC infringement fees only when exceptional circumstances exist.
- Streamlined prosecution system minimising time spent preparing files and in court.

## 2.3.2 ECU

The New Zealand Transport Agency Economic Compliance Unit administers RUC, including audit and civil recovery of debt.

### Key business drivers are:

- Maximising compliance with RUC legal requirements.
- Maximising detection of non-compliance with RUC legal requirements.
- Minimising time spent collecting, processing and obtaining civil debt recovery of payment shortfalls and evasion.

### Strategic business requirements are:

- A simple, fair RUC system, with no (or minimum) legal defences available.
- Continuously available access to real time RUC data with printed results of any ECU or Police query being legislated as primary evidence of compliance or non-compliance.
- Ensuring any refund payment system is manageable, requires evidence, is simple to follow and simple to audit.
- Automated system generation of binding debt recovery notices, wherever possible.
- A similar assessment system to Inland Revenue Department with assessments being amounts due unless the subject requests a hearing.
- Accurate, evidence based, intelligence gained from the largest possible pool of data about vehicle movements and compliance. This may include data from:
  - enforcement checks
  - automated audit systems
  - mobile ANPR
  - exception reports from commercial tracking providers,

All this information may be electronically collected and collated real time then analysed in conjunction with other relevant information to minimise enforcement of compliant operators and provide an evidence base for targeted enforcement of non compliant operators.

- Legislation providing no discretion for judges to reduce assessed amounts payable unless:
  - exceptional circumstances exist and

- sound proof of actual distance travelled is produced by the subject.
- Streamlined debt recovery system minimising time spent preparing files and in court.

## 2.4 Commercial Tracking Providers

Commercial tracking providers already perform the service of using GNSS systems to track vehicle movements. With some modification most or all of the current providers are likely to be able to provide RUC services.

### Key business drivers are:

- Maximising profit.
- Competitive advantage.
- Customer service.
- Minimising administrative costs.
- Ensuring the service provided meets the requirements of all stakeholders.

### Strategic business requirements are:

- Clear definition of the requirements for the RUC system so that the tracking system can be built (or modified) to specification. For example:
  1. What is on road or off road? (is this a set distance from the centre line irrespective of road width, legal boundary, edge of road surface (tarmac or gravel) or self defined and verified GIS polygon?)
  2. What data does the RUC administration require and in what format?
  3. What degree of accuracy and security is required?
  4. Can the tracking provider collect RUC on behalf of the Government?
  5. How are trailers dealt with?
- Web service interface with Government RUC administration.
- Definition of security and audit requirements
- Definition of OBU (device) and system requirements
- Definition of standard data requirements and format.
- Definition of commercial terms of engagement.

### 3 Estimated Time Requirement - RUC Inspections

In estimating the time required for the RUC inspection component of an enforcement stop there are a number of key variables under the current system and alternatively with a handheld electronic device (working with an associated back office – assumes use of the RID system<sup>6</sup>):

- Number of vehicles in a given combination and number of axles in each.
- Whether the vehicle (combination) is weighed and by what method.
- Whether further background checks are considered necessary under the current system. (not included in the time estimate but may add another 5-10 minutes to an inspection)

It is assumed in the following time models that the inspection described is straightforward and thorough, checking and recording each component against that displayed on (or electronically obtained for) each RUC distance licence. The estimated time in minutes is based on more the author’s practical experience of more than 10 years checking and weighing trucks as an enforcement officer. These times are indicative estimates of each check component rather than a scientific sample of timed checks.

Type of vehicle	Tractor				Trailer 1				Trailer 2			
	1	2	3	4	1	2	3	4	1	2	3	4
Number of axles	1	2	3	4	1	2	3	4	1	2	3	4
Average wait time prior to check	2											
<b>Check:</b>												
Driver/ operator /owner details	5											
registration number (label, front and rear plate)	1				1				1			
Distance (min/max and hubo)	1				1				1			
Vehicle type / configuration	1				1				1			
Hubo serial number (label/hubo)	1				1				1			
Nominated weight (label only)	1				1				1			
<b>Weigh type</b>												
No weigh	0	0	0	0	0	0	0	0	0	0	0	0
Dynamic weigh	0.5				0.5				0.5			
Pits weigh	1	1	1	1	1	1	1	1	1	1	1	1
Ramp and dummy weigh	5	5	5	5	5	5	5	5	5	5	5	5
<b>Totals</b>												
No weigh	12				17				22			
Dynamic weigh	12.5				18				23.5			
Pits weigh	13	14	15	16	16	17	18	19	19	20	21	22
Ramp and dummy weigh	17	22	27	32	32	37	42	47	47	52	57	62
					(For 3 axle tractor)				( 3 axle tractor/ 3 axle trailer 1)			
Pits weigh					17	18	19	20				
Ramp and dummy weigh					37	42	47	52				
					(For 4 axle tractor)							

Figure 3.1: Current estimated RUC inspection time (in minutes)

<sup>6</sup> Refer to Appendix 3 and the primary report for information about RID.

Type of Vehicle	Tractor				Trailer 1				Trailer 2			
	1	2	3	4	1	2	3	4	1	2	3	4
Number of axles	1	2	3	4	1	2	3	4	1	2	3	4
Average wait time prior to check	1											
<b>Check:</b> Scan driver/ operator /owner details from cards	0.5											
Physical confirmation of rego/ type/ hubo serial	1				1				1			
Physical distance entry	0.5				0.5				0.5			
<b>Weigh type</b>												
No weigh	0	0	0	0	0	0	0	0	0	0	0	0
Dynamic weigh	0.5				0.5				0.5			
Pits weigh (electronic link)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Ramp and dummy weigh	5	5	5	5	5	5	5	5	5	5	5	5
<b>Totals</b>												
No weigh	3				4.5				6			
Dynamic weigh	3.5				5.5				7.5			
Pits weigh (electronic link)	3.5	4	4.5	5	5	5.5	6	6.5	6.5	7	7.5	8
Ramp and dummy weigh	8	13	18	23	23	28	33	38	38	43	48	53
					(For 3 axle tractor)				(3 axle tractor/ 3 axle trailer 1)			
Pits weigh					5.5	6	6.5	7				
Ramp and dummy weigh					28	33	38	43				
					(For 4 axle tractor)							

**Figure 3.2: RUC inspection time model with handheld devices linked to RID system (minutes)**

This model indicates that, if RUC enforcement was conducted electronically, between 10 to 15 minutes might be saved on every Police CVIU enforcement stop. Electronic RUC enforcement is assumed to be based on handheld devices that communicate real time with the relevant real time back office databases. (unless outside range of communications).

The time savings will be made by electronic collection of key data fields (digital imaging or scanning bar codes) to query “known” relevant electronic information from existing source databases. This replaces the current system where the same information is copied from printed forms onto another paper form which is manually keyed back into several databases at a later date.

The physical checks are then completed confirming the accuracy of “known” information.

The result is anticipated to be a highly accurate near real time enforcement record that may be automatically emailed to the operator, with the same electronic evidence being admissible in court (if required).

Secondary time savings may be made in eliminating the current time, cost and error potential with electronic data entry and thirdly eliminating subsequent scanning of paper forms and storage of images.

It is equally feasible to automate generation of a range of offence notices from the same information providing further time and cost savings.

## 4 Strategic Automated Audit / Enforcement Sites.

### 4.1 Purpose

On their own, remote electronic tracking systems can potentially provide inaccurate results (for a variety of reasons legitimate and otherwise). The tracking service provider may not necessarily detect that fact. Strategic automated audit / enforcement sites add a layer of confidence and security to any information gained from an automated tracking system. The physical confirmation of vehicle position and weight if WIM (weigh in motion) is included at a given time assures providers that the electronic tracking information is accurate. Deliberate avoidance of strategic automated sites will, in itself, carry an economic burden.

### 4.2 Business requirement

The business requirement for automated strategic audit sites is as follows:

- Electronic tracking services do not physically view any vehicles. If an evasive operator devised a method of electronically transmitting false electronic position and weight readings for a vehicle, audit sites reporting the physical weight and position of a vehicle at a given time supply information for automated comparison and generation of exception reports if the electronic position and weight do not correspond.
- Road User Charges evasion estimated variously between \$40 million and in excess of \$200 million occurs every year using current enforcement methodologies.
- Strategic placement of automated sites identifies those operators who are operating in a compliant way, therefore require minimal enforcement stops, while reporting those operators who are not operating in a compliant way for targeted enforcement action.
- Targeted enforcement of non compliant operators will optimally rely on a wealth of evidence based information about non compliance. Currently this is largely gained by enforcement stops. Automated data collection provides continuous, unbiased coverage and increases the accuracy and fairness of information about compliance.
- Automated sites can provide accurate RUC enforcement information which could potentially be legislated to generate automated infringement notices in a method similar to speed cameras and red light cameras.
- Automated sites may readily be configured to provide screening of all vehicles approaching a weigh station (in conjunction with real time tracking information) and identify and prioritise a range of non compliant issues with a vehicle while permitting compliant vehicles to stop briefly or bypass the weigh station.
- Consideration might be given to using the same sites and system for automated fatigue monitoring, heavy vehicle driving hours and point to point speed (as per the Australian Safe T Cam system).

### 4.3 Business benefit

The benefit of an automated system is provision of a highly accurate, continuously available and unbiased stream of data about vehicles subject to road user charges. The New Zealand Police are physically unable to continuously manually record details of all commercial vehicles passing any given site and automated systems provide valuable enforcement tools.

The United Kingdom Vehicle and Operator Services Agency VIPER automated ANPR/WIM (automated number plate recognition/ weigh in motion) trials showed a 700% increase in the identification and prohibition of overweight vehicles. The German LKW Maut system combines GNSS, Gantries with DSRC (digital short range communication) and stringent enforcement which has reduced evasion to significantly below 2%. These systems are indicative of the inroads that strategic sites in addition to a GNSS based system may make to current New Zealand RUC evasion issues.

## 4.4 Location

Hyder Consulting was requested to provide a desktop list of possible strategic automated audit sites. These are split into a primary set of sites on approach to existing weigh stations, a primary set of sites with high heavy traffic volume and a secondary set of sites in areas with medium heavy traffic volume that are remote from primary sites. Each site should be located at a position where it is uneconomic to use avoidance routes on a regular basis. Use of alternate routes might also be detected by a range of other options, generally including the tracking system itself.

It is acknowledged that there may be some locations that may have existing gantries with power and optic fibre communications. RUC audit equipment could be added relatively simply in these cases significantly lowering costs.

As the list is a desktop indication, detailed consultation with experienced local CVIU staff (in each area) is strongly recommended as a next step in developing the proposal.

### 4.4.1 Indicative Primary Sites (32 total)

Primary sites are adjacent to weigh stations where no alternative routes are available, near major port and rail yard entrances/exits where there is only one entrance/exit and in other areas with an annual average daily heavy traffic volume of over 2,000 vehicles. There is significant scope for further sites, particularly in the Auckland area.

#### Weigh stations (15 sites)

Weigh station	Comment	Number of sites	Number of lanes
Stanley Street, Auckland	May not be suitable due to many alternate routes. Possible site: Port of Auckland container terminal entrance/exit gates	2	2 each side
Neilson Street, Auckland	Serves Metroport	1	2
Drury, Auckland	1 site to north and 1 site to south on SH1	2	2 each side
SH30 Rotokawa (Eastern side of Lake Rotorua);	Te Ngae Rd between Tarawera Rd and Brent Rd	2	2
SH1 Turangi	1 site to north and 1 site to south	2	2
SH1 Ohakea	1 site to north and 1 site to south	2	2
SH1 Plimmerton (north and south bound)	1 site to north (possibly Pekapeka, as below) and 1 site to south (north of Grays Rd)	2	2 each side
SH1 Glasnevin	1 site to north and 1 site to south	2	2

**Comparison:** The Californian pre pass system (figure 4.1) is indicative of the general layout and operation of WIM associated with weigh stations. WIM sites associated with weigh stations have proven to be effective screening devices. The Netherlands WIM screening system has demonstrated that overloading offences are present in 95% of vehicles selected by WIM.

## How PrePass™ Works

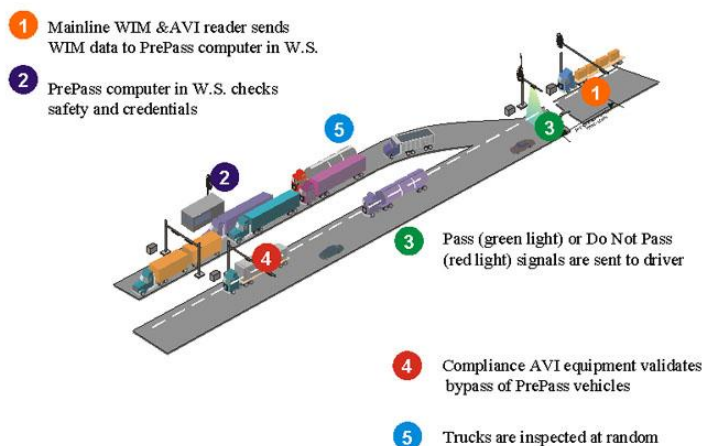
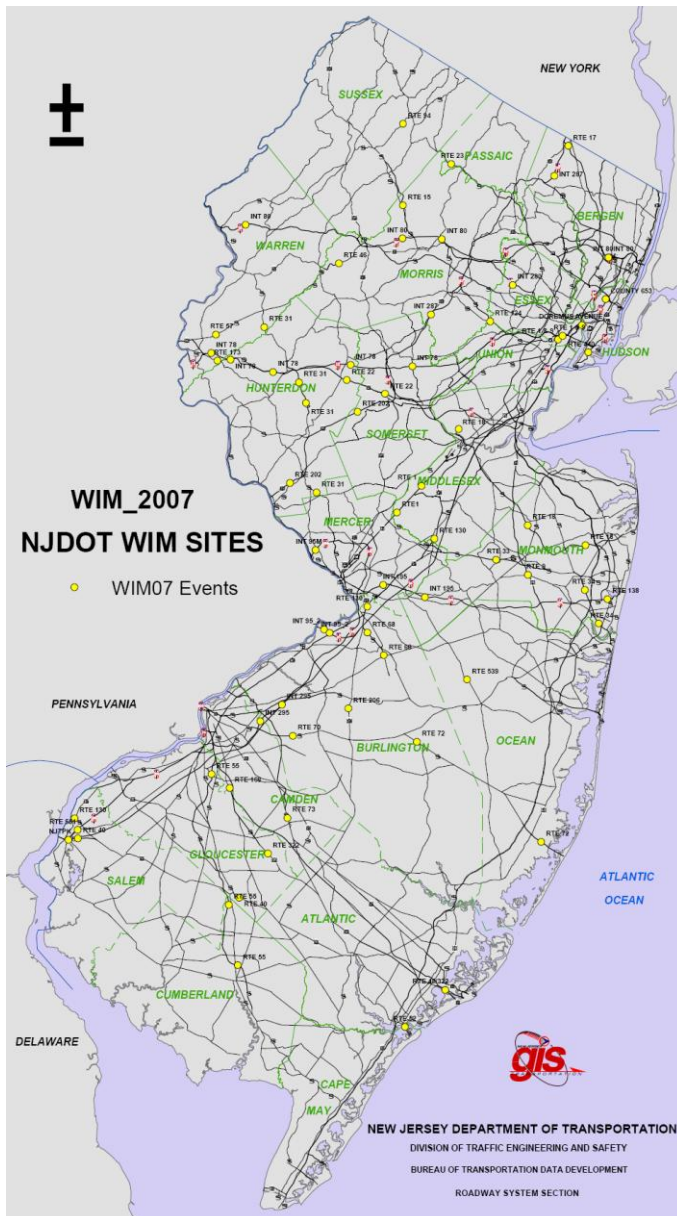


Figure 4.1: Californian prepass system overview (WIM associated with weigh stations)

### 4.4.2 Heavy traffic volume over 2 000 AADT and strategic (17 sites)

Site	Comment	Number of sites	Number of lanes
Otaika Rd, Whangerau	South of Tarewa Rd covering all lanes	1	2
Northshore near Auckland Harbour bridge	Covering all northbound and southbound lanes prior to Esmonde Rd off ramp Note: existing gantries	1	5 each side
SH16 Te Atatu (North Western motorway)	Covering all northbound and southbound lanes Note: existing gantries	1	3 each side
SH1 north of Ngaruawahia	Covering all northbound and southbound lanes	1	2
Wiri, Auckland	Wiri inland port, Auckland	1	2
Ngati Maru Highway (Kopu - Thames)	SH25 Covering all northbound and southbound lanes	1	2
SH1 Cambridge	Tirau Rd between Dominion Ave and Shakespeare St	1	2
SH2 Tauranga	Between Welcome Bay Rd and Bell Rd	1	2
SH2 Tauranga	Between Bethlehem Rd and Mayfield Lane	1	2
SH5 Rotorua	Ngonotaha Rd Near Fairy Springs	1	2

Site	Comment	Number of sites	Number of lanes
SH1 Taupo (north)	Bridge over Waikato headwaters (Tongariro St)	1	2
SH1 Taupo (south)	South of Anzac Memorial Drive	1	2
Devon Rd New Plymouth	Between Queens Rd and bridge	1	2
SH2	Between Ngarauanga and Petone, north and southbound	1	2 each way
Aotea Qy Wellington	Between rail freight yard and motorway on/off ramps, also at rail ferry exit northbound	2	2 each way
SH1 Christchurch	Between Burnham and Rolleston	1	2



**Comparison:**

The State of New Jersey network of strategic weigh in motion sites provide traffic counts, vehicle classification, weight and speed monitoring for the state Department of Transportation.

The purpose of these sites is primarily safety and maintenance. The method of operation (strategic electronic sites) is well established and the technologies are well established.

Figure 4.2: New Jersey Strategic Weigh in Motion Sites



### 4.4.3 Indicative Secondary Sites (10 sites)

Secondary sites are on major strategic routes with high heavy traffic volumes (1000 – 2000 AADT) where there is no economic alternative route and no other site in the area. If cost is an issue consideration may be given to ANPR without WIM.

Site	Comment	Number of sites	Number of lanes
SH3 Te Kuiti	North of Te Kuiti	1	2
SH1 Waikanae	North of Pekapeka – captures any vehicles that have bypassed Plimmerton weigh station	1	2
SH2 Kaitoke	Alternately SH2 Featherston captures any vehicles that use Rimutakas to avoid SH1 Waikanae to/from Wellington.	1	2
SH6 Nelson	Between Havelock and Nelson	1	2
SH1 Picton	Between Koromiko and Tuamarina	1	2
SH6 Nelson	Between Hope and Nelson	1	2
Christchurch – Port of Lyttleton	Alternately Brougham St near Opawa Rd	1	2
Site to be selected	Timaru/ Oamaru	1	2
SH1 Dunedin	Waikouaiti – Waitati Rd	1	2
Site to be selected	Invercargill	1	2

## 4.5 Cost Estimate

Costing of ANPR/WIM sites is necessarily site specific by component to meet business requirements. The cost variation by site for a more accurate estimate will study:

- The amount of new installation required versus using existing infrastructure for example:
  - Existing overhead gantries (and possibly high resolution cameras) owned by NZTA Highways might be used at some sites including the existing power and communications. There are existing gantries at the two multi lane sites (SH1 Northshore and SH16, Te Atatu.
  - Existing bridges might be used for the addition of WIM installations (measuring gross weight).
  - Availability of existing power and suitable communications reduces capital costs.
- ANPR without WIM might be considered where WIM installation is not feasible or as a low cost alternative, increasing the number of audit sites. It should be noted that WIM is an important element if the RUC system retains nominated or actual weights.
- The number of lanes at a given site dictates the size and cost of a gantry:

- Two lane highways might utilise ANPR cameras mounted at the side of the road or on long overhead poles (refer photograph 4.3) rather than on overhead gantries.
- Road resurfacing may be required to provide a level approach to WIM apparatus.

The technologies being considered are in use in a variety of countries. The Netherlands system is a sound example of an integrated WIM system. Similar systems are used in UK (VOSA Viper system), Australian (NSW) system, and in state systems in USA, these include the California “prepass” system and the New Jersey system and Connecticut systems.



**Photograph 4.3: Automated WIM /ANPR in Connecticut, USA**

A high level indication of cost may be broken down by component as follows:

### Fixed cost component

- High resolution digital ANPR cameras
- WIM (piezo, plate or bridge installation)
- Poles or gantries (where existing infrastructure is not available)
- Roadside ANPR processing
- Installation of ANPR
- Installation of communications
- Installation of power supply
- Installation of WIM per lane (includes levelling of approach when required)
- Back office: this is a portion of overall cost and is not readily able to be estimated until specific design requirements, number of services and constraints are known (as per section 8). Current high level estimate ranges between \$3 million and \$200 million.

## Operational cost component

- Back office: the cost is entirely dependent on the simplicity of architecture and actual degree of automation. Simpler architectures generally require less power, servers and staff to operate.
- Maintenance: may form part of supply contract for each component.
- Power supply: includes line charge and usage, may form part of supply contract. Power supplies are required for roadside equipment, communications, back office servers and refrigeration where a significant number of servers are in operation in a one room.
- Communications: The cost depends on the type of technology used, the amount of data that is required to be transferred and the communications channels. Live video transmission is data intensive. Roadside ANPR processing used in effective systems does not transmit live video; instead it only transmits relevant data and static pictures as in photograph 4.4.



Photograph 4.4: Communicating WIM data directly to a handheld device is an option.

## 4.6 Cost model for automated roadside sites

A high level indicative cost model has been developed estimating capital costs of combined audit sites (WIM / ANPR sites and associated on site technologies).

If no existing infrastructure exists and road levelling is required, high level indicative estimate for a complete installation of an audit site is around \$250 000 for a two lane site. This covers almost all indicative sites with the exception of SH1 north of Auckland harbour bridge (5 lanes each direction), SH16 Te Atatu (3 lanes each direction) with existing gantries and infrastructure. For this reason \$250 000 has been used as a base price in the high level benefit cost analysis.

The overall price may however be significantly reduced by maximising usage of existing highway infrastructure (power, communications, gantries etc). Consideration may also be given to sharing costs of new infrastructure with other Government agencies. This cost model does not reflect ongoing maintenance and operational costs.

# 5 Automated Audit Sites – A Rapid Benefit-Cost Analysis

A network of automated audit ANPR/ weigh-in-motion sites presents an opportunity to streamline the auditing and enforcement issues surrounding the management and administration of Road User Charges (RUC) on New Zealand's trucking fleet. (refer to appendix 4 diagrams) This section:

- identifies the potential benefits that accrue to society of creating an automated network
- identifies the potential costs associated with the creation of such a network
- Undertakes a rapid cost-benefit analysis.

This assessment is a rapid appraisal to gauge whether the inclusion of strategically placed gantries in a wider technology-based RUC system is likely to pass a detailed appraisal.

## 5.1 Benefits associated with a network of automated audit sites

The potential social benefits associated with the development of a network of automated audit sites are quite wide and include:

- The revenue gains from diminished RUC evasion practices. With increased perception that RUC evaders will be detected and penalised by automated electronic audit followed with targeted enforcement, evasion will decrease.
- Travel time savings for compliant truck operators. Operators who are recognised by the automated systems as compliant are unlikely to be stopped with a time saving for the driver and vehicle, conservatively estimated at \$29<sup>7</sup> per 30 minute enforcement stop.
- More productivity from better targeted policing. Compliant operators will more often than not be able to pass weigh stations without being stopped for a traditional enforcement check. Police will have a sound and unbiased evidence base to focus on targeted enforcement of persistent offenders.
- Safety aspects with respect to entry and egress from inspection points. With a reduction in number of heavy vehicles entering and leaving weigh stations other drivers face a reduced collision risk.
- Wider aspects of network reliability and maintaining free-flow conditions: Drivers of compliant commercial vehicles are able to continue potentially at highway speed. With a potential reduction in number of heavy vehicles entering and leaving weigh stations delays to other drivers are minimised and the network becomes more reliable.
- Wider aspects of network monitoring and management: Significant benefits may be gained in terms of monitoring and managing the network. These are outlined as services in section 7 of this document.
- Depending on the commercial model adopted, the inclusion of automated audit ANPR/ weigh-in-motion sites with a GNSS based RUC system might reduce the commercial risk to commercial tracking service operators, which might reduce risk premiums they charge to service users and improve commercial viability.

Chief amongst the benefits are the expected gains from less evasion of RUC by truck operators discussed in an earlier paper, entitled "Road User Charges Review: Expert Technological Advice".

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<sup>7</sup> Source: NZTA Economic Evaluation Manual page A4-2. Economic value of time for heavy commercial drivers per hour in 2008 dollars is \$23.92 and for the vehicle and the freight is \$33.43 (HCV Class II).

## 5.2 Impact of option on RUC compliance

The table below, taken from this report<sup>8</sup> represents the maximum lifetime cost for initiatives that improve RUC compliance, taking into account the flow-on economic benefits of funding additional transport projects with BCRs at or near the cut-off BCR. For example, an initiative that generates \$20 million per annum in RUC evasion savings when the transport sector's cut-off BCR is 4 is economically optimal if its lifetime cost does not exceed \$169 million.

Annual improvement to RUC compliance	BCR cut-off 2	BCR cut-off 3	BCR cut-off 4	BCR cut-off 5
\$10	\$56	\$75	\$84	\$90
\$20	\$113	\$150	\$169	\$180
\$30	\$169	\$225	\$253	\$270
\$40	\$225	\$300	\$338	\$360
\$50	\$281	\$375	\$422	\$450
\$60	\$338	\$450	\$507	\$540
\$70	\$394	\$525	\$591	\$630
\$80	\$450	\$600	\$675	\$720

**Table 5-1: Range of maximum costs (over 30 years) for implementing initiatives to improve RUC compliance (\$million)**

Source: Road user Charges Review: Expert Technological Advice 2008

It is to be anticipated that a level of evasion will continue regardless of the RUC system used. In assessing the probable compliance impact of introducing automated audit sites we estimate that the base model application of technology without automated audit sites will significantly reduce the current scenario (evasion estimate \$40 million to \$100 million per annum), perhaps halving it to the range \$20 million to \$50 million. The current German scenario relying on automated audit sites results in significantly below 2% evasion. 2% of New Zealand RUC revenue is around \$16 million per annum. Therefore when compared to the base scenario we might expect the option scenario (with automated audit sites) to result in annual improvement in compliance in the range \$4 million to \$34 million when compared to an electronic system without automated audit sites.

Annual improvement in compliance	Present value of compliance improvements
\$4	\$45
\$10	\$113
\$20	\$225
\$35	\$394

**Table 5-2: Impact of improvement in compliance from enforcement gantries (millions)**

<sup>8</sup> Hyder Consulting. *Road User Charges Review: Expert Technological Advice*. Table 4.3, page 16.

## 5.3 Costs associated with an automated audit network

The costs associated with the inclusion of automated audit ANPR gantries and weigh-in-motion sites suitable for two lanes (one lane per direction or two sites of two lanes in each opposing direction) are the initial capital costs and the replacement of components. We estimate that the initial capital cost per site is \$269,000 and the present value of lifetime costs per site is \$382,000 over an economic life of 40 years.

The option scenario involves 42 sites, summing to year 1 capital costs of \$10.5 million and present value lifetime costs of \$16 million. This is much smaller than any of the costs listed in Table 5-1 above.

## 5.4 Rapid benefit-cost analysis

The increase in RUC compliance resulting from the inclusion of automated audit sites is expected to be much greater than the cost of those gantries. If we were to exclude consideration of the wider impacts on the transport sector from the extra revenue and only compare the extra RUC revenue against the cost of the gantries we obtain what might be described as benefit-cost ratios in the order of 3–25. As well as excluding the wider impacts on transport infrastructure investment these simple ratios exclude the wider positive impacts to road users and enforcement agencies described in Section 5.1 above.

Annual improvement in compliance	Present value of improvements	Cost of option	Ratio of compliance improvement to cost
\$4	\$45	\$16	2.8
\$10	\$113	\$16	7
\$20	\$225	\$16	14
\$35	\$394	\$16	25

**Table 5-3: Impact of improvement in compliance from enforcement gantries**

The smallest improvement to RUC compliance that leads to more RUC being collected than it cost to install the gantries is \$1.4 million per year. Even at the lowest boundaries of what non-compliance might be in the base case scenario, it is quite unlikely that the inclusion of automated enforcement gantries would improve RUC compliance by less than this amount. Furthermore the wider benefits described above (e.g. travel time savings for compliant truck operators) are likely to be far in excess of \$1.4 million per year.

## 5.5 Summary

The key results to note are:

- 1 Our rapid cost-benefit appraisal indicates that the economic viability of automated audit sites is strong, even at very modest annual impacts to compliance.
- 2 While we know quite little about the impact on compliance, it seems quite likely that compliance improvements alone will be sufficiently large to warrant a detailed appraisal.
- 3 There are a wide range of benefits to road users and road controlling authorities excluded from this rapid cost-benefit appraisal that would add to the economic viability of including automated audit ANPR/ weigh-in-motion sites in the GNSS based RUC system considered here.

Because of the financial and economic crisis the Budget Policy Statement 2009 is strongly focused on initiatives that promote sustained productivity improvements and that will contribute to bringing Crown debt down to prudent levels.

*Over the medium term the Government's focus will be on taking policy actions to strengthen the economy, limiting expenditure growth, getting better value for money out of existing expenditure, continuing to ensure that tax bases are maintained, and ensuring that its assets are managed as effectively as possible. Actions in these areas will significantly improve the longer-term fiscal track, bring Crown debt back down to prudent levels, and increase net worth. (Budget Policy Statement 2009, p5).*

The inclusion of automated audit sites in a GNSS based RUC system strongly aligns with these objectives of Government to improve productivity and attain greater value for money:

- it will increase net revenue to the Government accounts now and in the future
- it will improve the productivity of industry and enforcement agencies now and in the future
- It will improve the productivity of the economy as a whole by funding more construction and maintenance of transport infrastructure now and in the future, and in particular improving the wealth of taxpayers to help bring Crown debt down to prudent levels.

# 6 Proposed Benchmarks for a Trial of GNSS Positioning Systems

The use of electronic devices for road user charging has been considered as a realistic possibility by a number of agencies along with commercial transport operators and technology providers.

Providers suggest that GNSS devices currently used in New Zealand tracking systems may be accurate to within 1-2% of recorded hubodometer distances. There is little dispute that GNSS systems are capable of this degree of accuracy. This relies on proper operation without tampering or failure. However to our knowledge there is no solid independent quantitative or qualitative New Zealand research confirming reliability and accuracy of GNSS based devices under normal operation, accidentally damaged and tampered conditions.

Providers of GNSS based tracking systems suggest new receiver systems are accurate under most conditions and rarely lose the ability to provide a position. (The exception is in tunnels). It is suggested that positioning ability is well in excess of New Zealand mobile data coverage.

The GPS (Government Policy Statement) recognises at section 11 that road user charges are a key funding source for the NZTS (New Zealand transport strategy) and at section 45 that the NZTS will encourage efficiency in the road freight sector by, for instance, considering vehicle weight restrictions and promoting efficient logistics management. Efficiency in the road freight sector may best be achieved by the integrated use of modern technology to achieve efficient logistics management, road user charging and a range of other outcomes. Therefore, the accuracy, reliability and security of GNSS based positioning devices may be fundamental to future collection of the NLTF (national land transport fund) RUC revenue stream. A number of technologies could be used, each with inherent weaknesses and inaccuracies.

If consideration is given to testing any device that directly replaces the hubodometer (in the absence of near real time fleet tracking), it is strongly recommended that the normal ECU testing regime is followed. This involves independent forensic laboratory testing by an instrument specialist and IRL (Industrial Research Limited) to ensure device suitability, security and accuracy prior to any field trials being conducted. Failure to follow the established protocol for a hubodometer device may risk procedural issues if testing is required for subsequent hubodometers or alternatives.

## 6.1 Concept of Operations

Consideration may be given to developing a Concept of Operations (CONOPS) approach to any trial. This consists of a document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system. It is used to communicate the quantitative and qualitative system characteristics to all stakeholders. A CONOPS generally evolves from a concept such as road user charging and is a description of how a set of capabilities such as GNSS positioning systems may be employed to achieve desired objectives or a particular end state for a specific scenario. It is readily developed from the highest strategic objectives through to position responsibilities or role descriptions and demonstrates the implications of removing any part of a system.

The CONOPS approach is widely used by Governments and militaries and is generally applied to Intelligent Transport Systems (ITS), from strategic design through to operational level.

ITS are defined by the International Standards Organisation (ISO) as: *The application of information technology, communications technology, and sensor technology, including the Internet (both wired and wireless), to the general challenges and opportunities of surface transportation.*



We suggest that firstly any trial of electronic systems falls well within the ISO definition of ITS.

Concept of Operations documents can be developed in many different ways, but usually share the same properties. In general, a CONOPS will include the following:

- Statement of the goals and objectives of the system
- Strategies, tactics, policies, and constraints affecting the system
- Organisations, activities, and interactions among participants and stakeholders
- Clear statement of responsibilities and authorities delegated
- Specific operational processes for implementing the system
- Processes for initiating, developing, maintaining, and retiring the system

A CONOPS should relate a narrative of the process to be followed in implementing the system. It should define the roles of the stakeholders involved throughout the process. Ideally, it will offer clear methodology to realize the goals and objectives for the system, while not intending to be an implementation or transition plan itself.

If a GNSS tracking system is adopted for RUC purposes, a CONOPS would assist architecture and design for a wide variety of other ITS services that are likely to share data obtained from a tracking system.

The highest level of a CONOPS in relation to RUC is to define the strategic purpose of RUC.

The next level is to define measurement parameters: to continue charging by nominated weight, axle configuration and distance or whether to use an alternate regime. For example, the European Union directive 2006/38/EC<sup>9</sup> raises other technically feasible parameters such as varying RUC by time of day, day of the week and 'Euro' emissions classes or particulate matter and nitrous oxides emissions.

## 6.2 Purpose of Proposed Trial

A trial might provide preliminary indicative results around the level of accuracy of technology based system that is not proven to be secure. This might be compared with the current hubodometer system. An issue arises in how to determine which system is recording distance more accurately.

The proposed trial might benchmark:

- Device accuracy levels against traditional hubodometer and odometer readings and known distances.
- Whether GNSS is accurate enough to identify when vehicles are on private roads parallel to the highway (a number of logging roads run alongside state highways).
- The effect of urban and rural landscape forms (including tunnels) on accuracy of current GNSS devices (canyoning and canopy effects).

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<sup>9</sup> amends directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructure

- The effect of known evasion methods that potentially reduce the measured distance and the ability of security mechanisms to indicate evasion.
- The three dimensional (triangulation or x,y,z coordinate) effect of altitude variation between actual road distance recorded by a wheel revolution based system and the two dimensional (x,y coordinate) distance recorded by GNSS systems.
- Significant differences (if any) between underlying GIS base maps and projections.

The trial subjects may also be asked to provide any ideas on how potentially one might attempt to overcome the technology based system.

## 6.3 Legislative Requirement

There is no current legislative authority to substitute alternatives to hubodometers in any capacity for “on road” road user charges in New Zealand. This does not preclude the trial of GNSS based or alternative electronic hubodometer devices *in addition to* the hubodometers required for payment of road user charges.

## 6.4 Security Considerations

Reduction in evasion causing taxation leakage is arguably the major driver for change from the current hubodometer based system. Security features are the primary means to mitigate evasion and reduce the cost to society of evasion.

Clearly the current requirement for hubodometer based charges mean that any trial would be additional to the existing RUC system. This removes any financial incentive to tamper with electronic trial devices.

The lack of financial incentive in turn removes any requirement for security measures including secondary and tertiary data streams (gyroscope and wheel revolution). It also eliminates the requirement for gantries mobile ANPR and electronic enforcement. This means that defined device standards, formal forensic testing of security features and automated audit are unlikely to feature in any preliminary trial.

Proven security features must form an intrinsic requirement for any operational road user charging system. Robust security considerations are the primary difference between many of the current commercially available tracking systems that may be trialled and the real requirement to mitigate the risk of evasion beyond the trial environment.

In the absence of rigorously testing device and system security features, it should be publicly noted that the trial only tests device accuracy and reliability without a security component.

## 6.5 Operators

Consideration might be given to selecting a range of operators for a trial in a variety of sectors representing urban and rural applications. Technologically there is unlikely to be a significant difference in results.

A mix of reputable operators chosen from several sectors providing a range of case studies is likely to ensure greater potential “buy in” to any change in the current RUC system. Ideally, a trial would include some fleet operators who believe a paper based system is more effective. Sectors that might be considered for inclusion are:

- Agricultural (perhaps nominated by Federated Farmers).
- Logging (perhaps nominated by Road Transport Forum)
- Stock transporters
- General freight (local and line haul, perhaps nominated by Road Transport Forum)
- Heavy haulage (perhaps nominated by New Zealand Heavy Haulage Association)
- Rental/Lease fleets
- Buses (urban) and Coaches (long distance) (perhaps nominated by New Zealand Bus & Coach Association)
- Refuse disposal, demolition or earthworks (to highlight the effect of the construction environment on hubodometers)
- Diesel taxi = light diesel vehicle (perhaps nominated by New Zealand Taxi Federation).

## 6.6 Tracking Systems

New Zealand has a range of tracking system providers (refer appendices 1 and 2) and consideration might be given to including as many as are willing to participate in the trial.

## 6.7 Audit Benchmarks

Consideration might be given to regular audit checks and involvement of ECU during the trial period to ensure that the hubodometers on the test vehicles are functioning properly throughout.

## 6.8 Weight Variable

It is assumed for the purpose of the trial, weights will not be measured or nominated electronically. Automated systems to remotely collect vehicle weights and charge by weight are not currently set up. It is technically feasible to set up weight systems using load cell or airbag pressure technologies.

## 6.9 Risks

The identifiable risks of a trial are:

- That any measuring system has inherent inaccuracies (and potential evasion methods). Therefore, physical testing, will to a degree, be subjective and indicative.
- That until such time as there is a financial incentive to tamper with any system, tampering is unlikely and therefore a trial is unlikely to provide any real indication of security requirements. This may necessitate further testing or trials.
- A trial in the absence of formal tests of security features may create unrealistic expectations and belief about suitability of a particular device or system for the purpose of road user charging.
- A marketing campaign based on an incomplete trial may raise product credibility by citing official Government road user charging trials, when in fact the suitability for the road user charging purpose might remain unproven.

## 6.9.1 Risk Mitigation

It is recommended that any device that performs the function of a hubodometer (rather than facilitating centralised near real time tracking) should be subjected to the current ECU testing protocol before any consideration is given to use in a field trial.

Consideration might be given to

- mounting more than one electronic system to each vehicle or
- Alternately mounting all to one or two vehicles for the purpose of the trial.
- preparing a full set of security requirements and
- Testing each device /system against those requirements before the trial.
- Publishing the trial purpose, methodology and constraints (on the internet) to mitigate the risk of any provider of products or services exaggerating claims about the trial for marketing purposes.

# 7 Services a Transport Sector Data Pool Might Offer Small, Medium and Large Enterprises

Other possible applications of the transport sector data pool fall within the wider domain of ITS (intelligent transport systems). ITS is a well established and well resourced discipline internationally. Hyder Consulting has prepared an ITS Strategy for NZTA highways, is close to completion of an NZTA research project outlining how New Zealand might develop an ITS framework and has a strong association with ITS New Zealand and the global ITS community.

Internationally, many ITS are either already available and many more are under development to provide a range of integrated services based in part on data collected from a single OBU (onboard unit) in each vehicle. The vehicle manufacturing industry already includes wiring and onboard electronics as a standard feature in many currently produced models. In many cases the potential application of the wiring is not yet used. The United States Federal ITS program is extensive and breaks ITS down into a number of indicative areas (services). The US diagram has been adapted to NZ terminology as below:

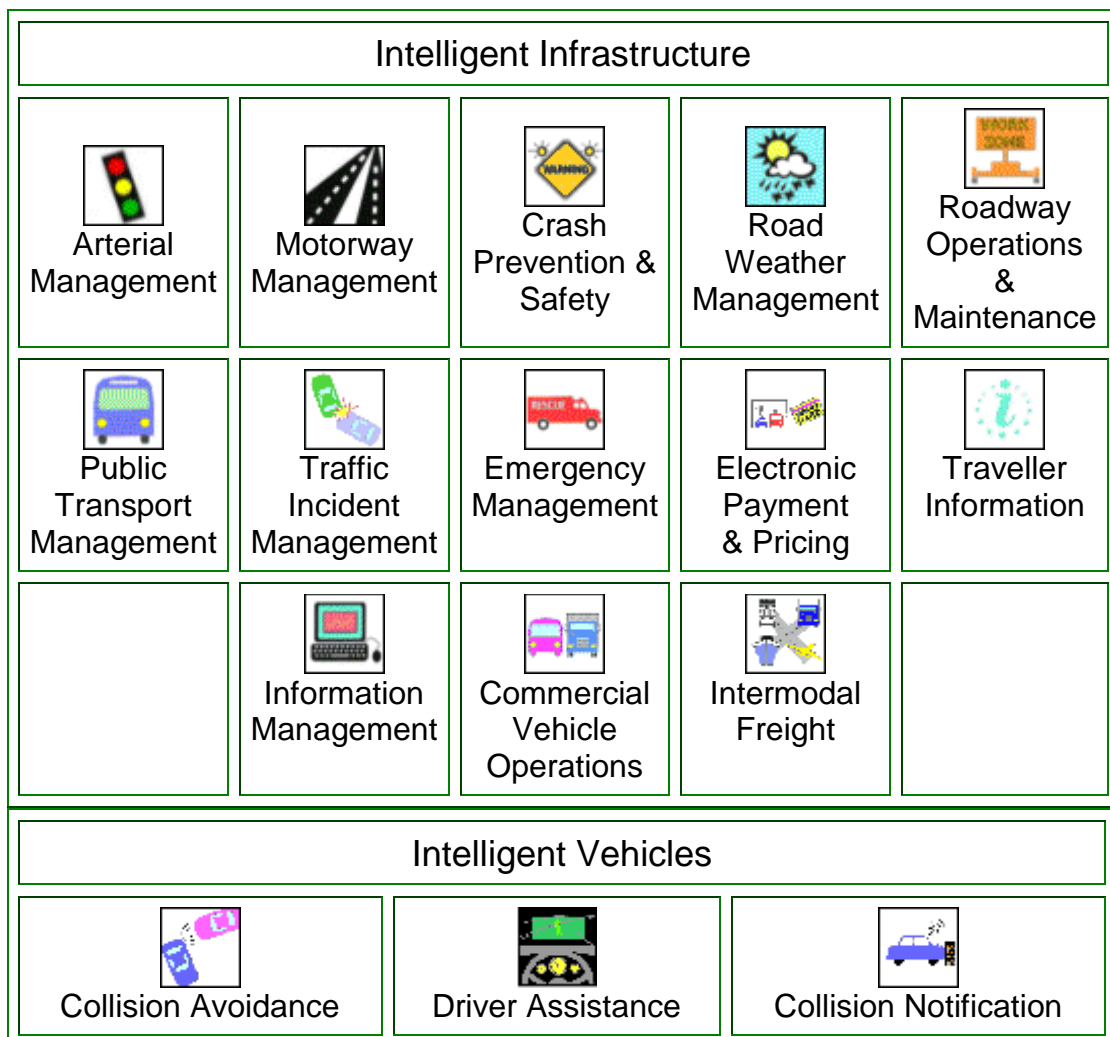


Figure 7.1 US Federal ITS program diagram

## 7.1 Single Point Of Collection

A sound strategic principle in management of information systems is that each type of data should be collected once only from a single point (input device).

The European Union adopted this principle in directive 2004/52/CE, specifying that each vehicle should only have one OBU to collect all required vehicle charging information anywhere in Europe.

The alternative is installing two or more OBUs and two sets of mobile data communications systems (per vehicle) to collect and transmit similar data for different purposes. The data collected from a vehicle OBU might include location, time, vehicle identification and weight. This data, in addition to known road user charges payment data for the vehicle, is sufficient to derive information for road user charging purposes (electronic road pricing). The data may also be used in conjunction with data from other vehicles to derive information about:

- Travel times.
- Traffic flows.
- Points of congestion.
- Arterial management enabling coordinated timing of traffic signals.

Each of these provides the basis for enhanced traveller information. The data may be used by an individual operator for:

- Logistics purposes.
- Advising customers where their goods are,
- Intermodal purposes advising of delays and estimated time of arrival.
- Driver assistance advising of congestion or delays in the planned route.

## 7.2 Efficiency of Data Sharing

Sharing of data, equipment, communications and information between Government agencies, the transport industry and the wider public has obvious national benefits in cost, physical space, efficiency of communications networks and electronic storage.

Sound application of ITS in the New Zealand environment potentially offers a wide range of cost effective information and payment services, using standardised vehicle OBUs supplemented by other information sources. The transport sector data pool is required simply as a collection point. The function of the data pool is to make data available so that it may be transformed into meaningful information by the different (system) services and disseminated appropriately, with minimal human intervention. Some smaller scale traffic information pools are already in use in New Zealand and provide a limited range of services discussed below.

## 7.3 Current New Zealand Transport Data Pools

A sound New Zealand example of a virtual electronic data pool is the NZTA GIS viewer. The viewer accesses information directly from a variety of source databases internal (NZTA) and

external (e.g. Statistics New Zealand) to obtain the most recent data. The SQL<sup>10</sup> data is transacted in a standardised XML<sup>11</sup> based interface and displayed as a visual layer in conjunction with other information layers on a single screen. This viewer is not configured to access historic data or to store any data. Layers of information can be secured from access by unauthorised parties. This business model is similar to the proposed transport sector web services interface.

Traffic management centres operated in Auckland and Wellington by NZTA Highways and a variety of city councils collect data from a number of sources and use the information for arterial and motorway management.

A current example of a near real time pool of traveller information is the NZTA TREIS (Transit Road Event Information) system available at <http://www.transit.govt.nz/road/highway-events.html>. This service collects highway information manually from a variety of sources and only publicly advises of road closures which are longer than 20 minutes. This system has a prototype linkage that in future will display through the NZTA GIS viewer.

## 7.4 Potential services:

An indicative range of sample current and future ITS services follows, significant further information is available on each service and further sub services if required.

### 7.4.1 Weather Service

US “Clarus” service already deploys (experimentally) an integrated national road weather observational network. The network collects data from traditional weather services. In addition a wide range of road vehicles (maintenance and other fleets) in eleven US states and three Canadian provinces are equipped with weather sensors and environmental sensor stations (ESS). This information is delivered to transportation managers, vehicles and other interested parties. New Zealand traffic management centres monitor weather however vehicle based sensors are not currently used.

### 7.4.2 Electronic Freight and Logistics Management

Many New Zealand and international freight and logistics providers already use electronic freight management systems. Many of these are integrated with suppliers and customers to form supply chain systems. In New Zealand, significant potential exists to facilitate multi modal transfer of freight and to broker resources between companies in order to make the freight task more efficient. Some advanced systems offer customers a web interface to view the actual location of their consignment.

### 7.4.3 Commercial Vehicle Administration

Many transport operators already use electronic administration systems of varying complexity ranging from email and accounting to interoperable fleet tracking, logistics and customer management systems. While there are a number of stand alone systems, New Zealand currently lacks a secure Government web service to enable effective automated electronic commercial

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<sup>10</sup> SQL is Structured Query Language – predominant programming language used for management and retrieval of data in relational database management systems. SQL has a number of variant forms.

<sup>11</sup> XML is extensible markup language – predominantly used to describe (as defined by the user) and contain structured data from different sources enabling standardised data sharing. Generally used in an internet web service context.

vehicle administration. Electronic automated services might include RUC, annual vehicle licensing, driver licensing monitoring, certificate of fitness, enforcement inspection information and other services offering benefit to the Government and operators of commercial vehicles.

#### 7.4.4 Hazardous goods management

Electronic hazardous goods management meets New Zealand legal requirements for documentation, enables accurate tracking of hazardous goods by the operator and in the event of emergency provides early advice of the hazard (integrated with emergency transportation requirements).

#### 7.4.5 Electronic payment of transport services

A range of services require payment and a payment service could readily provide an integrated means of payment for all services including RUC, licensing fees, parking and fines. Some New Zealand banks already offer this service via external websites belonging to other companies.

#### 7.4.6 Real-Time Multi-Target Vehicle Tracking (RUC audit function)

Vehicle tracking may be performed in real time and obviously would be limited to lawful purposes by authorised users such as auditing the RUC function for a vehicle or fleet.

#### 7.4.7 Temporal GIS for Road Information Management

General traffic information may be viewed in a GIS viewer for a wide variety of purposes including actual congestion and historic traffic data for planning purposes. The NZTA GIS viewer is ideal for performing this service in New Zealand and may soon be available to the public. The Snitch viewer already provides this service in the major cities, sponsored by the ZM radio network, for the purpose of live traffic broadcasts.



Figure 7.2 Snitch viewer showing near real time traffic information.



## 7.4.8 Driver support systems

Drivers are able to be supported in a number of ways including automated adaptive directions, fatigue management, driving hours monitoring, driver security, event and crash recording. Potentially the technology exists to prevent a vehicle being started until an authorised driver provides proof of identity.

## 7.4.9 Emergency Transportation Operations

Emergency transportation operations is a US term to address activities along a response continuum, regardless of cause and to provide technical assistance, knowledge and tools. The European “e-call” initiative seeks to provide automated early advice of collisions and precise location (GNSS based) when collision systems in a vehicle are activated. The e-call system integrates with an automated emergency supply chain that activates first responders and alerts hospitals of incoming casualties to improve the overall speed and standard of trauma care. The US service also includes military assistance if required. Priority at traffic lights is a related service that may also be offered to public transport vehicles.

## 7.4.10 Integrated Corridor Management Systems

Corridor management systems are aimed at management of the entire national transport system rather than a single local network. A standardised national near real time transport sector interface is considered vital in providing coordination to a range of local network management systems in the New Zealand context.

## 7.4.11 Cooperative Intersection Collision Avoidance Systems

These systems aim to reduce intersection collisions through the use of cooperative (infrastructure and vehicle based crash avoidance systems. They may operate locally near intersections to provide the speed of service required to prevent crashes. Essentially the systems either pre set braking and warn the driver or ultimately might assume control of braking and steering.

## 7.4.12 Real Time Traffic Detection And Prediction

Real time traffic detection and prediction services are based on current tracking information (GNSS, anonymised cell phone and bluetooth tracking) combined with historic data for the site and time of day to predict traffic flows. Some established systems claim accurate predictions of problems up to 10 minutes in advance.

## 7.4.13 Traffic control and management

Traffic control and management are services performed from traffic management centres. New Zealand centres currently use camera information combined with emergency services information. Improved information integrated from a wider variety of sources would lead to improved traffic control and management.

## 7.4.14 Traveller and spatial information systems

Traveller information systems based on near real time and predictive information permit drivers to make informed choices, information includes for example:

- Time of travel

- Mode of travel
- Travel route

The ultimate result of sound information may be to relieve congestion and fuel usage.

## 7.4.15 Image processing

Image processing is a service required to accurately deal with exception reports. Images associated with exception reports can be used for a variety of legitimate purposes primarily providing evidence that a vehicle reported electronically by ANPR was at a given location at a given time.

## 7.4.16 Voice recognition for vehicle navigation and control

Voice recognition for vehicle navigation and control is a future technology; however it is increasingly reliable in cell phone and computer applications where absolute reliability and safety is not critical.

## 7.4.17 Modelling Land-Use and Transportation Interaction (through Large-Scale Systems Laboratory)

Transportation modelling is currently conducted using a range of samples and inferences. Accurate (anonymised) actual data is likely to significantly improve the ability of modellers to provide accurate results.

## 7.4.18 Intelligent Road Maintenance Scheduling and Monitoring Systems

Road maintenance and construction can be integrated to provide automated alerts, traffic monitoring and coordination between contractors who may be potentially performing works on the same section of road in adjacent weeks or months.

## 7.4.19 Other services

There are a raft of other services and sub services available and required in the future.

The main point is that any system should be readily capable of modular and scalable expansion. A services oriented architecture supported by web services offers this capability. The majority of “hard coded” legacy computer systems are relatively inflexible and difficult (comparatively costly) to modify as requirements progress.

Because these technologies are already in widespread use, New Zealand has a strategic choice of planning, facilitating and harnessing electronic capabilities in the short to medium term, or perhaps dealing with a significant and costly integration problem longer term.

## 8 High Level Description and Estimate of Costs for a Transport Sector Standard Web Service Interface

Once the requirements for road user charging in the future are known and the data requirements able to be accurately defined, the amount of data to be transacted may be estimated. Road User Charging falls within the (US) description of an electronic payment and pricing service.

Section 7 (single point of collection) demonstrates how the same data that is collected for RUC purposes can be used very effectively for a variety of other purposes by other services.

In designing a web service interface a significant question is whether there is political will, backed by sufficient funding, to create the backbone of a single transport sector web interface for a wide variety of services apart from road user charging.

The cost of information systems can vary widely, dependent on the tasks to be performed, the design, the constraints and whether or not any data is stored and/or archived by the system itself.

This in turn revolves around a number of criteria, including the business requirements driving the system design, the quantity of data and data streams that might use the interface, and whether any provider has available capacity or systems that are capable of performing some or all of this function.

It is possible that some providers might recognise the commercial value of such a system and reduce the cost to Government accordingly.

A high level indication of the cost range that might be anticipated for a “platform” described as the “transport sector standard web services interface” ranges between \$3 million and \$200 million until requirements are better defined. This high level estimate is based on the following:

### Low cost > \$2 million

The NZTA GIS viewer (under \$2 million) for a real time view (read only) of external databases using an XML variant to standardise (contain) SQL database information for viewing (without storing any information). This is indicative of the price that might be expected to set up a transport sector web services interface. This figure is exclusive of storage requirements, source databases and services. This price includes only the “standardised information exchange” or data integration portion, internet logins and the GIS viewer service. It is likely that there will be a business, technical and legal requirements to provide data storage facilities, services and secure internet logins for a range of clients.

### Mid range ~ \$20 million

Singapore: the 2002 “i-transport” platform was priced at S\$13.3 million or New Zealand\$17 million. This system is comparable as it accepts information from a wide variety of sources and processes it for traffic management and charging purposes.

### High cost ~ \$200 million

The proposed 2009 IT system for a merger the IT systems of ANZ and National banks was estimated in the vicinity of \$200 million. Although this is a banking system comparisons may be made because this proposal is for a high volume, continuously available real time transactional data system with a range of services including secure internet login and transaction capability from numerous clients.

## 9 Cost/Availability of OBU and Digital Tachygraph

Major vehicle manufacturers are increasingly including standard provision for ITS systems in wiring looms and many now install ITS equipment in production vehicles.

The components for any OBU are readily available and will be for the foreseeable future.

The European Commission electronic fee collection directive 2004/52/CE made it clear that GNSS and digital tachygraph technologies will become a European standard along with DSRC<sup>12</sup> communications on the 5.8GHz band. The basis of the directive is that each vehicle will only require only one OBU to travel across Europe. The uptake of the European standard has not been as rapid as anticipated but is continuing.

Digital tachygraphs are well established in the European market having replaced the older analogue tachygraphs. These are required by law in many European countries. One of the main suppliers, VDO has produced over a million digital tachographs for the European market.

The US market also uses a variety of OBUs and DSRC for tolling, parking fee collection and weigh station bypass. The DARPA grand challenge project<sup>13</sup> is one of the leading research projects using integrated “in vehicle” robotics and technology solutions.

Many other countries are already using various ITS services. Singapore uses OBUs for a variety of services including the electronic road pricing and vehicle quota system. The same system permits the Land Transport Authority to collect real time traffic information and adjust traffic signals and road pricing accordingly. The system electronically advises road users make informed decisions about travel. The system is soon to include payment for public parking buildings.

The real issue is for any jurisdiction to define the purpose, the required components, security requirements and technical requirements for an OBU. This in turn defines the cost of a particular OBU. OBUs contain a number of components and a variety of manufacturers would readily tailor their OBUs to requirements of a national system. Communications is the most significant factor in the cost of fleet tracking followed by the cost of back office post processing.

Some current NZ fleet tracking providers offer an all inclusive service package (including a leased OBU) in the vicinity of \$100 per month per vehicle.

Based on currently available multipurpose OBU's, the retail cost of an OBU with all requirements of a national standard may be around \$500 per unit. Additional components within a basic OBU design are unlikely to add significantly to the overall estimate of retail cost. It is accepted that some OBU units retail for significantly less than \$500 at present and some exceed \$500. Digital tachygraphs are priced at around GB£650 (NZ \$1800) per unit (exclusive of tax) in UK. They are well proven as reliable, secure and interoperable units, offering an interface to the vehicle's CAN (electronic management system) and a number of other vehicle services.

Following trends of the last 5 years, the price of each component (OBU, communications, and back office) are likely to drop significantly and the positioning receivers are likely to become more accurate. It is also noted that the retail price of electronics in UK may be higher than in NZ.

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<sup>12</sup> Digital short range communications

<sup>13</sup> Refer to the expert technological advice report

# Appendix 1 – New Zealand Fleet Tracking Providers

Astrata  
Auckland  
<http://www.astrata.co.New Zealand/home.htm>

Atrac Ltd.  
Auckland  
<http://www.atrac.com/>

International Telematics - (I bright tracking system)  
Auckland  
<http://www.internationaltelematics.com/#Home>

Minorplanet New Zealand Pty Ltd  
Auckland  
<http://www.minorplanet.co.New Zealand>

Navman wireless fleet tracking  
Auckland  
<http://www.navmanwireless.co.New Zealand/?qclid=CNm6u6jggpgCFR0SagodYn-qnQ>

Precision Tracking  
Christchurch  
<http://www.precisiontracking.co.New Zealand>

Smarttrack  
<http://www.smart-track.co.New Zealand/>

TOMR telematics  
<http://www.tomr.com.au>

Tracmap New Zealand Ltd – Specialises in agricultural applications eg fertiliser spreading.  
Mosgiel  
<http://www.tracmap.co.New Zealand>

TVD  
Auckland  
<http://www.tvd.co.New Zealand/>

Xlerate Technologies Limited  
Auckland  
<http://www.xlerate.co.New Zealand/>

Visfleet  
Auckland  
<http://www.visfleet.com/>

## Appendix 2 - Inactive Fleet Tracking Systems

Eroad – product under development.

Farmworks - Specialises in agricultural applications  
<http://www.farmworkspfs.co.New Zealand/>

Snitch /Armada – Snitch specialises in tracking for real time radio traffic reports. Armada is Snitch adapted for fleet use but does not advertise as a RUC provider. Snitch advise they intent to offer RUC services in the near future.  
<http://www.snitch.co.New Zealand/>

DriveSafe Technologies Ltd – specialises in dangerous goods and driver attitude. Has a tracking system but not currently in use.  
Christchurch  
<http://www.drivesafe.co.New Zealand>

## Appendix 3 – NZTA RID System

### What is the roadside inspection database (RID)?

RID is an electronic database that stores the results of roadside inspections carried out by the New Zealand Police and the New Zealand Transport Agency (NZTA). It will eventually replace the paper-based records system currently used, but does not change the inspection process and the information recorded.

### Why has RID been introduced?

The results of roadside inspections will contribute to the assessment of an operator's safety rating under the Operator Rating System (ORS). Capturing this information electronically allows the NZTA to easily feed the information into the ORS. It will also provide greater accuracy and reduce time spent with paper work at the roadside. The process for inspecting a vehicle and the information recorded during the inspection has not changed. Inspections will still be carried out according to current procedures and standards in the HMV *categorisation of defects* manual.

### What is the HMV categorisation of defects?

This is a set of standards that enable enforcement officers and NZTA inspectors to apply consistent criteria to vehicle faults identified at the roadside, based on the risk to the safe operation of the vehicle. These standards do not replace the need for enforcement officers to exercise discretion on a case-by-case basis.

### Where does the information in RID come from?

Driver and transport service licence (TSL) information on the report is retrieved automatically from the national driver licence and TSL registers. Vehicle information on the report is retrieved automatically from the motor vehicle register. The faults, and actions to be taken, are those identified by the enforcement officer.

### How does an operator receive information when a vehicle is inspected?

The person driving the vehicle at the time of inspection will be given a copy of the report at the roadside. In the future, if the NZTA holds an email address for the operator responsible for the vehicle, they will also be emailed a copy of the inspection report.

### What's the connection between roadside inspections and a certificate of fitness (CoF)?

A CoF inspection is a regularly scheduled safety check carried out at an approved testing facility. Roadside inspections are designed to complement the checks made at the time of a CoF. There are some limits to what checks can be done at the roadside and these inspections do not replace the need for a CoF. Operating vehicles must hold and display a current CoF at all times.

### How can operators and drivers be prepared for a roadside inspection?

A roadside inspection can happen anywhere at any time. Operators and drivers should:

- always ensure that their vehicles have a current CoF
- carry out daily pre-departure checks to identify faults which may develop between CoFs, and appropriately record any faults
- ensure good communication and business practices so that identified faults are fixed
- if in doubt, have a technician check the vehicle before taking it on the road.

*Source: NZTA Commercial road transport toolkit for drivers and operators October 2008*

# Appendix 4 – Diagrams of Options (Audit Sites or no Audit Sites)

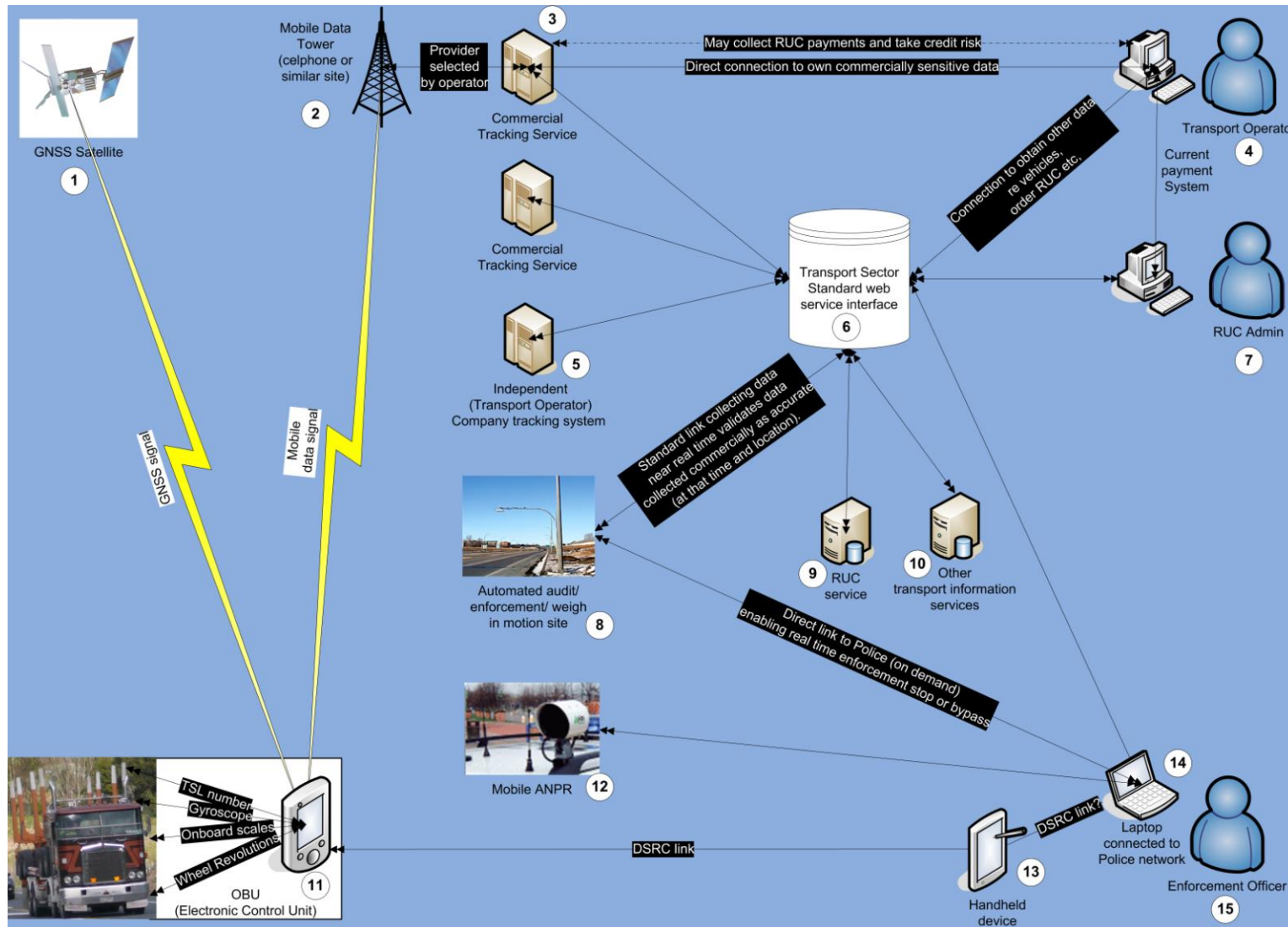


Figure 10.1 Option scenario (with automated audit sites)



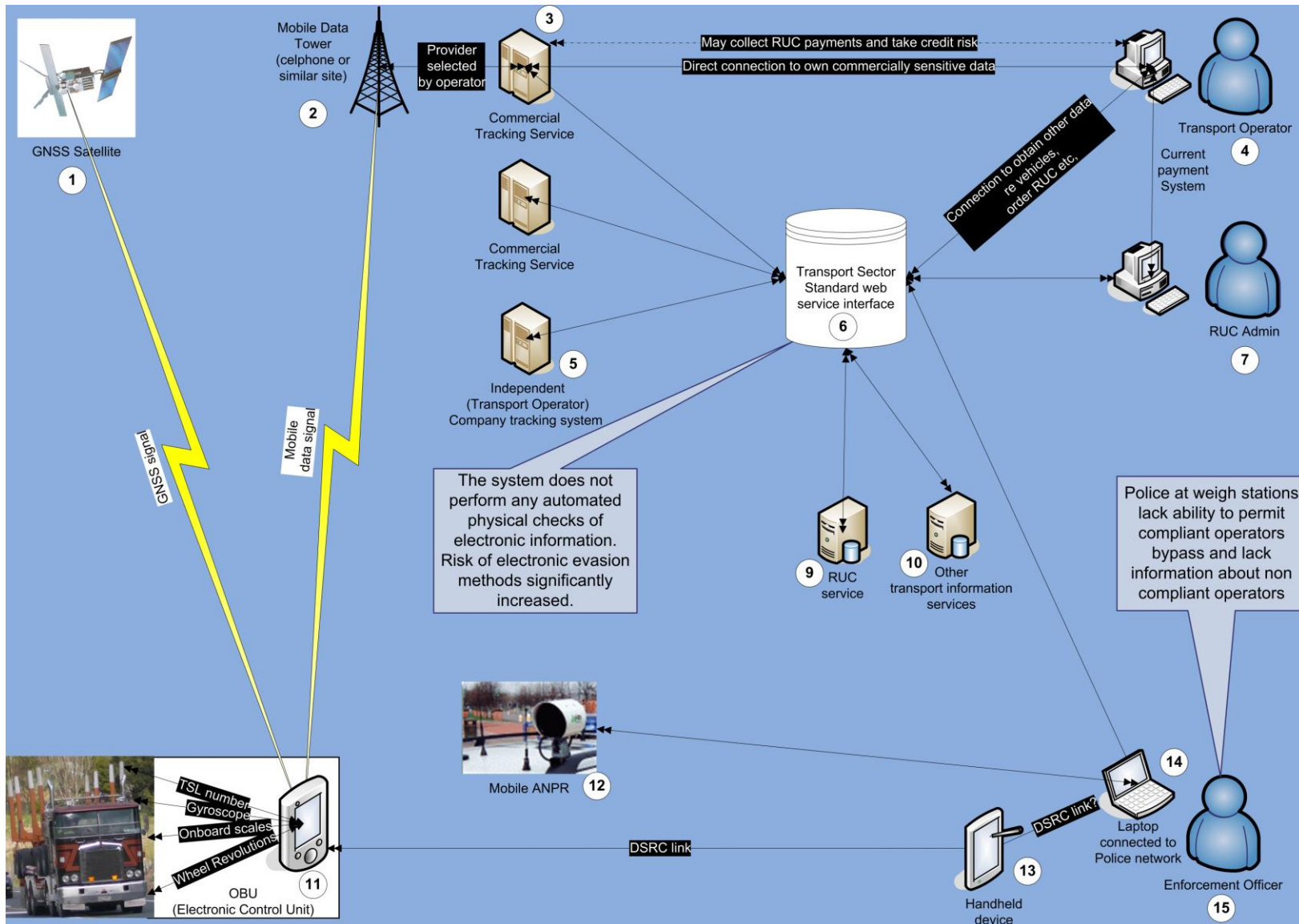


Figure 10.2 Base case scenario (electronic RUC with no automated audit sites)