Light Rail Transit in Dublin

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ABSTRACT

In 1995, the Dublin Transportation Initiative Final Report (*1*) put forward a wide ranging set of recommendations on transportation, land use, environment and quality of life for the Greater Dublin Area. In addition to a comprehensive set of quality bus corridors, the report also recommended Light Rail Transit (LRT) for three corridors in the city. The aim was to link 1) the city centre to Tallaght, an expanding area in the south west of Dublin 2) the city centre to Ballymun, in the north of the city near the airport, and 3) to Sandyford in the south of the city, along an existing right of way for rail on part of the route. Sandyford has the largest industrial estate in the country with traffic speeds of 5 mph in the peak period. The area around Sandyford has also suffered from poor public transport infrastructure in the past.

Design and construction of the LRT started under the auspices of Coras Iompair Eireann (CIE), the state owned public transport company, but in January 2002 a new agency entitled the Railway Procurement Agency (RPA) was set up and charged with procuring light rail and metro systems and since then the RPA has taken over the implementation of the LRT and is also preparing the feasibility stages for a metro system.

This paper focuses on the two LRT lines which will be completed mid-2004 i.e. to Tallaght and to Sandyford. Development of the third line (to Ballymun/airport direction) was postponed and is now under consideration as the first line of a metro system for the city. The paper describes the design and construction of the LRT (the Dublin Scheme is called Luas) and also comments on its potential in offering high quality public transport for the city.

BACKGROUND

The Dublin Transportation Initiative made recommendations for a comprehensive rail system for Dublin, outlined in Figure 1. This was part of a larger integrated strategy involving the introduction of an extensive network of quality bus corridors, parking policies, better integration between transport and land use planning and demand management strategies. Market research done as part of the development of the recommendations demonstrated a preference for on-street light rail with 64% in favour of LRT and 26% in favour of an underground system. The name that has been given to the system is Luas, the word for 'speed' in Gaeilge.

Two LRT lines are currently under construction to be completed mid-2004. Line A (and C) and Line B, the lines to Tallaght and Sandyford respectively, are shown in Figure 1 and are outlined in more detail in Figures 2 and 3. Line A commences in Tallaght and winds its way in through the south west of the city to the city centre ending at Abbey St. Line C extends from Abbey St to Connolly between which there is major interchange with the central bus station, Busarus. At Connolly there is an interchange with the mainline rail to Belfast and with the Dublin Area Rapid Transit (DART) system, a heavy rail commuter service running North-South on the coast. As Line C is so short for the purposes of this paper it will be presented as part of Line A. There are 23 stops between Tallaght and Connolly on Line A. Plans are currently underway to progress Line A beyond Connolly station to the Docklands; an area which is currently undergoing major development.

Line B commences in Sandyford, an industrial area in the south of the city, and comes into the city centre along an old railway right of way through Stillorgan, Dundrum, Ranelagh and into St Stephens Green, a central shopping area in the city. The end point does not intersect with other rail services but the plan is to run the first line of a metro system from St. Stephens Green under the river linking with the West-East Luas line from Tallaght and on to the airport. There are 11 stops between Sandyford and St. Stephens Green on Line B.

The paper examines the construction of Lines A and B, the Luas vehicles, the control systems, the user interface, the operating contract and park and ride facilities. Connex won a contract to operate Luas for the first five years of its operation from 2004; a contract based on a set of detailed performance related conditions in which bonuses and penalties play a major part.

In terms of how Luas will fit within the current urban rail environment in Dublin, it is useful to examine what already exists. Dublin does not have a metro system as yet. It has the DART service already mentioned which offers a good level of service (LOS) in relation to frequencies – about 10-15 minutes in peak periods. There are three other urban rail corridors (again heavy rail) from Dundalk (north) running on the same line as DART for part of the route, Mullingar (north west) and Kildare (south west). The LOS in these cases is markedly different from the DART service. Between the period 6.00 and 9.00 in the weekday morning peak period, the number of trains leaving from Mullingar and Dundalk are three to four within that period. In the case of Kildare service, there are eight trains (4 of which are interurban trains calling at Kildare on their

way to Dublin). The 4 interurban trains do not call at all stations between Kildare and Dublin and therefore from a station such as Clondalkin which lies between Kildare and Dublin, there are 3 trains during the 6.00 – 9.00 period. Luas will offer the highest LOS of all urban rail services in Dublin and will provide a service on routes where no rail option currently exists.

TRAM DESIGN

All tram vehicles have been delivered since Sept 2003 and they are currently undergoing test. They are also being used to train drivers for operation commencement next year. The Citadis trams are manufactured by Alstom and 40 trams in total have been ordered (*2*). The basic 30 metre tram can carry up to approximately 235 persons, 60 of whom will be seated. The trams are electrically powered and the tram floors are at the same level as the platform. 26 trams are 30 metres in length and 14 are 40 metres in lengths. The 40 metre trams will be capable of carrying about 320 passengers. The height is 3.27 metres excluding the pantograph. The trams will be powered by electricity drawn from overhead wires at 750V D.C. The maximum speed of the trams is 70 km/hr. Platforms will be 300mm above street level.

LINE A – TALLAGHT TO CONNOLLY

Line A of Luas will run from Tallaght to Connolly, a distance of 15 km on double tracks. Road traffic will share the alignment in a limited number of locations and there will be provision for traffic to cross the lines where necessary. The carrying capacity of Line A will be 2800 passengers per hour in each direction and this will cater for the expected maximum demand at opening although there is potential for increased capacity if necessary. Service frequency will be at 5 minute intervals during peak hours in the morning and evening (from 07:00 – 10:00 and 16:00 – 19:00), at 10 minute frequencies between 05:00 and 07:00, at 7.5 minute frequencies during 10:00 – 16:00 and 19:00 – 22:30. For 22:30 – 0:30 the service frequencies will be every 15 minutes. On Saturdays, the frequency for 06:30 – 09:30 will be 10 minutes, between 9:30 – 19:00 it will be 7.5 minutes and for 19:30 – 0:30 the frequency will be 10 minutes. On Sundays, the frequency throughout the day will be 10 minutes. The approximate journey time will be 40 minutes. 26 trams will operate on Line A. Most of Line A will run on segregated rights of way adjacent to the road, generally separated from other traffic by a low kerb. The remainder, about 4 km, will consist of shared running, primarily at junctions where the trackbed is shared equally with road traffic. Line A will pass through a number of junctions including two motorway slip roads for the M50 (motorway ring around the city) (*3*).

LINE B – SANDYFORD TO ST. STEPHENS GREEN

Line B of Luas will run from Sandyford Industrial Estate to St Stephens Green, a distance of 9km on double tracks. Road traffic will share the alignment in a limited number of locations and there will be provision for traffic to cross the lines where necessary. The carrying capacity for Line B will be about 3000 passengers per hour in each direction;

this is the expected demand at opening in 2004. The service frequencies will be the same as for Line A. The approximate journey time will be 25 minutes end to end. Line B will run along protected rights of way for most of its route operating on the old Harcourt St heavy rail corridor. Less than 1 km will run on segregated rights of way adjacent to the road with occasional shared running as it goes into the city centre. Line B passes through a smaller number of junctions than Line A. (*4*).

LUAS OPERATING SYSTEM

The three principles governing the operating system include safety of operation, efficient service management and the provision of passenger information. The operating systems of the Luas include the following: a Central Control System (CCS), an Automatic Vehicle Location System (AVLS), a Supervisory Control And Data Acquisition (SCADA) System, a Stop (where the Luas stops to pick up and set down passengers) Passenger Information Display (PID) System, a Stop Public Address (PA) System, a Radio Transmission System, a Cable Transmission Network (CTN) System, a Telephone System, an Emergency Telephone System, a Video Monitoring System (CCTV), a Timing System, a Line Signalling System (LSS) a Depot Control System (DCS) and an Automatic Fare Collection (AFC) System (Railway Procurement Agency). Two schematic diagrams in Figures 4 and 5 demonstrate two of the Luas systems. (*5*)

The Central Control Room (CCS) is located at the Red Cow Depot on the Line A route. This control rooms monitors all Luas lines and has radio/telephone facilities for CCS operators to communicate with tram drivers, line inspectors, line & operations personnel, depot staff, maintenance staff, emergency services & passengers at stops and within the trams. The CCS also has a bank of 17 large screen (25") CCTV monitors. Some of the Luas systems are dealt with in more detail below.

Automatic Vehicle Location System

The automatic vehicle location system (AVLS) allows the CCS operators to manage Luas service quality by monitoring every tram location. Each tram reports its location every 10 seconds using induction loops in track and the on board odometer. There is also AVLS on board which compares the actual tram location with timetabled location to 10 seconds precision for presentation to the tram driver. The on board AVLS also monitors status of the tram and reports faults or alarms back to the CCS. The AVLS interfaces with other systems e.g. it triggers on board next stop internal passenger information display (PID) and on board PA announcements. The system also determines which of the three levels of priority (detailed below) to send to traffic light junction controller, depending on how the tram is performing to timetable (*5*).

Passenger Information Displays

Passenger information displays (PID) will be located at the Luas stops to present real time wait-time information to passengers. There will also be PIDs on board the trams to indicate the next stop and interchange information. The PIDs will be supported by

public announcment (PA) speakers on all platforms, the sound level of which is automatically reduced at night so as not to cause nuisance to neighbouring residents.

Supervisory Control and Data Acquisition System (SCADA)

The supervisory control and data acquisition system (SCADA) permits a centrally located operator to monitor and control remotely located items of equipment. There are two separate SCADA systems on Luas; the Fixed Equipment SCADA which allows the CCS operators to monitor and control items of equipment at stops and within depots. The Power Supply SCADA allows the CCS operators to monitor and control power related equipment within Luas substations and along the lines.

Radio Transmission System

The Radio Transmission System allows audio communications between CCS operators, operational personnel (e.g. tram drivers) and service personnel (e.g. revenue inpsectors, maintenance staff). It also enables data communications with tram vehicles for AVLS location and tram status messages. There will be a fibre optic communications backbone, using a dual fibre ring structure, to transfer audio signals (e.g. PA, Emergency Telephones), data (e.g. Stop PID, SCADA messages) and video (CCTV) around the Luas network (*5*).

Video Monitoring System

There will be a total of 149 CCTV colour cameras on the Luas network, located within depots, at stops, at major road junctions, at lifts and in Park & Rides (P&Rs). Most cameras are dome type Pan, Tilt, Zoom (PTZ) and they will be located at stops, junctions and P&Rs; all fully controllable from the CCS (111 cameras). All images are presented to a bank of 17 large screen colour monitors in the CCS. The images are time-lapsed recorded, but there exists a facility for real-time recording under certain circumstances.

Dublin City Council (DCC) manages the traffic signalling system in the city and as part of that they too have a control centre with feed coming from cameras on roads and junctions throughout the city. The Luas camera system allows image exchange with the Dublin City Council (DCC) Traffic Control Centre and the Luas CCTV cameras will also be relayed to the Garda (Police) Command & Control Centre.

Each tram will have four internal miniature black & white cameras, mounted within protective housings. The camera images will be transmitted to a recorder on board the vehicle, enabling 4 hours of time-lapse recording.

JUNCTION NEGOTIATION AND PRIORITY

The ‘Prepare Detector loop’ is located at a distance from the junction such that, even in the worst case, the tram is able to obtain the Luas signal phase before reaching its ‘critical braking point’ for the design speed on the approach. The tram’s priority signal is transmitted via this loop. The ‘Demand loop’ is located at a distance from the junction such that when the tram passes this loop the Traffic Controller immediately presents the

Luas phase. The 'Stop loop' is generally located 3 metres from the junction stop line and the 'Exit Clear loop' is normally located 5 metres after the stop line.

For junctions involving main roads, the Luas junction priorities are being negotiated with Local Authorities on a junction by junction basis. For smaller, back-street junctions, the tram will always have full priority. On approaching a road traffic junction, the tram has the capability to transmit one of three priority levels to the Traffic Controller (TC), depending on how well the tram is adhering to its schedule (as determined by on board ALVS). Priority Level 3 is the highest level of priority and this will be called when the tram is behind schedule. Priority Level 2 will be called when the tram is on schedule and Priority Level 1 is the lowest priority level and will be called when the tram is ahead of schedule.

The traffic signal controller is interfaced to the relevant local authority's traffic signal control system to enable centralised control, change of operating parameters, equipment testing and fault reporting. The Luas CCS is interfaced to the local authority's traffic signal control system so as to receive information on traffic signal operation including images from the local authorities CCTV systems.

FARE COLLECTION

Automatic Ticket Vending Machines (TVMs) will be located on all platforms at all stops. The Automatic Fare Collection (AFC) Central Management System (CMS) located at the CCS monitors, controls and manages operation of the AFC System. There will be 93 TVMS with touch screen user interface on the network located at stop platforms. Their design involved a consultative process with disability groups (partially sighted, wheelchair users etc). All TVMs will accept coins, banknotes, credit cards and debit cards (laser) and will issue change. Ticket types will include Adult, Child and Student. Users can choose between single, return, weekly and monthly tickets. The magnetic strip type tickets are compatible with similar tickets already in operation on Dublin Bus (main bus operator) and Irish Rail (heavy rail operator).

PERFORMANCE BASED OPERATING CONTRACT

A detailed performance contract has been negotiated with the operator, the performance elements of which relate to availability requirements, reliability requirements and service quality requirements. A set of service quality indicators have been drawn up and will be measured during the course of the contract. The contractor will receive a base line payment for each period. A reduction in payment will be made based on the availability deduction (in respect of cancelled journeys on each line), on the reliability deduction (in respect of irregularity in the frequency on each line) and on the service quality (in respect of other service quality indicators for each line). Two bonus levels will be in operation based on patronage levels so that there is incentive for the operator to actively seek and deliver higher patronage levels.

PARK AND RIDE

Most parts of the new Luas lines are going through already well developed areas and so there is perhaps less scope than might be considered ideal to develop Park and Ride (P&R) sites. There will be 6 Park and Ride sites at commencement date (5 are being implemented and planning permission is sought for the sixth). The two P&R sites on Line A are at Tallaght (450 spaces) and Red Cow (756 spaces) totaling 1206 spaces on that line. There are four P&R sites on Line B: Sandyford (110 spaces), Stillorgan 1 (149 spaces), Stillorgan 2 (164 spaces) and Ballally (426 spaces), a total of 849 on Line B. Some of the sites, e.g. those in Stillorgan are close to popular shopping areas. Therefore there may be a need to provide a higher P&R service level at those sites and perhaps at others so that Luas users only can use them or at least have priority access. The service levels and related operating systems e.g. staffing, barrier types, parking charges etc are currently under review by the RPA.

CHALLENGES

In relation to the challenges that have presented themselves in terms of the implementation of LRT to Dublin, four main ones are mentioned below.

1. The lenghty time it currently takes from project conception to implementation for transport infrastructure in Ireland was the first challenge. This not only applies to rail infrastructure but also to road and is the fault of no one entity but is the result of a combination of long system processes including public consultation, environmental impact statements, compulsory land purchase etc. The government is currently working on introducing new legislation (Critical Infrastructure Bill) to speed the process up for projects designated as having strategic national importance.
2. The second challenge relates to the fact that in a relatively short space of time the Irish economy has gone from being extremely strong (at its peak - the Celtic tiger) to a situation where some cutbacks in public spending are necessary. As Luas is one of two large infrastructure projects underway in Dublin (both by which by their nature involve large funds) Luas has come under considerable scrutiny in terms of whether it offers the best use of public funding in the current economic climate. Although this knee-jerk reaction is somewhat understandable it does not offer a practical or realistic solution as the project is now almost complete. The correct time to look at this question will be during the ex-post evaluation but it would be important for that evaluation to take into account the projected longer term benefits of Luas as well as short term.
3. The third challenge is the usual challenge posed to any city in relation to the disruption that new construction causes. Although there have been a few ‘hot spots’ in terms of the Luas line construction in Dublin, the disruption has been well managed. Good lines of communication with all put in particular those entities that are hit hardest by the disruption would appear to be critical to ensuring good management of this issue.

4. The fourth challenge relates to the excessively large amounts of money that property owners are demanding and obtaining under arbitration. These lands are required by the RPA for construction of the line. The high costs and delays associated with this issue are of concern to the RPA but also raises a wider issue of whether property owners on the alignments of new infrastructure should be able to claim such sums; in some cases bearing no link with current market value.

CONCLUSIONS

The paper provides an update on the construction of two light rail lines due for completion in mid-2004 in Dublin. These lines are the first light rail lines to be introduced in Dublin although trams were a feature of Dublin several decades ago and the two lines are the first stages of a more ambitious urban rail programme involving light rail transit and metro planned for Dublin. The first line runs from Tallaght a rapidly expanding area in the south west of the city to the city centre. The end stop in the centre is Connolly Station, one of the two mainline rail stations in Dublin. The second line runs from Sandyford Industrial Estate in the south of the city to St. Stephens Green, a primary central location in the city centre serving retail, government and business entities.

REFERENCES

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(2) Railway Procurement Agency. http://www.luas.ie/home/ accessed July 2003

(3) CIE Light Rail Project Office, Environmental Impact Statement for Lines A. Non-Technical Summary. July 1998.

(4) CIE Light Rail Project Office, Environmental Impact Statement for Lines B. Non-Technical Summary. December 1998.

(5) Railway Procurement Agency. Working paper on Luas Operating Systems, RPA, Dublin 2003.

(6) Dublin Transportation Office, A platform for change. Strategy 2000-2016. Dublin Transportation Office, Dublin, 2001.

LIST OF FIGURES

Figure 1. Proposal rail infrastructure for Dublin (*6*)

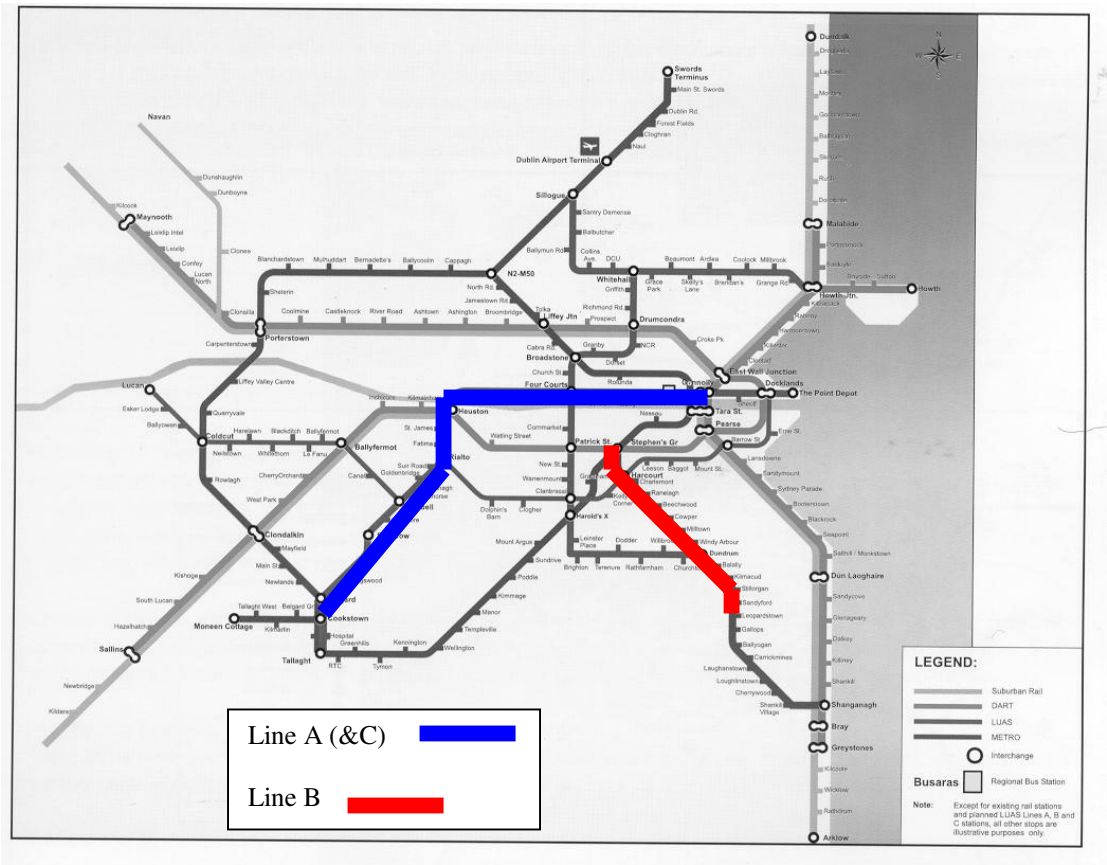

Figure 2. Line A (and C) From Tallaght to Connolly Station (just beyond Abbey St in Figure) (*2*)

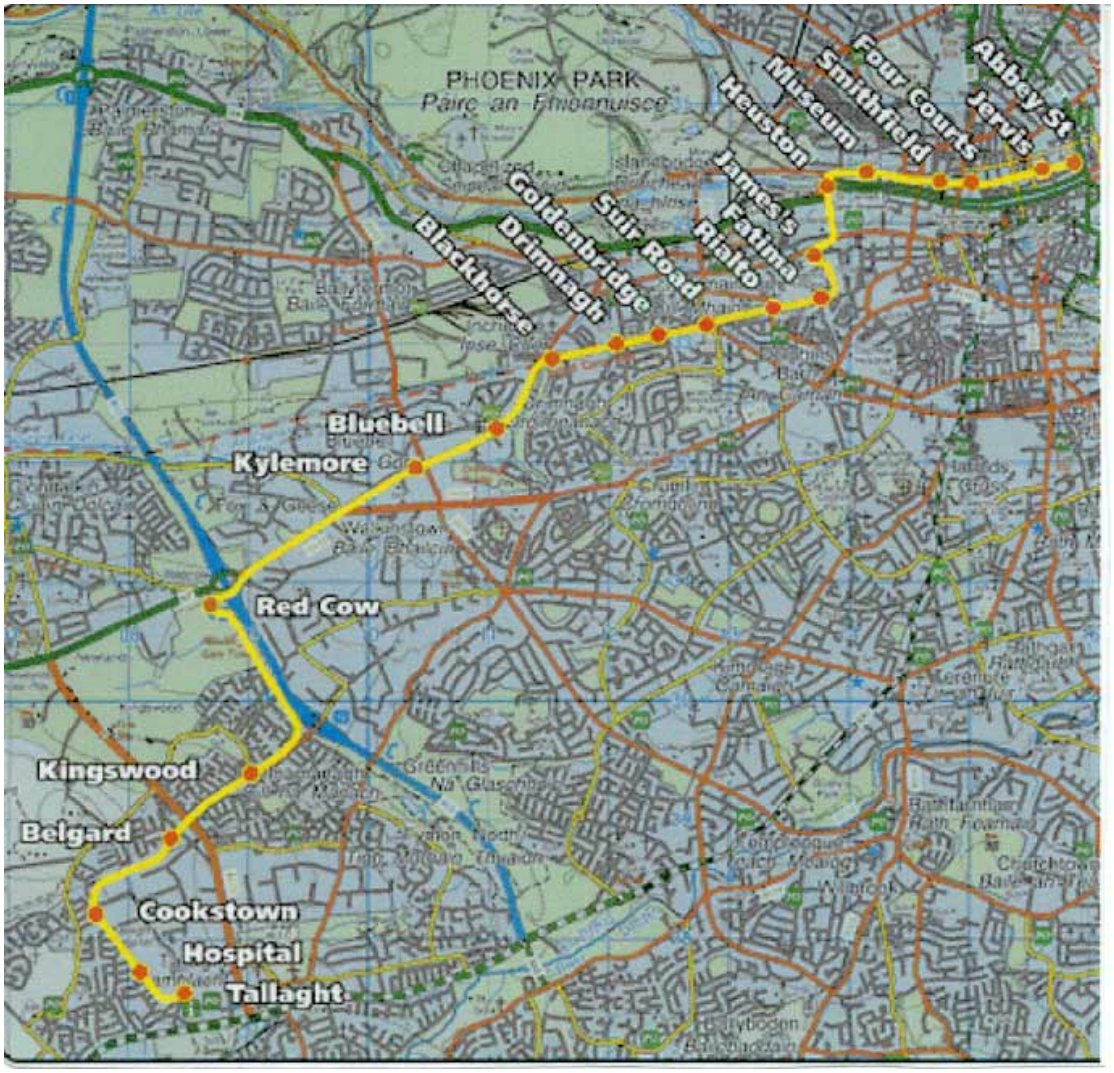

Figure 3. Line B route from Sandyford to St. Stephens Green (*2*)

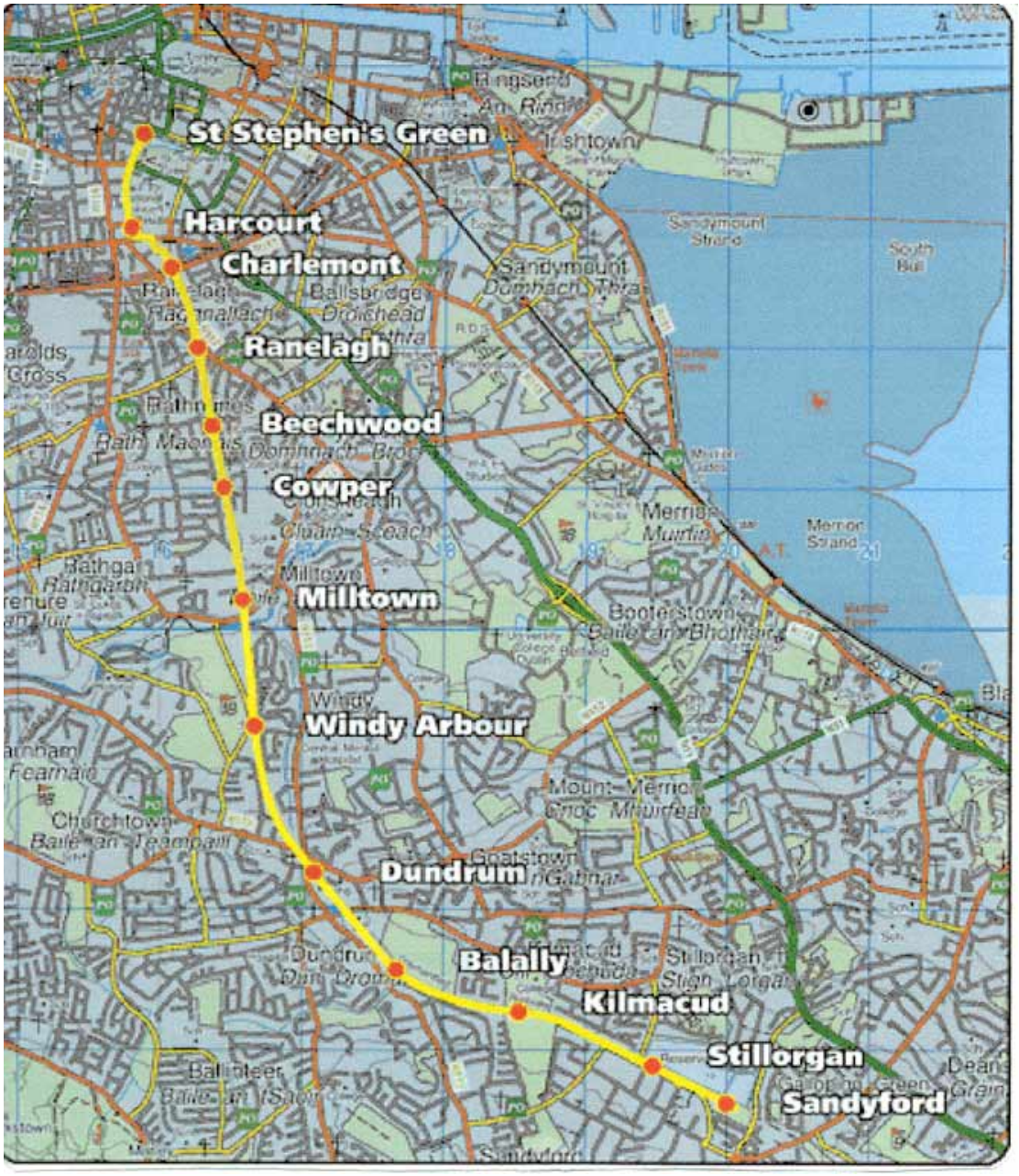

Figure 4. Luas passenger information and vehicle location systems

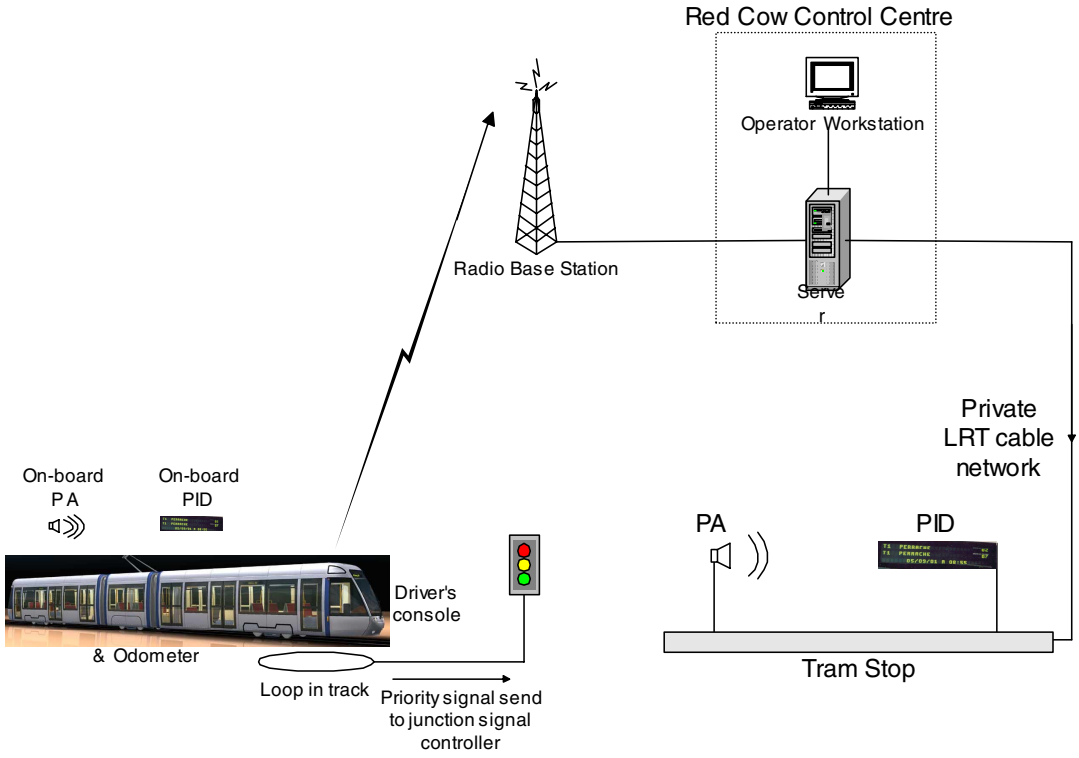

Figure 5. Simplified junction schematic