

Strategic Justification of Three Existing Modes of Transportation in Rouen

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General Outline of *Métrobus* Light Rail–Bus Network

The Rouen Conurbation (pop. 390,000) in northern France is a large metropolitan community composed of 34 districts (*communes*) with transport administered by the Rouen Conurbation authority. In the last 10 years, this body has followed a policy of developing an urban transport network called *Métrobus* based around bus services and a light rail which was complemented by the Rouen East–West Transport (TEOR) project. During the 10-year development period, *Métrobus* network passenger kilometers have increased by 22%, while journeys have grown by 56% and revenue by 64% (Table 1).

Historical Review of Light Rail

The final decision to build the Rouen light rail was made in 1990 following 10 years of feasibility series. The geography and location of Rouen imposed several major constraints on transportation; the conurbation is bisected by the River Seine and the city of Rouen is surrounded by several elevated plateaus at 150 m. In addition, the city has an ancient and historic centre. These three elements create severe difficulties for urban transport operations and have hindered development of efficient mass-transit systems. Furthermore, other unfavourable factors adversely impact development of mass-transit systems, including: urban sprawl, runaway growth in private automobile ownership; oversupply of city-centre parking; urban road congestion due to absence of bypass; excessive heavy truck traffic in city centre due to high economic activity; and lack of priority attached to mass transit.

The transport capacity and structuring effect of a light rail were major factors in the decision to build the north–south light rail on a segregated right of way.

Table 1 *Métrobus* Results

	1993	2003	
Passenger-km (A)	10,677,201	13,106,353	22.75%
Passenger journeys (B)	25,316,618	39,718,479	56.89%
Journeys* (C)	21,582,796	30,779,288	42.61%
Fare revenues (D)	9,893,787	16,235,990	64.10%
B/A	2.371	3.030	27.81%
D/C	0.458	0.527	15.07%

Note: Non-connection trips

Figure 1 Rouen Light Rail Network



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Table 2 Light Rail Specifications and Figures (2003)

Length	15.1 km
Length underground	2.2 km
Stations	31
Underground stations	5
Train sets	28
Schedule speed	19.1 km/h
Peak frequency (shared trunk section)	3 minutes
Peak frequency (each line)	6 minutes
Passenger-km (A)	1.427 million
Passenger journeys (B)	15.233 million
B/A	10.67

Description of light rail

The light rail lines follow the routes of the two most heavily used bus lines based on population density and industrial workforce. They cross five rural districts—Rouen, Petit-Quevilly, Grand-Quevilly, Sotteville and Saint-Etienne-du-Rouvray. The two branches south of the Seine join at Saint-Sever Station and cross the river over a road bridge. The common trunk ends at the Boulingrin terminus (Fig. 1). Most of the northern section runs in a 1.7-km tunnel with four underground stations (Beauvoisine, Gare-Rue Verte, Palais de Justice, Théâtre des Arts). The tracks on the south bank are mostly elevated, but there are three underground intersections (Place Joffre, Boulevard de l'Europe and Avenue Jean Rondeaux) and one underground station (Joffre-Mutualité). The Alstom-built rolling stock is a standard French tramway design comprised of two articulated bodies on two driving bogies and a low-floor middle section over a median carrier bogie. The Rouen Conurbation Subway Company (SOMETRAR) was granted the franchise to finance, build and operate the Rouen light rail, while the Rouen Public Transport Company—TCAR, a Connex subsidiary—operates the *Métrobus* network and assumes both the financial and operating risks (Table 2).

Performance assessment

The Rouen light rail is one of the first wave



Ground-level Léon Blum Station by architect Jean Michel Willmotte

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of Light Rail Transit (LRT) systems built in France between 1985 and 1995. Others include Nantes, Grenoble, St Denis Bobigny and Strasbourg. The 10-year history of these networks offers some perspective from which to assess their long-term performance.

As in all urban areas served by a mass-transit system, the Rouen light rail has exerted a considerable impact on Rouen's businesses, metropolitan structure and overall urban development.

Its comfortable carriages provide reliable and frequent services that are easy to access as evidenced by the 60,000 or so daily passenger journeys amounting to some 15 million annual journeys. Moreover, the light rail has played a role in driving the overall results of the *Métrobus* network. Furthermore, its use of high-level architectural features matching the surrounding environment has added to the city's attractiveness. And finally, the light rail has gone beyond its primary transport role to become a development tool through its effect of revitalizing public urban spaces and the city centre.

Historical Review of TEOR Project

Soon after services started on the first Rouen light rail line in December 1994, the organizing authority ('District' at that

time) studied various options for building an exclusive right-of-way line on the east-west axis. However, the solution had to:

- Have the capacity to serve a populous university campus, regional hospital, and the Rouen Heights district
- Be able to handle the grades required to reach the Rouen plateau at an elevation of 150 m
- Match more-patchy demand due to the lower population densities and fewer jobs than on the north-south axis
- Be easily financed in the light of repayment burdens for the Rouen light rail and other new obligations

Various technologies were explored, including a light rail, single-guideway tyred tramway (TVR, Transport sur Voie Reservée), urban cable car, and buses. At the end of 1997, the authority decided to build three new TEOR lines on an exclusive right of way using the TVR concept that would be integrated with the Rouen light rail opened in 1994.

The objective was to operate a mass-transit system on an exclusive right of way through the east-west axis of the Rouen metropolis. The system would offer good operations speeds, frequency and comfort equivalent to a tramway commensurate with available financial means and citizens' transportation needs.

Description of TEOR lines

The plans called for building three lines on the right bank of the Seine to serve the heavily populated valleys and plateaus east and west of Rouen, running on a shared segregated right of way to the city centre (Fig. 2). The proposed routes are:

- Line T1 (16 km, 26 stations): Mont aux Malades in Mont-Saint-Aignan to Alfred de Musset in Rouen
- Line T2 (12 km, 25 stations): Mairie-V. Schoelcher in Notre-Dame-de-Bondeville to Durécu in Darnetal
- Line T3 (20 km, 41 stations): Bizet in Canteleu to C.H.U. Charles Nicolle in Rouen

The shared section near the centre of Rouen will be about 4 km with 11 common stations between Mont Riboudet and C.H.U. Charles Nicolle.

The proposed design uses new high-performance technically innovative rolling stock consisting of 66 Irisbus-built *Agora*-type articulated vehicles with optical guidance in order to permit perfect accessibility in the stations. High schedule speed will be assured. Station infrastructure will also be very high quality and able to handle daily movements of up to 50,000 passengers in conditions equivalent to guided transport lines.

Construction plans called for two phases:

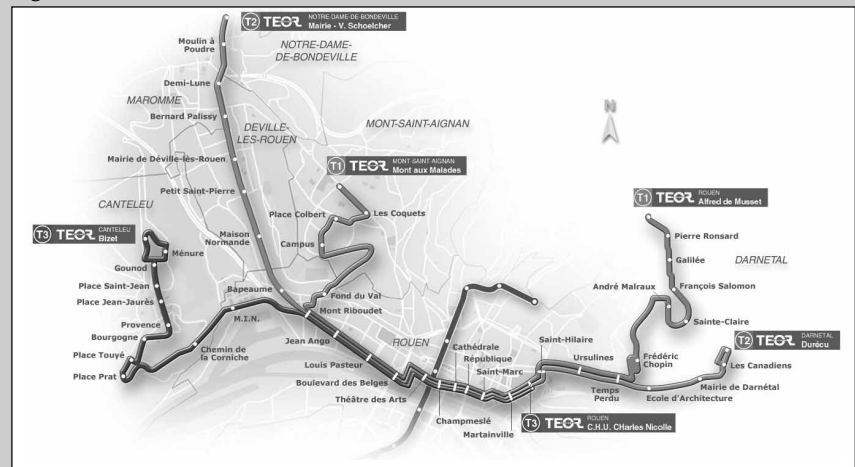
- Phase 1 with 50 stations on entire lengths of T1 and T2 and some sections of T3 with completion by 2006
- Phase 2 with completion of T3 after 2006 to serve final total of 70 stations

However, pre-production testing of two Irisbus *CIVIS* vehicles (articulated bus with electric powered wheel axles) resulted in adoption of the proposed optical guidance technology on *Agora* articulated vehicles.

Current situation

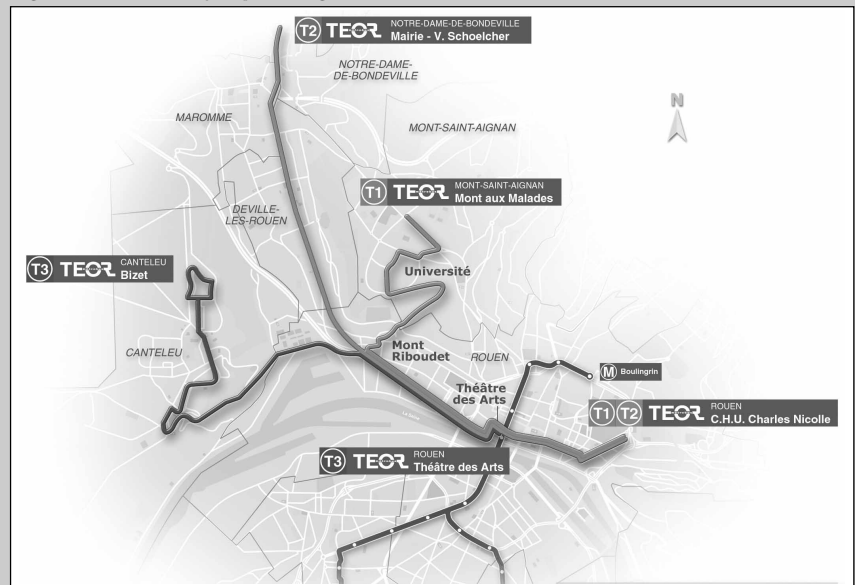
So far, only the western ends of the T1 and T2 lines and part of T3 line have been opened (Fig. 3). The current 41 stations

Figure 2 Three Planned TEOR Lines



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Figure 3 Currently Operating TEOR Lines



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(16 fully completed) are served by 38 *Agora* articulated vehicles fitted with optical guidance, as well as by two preproduction *CIVIS* vehicles. The optical guidance system pulls the vehicles to within 50 mm of the platform offering barrier-free access to all passengers and eliminating the need for wheelchair ramps, etc., when the self-service doors open.

The driver can switch from guided to manual operation without stopping or slowing down (Table 3).

Table 3 TEOR Specifications and Figures (2003)

Length	25.6 km
Stations	41
Completed stations	16
Vehicles	
<i>Agora</i> buses	38
Preproduction <i>CIVIS</i>	2
Peak frequency (shared section)	3 minutes
Peak frequency (each line)	4 minutes
Passenger-km (A)	1.658 million
Passenger journeys (B)	6.854 million
B/A	4.13



Agora articulated vehicle at stop with ground lines for optical guidance

(TCAR)

Performance assessment

Only part of the TEOR project has been completed so far—the sections in the city centre and to the east of Rouen will be built from 2004 on. As a result, it is difficult to assess the performance accurately. The completed segregated right of way exceeds 10 km and people are making close to 30,000 daily journeys in the comfortable vehicles. Some lines are seeing substantial increases in ridership of 10% to 30% compared with passenger numbers on the former bus lines, and undoubtedly, there will be increases as soon as the city centre is fully developed. The TEOR project seems to offer an interesting and a good quality alternative to communities wanting to avoid massive costs by integrating with other transport lines on a previously built segregated right of way.

The Buses

The services offered by the Rouen light rail and TEOR lines outlined above are complemented by bus services organized vertically around the exclusive right-of-way lines as follows:

- Backbone bus network
Buses in this network operate services radiating from or feeding into the light rail and TEOR lines at frequencies of 12 minutes or less.

- Supporting bus network
These are typical bus services running at frequencies of between 12 and 25 minutes.
- Expansion bus network
Regions with very low population densities are mostly served by smaller minibus-type vehicles.
- Interurban coach network
Long-distance travel between urban perimeters is achieved using interurban coaches.
- School bus network
When there is no regular bus service, school buses provide links between residential districts and educational areas when schools start and end (Table 4).

Synergy between Three Modes

Although the Rouen *Métrobus* network constitutes a coherent and effective transport network, it is based on a synergy between three transport modes: the Rouen light rail, the TEOR lines and the bus lines.

Network and problems with feeder services

Using the bus lines to feed the light rail and TEOR lines has three major benefits—more economic operating costs; better city-centre environment with only

necessary bus services; minimized monopoly of city-centre roads by segregated right-of-way lines. However, since customers form a captive market, they require some form of protection in terms of frequency, reliability and comfort of bus services feeding termini or major stops on the light rail and TEOR lines.

Special attention must be paid to the frequencies of feeder services in relation to the light rail and TEOR lines that they serve, especially because a potential customer may choose to remain on the feeder mode rather than change to the light rail or TEOR line if the connections are bad.

In Rouen, the light rail and the TEOR lines are served by four and three backbone services, respectively, out of a total of 34 bus lines.

In each case, the bus timetable, service frequency, and connecting stops had to be adjusted to match the other services before customers felt satisfied.

Equipment

Ideally, customers using a transport network based on different modes each utilizing different technologies should not view the network as multi-speed. The ‘appearance’ of a single-speed network can be achieved by ensuring that technologies used by each mode are beneficial to all modes.

Various solutions have been adopted on

Table 4 Bus Specifications and Figures (2003)

Regular lines	34
Length	460 km
Stops	1600
Buses	226
Standard buses	162
Articulated buses	48
Minibuses	16
Schedule speed	17.32 km/h
Passenger-km (A)	10.021 billion
Passenger journeys (B)	17.631 billion
B/A	1.76



Connection at Boulingrin terminus of light rail and No. 5 bus line (TCAR)



Segregated right of way at Mont Ribouidet on lines T1, T2 and T3 of Rouen TEOR (TCAR)

the Rouen *Métrobus* network as follows:

- Installation of Operation Assistance System (SAE) on all light rail, TEOR and bus lines
- Installation of Passenger Information System (SIV) terminals in all light rail and TEOR stations, as well as in major bus connection stations
Some information is also provided by in-vehicle electronic displays on all transport modes.
- Network-wide magnetic ticketing
- Through-ticket vending machines throughout light rail and TEOR lines (expected by 2004)
- Same-level barrier-free platforms on light rail, TEOR and Liaison Sud-Ouest Rapide (LISOR) bus lines (in progress)

Consistent information

Passengers making intermodal connections require information about location and connecting services. Station displays must be easily seen, up-to-date, correctly located, and easily followed.

In addition, there must be consistency of design, colour, logomarks, symbols, positioning of displays, etc.

All three transport modes in the Rouen *Métrobus* system use a common set of standards governing these items.

Fare pricing

To assure ease of use and freedom of movement, all three modes in the *Métrobus* system use through ticketing based on the same pricing structure.

A ticket can be used on all three transport modes for an hour once it is validated.

Why Three Transport Modes?

Why is Rouen's *Métrobus* system based on three transport modes? There are three reasons: the constraints of urban environment and geography mentioned earlier; politics and history; and service requirements.

The last 20 years have seen major developments in new transport technologies suited to provision of medium-capacity transport in smaller cities. New LRT systems first appeared in Nantes and Grenoble, and were immediately seen as a possible solution to Rouen's problem of how to reunite the two banks of the Seine. A light rail also offered two politically attractive possibilities: revitalizing the hollowed-out city centre, and overcoming the increasingly harmful dominance of the automobile.

Rouen's subsequent choice of the guided TEOR lines showed how a metropolis with limited financial resources could reliably

meet higher demand than that provided by buses at reasonable cost.

Although the bus is the only conceivable mode for very remote areas, Rouen has been able to adapt it in terms of both design (low floors, pollution-free standards), and operations (segregated right of way and location of connecting stops) to complement the other two modes as feeder services, thereby ensuring easy and barrier-free access for all passengers to all modes.

As a consequence, Rouen seems to have avoided the main stumbling block of a network based on three different transport technologies and the successes achieved so far are a model for future expansion of the TEOR and buses. ■



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