



Road User Charges Review Group



## Road User Charges Review:

Expert Technological Advice – Updated Diagram,  
Narrative, Strategic Standards and Security

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### Expert Technological Advice – Updated Diagram, Narrative, Strategic Standards and Security

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# 1 SUMMARY

This document accompanies and should be read in conjunction with the “Expert Technical Advice” provided to the Road User Charges Review Group. It contains the following:

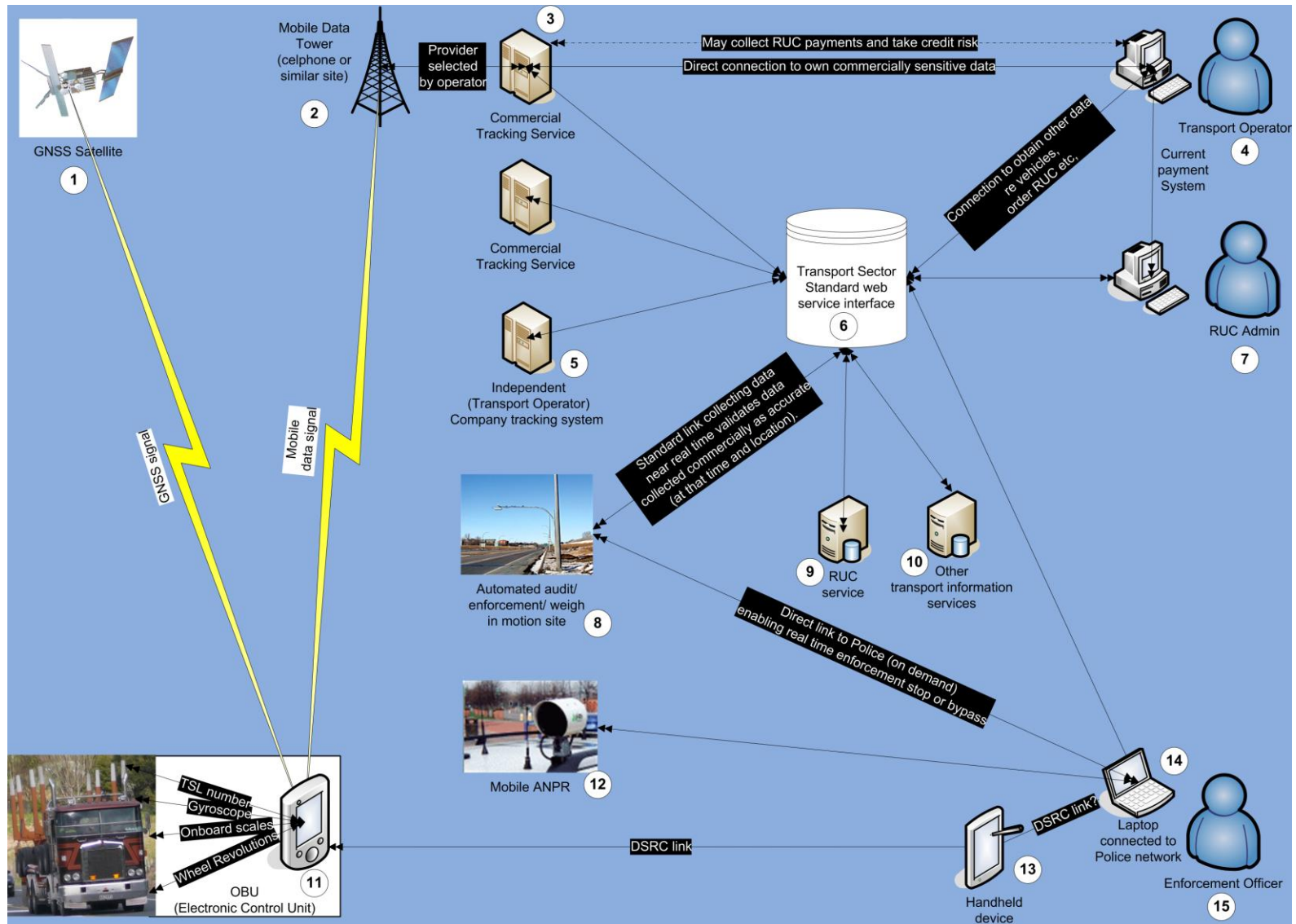
- 1 An updated version of the sample architecture diagram following discussions between the group and industry. This version contains numbered keys for each functional section and other minor variations to the sample architecture as discussed with the group.
- 2 A narrative briefly explaining each functional section of the diagram identified by the key numbers.
- 3 A section on the purpose and strategic models of security.
- 4 A section on the purpose of standards and a strategic model of how it may be possible to fast track standards and adoption of existing international standards by Standards NZ.

This work has been prepared as a priority in time for a meeting on 28 January 2008.

Further work requested consists of:

- 1 Proposed benchmarks for a trial of GNSS based positioning systems.
- 2 A high level desktop based list of possible strategic sites for automated audit/ enforcement gantries and high level principles and dependencies. It is recommended that further development of this list of sites would require close consultation with local CVIU staff to confirm the applicability to actual heavy traffic volumes and precise optimum positioning including the availability/ elimination of viable bypass routes.
- 3 A high level benefit cost ratio for implementing strategic sites for automated audit/ enforcement gantries.
- 4 The business drivers and business requirements of the various “actors” to use an automated technology based system as proposed by the sample diagram:
  - (i) Transport Operators
  - (ii) RUC administration
  - (iii) Police
  - (iv) Commercial tracking providers
- 5 Other potential uses/ services that a transport sector data pool offers.
- 6 High level description and high level estimate of costs for the proposed transport sector standard web service interface.
- 7 The estimated time requirement of the RUC inspection component during an enforcement stop.

## 2 SAMPLE ARCHITECTURE



## 3 KEY TO SAMPLE ARCHITECTURE

The sample architecture is a strategic picture of the basic components that are required or are strongly recommended to achieve a workable and reliable road user charging system. The strategic picture is highly simplified; there are many layers of complexity below each of the components in the diagram.

- 1 **GNSS Satellite:** GNSS (global navigation satellite system) including (and often referred to as) the well known US NAVSTAR GPS system, the Russian Glonass system, the European Galileo system, the Chinese Beidou system and India's IRNSS system. Of these, the only fully operational system is GPS.
- 2 **Mobile tower:** This tower is representative of the requirement for wireless communications to ensure near real time tracking. Currently mobile data networks such as GSM or 3G are the most commonly used. There is potential in the future for other wireless communications protocols to be used. For example a specialised form of Wimax (wireless wide area broadband) is being developed for use with moving vehicles.
- 3 **Commercial tracking service:** There are currently a range of NZ Fleet tracking providers who use GNSS to monitor vehicle movements of their client's fleets for various commercial purposes such as claiming RUC off road rebates and management, driver management, speed monitoring, logistics, agricultural and travel times.
- 4 **Transport operator:** A transport operator is representative of a RUC customer. It is recognised that there are both light and heavy vehicle customers however the uptake of a technology based RUC system is more likely to have commercial advantage to a heavy vehicle operator that is already using or considering a fleet tracking system.
- 5 **Independent (Transport Operator) company tracking system:** There are currently a small number of large firms in NZ who use GNSS to monitor vehicle movements of their own fleets for various commercial purposes. This is an expensive option that may only suit large fleets. There is potentially an increased scope to tamper with data when compared to an independent tracking service.
- 6 **Transport Sector standard web service interface:** This is an extensible, standardised pool of real time, continuously available data relating to the transport sector. The principle is that each data set is collected once only, by one input device (creating simplicity and eliminating duplication of resources). The data is then available at various levels of legitimate use. For example RUC administrators might require access to vehicle and fleet routes taken and distance charged. Providers of traffic information for real time traffic broadcasts might require the number of vehicles and the average time taken to travel between points, crash, road works and weather information. Personal and vehicle information would be "anonymised" preventing identification to protect privacy. Transport operators might require all data relating to their own fleets and vehicles. This might include RUC, Certificate of Fitness (COF), licensing information (vehicle, operator and driver), location, speed etc. The data in the pool may technically be virtualised (not required to be physically stored in one database) although a database is another definite option. The exact nature of the interface will be subject to definition, by legislation, by private sector commercial forces (possibly guided by Government), and / or by lengthy negotiation and consultation process.
- 7 **RUC admin:** The RUC admin is the role currently provided by the NZTA ECU and agencies. This role is responsible for managing, auditing and debt recovery/ civil law enforcement of the RUC system.
- 8 **Automated audit/ enforcement / weigh in motion site:** Given that the primary stream of RUC data will be collected electronically without any physical means of inspection a possibility exists that the electronic data could be tampered with to evade RUC tax. The

purpose of strategic automated sites is to provide a physical verification of the primary electronic stream of data. If the verification fails an “exception report” may be generated for investigative or enforcement action. The sites may consist of standard technologies such as high resolution digital cameras with images processed by ANPR (automated numberplate recognition) to recognise vehicles by number plate, DSRC (digital short range communication) to communicate with OBUs (11) of passing vehicles and weigh in motion equipment that weighs axle by axle at highway speed. The advantage of this system is that a large pool of accurate data is accumulated showing both consistent patterns of compliance with the law (permitting reduced enforcement stops and lost time) and highlighting consistent patterns of non compliance (enabling targeted enforcement of non compliant and evasive operators).

- 9 RUC service:** In a service oriented architecture (SOA) each business process is carried out by a “service”
- 10 Other Transport Information services:** In a SOA relating to vehicles other services may potentially include: Traffic management, travel demand management, driver monitoring systems, vehicle monitoring systems, vehicle safety and control systems, fleet services, public transport services and integrated ticketing, electronic payment services, ecall
- 11 OBU (electronic control unit):** This unit collects one or more streams of electronic information. The fields below are indicative dependent on system requirements:
  - (a)** Positioning chipsets for general commercial use are currently accurate (at device level) to around 5-7 metres with older and less expensive devices having reduced accuracy. GNSS is prone to a number of weaknesses such as canyoning (bouncing signals) and loss of signal at certain locations (due to canopy cover) and times (poor satellite constellation reception). GNSS receivers form a part of the system with communications and back office systems supporting the receivers.
  - (b)** Transport Service Licence number is a key field to identify information about which licensed transport operator is operating the vehicle at a point in time.
  - (c)** Gyroscopes are essentially movement sensors that are capable of approximating position and either confirm GNSS signals or in their absence provide a degree of reliability to tracking.
  - (d)** Onboard scales are electronic methods of determining weight of the vehicle and its load. These technologies are currently claimed to be accurate to within 10%. Alternately some international examples require self declaration of weight by the driver, others rely on axle configuration and others rely on the specified gross laden weight of the vehicle (rather than the actual weight).
  - (e)** Wheel revolutions are an accurate indication of the physical distance travelled and may be obtained from a variety of points on a modern vehicle. This is the function of the current mechanical hubodometer.
- 12 Mobile ANPR:** (automated numberplate recognition) records images using high resolution digital cameras assisted by IR (infra red) or other technologies for night time detection. The images are automatically detected and processed, accurately and automatically reading the numberplates of around 95% of vehicles, at highway speeds and forwarding images that cannot be recognised to operators for manual inspection. ANPR in this system positions a known vehicle at a given time and place for automated cross referencing with the position information obtained from the tracking service. Any significant difference in reported position (via the tracking service) and actual position (via the ANPR coupled with GPS) would result in an exception report, ideally within four seconds, enabling the enforcement officer to stop and check the vehicle if required.
- 13 Handheld device:** A handheld device is essentially a hand held computer that may contain a number of features to simplify the enforcement task. It is not feasible to carry a

laptop computer around a vehicle combination while performing an inspection however it is feasible to carry a hand held (PDA or XDA). The features required are likely to include:

(a) An imaging device (camera to scan 2D and 3D bar codes), this enables highly accurate electronic collection of vehicle, transport service licence (and for other purposes) drivers licence numbers as key reference fields.

(b) Wireless communications including:

(i) DSRC to obtain information from the OBUs,

(ii) Wireless to a nearby computer (or directly through the mobile data network) to the NZTA or Police computer network or possibly directly to the transport sector standard web service interface.

(c) GNSS receiver (to confirm electronic position).

(d) Browser capability.

Health and safety considerations might suggest use of the slightly larger XDA rather than the smaller PDA.

**14 Laptop connected to Police network:** This indicates that an enforcement officer should have immediate access to a full size computer within the immediate vicinity of an enforcement check. The requirement is to minimise the time spent using the hand held devices for data entry and for ease of checking.

**15 Enforcement Officer:** This instance refers generally to Police CVIU as the predominant RUC enforcement group but does not exclude other Police or NZTA enforcement staff. Note: NZTA enforcement staff do not connect to the Police network.

**DSRC** (digital short range communication) generally between “RFID tags” or OBUs carried in vehicles, corresponding roadside infrastructure and handheld devices used by enforcement officers to collect vehicle specific identification data at highway speed. DSRC is widely used in tolling and vehicle safety systems. The 5.9 GHz radio frequency band is widely used internationally for DSRC and the range is around 100 metres. This provides an effective communication time in excess of three seconds for a moving vehicle travelling at 100kmh past a static device.



# 4 PURPOSE AND STRATEGIC MODELS OF SECURITY

New Zealand currently has a number of tracking systems that accurately track vehicles for commercial purposes. The accuracy of these systems relies on the fact that the equipment and data is not tampered with. There is little or no incentive to tamper with tracking equipment that is installed voluntarily for purely commercial purposes.

The current road user charges system collects around \$875 million per annum and has evasion or taxation leakage commonly estimated at between \$40 million (4.6%) and \$100 million (11.4%) per annum, or by a different definition including all RUC not paid at the time of travel, in excess of \$200 million (22.8%).

This indicates that, realistically, a significant percentage of operators are also likely to attempt evasion of any technology based RUC system. In any system with no security or little security (such as those commercial systems currently in operation) a variety of electronic evasion methods become relatively simple.

The purpose of physical and electronic security in a technology based system is to mitigate the risk of evasion, using a variety of cost effective business processes, minimising potential opportunities to tamper with system components and verify the electronic information with physical confirmation.

The German charging system has demonstrated that sound use of technology in a secure system can minimise the taxation leakage to significantly below 2%. This is a target level that may readily be achieved in NZ given implementation of appropriate legislation, standards and system design criteria.

A strategic security model will consider the likelihood of tampering with each element in the system and the consequences of tampering with each element. It is strongly recommended that security measures are applied to address the fundamental risks (where these occur) and eliminate the risk, mitigate the risk or enhance the likelihood of detection.

The technology to provide adequate security already exists; it is simply a matter of requiring that any components in a technology based system include the security requirements. This is one aspect of standardisation.

## 4.1 Sample security specifications

An incomplete sample of generic security specifications for OBUs follows:

### **OBU Physical security:**

1. The OBU must not be opened by anyone apart from an authorised certifying engineer. The authorised certifying engineer shall electronically notify the tracking service prior to servicing, opening or removing an OBU.
2. The OBU must be fully enclosed in an approved tamper evident housing that will not permit adjustment of any internal components or data, apart from Transport Service Licence (TSL) number unless it is opened.
3. The OBU must be constructed of durable materials that will not decompose with heat or light and will withstand dust and moisture to IP67 rating.

4. The OBU must withstand drops and vibration to specification xxxx
5. The OBU must be free from electrostatic discharge and sparks. (to enable fitting to potentially explosive environments such as fuel tankers) to specification xxxx.
6. The housing must be permanently secured to the vehicle in such a way that the housing must be opened to service the OBU or detach it from the vehicle.
7. An authorised certifying engineer must confirm that the unit is secured correctly to the vehicle and is sealed before the tracking service attributes any data to that vehicle.
8. If the OBU housing is opened:
  - (i) the OBU must generate an immediate exception report and transmit it to the tracking service.
  - (ii) the OBU must continue to transmit the exception report and device location until such time as an authorised certifying engineer confirms that the OBU is functioning correctly, is fitted correctly to a specified vehicle (VIN number) and has correctly resealed the unit.
  - (iii) the tracking service will record but will not attribute any movement data to the vehicle unless the device is sealed and certified.
9. The OBU must contain:
  - (i) the “trusted RUC module” which collects time, position and weight data, and stores:
    - (a) vehicle data in a manner that can only be changed when a certifying engineer opens the housing.
    - (b) TSL data that can only be changed by a licensed transport operator’s digitally certified electronic transaction (via the tracking service).
  - (ii) the “trusted communications module” enabling digital encrypted mobile data transfer and DSRC communications.
10. The tracking service shall provide enforcement agencies with real time internet access to electronic status of tracking devices and all OBU exception reports.

### **OBU Electronic security**

1. The OBU will poll the electronic feeds for position, weight and wheel revolutions. If the data feeds are interrupted, detect recalibration or are found to be absent:
  - (i) the OBU must generate an immediate exception report and transmit it to the tracking service.
  - (ii) the OBU must continue to transmit the exception report and device location until such time as an authorised certifying engineer confirms that the electronic feed (and device) is functioning correctly, is fitted correctly to the specified device and is correctly calibrated.
  - (iii) the tracking service will record but will not attribute any movement data to the vehicle unless the data feeds are certified.

### **Certifying Engineers**

1. All device and OBU certifications must be digitally signed electronic transactions with the tracking system confirmed by two factor identification e.g. a unique confirmation code sent from the tracking system by text message to the certifying engineer for entry into the certification transaction within two minutes of transmission.

# 5 PURPOSE AND STRATEGIC MODEL OF STANDARDS

Standards applied to a technology based RUC system would ensure data quality, consistency and reliability, ensuring all compliant systems meet the required information objectives and measure the same variables in the same way.

The benefits for private sector tracking services and the public sector involved with RUC would include clarity of information and elimination of unnecessary business compliance costs.

Current New Zealand tracking systems were designed by a range of entrepreneurs and companies who recognised the commercial potential of providing a vehicle tracking system and associated services without guidance from any defined standards. It is recognised that some providers sought guidance and in the absence of any defined standards were not given any.

Consequently each current tracking system is designed differently, may use the same or different components, operate in different ways, measure the same things differently and may produce slightly different results for the same RUC (off road) task.

Put simply standards rely on strategic definition of a task providing a common basis for definition of how to achieve that task by way of prescriptive or outcome focused definition.

It is noted that prescriptive technical standards are difficult to maintain because technology progresses rapidly requiring regular updates. Conversely purely outcome based standards may not be prescriptive enough to achieve the stated goals particularly the security task.

It is worthwhile considering a hybrid system specifying required outcomes at component and system level then overlaying generic security and specific measurement requirements as indicated in the sample security specifications. This approach would minimise the requirement for continuous updates.

It is noted that NZTA are currently working with Standards NZ to create a NZ standard for tracking systems. It is noted that an estimated time for completion may be around late 2010. It is noted that due to the consensus approach used by the Standards NZ the completed Standard might require additional security specifications and data format requirements for RUC purposes.

## 5.1 Fast Tracking of Standards

While Standards NZ is drafting a New Zealand Standard there is little hindrance to adopting a robust set of independently defined standards or adopting or adapting internationally defined standards for the purpose of trialing a RUC tracking system.

It is noted that a legislation change is required to enable an alternative distance recording system to be used on a trial basis.

The risk exists that internationally defined standards may not reflect the purpose of the New Zealand system or New Zealand culture and these differences may potentially create difficulties. Careful scrutiny of any proposed standard should be considered.

A further risk exists that an adopted standard may not be supported by fundamental requirements. For example, if an authorised certifying engineer or an automated audit system were required as part of the standard, there are currently none in NZ.

## 5.2 Adoption of Existing International Standards by Standards NZ

The Standards NZ website states: a Standard can enable highly technical information, often needed to support policies or legislation, to be written into a document to aid understanding of context by users. An existing Standard can help minimise unnecessary duplication, confusion and inconsistencies. Standards are especially useful tools to support policy development and implementation.

Clearly Standards NZ welcomes the input and application of international standards to speed up the process; however international standards still require application of the consultation and consensus approach before adoption or adaption.