ROAD AND TRANSPORTATION MASTERPLAN

PALESTINE

TA 2012013 PS 00 F10

IV.5 Public Transport

SEPTEMBER 30,2016

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1 Introduction

This chapter shows the proposal for public transport sector included in the NTMP. The proposal for a renewed public transport system is introduced with a brief overview on the existing situation, carried out with a SWOT analysis and the definition of key-level factors.

2 Overview of Public Transport Sector

Public transport exists both in West Bank and Gaza Strip howeverit does not work as an integrated system; on the contrary, it is composed of several private initiatives that do not cooperate under a single and unified system. Supply is mainly based on two modes, namely buses and shared taxi, furthermore cab taxi can be considered as a form of para-transit.
Buses usually travel when full or almost full along variable routes, while shared taxi is the most used mode of public transport. Public Transport routes are not properly equipped: no dedicated lanes nor signals are currently present; stops are not frequent and stations are not in very good conditions.
Public transport is regulated by the MoT that is responsible of:

- Issuing licensing services, machinery, garages and workshops, car rent offices, car galleries, bus companies, technical centres, driving schools;
- Developing training curricula, and providing professional training courses;
- Monitoring and enhancing traffic safety through guidance brochures and awareness programs;
- Formulating legislation to regulate traffic and achieve traffic safety in coordination with relevant stakeholders.

2.1 SWOT Analysis of Existing Public Transport Sector

The following SWOT analysis aims at providing a critical set of highlights concerning existing public transport sector in West Bank and Gaza Strip. It is focused on Infrastructure and Fleet, and Institutional and Operational topics.

Tab 1. SWOT Analysis of Existing Public Transport: Infrastructure and Fleet

Public Transport Infrastructure and Fleet	
Strengths	Weaknesses
• High demand for public transport both in West Bank and Gaza Strip, where patronage almost ever exceeds bus capacity; • Registration fees are: 100 Nis per year for buses and 2,600 Nis per year cab taxi. Together with fuel tax generate high income for Local Public Transport Authorities; • Small-sized vehicles allow for better flexibility in case of unexpected unrest and/or military roadblocks.	• Needed small-sized vehicles imply high investment and operational costs; • Unscheduled services affect public transport reliability; • Unscheduled public transport routes have significant negative effects on both safety and congestion; • public transport working time is not defined: service is certain only during the day and it is not provided after sunset; • Fare structure is high if compared to customers' average income; furthermore, it does not include subscriptions for public transportation or lower fares for frequent customers and commuters; • public transport Fleet is old: buses and shared taxi service life is normally set at 20 years;

	• Public Transport Fleet is not used efficiently: routes with different demand are served by the same supply, in terms of fleet and headway.
Opportunities	Threats
• Enhanced standards can lead to higher demand of public transport, resulting also more affordable than private-based transport for the majority of Palestinian population; • Improved public transport can stimulate economic growth and increase job opportunities (i.e. if a night extension of service is considered); • Improved public transport can act as a social cohesion factor, stimulating both social and cultural activities.	• Constraints of movements, operated with checkpoints and roadblocks, can affect negatively public transport reliability, also with a re-organised and scheduled service; • Constrains on import/export can ban and/or delay the import of transport technologies; • Unrest and riots can lead to sabotage episodes of public transport vehicles and infrastructure.

Tab 2. SWOT Analysis of Existing Public Transport: Operational and Institutional

Public Transport Operational and Institutional	
Strengths	Weaknesses
• Agreements, studies, plans and data, are available and can be used to develop public transport; • MoT and Local Departments are provided with connected automated systems; • MoT holds good relationships with main public transport stakeholders (i.e. private investors and unions) allowing for strong partnership aimed at public transport enhancement; • Public transport infrastructure are already partially available and represent assets for public transport development; • Public transport can rely on existing regulatory framework, needing to be re-organised.	• Monopolies giving operators (public/private) exclusive right on public transport routes reduce the competition and therefore the quality of service provided; • Poor operational management of licensed public transport companies, causing very often financial losses; • Implementation of stakeholders' responsibilities and roles are not efficiently set; • Signed agreements and MoUs implementation is obstructed by PNA's weak capacity of public transport sector management; • High car accident rates, due to poor control and record of road traffic safety; • Traffic regulations and technical requirements are not existing or inappropriate (i.e. road sign); • High number of taxis affects negatively public transport management and development; • Public transport Supervising body is not currently present, provoking uncertainties in stakeholders' roles and competencies; • Unavailability of public transport automated facilities at border crossing causes delays and malfunctioning.
Opportunities	Threats
• A corpus of reformative laws already exists; this can contribute to stimulate general development; • MoT holds a legal department in charge with the definition of new laws aimed at reforming transport sector; • Several international donors are interested in funding PNA's development plans; • Private investments in Palestine have been recently increasing, involving also public transport in both West Bank and Gaza Strip; • West Bank-Gaza Strip Corridor Link realisation entails a boost to national economy and social cohesion.	• Mobility restriction affect social and economic development; • Funding donors dependence, vital for public transport development, might hinder proper planning policies; • Employment decrease is directly linked to uncontrolled taxi drivers increase (since this represent the easiest way to find a job) affecting negatively public transport and road traffic conditions.

2.2 Key-Level Factors Definition for Public Transport

The definition of key-level factors for public transport in West Bank and Gaza Strip is focused on infrastructure and fleet, and institutional and operational topics.
The main key-level factors that can contribute to the enhancement of public transport sector in terms of infrastructure and fleet provision follow:

- Schedule Reliability and Headway: public transport supply needs to be based on a properly scheduled service, granting a stronger and certain reliability; moreover headway needs to be reduced and defined according to the existing and forecast demand on each single routes;
- Coverage and Operational Time: public transport supply needs to serve the entire area of West Bank and Gaza Strip, linking the most urbanised areas to the rural ones with the main transport hubs and attractor poles (i.e. universities, hospitals); moreover operational time needs to be extended, with a creation of a night service;
- Hierarchy and Poles: public transport supply needs to be based on a hierarchical network including hubs, main and secondary poles, providing efficient public transport services at different scales;
- Passengers Facilities: public transport passenger facilities need to be provided along all the routes serving both West Bank and Gaza Strip, in order to improve the quality of the service and the safety of customers;
- Fleet Refurbishment: public transport fleet needs to offer better standards, based on international best practises;
- New Modes Introduction: public transport supply needs to consider the introduction of unedited collective transport modes that have already shown good results abroad (i.e. bus rapid transit, light rapid transit);
- Multi-Modality: public transport supply needs to interact with other transport modes to define a real multi-modal service including road, rail and maritime transport;
- Soft Mobility: when possible, and according to topography and weather conditions, public transport supply needs to involve also the so-called soft mobility comprising biking and walking for which *ad hoc* development policies need to be set.

As it concerns the institutional and operational aspects, the main key-level factors that can contribute to the enhancement of public transport in Palestine can be summarised as follows:

- Service Rules: public transport sector regulation needs to be clearly set for all modes composing the entire network and private initiative: from the smallest (taxi) to the largest (bus);
- Stakeholder Coordination:MoT need to draw Public Transport rules in coordination with other relevant stakeholders to assign specific competencies to distinct bodies, avoiding legal and regulatory *vulnus* and responsibilities' overlaps;
- Fare Structure: Tariff system needs to be defined for all the modes composing public transport network, from the smallest (taxi) to the largest (bus);
- Subsides and Funds: public transport needs to be subsidised in order to be competitive with and discourage private-vehicle-based transport;
- Safety and Security: control on safety and security needs to be enforced both on-board and at all PT facilities located along the network.

3 Public Transport Network Proposal

The proposal for a public transport in West Bank and Gaza Strip herein presented is described in the following two main aspects:

- Public Transport Infrastructure Network;
- Public Transport Service Supply.

The proposed system considers equally West Bank and Gaza Strip and aims at satisfying existing demand, improving the level of service of existing public transport, and increasing the area covered by public transport supply.
The achievement of these three main objectives is possible only through a widespread public transport network, involving both urban and non-urban areas, and a multi-modal public transport service, combining different – and sometimes new for West Bank and Gaza Strip – modes of transport.On this concern, the following paragraphs provide detailed information accompanied by a set of maps produced for the purpose.

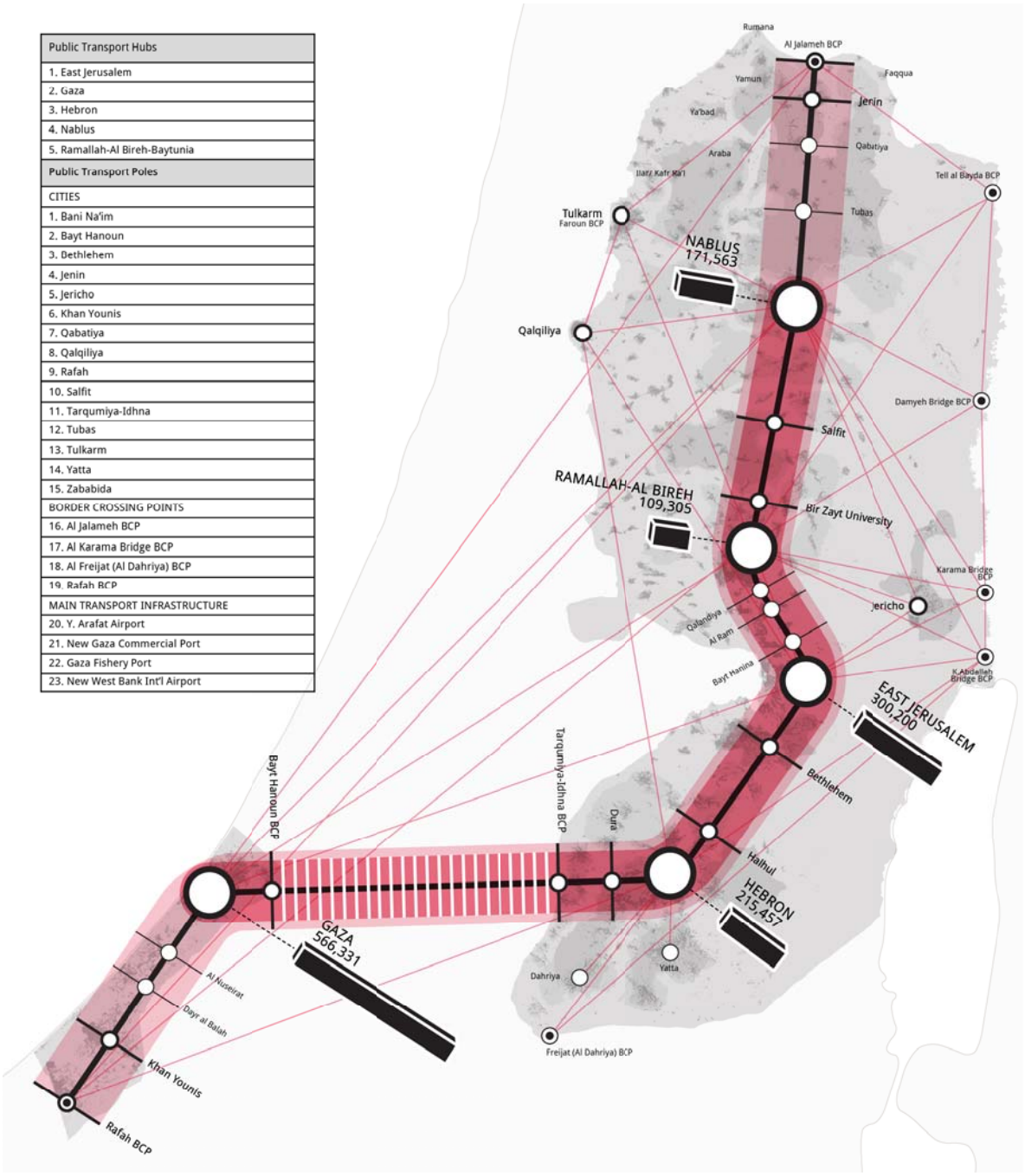
3.1 Public Transport Spoke-Hub Network

The definition of public transport network starts from an attentive analysis of recent and future demographic trends in West Bank and Gaza Strip. According to the PCBS currently around 4.81 million people live between West Bank (around 2.93 million) and Gaza Strip (around 1.88 million) and this value is expected to increase up to around 13 million in 2050.[1]Population in West Bank and Gaza Strip is not uniformly spread[2], indeed, today Palestinians live mainly in cities: Ramallah, East Jerusalem, Hebron, Bethlehem, Jericho, Nablus and Jenin, in West Bank; Gaza City, Rafah, and Khan Younis, in Gaza Strip. An ideal linear axis could be traced to link them into one national urban system where each city plays its role and holds its importance.
The proposed public transport system unveils said ideal linear axis and turns it into a backbone structuring the entire network, conceived to cover both West Bank and Gaza Strip with the same level of service. The backbone runs between Rafah in the South of Gaza Strip and Jenin in the North of West Bank, where it crosses the most urbanised areas between Hebron and Nablus. Five main hubs are located along the backbone, attracting and generating the biggest inbound and outbound systematic and occasional flow of people. These hubs consist in the most populated cities, namely: Gaza City, Hebron, East Jerusalem, Ramallah-Al Bireh-Beitunia, and Nablus.
These five hubs are all interconnected each other. Moreover, they are also linked with areas located outside the identified backbone, where other poles are located, attracting and generating minor but important flows of passengers. The pattern of connections therefore do not consider only the relations between the five main hubs, on the contrary it extends along and outside the backbone to catch other primary urban poles and secondary extra-urban nodes which inclusion appears vital for the achievement of a sound and efficient public transport system. Public transport urban poles and extra-urban nodes are identified according to demographic parameters, in line with what is done for public transport hubs, and according also to the results of the survey campaign carried out simultaneously at the biggest terminals of

[1] PCBS, Annual Statistics-Estimated Population in the Palestinian Territory Mid-Year By Governorate, 1997-2006.
[2] The Governorates of Gaza City and Hebron are the most populated, on the contrary the Governorates of Jericho, Qalqiliya, Salfit and Tubas possess the lowest population rate. The difference of population distribution is confirmed by density ratios that differ very much among each other: Gaza Strip holds the third highest density rate worldwide, 4045 people per km^2, while West Bank's average density rate stands at 468 people per km^2. In general, the most populated Governorates are those with the highest number of urban centers.

public transport in West Bank and Gaza Strip. *For more detail, refer to; ¶ Annex 12. Public Transport Survey.*The scheme of public transport backbone, with the list of hubs and primary urban poles, follows.

Figure 1. Public Transport Backbone Scheme



Identifying public transport constitutive elements (backbone, hubs, urban poles and extra-urban nodes) composing the public transport proposal is propaedeutic but not sufficient *per se* to define public transport network. On this concern, defining the connections between these constitutive elements represents the next and indispensable step towards the definition of an appropriate public transport network.
For this reason, the following three levels of connectivity are determined:

- Regional Connections; linking each of the five hubs to the highest number of urban poles at any distance and then linking urban poles with closest extra-urban nodes.
- Inter-Hub Connections; linking the five hubs to each other, using the fastest path.
- Inner-Hub Connections; servicing urban and peri-urban connections at each hub.

These three levels of connections compose the entire proposed public transport network for West Bank and Gaza Strip, structured according to the hub-and-spoke model[3], that is hinged on multiple hubs, which connectivity is organised in turn into multiple scales, namely (from the biggest to the smallest):

- Hub-to-Hub
- Hub-to-Urban Primary Poles
- Urban Primary Poles-to-Extra-Urban Secondary Nodes

The so-defined connectivity pattern allows public transport network to extend over West Bank and Gaza Strip servicing both urbanised areas, where the majority of people lives and the biggest part of tertiary functions vital for economic developments is located, and extra-urban areas, where the weakest social groups live, currently in strong need for improvement of their mobility conditions.
The proposed public transport network has two main objectives: on the one hand, it aims at boosting economy, by networking all the major economic centres of West Bank and Gaza Strip; on the other hand, it acts as a social cohesion factor, putting the peripheral areas, currently isolated, in contact with the central ones.
This twofold objective is achievable only through an attentive definition of public transport supply that is illustrated in the following paragraph.

[3]The spoke-hub distribution paradigm (or model or network) is a system of connections arranged like a wire-wheel, in which all traffic moves along spokes to hub at the center. In transportation, the spoke-hub model is applicable to many forms of transport, with the only exception of road transport, where spoke-hub model does not apply because drivers generally take the shortest or fastest route between two points. In public transport, the spoke-hub model utilizes various transport hubs to allow passengers to transfer between different lines or transportation modes.

3.2 Public Transport Multi-Modal Supply

A multi-modal transport supply is proposed for public transport in West Bank and Gaza Strip, where both road-based and unprecedented rail-based shared services are provided.
Road-based services can be distinguished between:

- Inter-city Bus;
- Bus Rapid Transit, along Urban Corridor.

Rail-based service consists of:

- Inter-city Rail.

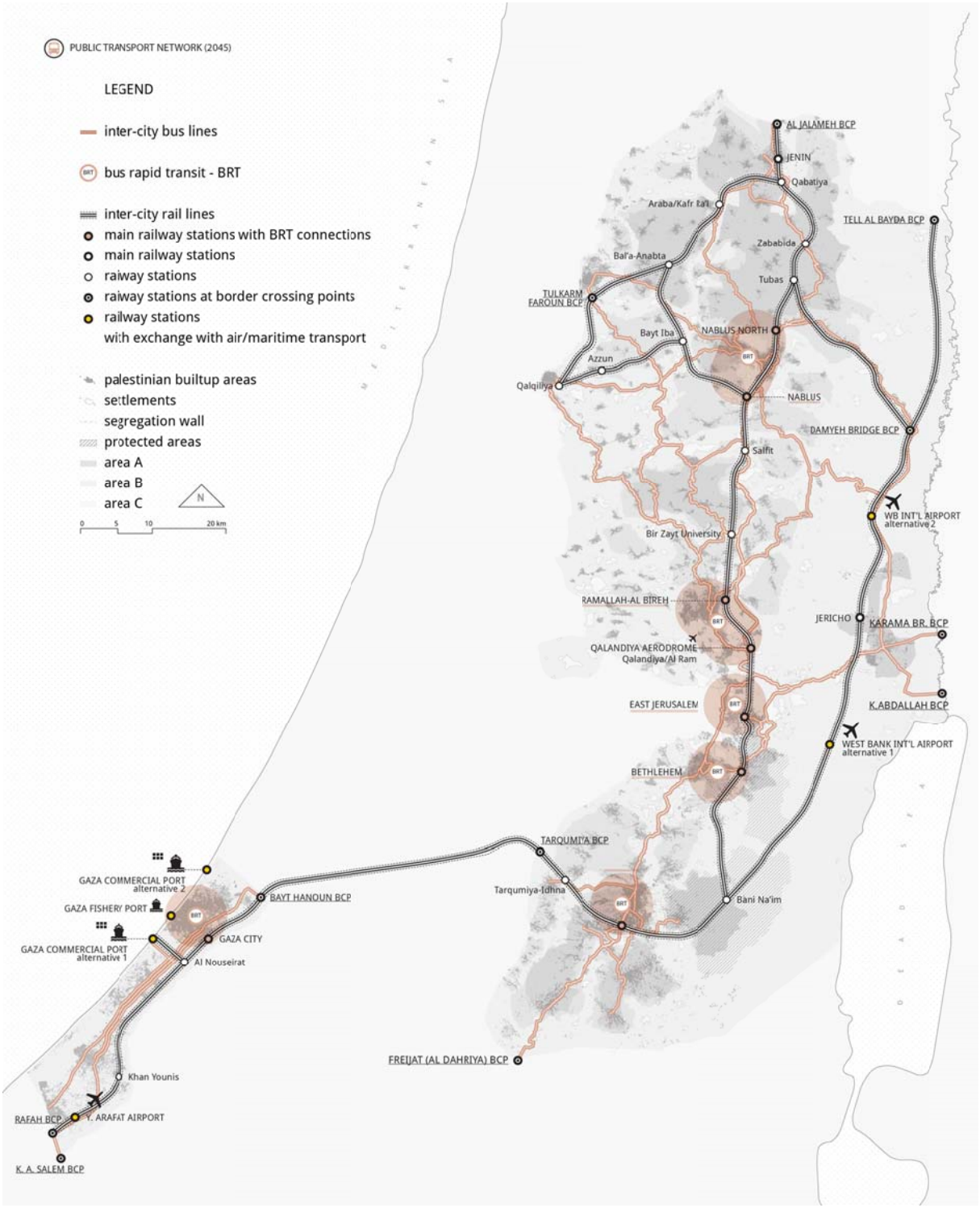
Public transport supply connects cities, towns and villages with major border crossing points and principal transport infrastructures located in West Bank (New International Airport) and Gaza Strip (Y. Arafat Regional (EU-MENA) Airport, New Gaza Commercial Port, Gaza Fishing Port). Therefore, public transport supply's multi-modality is further enhanced by the involvement of all the transport sub-sectors included in the Master Plan: road transport, rail transport, maritime transport, air transport, and border crossing points.

3.3 Public Transport Network Proposal Development by Phases

The several services composing the overall supply proposed for public transport do not become operative at the same time but develop and extend according to the already introduced phases.For this reason, the description of each shared transport service herein presented is organized by phase.*For more details, refer to: ¶III – Road and Transportation Master Plan Overview.*

Before proceeding to describe in details the development of public transport by phase, the entire proposed system is illustrated in the figure reported in the following page.

Figure 2. Public Transport Network (2045)



3.3.1 Public Transport Supply in Phase 1 (2016 – 2024)

Both rail and road-based shared service are proposed for Phase 1. Indeed, in this phase public transport supply consists of:

- Inter-city Buses network: 62 LINES;
- Inter-city Rail Lines: 4 STATIONS;

Inter-city busesoperate on fixed schedule and are organized by hub. Inter-city buses are proposed to carry passengers between the five main hubs (Gaza City, Hebron, East Jerusalem, Ramallah-Al Bireh-Beitunia, Nablus) towns and villages located in West Bank and Gaza Strip. Inter-city buses travel medium/long distances and stop mainly twice: once at the departure stations and once at the arrival station, with a limited number of further stops located along the routes, where major mobility attractors are located. The proposed headway for inter-city bus is one hour which may however be subjected to variations based on fluctuations in demand. **Inter-city rail lines**operate between Ramallah and Nablus, servicing four stations. *For more details, refer to: ¶IV.2 Rail Transport.*

As said above, the entire inter-city bus network is hub-based and includes 62 lines that are listed in the table below. Lines indicated with "^" are Inter-Hub Lines; lines indicate with "*" connect hubs with border crossing points.

Tab 3. Public Transport Supply for Phase 1

Road-Based Public Transport		
Line Number	Hub	Line Name
Line 1	Ramallah	Ramallah-Tarqumiya-Ramallah
Line 2^	Ramallah	Ramallah-Hebron-Ramallah
Line 3	Ramallah	Ramallah-Bethlehem-Ramallah
Line 4^	Ramallah	Ramallah-East Jerusalem-Ramallah
Line 5	Ramallah	Ramallah-Bir Zayt University-Ramallah
Line 6	Ramallah	Ramallah-Jericho-Ramallah
Line 7^	Ramallah	Ramallah-Nablus-Ramallah
Line 8	Ramallah	Ramallah-Qalqiliya-Ramallah
Line 9	Ramallah	Ramallah-Tulkarm-Ramallah
Line 10	Ramallah	Ramallah-Jenin-Ramallah
Line 11*	Ramallah	Ramallah-FreijatBCP-Ramallah
Line 12*	Ramallah	Ramallah-Al Jalameh BCP-Ramallah
Line 13*	Ramallah	Ramallah-Al Karama Bridge BCP-Ramallah
Line 14	Nablus	Nablus-Tarqumiya-Nablus
Line 15^	Nablus	Nablus-Hebron-Nablus
Line 16	Nablus	Nablus-Bethlehem-Nablus
Line 17^	Nablus	Nablus-Ramallah-Nablus
Line 18	Nablus	Nablus-East Jerusalem-Nablus
Line 19	Nablus	Nablus-Bir Zayt University-Nablus
Line 20^	Nablus	Nablus-Jericho-Nablus
Line 21	Nablus	Nablus-Qalqiliya-Nablus
Line 22	Nablus	Nablus-Tulkarm-Nablus
Line 23	Nablus	Nablus-Jenin-Nablus
Line 24	Nablus	Nablus-Salfit-Nablus
Line 25	Nablus	Nablus-Tubas-Nablus
Line 26*	Nablus	Nablus-FreijatBCP-Nablus
Line 27*	Nablus	Nablus-Al Jalameh BCP-Nablus
Line 28*	Nablus	Nablus-Al Karama Bridge BCP-Nablus
Line 29	Hebron	Hebron-Tarqumiya-Hebron
Line 30	Hebron	Hebron-Bethlehem-Hebron
Line 31^	Hebron	Hebron-Ramallah-Hebron
Line 32^	Hebron	Hebron-East Jerusalem-Hebron

Line 33	Hebron	Hebron-Bir Zayt-Hebron
Line 34	Hebron	Hebron-Jericho-Hebron
Line 35^	Hebron	Hebron-Nablus-Hebron
Line 36	Hebron	Hebron-Qalqiliya-Hebron
Line 37	Hebron	Hebron-Tulkarm-Hebron
Line 38	Hebron	Hebron-Jenin-Hebron
Line 39	Hebron	Hebron-Dura-Hebron
Line 40	Hebron	Hebron-Dahriya-Hebron
Line 41	Hebron	Hebron-Samu'a-Hebron
Line 42	Hebron	Hebron-Yatta-Hebron
Line 43*	Hebron	Hebron-FreijatBCP-Hebron
Line 44*	Hebron	Hebron-Jalameh BCP-Hebron
Line 45*	Hebron	Hebron-Al Karama Bridge BCP-Hebron
Line 46	East Jerusalem	East Jerusalem-Tarqumiya-East Jerusalem
Line 47	East Jerusalem	East Jerusalem-Hebron-East Jerusalem
Line 48	East Jerusalem	East Jerusalem-Bethlehem-East Jerusalem
Line 49^	East Jerusalem	East Jerusalem-Ramallah-East Jerusalem
Line 50	East Jerusalem	East Jerusalem-Bir Zayt-East Jerusalem
Line 51	East Jerusalem	East Jerusalem-Jericho-East Jerusalem
Line 52^	East Jerusalem	East Jerusalem-Nablus-East Jerusalem
Line 53	East Jerusalem	East Jerusalem-Qalqiliya-East Jerusalem
Line 54	East Jerusalem	East Jerusalem-Tulkarm-East Jerusalem
Line 55	East Jerusalem	East Jerusalem-Jenin-East Jerusalem
Line 56*	East Jerusalem	East Jerusalem-FreijatBCP-East Jerusalem
Line 57*	East Jerusalem	East Jerusalem-Al Jalameh BCP-E. Jerusalem
Line 58*	East Jerusalem	East Jerusalem-Al Karama Bridge BCP-E.J.
Line 59	Gaza City	Gaza City-Khan Younis-Gaza City
Line 60	Gaza City	Gaza City-Rafah-Gaza City
Line 61*	Gaza City	Gaza City-Bayt Hanoun-Gaza City
Line 62*	Gaza City	Gaza City-Rafah BCP-Gaza City

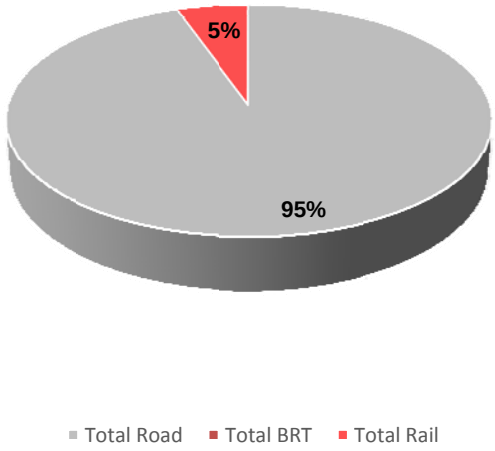
Rail-based Public Transport Supply	
INTERCITY RAIL LINES (4 STATIONS)	Ramallah-Al Bireh-Beitunia, Bir Zayt University, Salfit, Nablus

Figure 3. Inter-city Bus in Munich, Germany[4]

In Phase 1, traffic volume generated by public transport is split as follows:

[4] Source: DB Bahn

Figure 4. PT Modal Split (Road and Rail) in Phase 1 (%)



3.3.2 Public Transport Supply in Phase 2 (2025 – 2031)

Both road-based and rail-based shared services are proposed for Phase 2. In this phase public transport supply consists of:

- Inter-city Buses network: 62 LINES;
- Bus Rapid Transit: 2 CORRIDORS;
- Inter-city Rail Lines: 14 STATIONS;

Detailed information is presented in the following table.

Tab 4. Public Transport Supply for Phase 2

Road-Based Public Transport Supply	
INTERCITY BUS LINES (62 LINES)	See Table 3 for more details
BUS RAPID TRANSIT (2 BRT CORRIDORS):	1) Ramallah-Al Bireh-Beitunia (total length: 18 km) 2) Nablus (total length: 18 km)
Rail-based Public Transport Supply	
INTERCITY RAIL LINES (14 STATIONS)	Ramallah-Al Bireh-Beitunia, Bir Zayt University, Salfit, Nablus, Bani Na'im, Bethelehem, East Jerusalem, Qalandiya/Al Ram, Nablus North, Tubas, Zababida, Qabatiya, Jenin, and Al Jalameh BCP

Bus Rapid Transit systems are proposed for the hubs of Ramallah-Al Bireh-Beitunia and Nablus, with the aim of creating several new urban corridors with enhanced mobility conditions. Bus Rapid Transit systems, also known as BRT, are bus-based mass transit system. They consist in enhanced bus service servicing multiple origin and destination pairs, which operating mainly on arterial roads with frequent stops along the route. BRT differ from traditional local bus services because of their following main characteristics:

- Dedicated guideway system;
- Traffic signal prioritization;
- Dedicated lanes at intersections, and;
- Expedited fare collection.[5]

For more details about BRT systems, refer to: "The LINE G in Strasbourg: A Successful Study-Case of European BRT").

Two networks of BRT corridors of 18 km each are proposed; multiple-car vehicles run along these corridors with short headway[6]. New railway stations are included in the new BRT Corridors that links them to the city centers. The following schemes illustrate the BRT Corridors proposed for Ramallah-Al Bireh-Beitunia and for Nablus Hub.

Figure 5. Bus Rapid Transit in Quito, Ecuador[7]

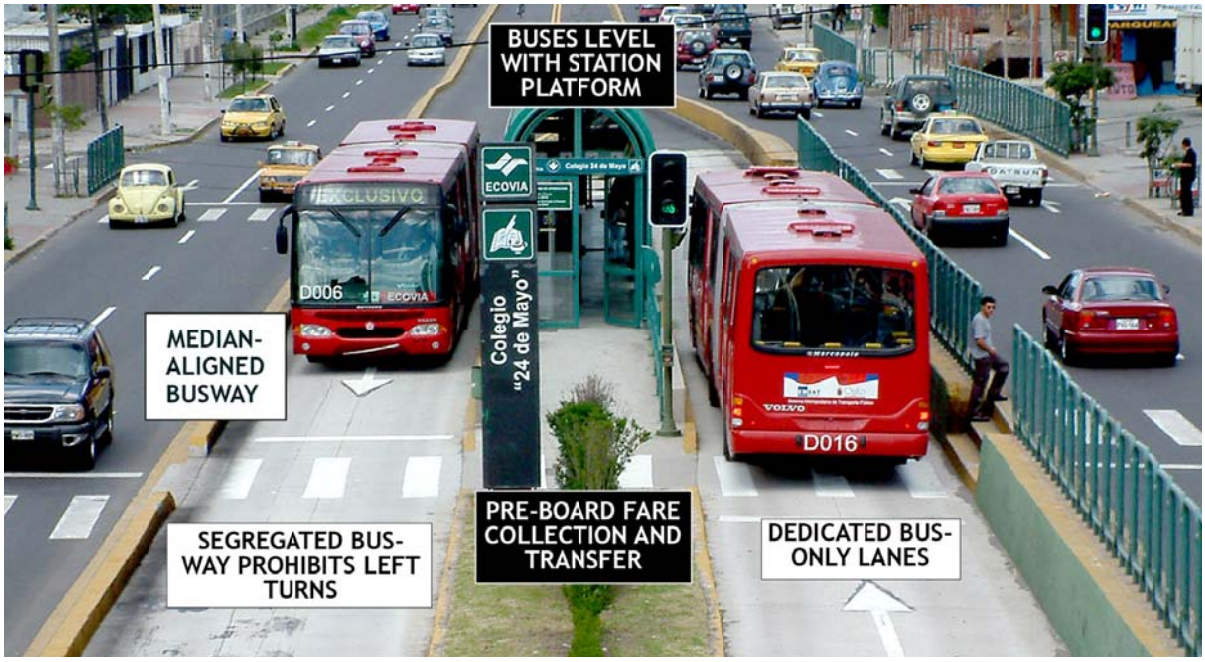
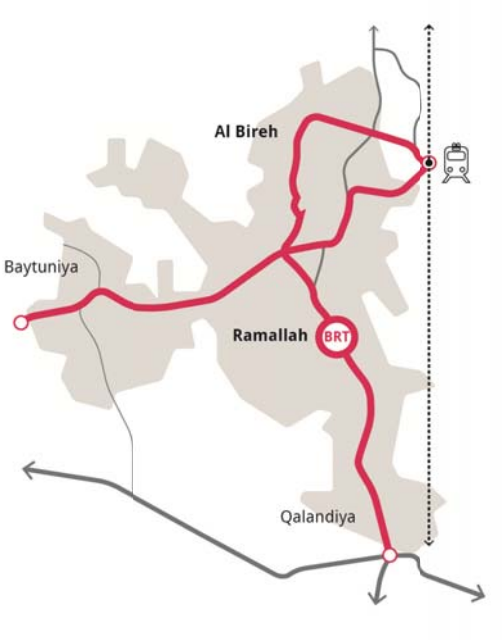
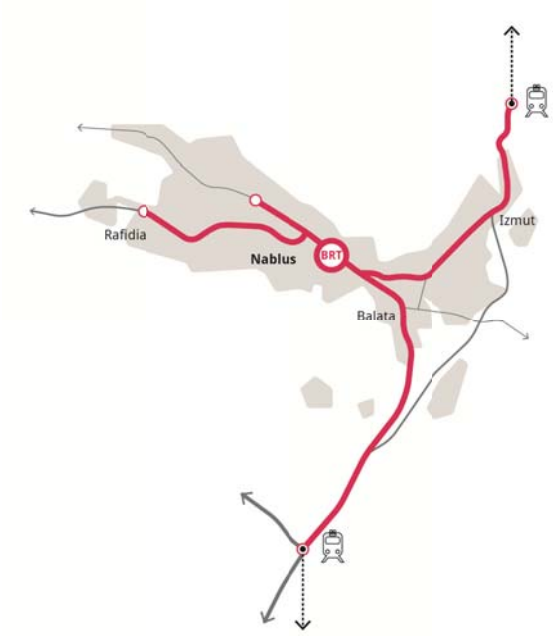


Figure 6. BRT Corridors Scheme for Ramallah-Al Bireh-Beitunia Hub and Nablus Hub

[5] Feigenbaum, B., Bus Rapid Transit and Managed Lanes: Low-Cost High-Quality Transportation Solutions for 21st Century, Reason Foundation, 2014.
[6] BRT headway is to be defined according to *ad hoc* in-depth travel demand studies, to be carried out at macro-urban scale.
[7] Source: Institute for Transportation and Development Policy


Al Bireh
Baytuniya
Ramallah
BRT
Qalandiya


Rafidia
Nablus
BRT
Izmut
Balata

THE LINE G IN STRASBOURG: A SUCCESSFUL STUDY-CASE OF EUROPEAN BRT

MAIN FEATURES

Total Length: 5.2 km (80% with exclusive lanes)
Patronage Service: 15,000 people (8,000 inhabitants, 6,000 employees, 1,500 students)
Operating Time: from 5:15 AM till Midnight, 7 days/weak
Headway: every 6 mins during peak time; every 8 mins during day-non-peak time; every 30 mins during night
Total travel time: 14 mins
Fleet Characteristics: 11 multi-car vehicles with a capacity of 120 passengers
Vehicle Type: Mercedes-Benz Citaro G (485,000 Euro)
Urban Operating Speed: 20 km/h
Investment Costs (excluding vehicles: 4,8 Euro/Km
Equipment: 12 Stations, 1 P+R, 1 Bicycle Parking, 1 Car-Sharing Station, 1 Bike-Sharing Station

PROJECT TIMELINE

2011-2012 : regulatory consultation and launch of preliminary studies
2012 : public hearing
2013 : start of works
end of 2013 : entry into service.

Line G multi-car vehicle stopping at one of 12 stations located its route; source: Mercedes Benz

BRIEF DESCRIPTION

Line G has been operating since 2013, linking the cities of Strasbourg, Schiltingheim and Bishheim. Conceived for an expected patronage of 10,000 pax/year, Line G is part of the wider public transport network that is operated by CTS and is mainly composed of tramlines. Although Line G is a road-based public transport service, it works as a tram, with which it shares many of its features, i.e.: priority at intersections regulated with traffic lights; off-board fare collection; stations' layout designed at level with the bus for quick and easy boarding also for PRM.
Line G was conceived and designed in order to accomplish the following principle objectives:

Improve public transport connections in and out of Cronenbourg, especially the Cité Nucléaire and planned housing estates.
Provide better connections to the CNRS research and higher education centre and to the Espace Européen de l'Entreprise business park.
Provide direct and frequent connections between the central railway station and the sectors and offer a greater choice of connections in the railway station/city centre sector.
Help improve air quality and reduce noise levels through the use of public transport rather than private cars.

The project has the added advantage of providing enhanced road layouts and new cycle tracks. It also provides a more secure pedestrian system, in line with accessibility standards.

Line G exclusive lanes; source: Mercedes Benz

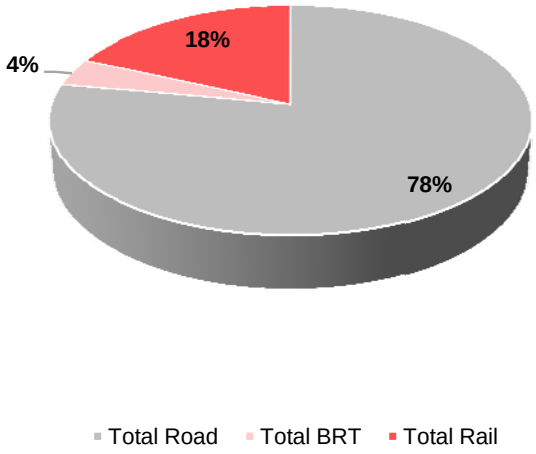
THE RESULTS

After only two years of planning and one year of construction works, the 5km long Line G has been operating successfully since its inauguration in November 2013. Providing a rapid and comfortable transport connection, the buses have been well-accepted by customers. Nowadays, Strasbourg is a prime example of how to adapt BRT to the context of European cities, while demonstrating how public transport projects can be used as an urban project. It shows how thinking about BRT in a holistic and innovative way, with a focus on high quality and excellence in design can lead to successful bus-based public transport.

Sources:
http://www.en.strasbourg.eu/en/transport-and-environment/innovation-led-projects/bus-rapid-transit/
http://www.cts-strasbourg.eu/fr/la-cts/projets-dextension/ligne-g-bus-a-haut-niveau-de-service/
https://fr.wikipedia.org/wiki/Ligne_G_du_BHNS_de_Strasbourg
http://www.mercedes-benz.de/content/germany/mpc/mpc_germany_website/de/home_mpc/bus/home/consulting/bus_rapid_transit/solutions/strassburg.html
https://www.mercedes-benz.com/en/mercedes-benz/vehicles/buses/citaro-g-ngt-bus-rapid-transit-for-strasbourg-video/

In Phase 2, traffic volume generated by public transport is split as follows:

Figure 7. PT Modal Split (Road and Rail) in Phase 2 (%)



3.3.3 Public Transport Supply in Phase 3 (2032 – 2037)

Both road-based and rail-based shared services are proposed for Phase 3.In this phase public transport supply consists of:

- Inter-city Buses network: 62 LINES;
- Bus Rapid Transit: 4 CORRIDORS;
- Inter-city Rail Lines: 27 STATIONS.

Detailed information is presented in the following table.

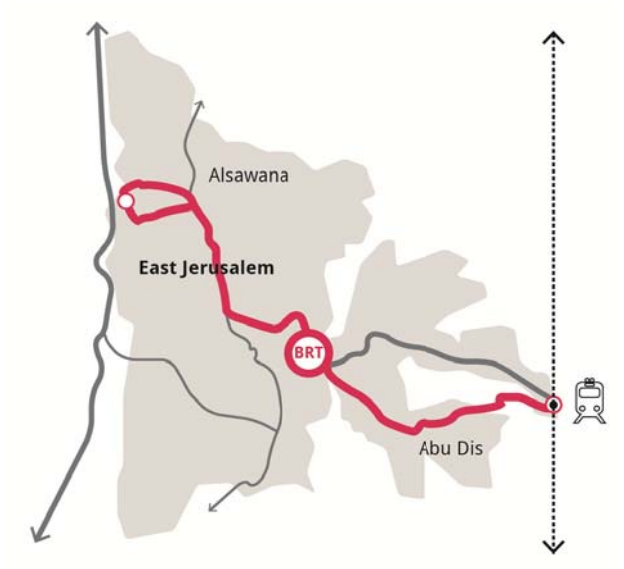
Tab 5. Public Transport Supply for Phase 3

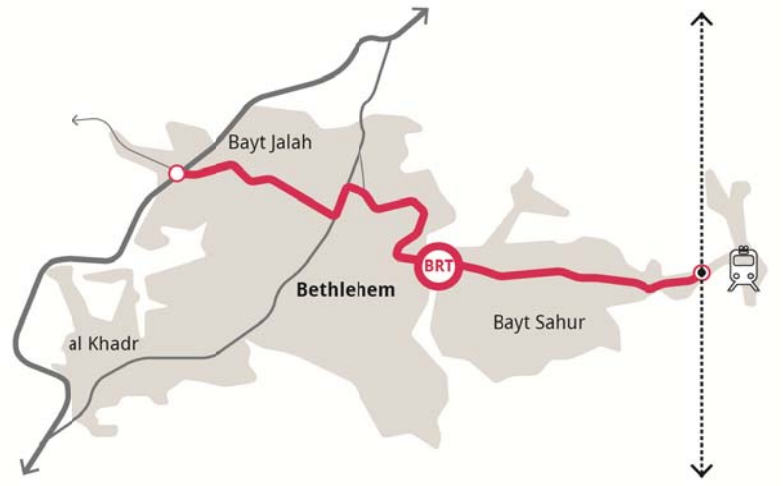
Road-Based Public Transport Supply	
INTERCITY BUS LINES (62 LINES)	See Table 3 for more details
BUS RAPID TRANSIT (4 BRT CORRIDORS):	1) Ramallah-Al Bireh-Beitunia (total length: 18 km) 2) Nablus (total length: 18 km) 3) East Jerusalem (total length: 9 km) +Bethlehem (total length: 9 km) 4) Hebron (total length: 18 km)
Rail-based Public Transport Supply	
INTERCITY RAIL LINES (27 STATIONS)	Ramallah-Al Bireh-Beitunia, Bir Zayt University, Salfit, Nablus, Bani Na'im, Bethelehem, East Jerusalem, Qalandiya/Al Ram, Nablus North, Tubas, Zababida, Qabatiya, Jenin, and Al Jalameh BCP, Rafah BCP, Y. Arafat Int'l Airport, Khan Younis, Al Nuseirat, New Int'l Port, Gaza City, Bayt Hanoun, Tarqumiya-Idhna, Hebron, New West Bank Int'l Airport, Jericho, Damyeh

	Bridge BCP, Tell Al Bayda BCP.

Two networks of BRT corridors of 18 km each are proposed: one in East Jerusalem+Bethlehem[8], and one in Hebron. New railway stations are included in the new BRT Corridors that links them to the city centers. The following schemes illustrate the BRT Corridors proposed for East Jerusalem+Bethlehem and Hebron.

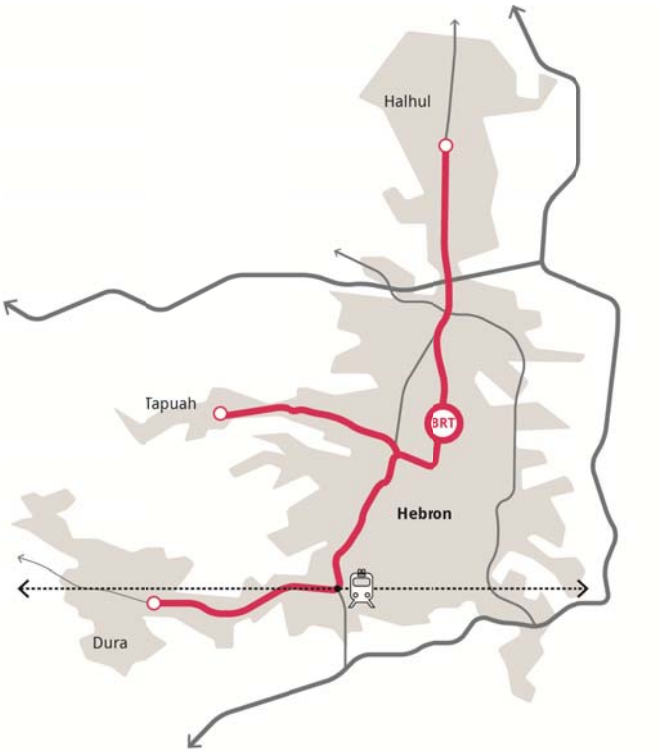
Figure 8. BRT Corridors Scheme for East Jerusalem Hub and Bethlehem





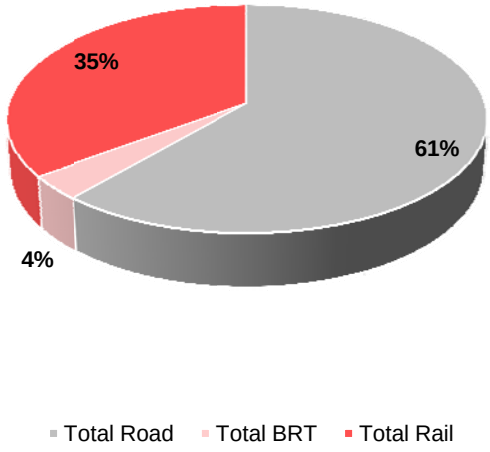
[8]East Jerusalem hub is herein considered as the conurbation including also Bethlehem. Two different BRT Corridors (total length: 18 km) are proposed: one in East Jerusalem and one in Bethlehem.

Figure 9. BRT Corridors Scheme for Hebron Hub



In Phase 3, traffic volume generated by public transport is split as follows:

Figure 10.PT Modal Split (Road and Rail) in Phase 3 (%)



3.3.4 Public Transport Supply in Phase 4 (2038 – 2045)

Both road-based and rail-based shared services are proposed for Phase 4. In this phase public transport supply consists in:

- Inter-city Buses network: 62 LINES;
- Bus Rapid Transit: 5 CORRIDORS;
- Inter-city Rail Lines: 33 STATIONS.

Detailed information is presented in the following table.

Tab 6. Public Transport Supply for Phase 4

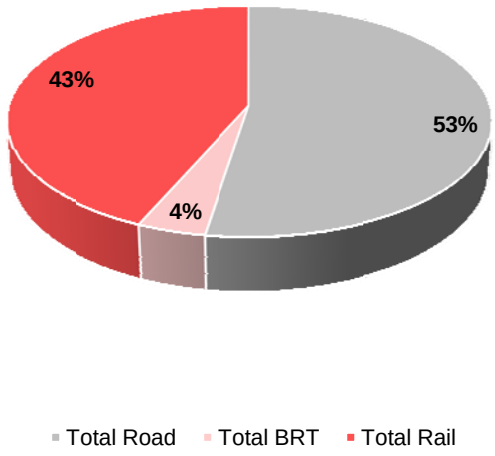
Road-Based Public Transport Supply	
INTERCITY BUS LINES (62 LINES)	See Table 3 for more details
BUS RAPID TRANSIT (5 BRT CORRIDOR):	1) Ramallah-Al Bireh-Beitunia (total length: 18 km) 2) Nablus (total length: 18 km) 3) East Jerusalem (total length: 9 km) + Bethlehem (total length: 9 km) 4) Hebron (total length: 18 km) 5) Gaza (total length: 18 km)
Rail-based Public Transport Supply	
INTERCITY RAIL LINES (33 STATIONS)	Ramallah-Al Bireh-Beitunia, Bir Zayt University, Salfit, Nablus, Bani Na'im, Bethelehem, East Jerusalem, Qalandiya/Al Ram, Nablus North, Tubas, Zababida, Qabatiya, Jenin, and Al Jalameh BCP, Rafah BCP, Y. Arafat Int'l Airport, Khan Younis, Al Nuseirat, New Int'l Port, Gaza City, Bayt Hanoun, Tarqumiya-Idhna, Hebron, New West Bank Int'l Airport, Jericho, Damyeh Bridge BCP, Tell Al Bayda BCP; Qalqiliya, Tulkarm/ Faroun BCP, Azzun, Bayt Iba, Bal'a/ Anabta, Arab/ Kafr Ra'l.

Finally, another network of BRT corridors of 18 km is proposed for Gaza City. The following scheme illustrates the BRT Corridors proposed for Gaza City

Figure 11.BRT Corridors Scheme for Gaza City Hub

In Phase 4, traffic volume generated by public transport is split as follows:

Figure 12.PT Modal Split (Road and Rail) in Phase 4 (%)



The development of multi-modal public transport network (road and rail-based) entails a relevant shift in modal split, where rail-based public transport volume increases, according to the evolution of rail transport network (from 5% in Phase 1 to 43% in Phase 4), hence discharging road network (from 95% in Phase 1to 53% in Phase 4).

The figures presented in the following page show the trend of road-based public transport volume and the trend of rail-based public transport volume.

Figure 13.Road-Based PT Traffic Volume Trend (2015 – 2045) (pax)

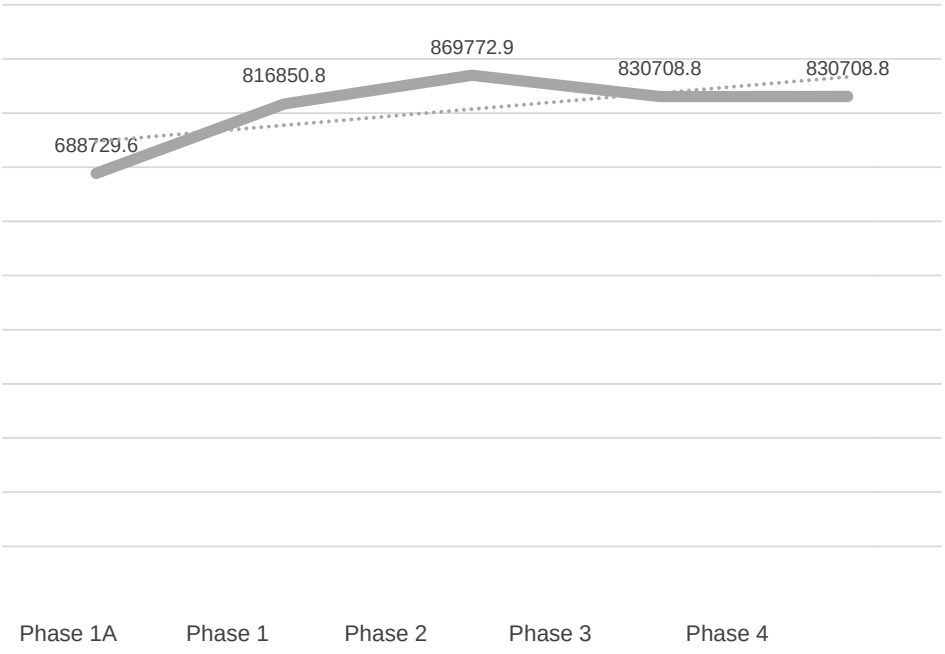
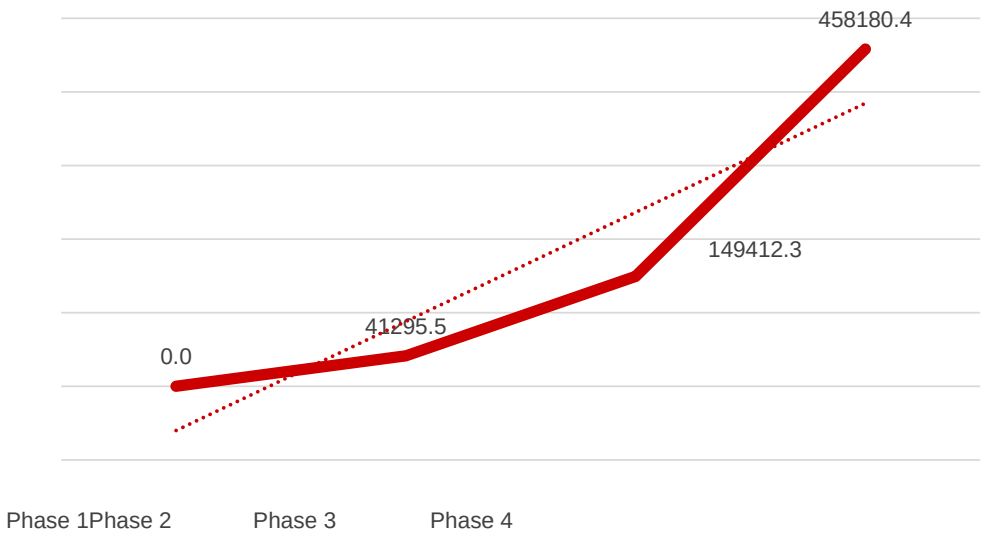


Figure 14.Rail-Based PT Traffic Volume Trend (2015 – 2045) (pax)



3.4 Public Transport and Urban Developments.

The presentation of the proposal for public transport in West Bank and Gaza Strip comprises also a brief description of public transport's role in urban development planning. This mutual relation, along with its good effects, is shown through a focus on the so-called Transit Oriented Development, commonly known as TOD.[9]In the most basic terms, TOD is a strategy to integrate public transportation investments and land-use practices: it is a walkable mixed-use form of development typically focused within 400m radius of a transit station or any public bus network, located in both city centers and suburban settings.
TODis located near stations to make transit convenient for people and encourage ridership. This form of development utilises existing infrastructure, optimises use of the transit network and enhances mobility for local communities.To integrate land use development with public transportation systems, the following objectives are identified:

- Ensure transit to support land uses;
- Increase density around transit stations;
- Create pedestrian-oriented design;
- Make each station a center for activity; and
- Manage parking, bus and vehicular traffic.

The development of the proposed public transport network and, at a wider scale, of the entire multi-modal transport network envisioned by NTMP will create precious opportunities for land-use developments, both in already urbanised areas, to be expanded, and in new zones of West Bank and Gaza Strip, to be urbanised. On this concern, TOD is herein considered as a best practise capable to allow for a sound and efficient territorial planning, aiming at the following outcomes:

- Increase "location efficiency" so people can walk and bike and take transit;
- Boost transit ridership and minimize traffic;
- Provide a rich mix of housing, shopping and transportation choices;
- Generate revenue for the public and private sectors and provide value for new and existing residents, and;
- Create a sense of place.

In order to better understand what TOD is, the study-case of Almere, in the Netherlands, is presented.

[9]The definition advanced by architect and planner Peter Calthorpe is typical and conveys the basic themes of TOD: "A Transit-Oriented Development is a mixed-use community within an average 2,000-foot walking distance of a transit stop and core commercial area. TODs mix residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot, or car" (Calthorpe 1993: 56).

TRANSIT ORIENTED DEVELOPMENT IN ALMERE, THE NETHERLANDS

MAIN FEATURES

Location: The Netherlands
Date: 1976 Town Foundation; 2010 BRT Network Implementation
Land Use: commercial/employment center – Residential – Parking
Type of Transit: Busway –Bus Rapid Transit
Distance between Transit Station: Optimal walking distance (ranging between 200 m and 700 m)
Pedestrian Connectivity: very good

THE CITY OF ALMERE

Almere is one of The Netherlands' famous reclaimed land projects lying on artificial islands, located 25km northeast of Amsterdam and founded thirty-seven years ago. This new land provided urban designers with the opportunity to build both a normal road system and a separated bus-way network that are deeply interwoven throughout the town.
Almere is centrally located in the Randstad conurbation, the urban region containing the four major cities (Amsterdam, Utrecht, The Hague, Rotterdam) in the west of the Netherlands. Being a part of the metropolitan area of Amsterdam, Almere is in the vicinity of two international airports, the port of Amsterdam and a plethora of railway and motorway connections. This makes Almere an indispensably strategic location for business development and unlimited business opportunities.
Currently, Almere is one of the fastest growing cities in Europe, with over 195,000 inhabitants and 14,500 businesses.

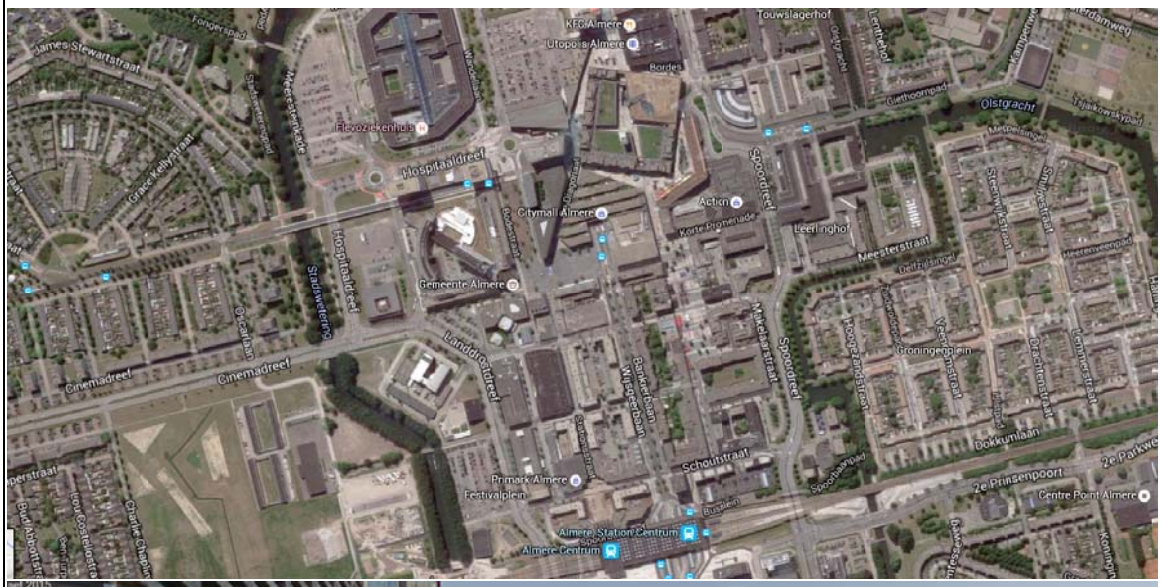
ALMERE'S TRANSIT-ORIENTED DEVELOPMENT

All Almere is a transit-oriented development, where bus represents the *fulcrum* of the entire transport network designed in accordance with land-use planning. In 2010 a new Bus Rapid Transit starts, to substitute the former and regular bus system. BRT is implemented in order to serve the city of Almere at local scale, covering all the districts of Almere Municipality.

Almere BRT Network Map; source: fff.nl

Almere's BRT is entirely provided with dedicated lanes along which buses move at moderate speed and stop relatively often throughout the network, with a distance ranging between 500 and 700m. Private car traffic is absentand bicycle circulation are not allowed along the busways. BRT dedicated lanes do not end when meeting a junction, on the contrary buses benefit of pro-active signaling at all traffic intersections, even at very central and high-traffic ones. The absence of any interference between BRT and other types traffic allows buses to run the whole system with near-perfect reliability; indeed, the only source of delay is a problem with passengers boarding and alighting. Finally, buswaysare planned and designed in full coordination with the aim of being incorporated into urban fabric.

The Central Road Axis in Almere; bus stops are highlighted in blue; source: google maps



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