7 MILAN RAILWAYS NODE

7.1 THE KEY ISSUES ADDRESSED BY THIS CASE STUDY

The present case study points out the main issues related to the integration and interconnectivity among the different levels of the rail infrastructures in the city of Milan. In detail, the analysis focuses on the description of the strategic role of the Milan node infrastructure in comparison with the national and international railway network, with particular regard to connections, accessibility and passenger information at the railway stations.

Deeper analysis of this study will be provided in a second phase of the INTERCONNECT project, when it will be used as a test bed for potential solutions. In that phase, the outcomes of the multi-modal transport model will be helpful to analyse the current level of interconnectivity and to assess the impacts of planned future connections with the high-speed national rail network, the improvement of connections with airports, a possible integration of fares and the need for reduced interchanges among different public transport networks.

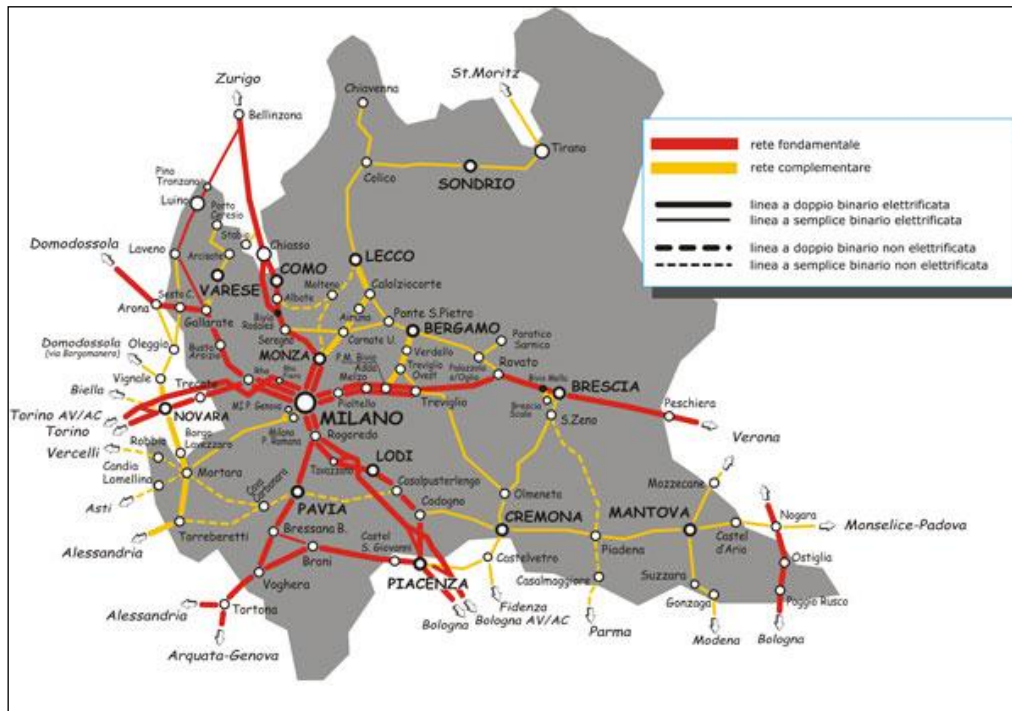### 7.2 GENERAL DESCRIPTION OF THE CASE STUDY

7.2.1 Overview

The railway node of Milan is characterised by a radial structure converging towards the city centre. Such a scheme does not fully satisfy anymore the demand of mobility in the district, where the industrial and production system is now scattered into several small local units located within the peripheral and suburban areas of the city. Over the last decades, a significant part of the population moved from the city centre to the small towns within the metropolitan area. As in many other metropolitan areas, it was impossible for the railways to follow this sprawl and nowadays the majority of the recent development areas are not served by the railway.

Looking at a larger scale, the Milan rail node is one of the most important nodes in the northern Italy railway network and its importance is threefold:

➢ At the international level Milan is directly connected with European cities, through international railway lines such as Milan-Chiasso–Zurich-Basel, Milan-Domodossola-Geneva, Milan–Turin–Paris, Milan–Turin–Barcelona.

➢ At the national level Milan is located at the intersection between two of the most important national railway axis:

- Turin-Milan-Venice, an east – west axis, which runs through one of the most densely populated and industrialised areas.

- Milan-Bologna-Florence-Rome which constitutes the backbone of the Italian High Speed rail network.

➢ At the regional and local level, Milan is the centre of trade and business in the Lombardy region, with several hundred thousand commuters reaching the city centre by train every day.

Figure 7-1 shows the railway connections of Milan. Red lines represent the main lines (international, national and high speed lines), while yellow lines represent the regional and local networks. The railway network in Lombardy region is 1,671 km long, of which 192 km are within the metropolitan node of Milan.
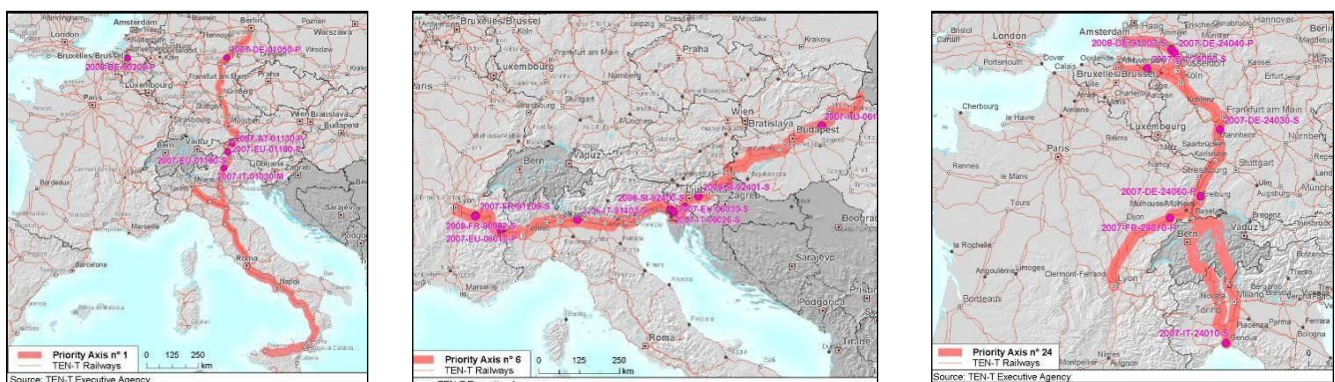
Figure 7-1   Milan railways node

The railway network of the city of Milan is constituted by different levels of service and importance. At the international level, Milan is directly connected with Paris, Zurich, Basel, Geneva, Bern and Barcelona. Connections are guaranteed every day for French and Swiss cities and three times a week for Spanish cities.

7.2.2   TEN-T and the High Speed Rail network

Regarding the European TEN-T networks, it should be noted that Milan is located at the intersection between the priority railway Axis 1 (Berlin-Verona/Milan-Bologna-Naples-Palermo) and Axis 6 (Lyon-Turin-Milan-Ljubliana-Kiev). Furthermore Milan is located also on the railway Axis 24 Lyon/Genoa–Basel–Duisburg–Rotterdam/Antwerpen, which will facilitate the transport of goods and passengers across EU countries in the south–north direction.

Figure 7-2   TEN-T Priority Axis 1, 6 and 24

The following paragraphs present the status of the high speed rail network as of May 2010, with reference to the TEN-T priority projects included in the Axis 1, 6 and 24.

➤ **HSR Milan – Bologne – Florence – Rome – Naples (axis 1)**

The above mentioned high speed railway line was opened in December 2008. Milan-Rome represents the most important railway connection since it connects the two main Italian cities in less than three hours on a direct service and in three hours and half by stopping in Bologna and Florence. The high speed rail service is in competition with the air connections operated by Alitalia and a few low cost airlines.

According to the Trenitalia timetable, every day 34 pairs of high speed trains connect Milan to Rome of which 20 pairs of trains stop also in Bologna and Florence. The Milan train stations used for high speed trains are Centrale, Rogoredo and Porta Garibaldi, which will be described in details in the next paragraphs.

➤ **HSR Milan – Treviglio – Brescia – Verona (axis 6)**

This line is 140 km long, of which 29 km between Milan and Treviglio are already completed and operational, since July 2007 (see Figure 7-3, where the black line represents the current railway line connecting the three cities and the red line corresponds to the new links).

Figure 7-3   Railway line Milan – Treviglio – Brescia - Verona

The construction works of the stretch between Treviglio and Brescia will start in the next months, since in May 2010 the Interministerial Committee for Economic Planning (CIPE) approved the final design: the railway will be 73 km long and it will be connected to the existing railway line through 7 km of interconnections. The remaining railway stretch between Brescia and Verona is still at the design stage.

➤ **HSR Verona – Venice (axis 6)**

The last stretch of the high speed line between Verona and Venice is 100 km long, of which 25 km are already operational between Padua and Venice (since March 2007). The remaining part, from Verona to Padua, is still at the design stage: it will be 76 km long (with two interconnections of 5 km with the existing tracks) and will be constructed beside the existing railway line and the A4 motorway.

Figure 7-4   Railway line Verona – Padua

> **HSR Milan – Genoa (axis 24)**

The new high speed railway line between Milan and Genoa will be 53 km long, with a 39 km tunnel, and it will be connected with the existing railway line through 4 interconnections of 14 km.

According to the project, the new HSR will offer better transport services by improving the rail connection between the port and harbour system of the Liguria region (Genoa and Savona) and central/northern Europe (e.g. Rotterdam and Antwerp). Construction works started in February 2010 and the completion of the railway is expected by the year 2013.

7.2.3 Regional rail service

The Milan railway belt constitutes six rail stations, not all located within the city of Milan, in which several stretches of railway lines converge. Table 7-1 reports the rail stations and their main directions.

Table 7-1   Milan rail stations

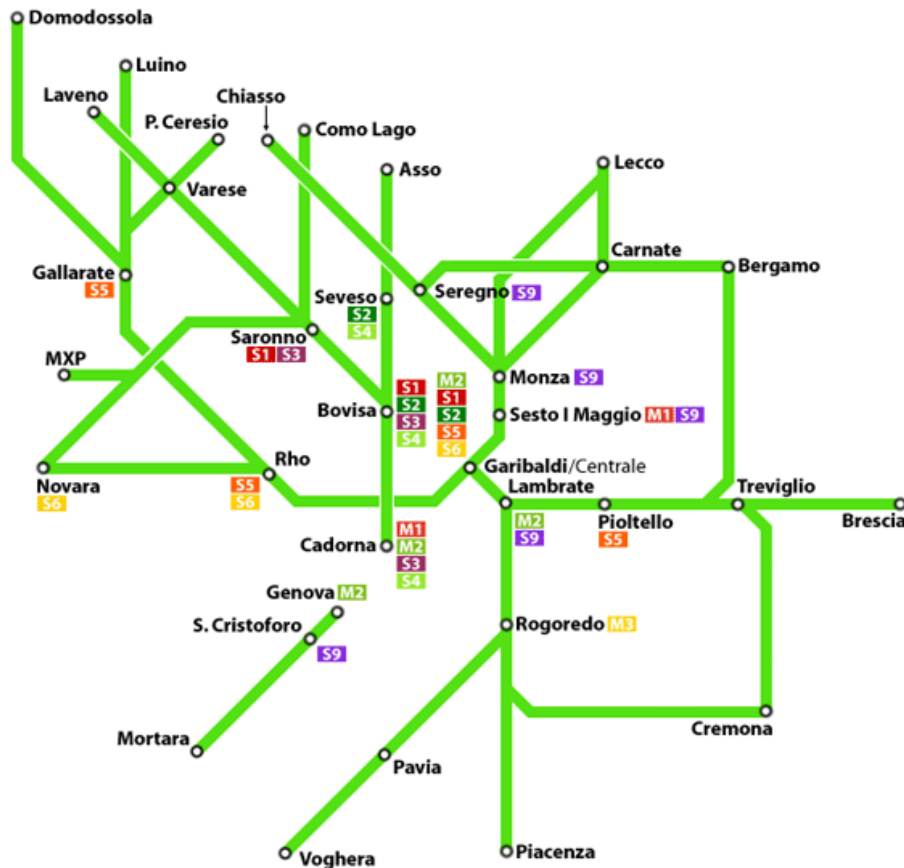| Rail Station	Directions
Rho	Turin, Simplon (CH), Varese RFI
Milano Bovisa	Como FNM, Asso, Novara via Saronno, Laveno, Varese FNM
Monza	Chiasso (CH), Sondrio, Lecco, Bergamo, Lecco via Molteno
Milano Lambrate	Venice, Bergamo via Treviglio, Cremona
Milano Rogoredo	Bologna, Genoa
Milano San Cristoforo	Mortara

(source: TRT elaborations)

Figure 7-5 shows the regional lines, usually known as "R Lines", connecting Milan to the rest of the Lombardy region and to its neighbouring regions Emilia Romagna and Piedmont.

With more than 2,000 trains and 600,000 passengers per day, the Lombardy regional railway network is one of the most used in Europe. Every year the rail service supplies 3.5 billion pKm, mainly related to the attraction/generation flows to/from Milan.

The regional service is constituted by the suburban service (S-lines- see next paragraph) and by the national service. Originally the rail service of the Lombardy region was operated by two different providers (Ferrovie Nord Milano and Trenitalia) which used their own rail infrastructure. For that reason the provided rail services were completely independent and there were no interconnections between the two infrastructures.

Recently robust investments have been made in order to connect the two infrastructures in order to harmonise the commuter service and to increase interconnectivity.

(source: www.msrmilano.com)

Figure 7-5   Milan regional rail service

7.2.4 Suburban Rail Service

In December 1997 the first stretch of Milan suburban railway was opened to traffic. This new underground infrastructure connected Milano Bovisa to Milano Porta Venezia and included the following railway stations:

➢   Milano Bovisa FNM;

➢   Milano Lancetti

➢   Milano Porta Garibaldi

➢   Milano Repubblica

➢   Milano Porta Venezia.

At the beginning, the only service provided was a "shuttle" train between Milano Bovisa and Milano Porta Venezia, with a frequency of 15 minutes per direction.

In 1999 the section between Milano Lancetti and Milano Certosa became operational and the regional services provided by FNM and Trenitalia started to stop at these stations.

In 2004 the Milano Porta Vittoria station was opened and the suburban service, known as "S Line" started to be operational. The new service provides a train every 30 minutes per direction and per line from 06.30 to midnight.

In 2008 the last station Milano Rogoredo was completed and the suburban service was reorganised and optimised for supplying 10 lines with 22 rail stations in the city and for connecting Milan and its
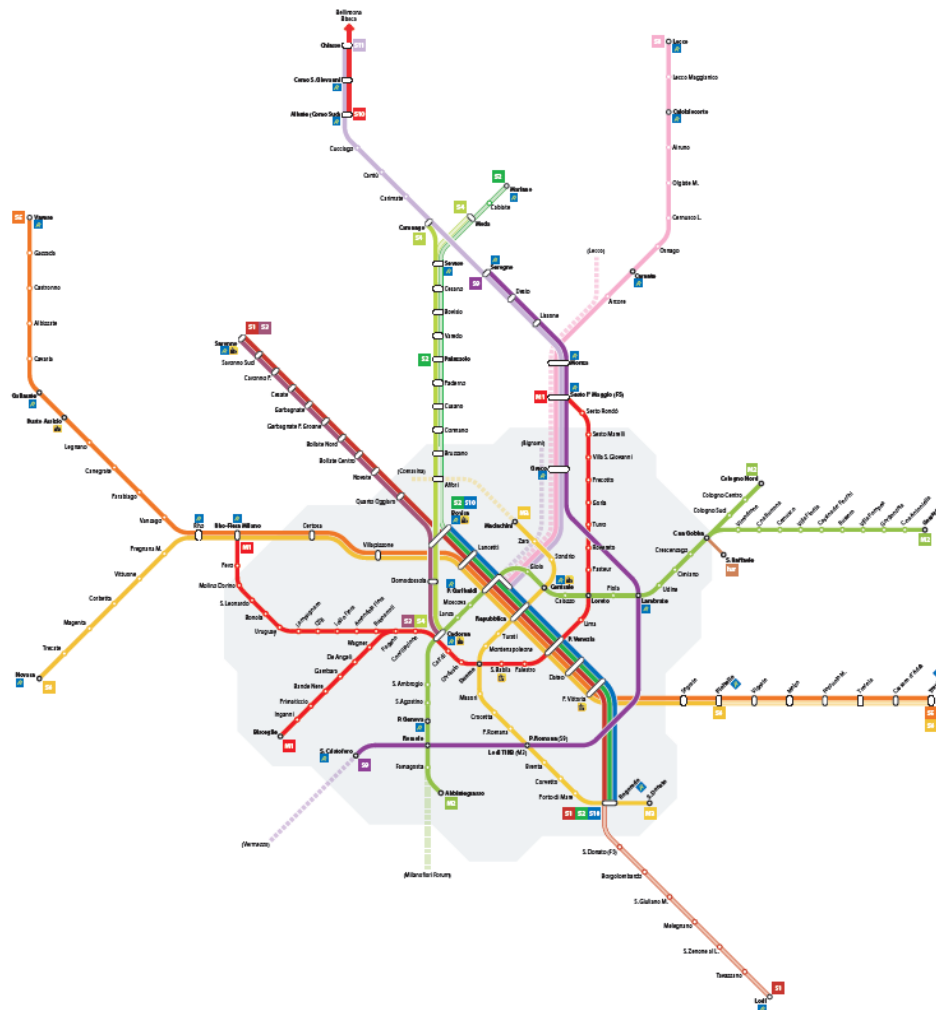
metropolitan area with Novara, Varese, Saronno, Como, Mariano Comense, Camnago – Lentate, Lecco, Seregno, Treviglio and Lodi.

The current scheme of the suburban service is described in Table 7-2 and in Figure 7-6.

Table 7-2   The suburban rail service of Milan

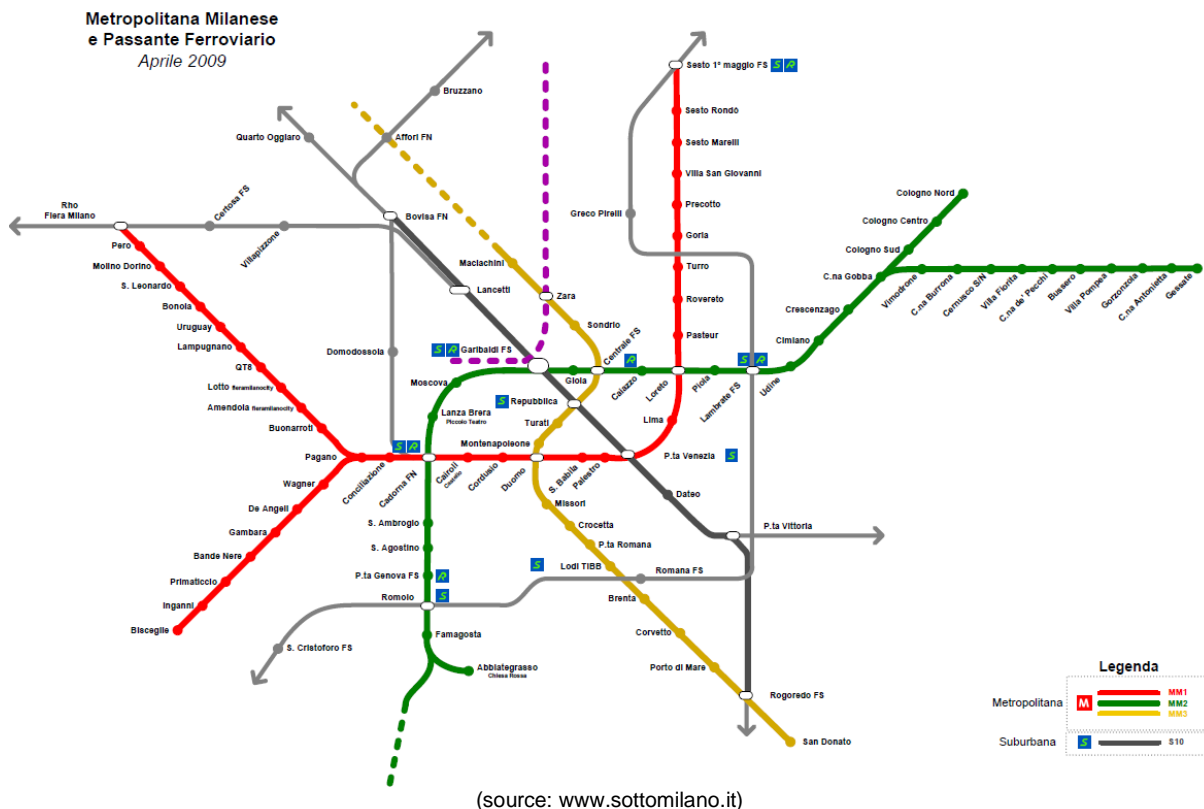| Line	Description	Length (km)	Number of Stations
S1	Saronno – Milano Passante –Lodi	55.4	25
S2	Mariano Comense– Milano Passante – Milano Rogoredo	30.9	20
S3	Saronno –Milano Cadorna	23.6	13
S4	Camnago Lentate – Seveso – Milano Cadorna	21.2	14
S5	Varese – Milano Passante – Treviglio	92.6	28
S6	Novara – Milano Passante – Treviglio	83.5	24
S8	Lecco – Carnate – Milano Pta Garibaldi	49.9	13
S9	Seregno – Monza – Milano S.Cristoforo	35	10
S10	(Malpensa Aeroporto) - Milano Bovisa – Milano Rogoredo	55.7	14
S11	Chiasso – Como S.Giovanni - Milano P.ta Garibaldi	51.4	13

(source: TRT elaborations)

(source: www.msrmilano.com)

Figure 7-6   The Milan suburban rail network

7.2.5 The underground network

The Milan underground network is composed by three lines for a total amount of approximately 75 km, of which 50 km are within the boundaries of Milan municipality. Further extensions of the lines are planned: the fourth metro line M5 is under construction as well as the extensions of the lines 2 and 3 that are expected to be completed by 2011, while the completion of the M4 line is expected by 2014.

The underground network connects the main railway stations with each other and all of them with the city centre. In order to promote the modal shift from private cars to public transport, each metro line is provided with at least one Park & Ride area. Figure 7-7 shows the current structure of metro network, and Table 7-3 summarises the main features of each line. More information on Park & Ride lots is given in the following paragraphs.

(source: www.sottomilano.it)

Figure 7-7   The Milan underground network

Table 7-3 The underground network of Milan

Line	Description	Length (km)	Number of Stations	Park & Ride
M1	Sesto 1° Maggio – Rho Fiera/Bisceglie	27	38	Molino Dorino M1; Lampugnano; Sesto S. Giovanni FS; Bisceglie
M2	Abbiategrasso – Cologno Nord / Gessate	34,6	33	Famagosta, Romolo, Cascina Gobba
M3	San Donato - Maciachini	13	17	San Donato

(source: TRT elaborations)

7.3 SPECIFIC CHARACTERISTICS OF THE CASE STUDY

7.3.1 Modes and Infrastructure Involved

As already mentioned, the Milan rail node is composed of 22 railway stations, 6 managed by FNM and 16 by RFI. Every day more than 700 trains, including regional services, high speed trains, Intercity, Eurostar and Express trains, reach Milan stations.

It should be noticed that Trenitalia and TLN operate regional services in different portion of Lombardy territory: Trenitalia operates between the provinces of Cremona, Mantova, Lodi, Pavia, Bergamo, Brescia, Sondrio, Lecco and Milan, while TLN operates between the provinces of Varese, Como, Monza Brianza and the municipalities of the province of Milan located in the north of the city.

Table 7-4 provides the number of daily trains arriving at Milan railway stations, grouped per type of service, indicated in the official 2010 Trenitalia timetable.

Table 7-4 Trains arriving at Milan stations daily

Type of train	Number of trains
Regional service (TLN)	236
High Speed	48
Eurostar	52
Express	9
Intercity	30
Regional service (Trenitalia)	334
Total	709

(source: TRT elaborations)

The graph in Figure 7-8 below shows the number of daily trains, grouped by type of service, stopping at Milan main stations Centrale, Porta Garibaldi, Rogoredo and Lambrate.

(source: TRT elaborations based on Trenitalia and FNM timetable 2010)

Figure 7-8   Trains stopping daily at Milan stations

As the graph highlights, the high speed trains stop in only three stations: Centrale, Porta Garibaldi and Rogoredo, which represent the most important interchange points of the Milan railway node.

Since December 2009, after the new opening of the high speed tracks towards Turin and the improving of service between Milan and Rome, more high speed trains running from Rome to Turin stop at Rogoredo or Porta Garibaldi station instead of Centrale station, depending on the origin of the train.

Long distance trains (e.g. Eurostar, Intercity, Express) are mostly directed to Centrale, but they stop also at Porta Garibaldi or Lambrate station.
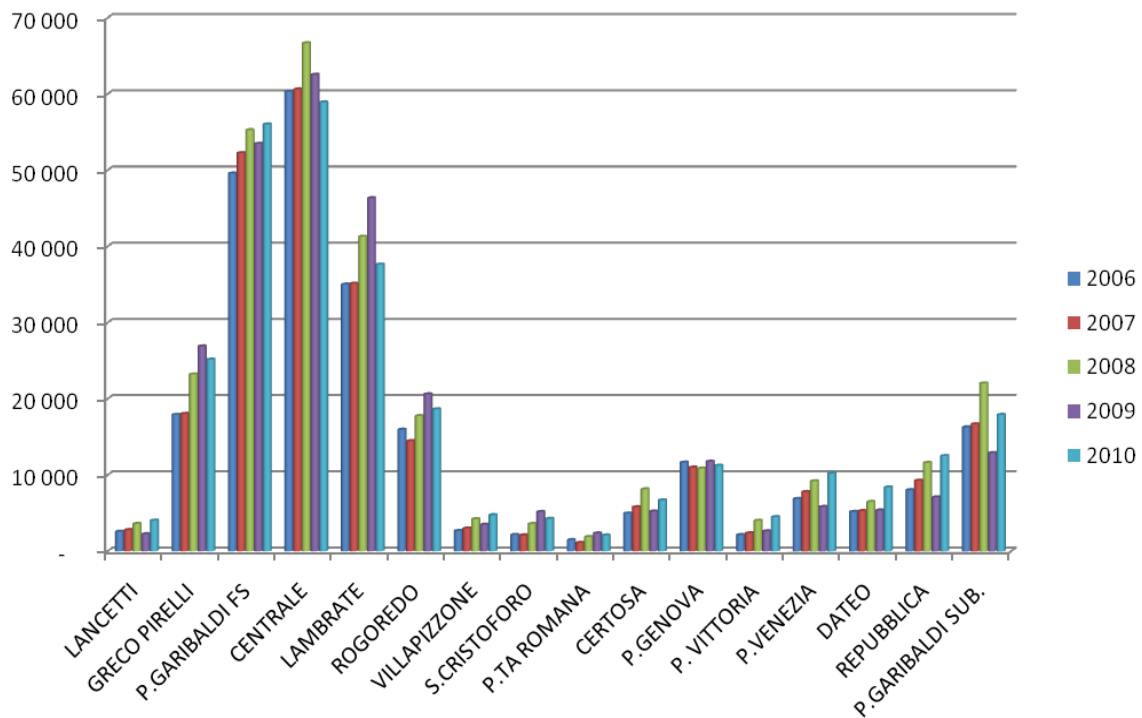
Lambrate station hosts the highest number of regional services provided by Trenitalia, followed by Porta Garibaldi and Centrale.

Rogoredo station is progressively increasing its traffic, due to the opening of the suburban station in June 2008.

Originally the rail infrastructures built by FNM and RFI were not interconnected. Rail services provided by FNM were not allowed to run through the RFI's infrastructure and vice-versa. Since 1999, after the opening of the suburban station at Lancetti, FNM's trains started to use the infrastructure built by RFI according to an agreement signed by the two companies and trains provided by FNM stop at RFI Rogoredo station.

Nevertheless the main "hub" of the services provided by FNM and by TLN remains the station of Cadorna, since every day 84% of the TLN regional trains arrive at this station.

Figure 7-9 shows the trend of boarding and alighting passengers related to the regional service at the Milan stations managed by RFI from 2006 to 2010.

(source: TRT elaborations based on Trenitalia data)

Figure 7-9 Boarding and alighting daily passengers at RFI's stations

The decline in the passenger numbers at the Centrale and Lambrate stations can be explained by a progressive reorganisation of the regional service that started in 2009: in order to relieve additional tracks dedicated exclusively to the high speed trains, regional and commuter trains have been deviated to Porta Garibaldi, San Cristoforo and Greco Pirelli stations. This situation penalises the interconnections between short and long distance trips, since it forces travellers to make at least one interchange with a consequent increase of travel time.

The suburban stations Rogoredo, Villapizzone, S.Cristoforo, P.ta Romana, Certosa, P. Vittoria, P. Venezia, Dateo, Repubblica and Porta Garibaldi show rising passenger traffic, especially in 2010.

7.3.2 Intermodal and Interconnection Opportunities

The level of interconnection and intermodality offered by Milan main rail stations is not so negative, since all of them are provided with metro and public transport connections. Nevertheless, even though continuous efforts have been made by the involved stakeholders in order to increase the quality of the services provided to travellers, some improvements are still needed.

For example, the lack of adequate signage for passengers, with maps or indications related to the interchanges with local public transport and of clear information about dedicated services for the High Speed travellers, has to be noted. Furthermore Milan rail stations are often characterised by the lack of logical paths and passengers can encounter some difficulties in finding their way within the interchanges.

In the paragraph below all offered interconnections from the main rail stations will be analysed.

Interconnection with the underground network

The main rail stations Centrale, Lambrate, Porta Garibaldi, Rogoredo and Cadorna are all connected at least with one of the three metro lines. The table below reports the interconnections between rail stations and metro lines.

Table 7-5   Interconnections between rail stations and metro lines

Railway Station	Underground lines
Milano Centrale	Lines M2 and M3
Lambrate	Line M2
Porta Garibaldi	Line M2
Rogoredo	Line M3
Cadorna	Line M1 and M2

(source: TRT elaborations based on ATM data)

Due to infrastructure problems, the intermodal changes are not often fast and intuitive. The lack of underpasses and of adequate information to travellers causes delays in finding the right direction of the underground line. In other cases, the underground station is not located within the rail station (e.g. at Lambrate), then travellers have to walk outside the rail station to reach the metro station. In other cases, like Centrale and Porta Garibaldi stations, the distance to be covered is quite long due to the extremely wide spaces at the interchange points.

Interconnections with local public transport (buses and tramways)

All Milan rail stations can be reached by bus or tramways but in most of the cases they don't run on segregated lanes. Therefore, given the existing traffic congestion, their average speed is very low and the travel time to reach the rail station is highly variable during the day.

Within the Milan urban area, a demand responsive bus service is also available from 8 pm until 2 am. The DRTS (Demand Responsive Transport System) allows passengers to travel the city by providing a "door-to-door" service.

Table 7-6 summarises the main features of the interconnections between the main stations and the local public transport network.

Table 7-6   Interconnections between rail stations and local public transport lines

Railway Station	Bus lines	Tramway lines
Milano Centrale	42, 60,82, 87, 90/91, 92	5;9, 33
Lambrate	53, 54, 75, 93	23
Porta Garibaldi	-	3,7, 4, 29/30
Rogoredo	84, 95	-
Cadorna	50, 57, 58, 61, 94	1,19, 27

(source: TRT elaborations based on ATM data)

Among the reported bus and tramway lines, only lines 90/91 and 29/30, approaching respectively Centrale and Porta Garibaldi stations, run on a segregated lane. For this reason, the most reliable way to reach railway stations in Milan is by metro lines or by suburban rail lines connecting rail stations.

Interconnections with taxi services

In principle each station has a taxi service, but taxis are numerous and available 24 hours only at Centrale and Cadorna stations. The service available at the remaining stations is generally scarce outside peak hours and during the weekend.

Interconnections with airport services

Connections with the three airports Linate, Malpensa and Orio al Serio are guaranteed by shuttle buses from Centrale station. Also, Lambrate station is connected to Linate and Orio al Serio airports by bus although a limited number of daily runs are operated. More details on airport connections are given in the Malpensa/Linate/Orio al Serio case study.

Malpensa is the only airport connected to Milan by train. A "shuttle train" from the airport to Cadorna station, named "Malpensa Express", runs every day every 30 minutes. A new rail link between Centrale and Porta Garibaldi station was completed on July 2010. The new connection will allow trains stopping at Centrale station to continue towards Bovisa FNM station and then to reach Malpensa. This improvement will allow passengers to have four connections per hour (every 15 min) with the airport, 2 leaving from Centrale and 2 leaving from Cadorna. Furthermore, two pairs of high speed trains from Rome to Milan will continue their run to Malpensa airport, by using the new rail infrastructure between Centrale and Bovisa.

Interconnections between regional and long distance services

Since the majority of long distance and high speed trains arrive at Milano Centrale station, some problems related to the interconnections with the local and, above all, with the suburban services exist.
Milano Centrale station, in fact, is not included into the suburban rail network and there are no plans to include it in the future.

At the moment, the interconnection between short and long distance trains are guaranteed only with Trenitalia regional service, since the major part of the regional trains arrive at Milano Centrale.

As far as the regional service provided by TLN is concerned, passengers proceeding to take a long distance train from Centrale or Lambrate station may find a connection train at Porta Garibaldi or Rogoredo stations. Passengers may also use the underground at Cadorna, Porta Garibaldi, Rogoredo or Repubblica stations. The following table summarises the suburban rail stations and their interconnections with the underground lines that allow Centrale or Lambrate stations to be reached.

Table 7-7   Interconnections between suburban rail stations and underground lines

S-Line station	Underground line
Repubblica	Line M3
Cadorna	Line M2
Romolo	Line M2
Porta Romana	Line M3
Porta Garibaldi	Line M2

(source: TRT elaborations)

Nevertheless, the interchange time is not so short, and this will be shown by some outputs of the multi-modal transport model that will be used in the second stage of this case study to test the impacts of some measures improving interconnectivity.

In the paragraph below three representative situations of trips to reach Milano Centrale railway station are presented.

The first trip is from Malpensa airport to Milano Centrale via Cadorna station; the second is from a rail station within the Pavia province (south of Milan) to Milano Centrale via Lambrate station; the third is from a rail station within the Milan province (north of Milan) to Milano Centrale via P.ta Garibaldi station.

For each trip the following travel steps are considered:

➢   Time to access the rail station

➢   Boarding time

➢   On board time to reach the interchange point

➢   Alighting time

➤ Walking transfer at the interchange point

➤ Waiting and boarding time at the underground station

➤ On board time

➤ Alighting time at Milano Centrale underground station and walking transfer

➤ Access to Milano Centrale railway station.

The following tables summarise the steps and the travel times of the three representative trips.

Table 7-8 Trip from Malpensa airport to Milano Centrale via Cadorna

Phase	Time (min)
Transfer at the airport terminal	10
Walking transfer from the airport to Malpensa railway station	10
Boarding time at Malpensa railway station	6
Rail on board time	36
Rail alighting time (Cadorna railway station)	4
Walking transfer at the terminal (Cadorna railway station)	5
Metro waiting and boarding time (Cadorna underground stop)	3
Metro on board time	9
Metro alighting time (Centrale underground stop)	2
Walking transfer at terminal of Milan Central Station	5
TOTAL travel time	94
Cadorna interchange time with relation to travel time (%)	**13%**

(source: TRT elaborations)

Table 7-9   Trip from Pavia province to Milano Centrale via Lambrate

Phase	Time (min)
Time to access the rail station from home	23
Boarding and waiting time at origin railway station	6
Rail on board time	23
Rail alighting time (Lambrate railway station)	4
Walking transfer at the terminal (Lambrate railway station)	5
Metro waiting and boarding time (Lambrate underground stop)	3
Metro on board	5
Metro alighting (Centrale Underground stop)	2
Walking transfer at terminal of Milan Central Station	5
Access to Milan Central Station	5
TOTAL travel time	80
Lambrate interchange time with relation to the total travel time (%)	**15%**

(source: TRT elaborations)

Table 7-10   Trip from Milano province to Milano Centrale station via P.ta Garibaldi

Phase	Time (min)
Time to access the rail station from home	5
Rail waiting and boarding time	6
Rail on board time	27
Rail alighting time (P.ta Garibaldi railway station)	4
Walking transfer at the terminal (P.ta Garibaldi railway station)	5
Metro waiting and boarding time (Garibaldi underground stop)	3
Metro on board time	4
Metro alighting time (Centrale Underground stop)	2
Walking transfer at terminal of Milan Central Station	5
Access to Milan Central Station	5
TOTAL travel time	65
P.ta Garibaldi interchange time with relation to the total travel time (%)	**18%**

(source: TRT elaborations)

As the tables highlight, the interchange time comprises up to 18% of the whole travel time. This is mainly due to infrastructural problems.

The underground station at the Lambrate interchange point is located outside the railway station and no direct underpass is provided. Furthermore the Lambrate station is not equipped with elevators and escalators, and then the transfer time increases noticeably.

As far as concerns Porta Garibaldi and Centrale station, it should be noted that both railway infrastructures cover a large area. Additionally, platforms at the Centrale station are located overhead

with respect to the road level while at Porta Garibaldi station there are three levels of infrastructures. The first level (road level) consists of the railway station for long distance and regional trains provided by Trenitalia. At the second level, which is the first underground level, the underground station of Line M2 is located, while at the third level, which is located below the underground line, there is the suburban rail station. Porta Garibaldi station is equipped only with escalators, while the distance to be covered for interchanging between the different stations is quite long.

Additionally, it should be underlined that there is a lack of clear and easy information to passengers at the interchange points. Even though Centrale and Porta Garibaldi stations have been renovated, information and logical paths for facilitating the transit of the travellers are still missing. Furthermore the lack of maps of the train stations with the indication of the provided services and the interchange points with the local public transport as well as the taxi stations or car hire areas increases the interchange time.

Intermodality between Private Car and Rail

While interconnections and intermodality between rail and local public transport services are quite satisfactory, the intermodality between private car and train are poor and under dimensioned.

At present, only two of the main stations (Rogoredo and Porta Garibaldi) are equipped with a Park & Ride lot close to the station; they are provided by RFI and managed by Metropark, a company of Ferrovie dello Stato holding. For both P&R infrastructures special fares are offered to the monthly subscribers of Trenitalia rail services.

In the table below the main features of P&R services are described.

Table 7-11   Park & Ride services at the rail stations

P&R	Number of car parking lots	Fare/h	Opening hours
Rogoredo	109	€ 1.00	06:00 to 01:00
Porta Garibaldi	67	€ 1.50	24 hours

(source: TRT elaborations)

7.3.3 Stakeholders Involved

Different stakeholders are involved in the Milan rail node: they are local authorities, operators of the services and owners of the rail infrastructures. In particular, **Lombardy Region** is the authority of the regional and suburban rail service.

The involved operators are:

➢ **Trenitalia-LeNORD (TLN)**, shared by Trenitalia (50%) and Ferrovie Nord Milano (FNM) (50%) which operates the S-Lines,

➢ **LeNord**, shared by FNM (100%) which operates regional service in some provinces of the Lombardy Region;

➢ **Trenitalia** which operates regional and national rail service.

Established in August 2009, the new company Trenitalia-LeNORD (TLN) is the single rail operator for the regional service born as a consequence of an agreement between Italian Government and Lombardy Region in order to unify the regional rail service providers. Trenitalia-LeNORD is shared by Trenitalia (50%) and Ferrovie Nord Milano (FNM) (50%) and its goal is to optimise regional rail services in order to achieve a more efficient service and to meet passenger needs.

The company is experiencing a pilot period after which the Lombardy Region, as transport authority, will verify the achievement of the objectives of punctuality, regularity, information to users and cleanliness of the trains fixed in the service contract.

Trenitalia-LeNORD operates 35 regional lines and 10 suburban lines overall the Lombardy Region, as well as the airport connection Malpensa Express.

The **Municipality of Milan** represents the Authority of the local public transport of Milan and its suburban area. It is responsible for planning and regulating the underground as well as the tramway and bus lines in the city operated by **ATM**. Founded in 1932 **ATM S.p.A.** (Azienda Trasporti Milanesi) is a public limited company owned by the Milan Municipality that operates public transport in the Lombard capital and in 72 provincial towns, serving a population of 2.6 million people.

Other private operators are responsible for the airport bus connections and for the inter-urban bus lines within the province of Milan.

Finally, as far as concerns the underground lines, the owners of the rail infrastructures are **RFI**, **FNM** and **Municipality of Milan**.

7.3.4   Current Cohesiveness of Multi-modal Networks

Despite the multi-modal network involved in the rail node of Milan, poor integration of services and ticketing exists. Currently an integrated monthly subscription called Trenomilano is valid both on Trenitalia and Ferrovie Nord services and allows commuters using the urban local public transport of Milan an unlimited amount of trips within a solar month. The fares of the subscription depend on the travelled distance of the rail service.

Additionally, an integrated ticketing system called SITAM is available only within the Milan metropolitan area. SITAM offers tickets and subscriptions for interurban buses that run within the province of Milan, with fares that increase progressively in dependence on the distance from Milan. The SITAM system is managed by ATM and is also joined by several local private transport operators. The structure of the ticketing system is as follows:

➢   Milan is divided into two ticketing zones;

➢   The municipalities outside Milan are divided into circular crowns that increase progressively their width and are identified by a different colour.

➢   Each crown is further split into semi-zones.

The calculation of the fares on a determinate path depends on the number of crossed semi-zones. The fares increase proportionally with the distance.

Users may choose the most appropriate ticket for their travel. Cumulative tickets and subscriptions are available for those users who want to use the urban local public transport of Milan in addition to the inter-urban bus lines. Rail connections are not included into the SITAM system, but users holding a cumulative ticket may use the urban public transport of Milan as well as the urban stretches of the suburban rail network.

Since the SITAM is managed by the main public transport operator, publicly owned by the Municipality of Milan, many problems with the private operators that joined the SITAM are occurring. The thorniest issue is related to the clearing system on which the revenue sharing among the operators is based. In fact, it is not perfectly clear how ATM divides revenues among the operators.

As a consequence private operators are progressively threatening to abandon the SITAM. Starting from September 2010 one of the main operator will supply its own tickets. This implies a worsening in travel conditions for passengers that have to hold two different travel tickets or subscription to reach Milan: one for the urban area of Milan, valid only on ATM's means and one for the other local transport operator supplying inter-urban services.

Finally, since the urban stretches of the suburban lines are considered as metro lines, a kind of harmonised ticketing between different infrastructures exists: the urban ticket is also valid for using suburban lines (only one way per ticket) within the boundaries of Milan municipality.

7.4 SOLUTIONS ALREADY IN PLACE

7.4.1 Overview

As described in the previous paragraphs, many solutions for improving interconnectivity at the stations are already in place. For instance, the main stations are well connected with the underground network as well as with the local public transport (by bus or tramway), even if a robust improvement for reducing transfer time between infrastructure is needed. Furthermore each station is equipped with a taxi station. Interchanges between private car and train are poor, since only Porta Garibaldi and Rogoredo stations provide a small Park & Ride lot close to the station.

Centrale and Porta Garibaldi stations have already been renovated in order to improve services and information for travellers. Dedicated services for HSR passengers at Centrale and Porta Garibaldi stations are now available.

The extension of the suburban rail network to Rogoredo station, the improving of the rail service and the upgrades of the rolling stock used for the suburban service all increase the comfort of commuters, even if further efforts are needed. The frequency of the service as well as the punctuality of the commuter trains is still poor.

In Table 7-12 solutions already in place for the main train stations are summarised.

Table 7-12   Solutions already in place

SOLUTION	CENTRALE	ROGOREDO	PORTA GARIBALDI	CADORNA
Regular Interval Timetabling		X	X	
General HSR system	X	X	X	
Metro/S-Bahn	X	X	X	X
Demand-Responsive Bus service	X	X	X	X
Rail station check-in for flights				X
Vehicle upgrade for increased comfort		X	X	
Park and ride sites		X	X	
Moving walkways	X			
Elevators & Escalators	X		X	X
Tactile guidance systems for disabled	X	X	X	X
Provision of services for travellers	X		X	
Increased provision of staff	X			
Provision of monitoring cameras	X			X
Convenient positioning of local transport services	X	X	X	X
Integrated ticketing for local public transport and rail	X	X	X	X

As mentioned before, Porta Garibaldi station has been already renovated while Centrale station is currently under renovation. More functional services to passengers have been provided, such as tourist information, more spacious waiting rooms, shops and luggage deposits. However additional efforts should be made in order to facilitate the interchange between transport modes. According to RFI's planning Rogoredo station is also included in a station restyling programme, which aims to improve services to passengers and to adjust the infrastructure for high speed trains.

7.5   SOLUTIONS ALREADY ENVISAGED

7.5.1 Overview

The railway node of Milan is currently involved in a planning process which aims at achieving a more efficient rail infrastructure. This means that interventions to extend high speed railway lines and to improve frequency of service have been planned. One of the most important solutions that will be available very soon is the opening of the new rail link between Centrale and Garibaldi stations. The importance of this infrastructure is mainly due to the possibility, so far denied, for Trenitalia's long distance trains to reach Malpensa airport, as shown in the Malpensa/Linate/Orio al Serio case study.

Within the scope of the present case study some other railway interventions are relevant. For instance the project of a rail circle line within the city will be discussed as well as the construction of new underground lines. Some of these projects were planned many years ago; however in preparation of the EXPO 2015 transport infrastructures have been prioritised.

7.5.2 New Metro Lines

Problems addressed

As already mentioned, the Milan underground network is composed of three lines: M1, M2 and M3.

Line M5 is under construction and the first section from Bignami to Zara is expected to be completed by 2011, while the remaining lot from Zara to Porta Garibaldi should be opened by the summer of 2012. A variant of the former project has been approved in July 2010 and the new M5 will be extended towards the San Siro Stadium on the west side of Milan.

Line M4 will connect the south-west area of Milan with Linate airport and it will be 15 km long. The new line will have 22 stations and three interconnections with the existing underground network and with two stations of the suburban rail service. An additional interchange is planned with the future Forlanini FS rail station. Furthermore, in order to promote passenger intermodality, two interchange parking areas are also planned.

The whole project has been divided into two functional sections: the first one connects the main city hospital with Linate airport. The second section continues from the hospital to San Cristoforo rail station. The completion of the M4 line is expected by 2014, in time for the EXPO 2015. More detail on this solution is provided in the Malpensa/Linate/Orio al Serio airport case study.

Other extensions of the existing metro lines are also planned - the extension of line M3 from San Donato to Paullo for an additional 15 km, the extension of line M2 from Famagosta to Assago and the extension of line M1 from Sesto FS to Monza Bettola.

By 2015 the underground lines of Milan will be 148.5km long with a total of 156 stations.

Recently approved by the Municipality of Milan, the "Piano di Governo del Territorio" a strategic urban planning document, hypothesises additional underground lines to a total of 11 lines by 2030.

Performance against main toolkit criteria

Cost

The total cost of line M4 is € 1,698 M; the Sforza/Policlinico – Linate airport section will cost € 910 M, the Lorenteggio – Sforza/Policlinico section will cost € 789M.

The first section of M5 (Bignami – Garibaldi) costs € 557M. The second section of line M5 (Porta Garibaldi – San Siro) costs € 563M.

The extension of line M3 costs around € 800M.

No information on M2 and M1 extensions is available.

Technical feasibility

In principle no problems with technical feasibility have been found.

Financial feasibility

Most of the new metro lines will be funded through project financing. The first lot of M5 has been funded by public funds for 60% and by private funds for 40%.

Acceptance by users

Since the improvement of the underground network will imply a better and sustainable mobility in the city, high acceptance by users is expected.

Other aspects of political acceptability

The projects have complete political acceptability

Impact on users' door to door travel time

Significant reductions in travel time are expected since underground connections are faster than bus or tramway lines especially in Milan where a limited number of segregated public transport lanes exist.

Impact on users' door to door travel cost

The new infrastructures will be included in the urban local public transport network, so that users may travel with the same urban fare.

Initial impact on comfort or convenience

Even though the accessibility to the underground infrastructure will be less comfortable that the access to a bus line, the faster service that will be provided should compensate the inconvenience.

Furthermore, using metro instead of private car or buses should be safer.

Personal security

Metro trains are provided with security cameras that would reduce the risks of personal security.

Region's prestige

Metro systems carry high prestige value for the region.

Access for people on low incomes

Normally people with low incomes that cannot afford a private car improve their access when they are provided with additional mass transit transport systems.

Access for people with physical disabilities

New underground stations and trains are equipped with facilities for disabled people. For people with physical handicaps that prevent them from driving a car, any additional offer of a public transport system improves their access.

Mode shift, congestion and GHG emission

The improving of public transport system will affect positively the modal shift in the city, by carrying more passengers and consequently by relieving traffic congestion in the city centre.
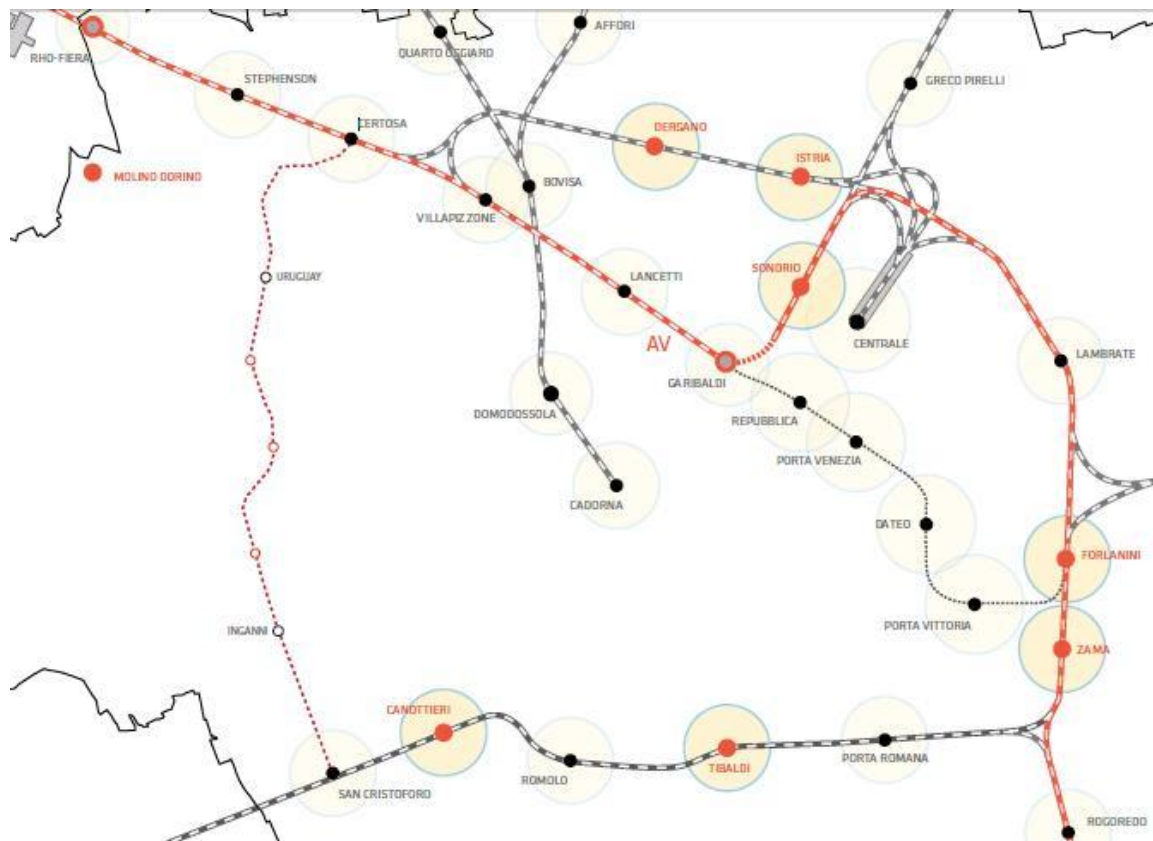
7.5.3 Circle Rail Line

Problems addressed

Figure 7-10 displays the proposed circle rail line of Milan that should be completed by 2014.

As mentioned in paragraph 7.2 Milan has a radial structure of the rail node and public transport. This represents a problem for those users that do not necessarily need to cross the city centre to reach their destination. The new circle line, in fact, will connect all peripheral areas of Milan with a rail line interchanging with the underground lines in several stations.

The project consists of building a further six rail stations on the existing rail line: Dergano, Istria, Forlanini, Zama, Tibaldi, Canottieri. The frequency of the new service will increase from the existing 30 minutes to an average of a train every 6 minutes. This means increasing train speed and consequently it will be possible to move from north-west to south-west of the city in less than 30 minutes. New rolling stock will be purchased in order to satisfy transport demand, which has been estimated at 12,000 passengers per hour. The completion of the circle line from Certosa station to San Cristoforo station on the west side of the city will be probably constituted by a tramway running on a segregated lane.

Figure 7-10   The future circle rail line of Milan

Table 7-13 shows the interconnections between the new rail stations of the circle line and the existing or new build underground lines as well as the suburban lines.

Table 7-13   Interconnections between the new circle line and the underground and suburban lines

RAIL STATION	INTERCONNECTION WITH UNDERGROUND AND SUBURBAN LINE
Garibaldi	M2, M5, S-lines
Rho-Pero	M1
Dergano	M3
Istria	M5
Lambrate	M2
Forlanini	M4
Zama	S-Lines
Rogoredo	M3, S-Lines
Porta Romana	M3
Romolo	M2
San Cristoforo	M4, S-lines

(source: TRT elaborations)

Performance against main toolkit criteria

Cost

The project cost is € 140M.

Technical feasibility

No problems have been envisaged.

Financial feasibility

The signed agreement between the Municipality of Milan and Ferrovie dello Stato plans to redevelop the old railway yards located in Milan in order to improve the mobility system and the railway node.

According to this agreement 1.2 million square meters of old railway yards will be converted into new residential districts or new public services. The whole mobility system of Milan will be improved by building new cycle paths, new railway stations and new roads. Ferrovie dello Stato will sell 450,000 square meters to a private company and the remaining part to the Municipality of Milan. Ferrovie dello Stato will earn € 800 million from the sale of the whole railway yards and a part of this income will be designated to the construction of the new railway circle line.

Organisational/legal feasibility

The circle line will be built after the adoption of the strategic urban masterplan of the city of Milan, named "Piano di Governo del Territorio" (PGT), since the new line has been included in the urban planning. The timetabling of the current suburban service will be likely reorganised. New rolling stock is needed.

Acceptance by users

The project will have high acceptance by users since it allows passengers to reach destinations in peripheral districts without travelling via the city centre. From a social point of view, peripheral area will increase their connections with a stronger transport service that will easily favour displacements within the city.

Other aspects of political acceptability

Politicians strongly support new infrastructures in preparation of the urban planning for EXPO 2015.

Impact on users' door to door travel time

Travel time will be reduced.

Impact on users' door to door travel cost

No impacts on users' travel cost have been envisaged since the new infrastructure will be assimilated to an urban underground line with the same urban fare.

Initial impact on comfort or convenience

Comfort and convenience will be increased since the new infrastructure allows passengers not to make interchanges in order to travel from north to south of the city. New rolling stock will be more comfortable than the older trains currently used on certain suburban lines.

Users' safety

Travelling by train is usually safer than travelling by car.

Personal security

New trains are equipped with security cameras, so the security of passengers will be assured.

Region's prestige

The redevelopment of the old and disused railway yards will imply a better transport service for the city of Milan as well as for the Lombardy region, since the suburban lines connect the provinces of the region with Milan.

Access for people on low incomes

People with low incomes could benefit of the new fast and affordable infrastructure to cross the city centre.

Access for people with physical disabilities

New rail stations as well as new rolling stock will allow people with reduced mobility to easily use the new service.

Mode shift, congestion and GHG emission

The new circle line will have important impacts on reducing traffic congestion in the city and consequently GHG emissions.

7.6   PROBLEMS STILL TO BE SOLVED

7.6.1   Existing Institutional and Regulatory Barriers

Some of the described solutions have been included into the strategic planning document "Piano di Governo del Territorio" (PGT) that is still under the approval process by the Municipality of Milan Council. The PGT will be approved by the end of the year 2010 and consequently the new projects (e.g. circle line) will be implemented. Furthermore, for some relevant projects, especially for the rail infrastructures, agreements between the Lombardy Region, Ferrovie dello Stato and the Municipality of Milan are needed.

7.6.2 Lack of Adequate Information and Facilities to Users

As described in details in the previous paragraphs, the common problems of the rail stations of Milan still to be solved are related to the lack of adequate information to passengers and the lack of facilities that could reduce the transfer time at the main interchange points.

For example, the stations where high speed or national trains stop should be equipped with maps containing the plan of the stations and the indications of the interchange points with local public transport. Furthermore, in those stations characterised by wide spaces, moving walkways and escalator systems could facilitate the transfer. Additionally, direct logical paths should be provided in those stations where several means of transport converge. Information to users may be supplied also by website, since many travellers are accustomed to check pre-journey information on the internet. Useful plans and maps as well as the opportunity to buy local public transport tickets via the internet represent a good chance for improving the quality of the interchange point.

7.6.3 Lack of Intermodality Facilities at the Interchange Points

The city of Milan is affected by traffic congestion. At the moment, the most reliable way to reach the train stations on time is represented by the only two means running on segregated lanes with respect to the private cars: the underground lines and the S-lines. The underground as well the S-line networks do not cover the whole city, so an alternative and sustainable mobility system may be represented by the bicycle. For example, many European cities have already equipped their train stations with cycle parking (sheltered and safe) and facilities in order to facilitate bicycle use. Currently, there is not enough cycle parking at the rail stations and the share of commuters cycling is very low.

Amongst the intermodality facilities check-in operations could be included in those stations that provide the interconnections with the airports. This type of service, in fact may enhance the interconnectivity between short and long distance trips.

7.6.4 Gaps and Inconsistencies in the Strategic Planning Processes

Some redevelopment areas within the city of Milan have been completed without providing them with local public transport connections. Similarly high speed rail connections were activated without adapting rail stations with information to passengers.

7.6.5 Lack of Integrated Timetabling

One of the main problems at the Milan rail stations is represented by the lack of integrated timetabling between long and short distance trains. This adversely affects the interchange time at the station.

Despite the fact that some rail stations (e.g. Rogoredo, Porta Garibaldi) host suburban trains as well as high speed trains, no integrated timetabling is available.

7.7 POTENTIAL SOLUTIONS

The table below provides a selection of potential solutions that could address the existing problems at Milan rail node interchange points.

Table 7-14   Milan Railways Node Potential solutions

POTENTIAL SOLUTIONS	CENTRALE	PORTA GARIBALDI	ROGOREDO	CADORNA
Park and Ride services	X			X
Cycle paths to/from interchange points	X	X	X	X
Integrated timetabling	X	X	X	X
Moving walkways	X	X		X
Elevators and escalators			X	X
Direct logical paths	X	X		X
Cycle facilities at modal interchanges	X	X	X	X
At- station check in for flights	X			X
Local Transport Ticket sales via internet	X	X	X	X
Pre-journey information about interchanges	X	X	X	X

As already mentioned, in the second phase of the INTERCONNECT project the impacts of some potential solutions related both to new infrastructures and improved services as well as to transport policies for fares integration will be assessed. In this context the impacts of new improved connections with Malpensa and Linate airports will be also analysed.
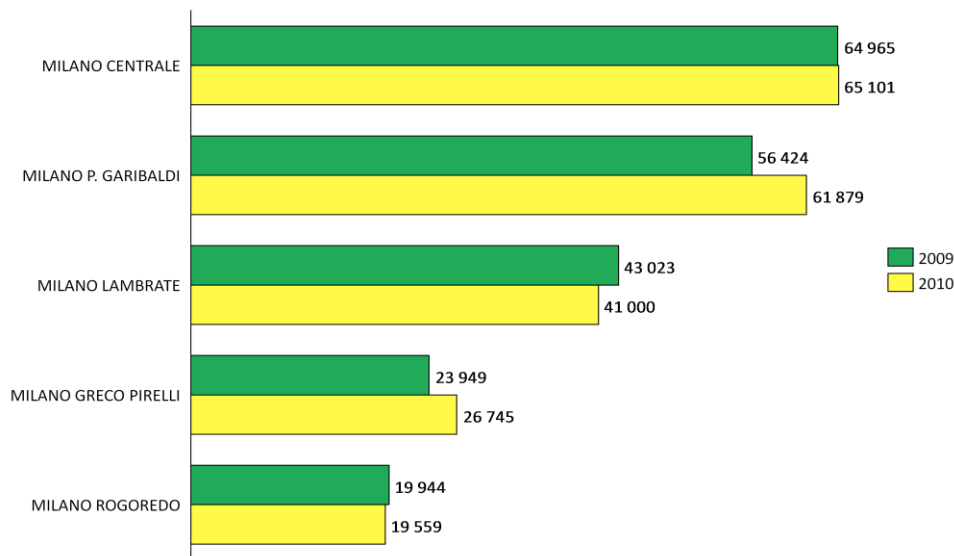
7.8   SUMMARY OF CONCLUSIONS

As described in the analysis, the Milan rail service is organised into different levels of importance: international connections, national and high speed trains, regional and suburban lines.

Milan railway node is a very complex intermodal point and continuous efforts have been made to improving the interconnections with local public transport as well as with the underground network. Each of the main rail stations is in fact reachable at least by one metro line and by bus or tramway lines. Figure 7-11 displays the number of passengers on the regional rail service boarding and alighting daily at the main Milan stations.

It should be noted that data provided in the graph does not include passengers on high speed and long distance trains and therefore the real load on stations is even higher.

The lack of integration and harmonisation between the services and the multiple providers is remarkable. For example, no integrated timetabling between long and short distance trains exists.

(source: TRT elaborations based on Trenitalia's data)

Figure 7-11   Daily boarding and alighting passengers at the main RFI stations

Ticketing integration is still at an early stage with respect to other metropolitan areas. Integration between railway and urban transport in Milan exists, but in general railway transport is not integrated with extra-urban local transport.

Concerning intermodality, the main issues highlighted by this analysis relate to the lack of user information and to the scarcity of facilities that could reduce transfer time at the interchange points. Currently Milan railway stations are connected to the urban transport network by the underground lines or by buses and tramways. Some of the main stations (e.g. Rogoredo, Porta Garibaldi) are connected also with the S-lines, while others (e.g. Centrale and Lambrate) provide airport connections by bus. Nevertheless, as the analysis pointed out, the intermodality facilities are scarce and poor in comparison with the main European cities. No clear signs and no maps are provided at the main interchange points. Many stations are equipped neither with Park & Ride lots nor with bicycle facilities.

Furthermore, the number of foreign passengers in Milan increases year by year. The lack of multilingual information and pictograms that could facilitate the transfers at the interchange point has to be underlined. Anyhow in preparation of the EXPO 2015, Milan Municipality has started a planning process whose aim is to improve city accessibility and the accessibility of attraction points by public transport. Important interventions related to the connections to airports as well as to the extensions of the underground lines have been planned.

In the next years, consistent improvements of the suburban rail service are expected. The extensions of the S-lines and the increasing of frequency of trains will enable more efficient connections between long-distance and short-distance services.

A deeper analysis of the study will be provided in a second phase of the INTERCONNECT project, when it will be used as a test bed for potential solutions. In that phase, the outcomes of the multi-modal transport model will be helpful to analyse the current level of interconnectivity and to assess the impacts of planned future connections with the high-speed national rail network, the improvement of connections with airports, a possible integration of fares and the need to reduce interchanges among the different public transport networks.

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