



CENTRALITY AND METROPOLIZATION: DETERMINING FACTORS AND REPRESENTATION

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INTRODUCTION

Metropolization can be defined as the extension of recruitment areas with intensified commuting. In this context of increased mobility, what does centrality mean?

This article attempts to answer to that question. We shall first examine the classic methods of identifying centrality: by concentration and attraction. We shall then present an original approach developed by French geographers that will enable us to elaborate our own method of identifying centrality. In order to define centrality, all of these methods have recourse to indicators of concentration and attraction. In addition, they consider that centrality can no longer be apprehended at the level of just one commune, and that communes must be grouped together in order to reach a significant level of centrality. We shall explain how these groups can be constituted.

When we have observed the results of this method, we shall conclude by evaluating the possibilities of development for the territory under study: the Gironde. Depending on the type of transport development strategy and the associated urban planning strategy, we shall obtain contrasting results for the territory.

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1. Identifying subcentres

a. Methods based on concentration

Methods based on concentration presuppose that a concentration of enterprises has a significant effect on the urban spatial structure (cf. spatial distribution of population, employment and property rates). They identify centrality in terms of local density peaks. These methods differ in the manner in which they identify these peaks. We can distinguish two types of methods based on concentration. One descriptive statistics as indicators of centrality while the other uses density gradient models.

Among the methods of the first type we retain those developed by McDonald (1987¹), and Giuliano and Small (1991²). There are many differences between these two approaches. The main controversy focuses on the indicator retained. While McDonald uses, among others, the work/population ratio, Giuliano and Small consider total work density to be a better indicator. They argue that the presence of population is not characteristic of centrality. For them, centrality is based on the proximity of enterprises (cf. localised externalities). Whereas McDonald considers that a work/population ratio > 1 expresses the capacity of a space to attract its neighbourhood.

Frédéric Gaschet (2001³) opts for this ratio after demonstrating that the work density retained by Giuliano and Small is too sensitive to certain factors:

- disparity linked to how long the different spaces have been urbanised
- heterogeneity of the proportion of non-urbanised space in different zones
- heterogeneity of the spatial breakdown used

¹ John F. MacDonald - *The identification of urban employment subcenters* - in Journal of Urban Economics 21 – 1987 - pp. 242-258

² Genevieve Giuliano and Kenneth A. Small - *Subcenters in the Los Angeles region* - in Regional Science and Urban Economics 21 – 1991 - pp. 163-182

³ Frédéric Gaschet - *La polycentralité urbaine* – Thesis - Université Montesquieu-Bordeaux IV - 21 December 2001

- disparity of ground consumption per product unit, depending on the economic activities in question

The second type of method is developed, by Craig and Ng (2001¹), McMillen (2003²) and McMillen and Smith (2004³), among others. These methods specify the function of the density, whether parametric or non-parametric. The interest of these more or less sophisticated methods lies in their capacity to define density peaks in relation to their distance from the centre. There is thus no need to adapt centrality thresholds in function of their distance from the centre, as we find with Giuliano and Small.

b. Methods based on attraction

Jean R. Boudeville (1972⁴) makes a distinction between an urban agglomeration (defined as a homogeneous region), and a region of polar attraction (which is heterogeneous i.e. it links centres with each other by means of flows)

We can distinguish two types of flow:

- material and immaterial flows that feed enterprises
- flows of people in transit, particularly commuters

The first type mobilises a reticular and dispersed space. We are interested in the second type because they mobilise a local and more or less compact space. This space is the subject of our study: local urban structuration through labour and centrality.

¹ Steven Craig and Pin T. Ng - *Using quantile smoothing splines to identify employment subcenters in a multicentric urban area* - in *Journal of Urban Economics* 49 – 2001 - pp. 100-120

² Daniel P. McMillen - *Employment subcenters in Chicago: Past, present, and future* - in *Economic Perspectives* - 2003

³ Daniel P. McMillen and Stefani C. Smith - *The numbers of subcenters in large urban areas* - *Journal of Urban Economics* 53 – 2003 - pp. 321-338

⁴ Jacques R. Boudeville - *Aménagement du Territoire et Polarisation* - Editions M. TH. GENIN - 1972

The method known as the preferential flow method is a good means of evaluating the attraction of urban spaces. This method enables us to distinguish gravitational attraction (linked solely to the weight of the territory under consideration) from an underlying attraction. Depending on whether this is positive or negative, we speak of "barrier effects" or "preferential effects". Global observation of flows and any reciprocity between them enables us to determine whether certain flows are dominant or not.

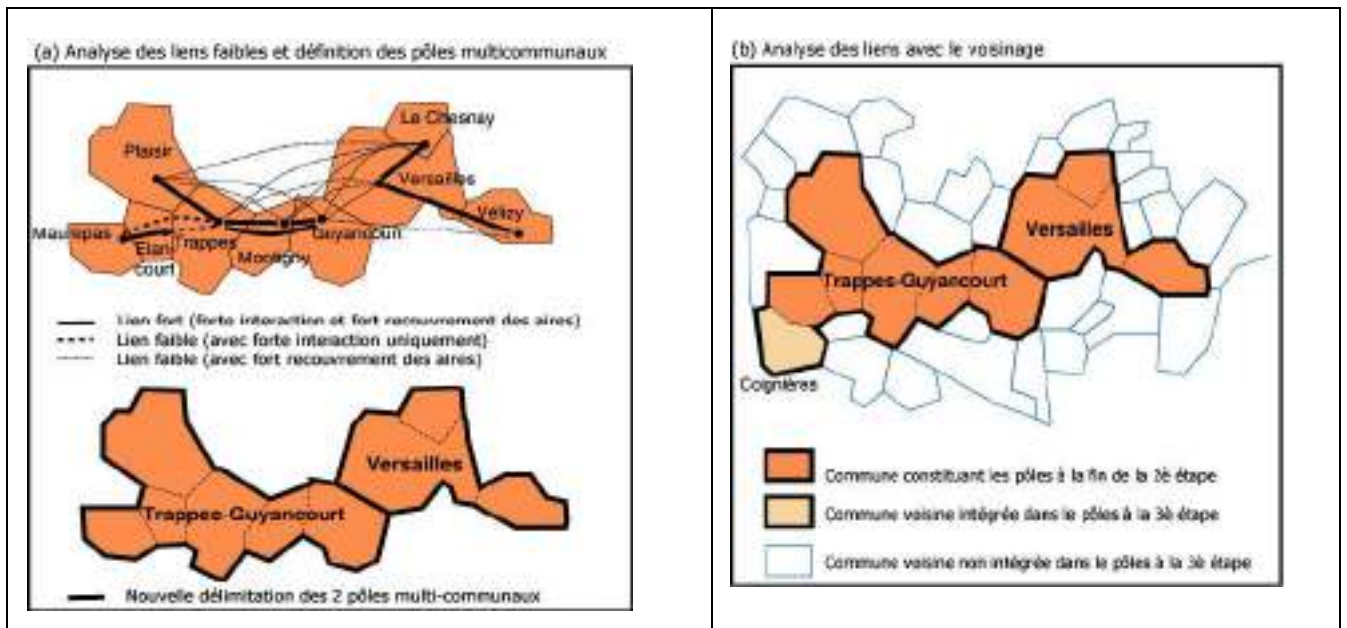
c. Berroir and Mathian's approach (2004¹)

Berroir and Mathian's approach has the advantage of combining the two previously mentioned approaches (concentration and attraction). They define five absolute or relative indicators of concentration and attraction. Using these measuring criteria they then proceed in stages:

- identification of node communes
- consolidation of multi-commune poles
- definitive formation of multi-commune poles

Figure 1 : Identification, consolidation and formation of multi-communes poles

¹ S. Berroir, H. Mathian et al, Mobilités et polarisations : vers des métropoles polycentriques – Le cas des métropoles franciliennes et méditerranéenne, for PUCA, January 2004



S. Berroir, H. Mathian and al - *La mobilité dans la construction du polycentrisme métropolitain* - in Thériault M., Des Rosiers F. (sous la direction) - *Information géographique et dynamiques Urbaines 1* - Hermes-Lavoisier - collection IGAT - p. 41

The great advantage of this method lies in its capacity to model the grouping together of contiguous communes that function together. Based on this method, we can construct a method of identifying centralities in Gironde.

2. Subcentres, commuting and metropolization

a. An approach based on concentration and attraction for the Gironde department: Method

Let:

- x_i : home-workplace travel inside commune i
- y_i : share of commune i employment relative to population
- χ a threshold of x
- ψ a threshold of y

$$\begin{cases} X_i = 0 & \text{if } x_i < \chi \\ X_i = 0,5 & \text{if } x_i > \chi \end{cases}$$

$$\begin{cases} Y_i = 0 & \text{if } y_i < \psi \\ Y_i = 0,5 & \text{if } y_i > \psi \end{cases}$$

Then $X_i + Y_i = \{0 ; 0,5 ; 1\}$

Aggregation criteria for forming Areas of Multi-commune Cohesion

Communes that reach the stability threshold and the work rate threshold, or communes that achieve only the stability criterion cannot claim to be a part of an area of multi-commune cohesion, their operational modes being largely self-centred.

An aggregation of communes implies that they meet the following conditions:

- a work rate that exceeds the threshold;
- contiguous;
- employment in excess of the thresholds 1500 or 5000 jobs, depending on whether its location is rural or urban, for at least one of the communes applying to form part of an aggregation.

Commune categories

Different types of centrality are thus defined depending on the conditions:

- communes that remain below the thresholds, regardless of the indicators, are classified as towns
- communes whose employment figures exceed the threshold are classified as cities

The distinction between a town and a city thus corresponds to its size, provided it meets no other conditions.

- communes having only the stability rate in excess of the threshold are classified as residential
- if, in addition, the employment figure exceeds the threshold, the commune is classified as an autarchic subcentre

When the majority of jobs provided in the commune are occupied by residents, the autarchic character of the commune is clearly asserted: few employed members of the active population leave the commune to work and, reciprocally, a large share of jobs in the commune are occupied by residents. If, in addition, the quantity of jobs does not exceed the threshold, the residential rather than economic vocation of the commune is clearly asserted. Against this, if the quantity of jobs exceeds the threshold, the term "subcentre" can be applied.

- communes in which only the employment rate exceeds the threshold are classified as centres

When the concentration of work is high, we can speak of a centre, in the sense that this commune acts as a focus for employment. However, because the quantity of jobs is too low, we cannot speak of centrality.

- moreover, if the quantity of jobs exceeds the threshold, the commune is classified as an "extrovert" subcentre.

When it meets both conditions, we can speak of a subcentre: employment is considerable and concentrated. However, jobs are not occupied primarily by residents, many of the active population leave the commune to work and, reciprocally, jobs there are occupied to a considerable extent by an active population from outside the commune: we can thus speak of extroverted commune employment.

- communes with an employment rate and a stable rate in excess of the thresholds are classified as local centralities because the quantity of work available in the commune does not allow it to radiate largely;

- moreover, if the quantity of jobs exceeds the threshold, the commune is classified as a primary centrality: it meets all the conditions.

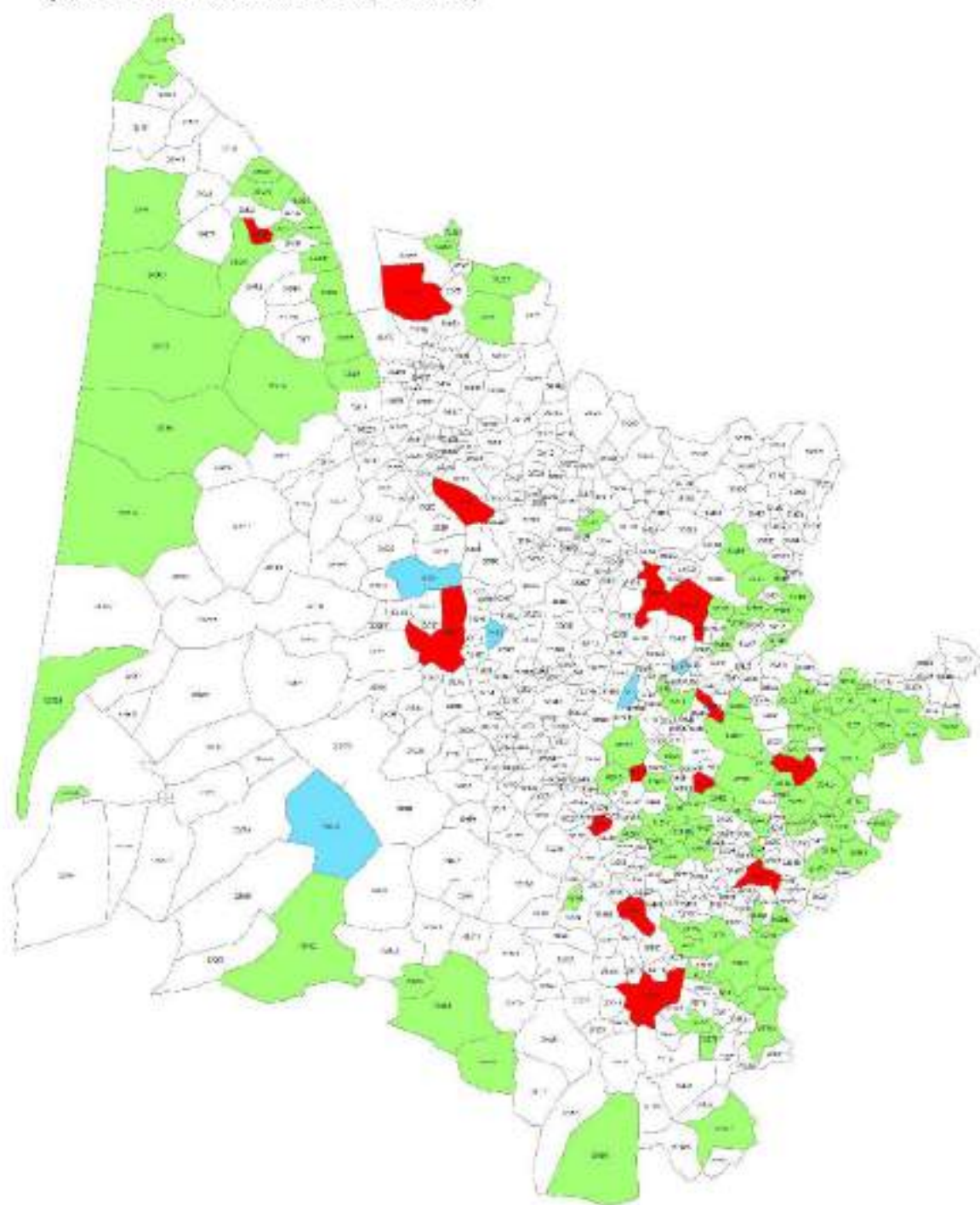
b. Subcentres and commuting in the Gironde department: Results

The candidate communes for grouping in order to constitute areas of multi-commune cohesion are: Bordeaux, Blanquefort, Mérignac, Le Haillan, Bruges, Cestas and Bouliac; Libourne, Saint Emilion, Pomerol, Vignonet, Saint Pey d'Armens, Saint Hippolyte and Saint Etienne de Lisse; Lesparre and Blaignan; Pauillac and Saint Julien de Beychevelle; Blaye and Cars.

The Areas of Multi-commune Cohesion method enables us to highlight certain striking characteristics. The first obvious feature that comes to the fore when we examine the maps is the almost total disappearance of the residential commune status and autarchic subcentre, with the exception of Soulac sur Mer. The second characteristic is the disappearance of the primary centrality status at the level of the commune. Third, a considerable number of communes have regressed to the rank of town. Fourth, the economic size of communes in terms of the quantity of jobs has increased greatly with the result that many towns have become cities, particularly within the urban unit of Bordeaux where the peripheral communes of the CUB have considerably increased their economic weight. Fifth, although the agglomeration comprising Arcachon, La Teste de Buche and Gujan Mestras concentrates jobs, this employment is insufficient in relation to the local population for it to exceed the centrality thresholds or aspire to AMC status. However, the reciprocal flows between these communes would enable it to meet the conditions for stability. Sixth, the fact that some communes regressed from the rank of primary centrality to lower ranks enables us to formulate the hypothesis that the department space was structured differently between these two dates: a change from local recruitment zones to an inter-connection of departmental sub-spaces.

Figure 2: Gironde – Area of Multi-commune Cohesion – 1982 (threshold 50%/65%)

glonde aia de ochirence multicomunale 1962 (seul 50%/65%)



Légende

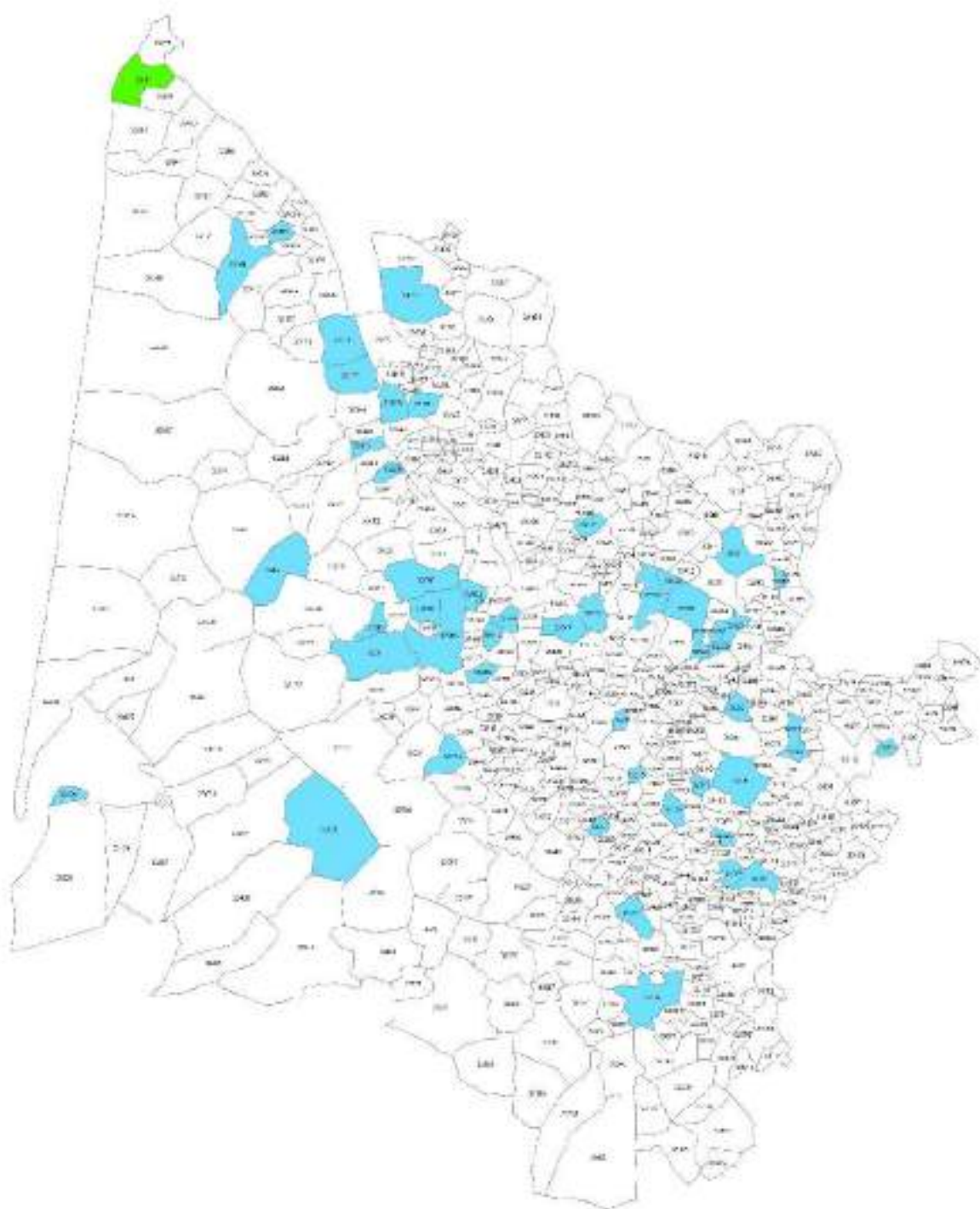
- ter. totiq.
- zonă cu 80-90%
- zonă cu 65-80%
- zonă cu 50-65%



60 Kilomètres

Figure 3 : Gironde – Area of Multi-commune Cohesion – 2006 (threshold 50%/65%)

grande aire de cohérence multikommunale 2006 (seul 50%/55%)



Légende

- Municipalité
- Municipalité de 2006
- Municipalité à la base



0

60 Kilomètres

Hierarchical transitions

Table 1: Communes in hierarchical transition between 1982 and 2006

2006 1982	City/Town	Extraverted commune	Autarchic commune	Centrality
City/Town	(Other communes)	Arcins; Bassens; Beychac et Caillau; Blaye; Bouliac; Bruges; Cars; Gironde sur Dropt; Le Haillan; Margaux; Martillac; Mérignac; Pomerol; Saint Exupery; Saint Hippolyte; Saint Léon; Salaunes; Vayres; Vérac; Vignonet; Yvrac	/	/
Extroverted commune	Branne; Espiet	Artigues près Bordeaux ; Le Barp; Blanquefort	/	/
Autarchic commune	(See list in appendix)	Arcachon; Blaignan; Gornac; Lesparre; Landerrouat; Lussac; Merignas; Pauillac; Saint Antoine du Queyret; Saint Cibard; Saint Etienne de Lisse; Sainte Foy la Grande; Saint Julien Beychevelle ; Saint Pey d'Armens; Sauveterre de Guyenne; Soussac	Soulac sur Mer	/
Centrality	Ambès; Cazaugitat; Prignac en Médoc; Rauzan	Bazas; Bordeaux; Braud et Saint Louis; Cadillac; Ladaux; Langon; Libourne; La Réole; Saint Brice; Saint Emilion	/	/

Areas of Multi-commune Cohesion

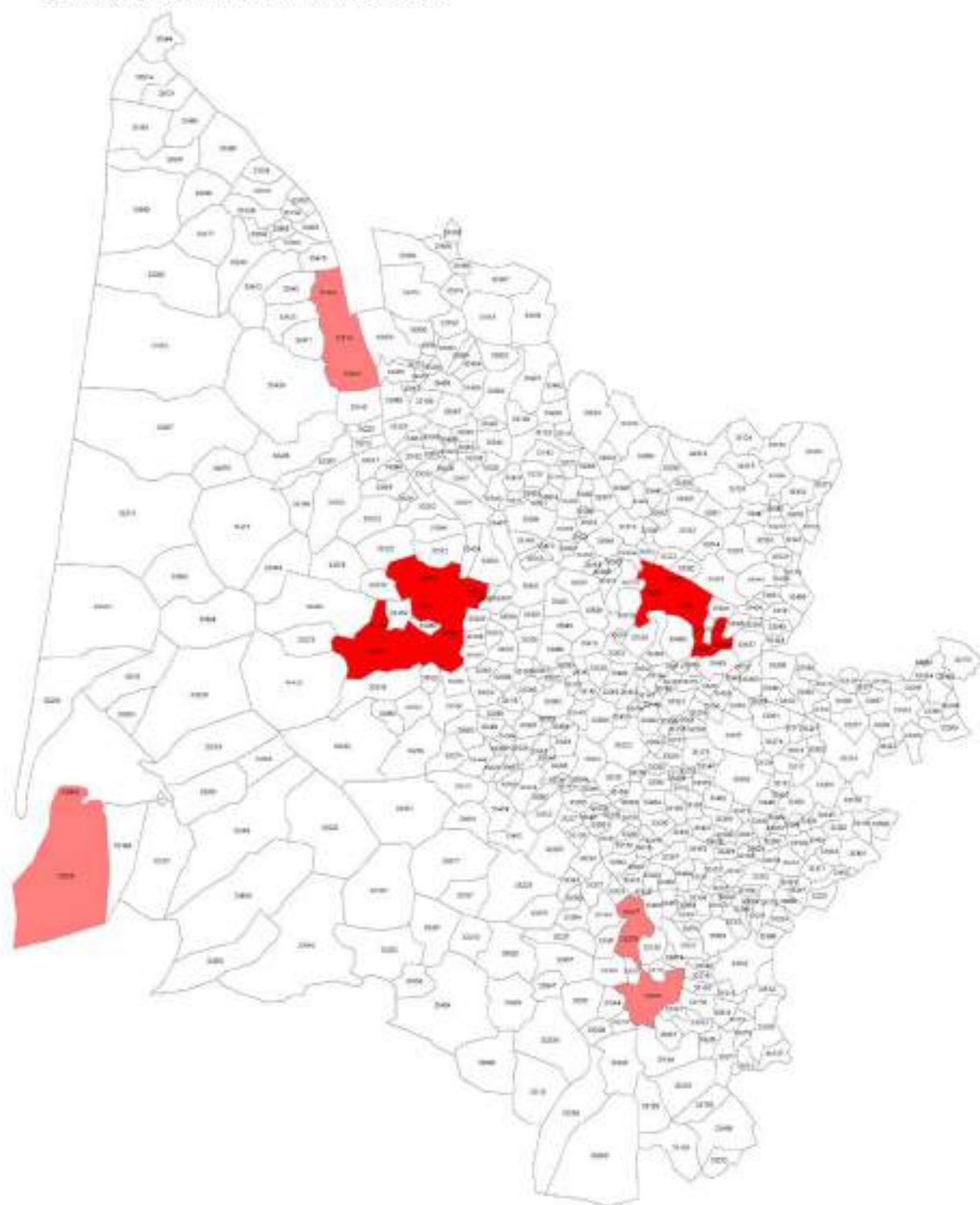
Based on our definition of AMCs, we can distinguish the communes comprising these areas in Gironde (cf. Table 8 and Figure 47)

Table 2: Communes comprising Multi-commune Coherence Areas

Thresholds AMC	50-65	40-65	65-65
Bordeaux	Bassens, Blanquefort, Bruges, Le Haillan, Mérignac	Bassens, Blanquefort, Bruges, Le Haillan, Mérignac, Pessac, Cestas, Le Barp, Canéjan, Martignas sur Jalle, Bègle, Latresne, Bouliac, Floirac, Cenon, Lormont, Artigues près Bordeaux, Tresses, Yvrac, Saint Loubès	Blanquefort, Mérignac, Le Haillan
Libourne	Pomerol, Saint Emilion, Vignonet, Saint Pey d'Armens, Saint Hippolyte, Saint Estèphe	Pomerol, Saint Emilion, Vignonet, Saint Pey d'Armens, Saint Hippolyte, Saint Estèphe, Vayres, Beychac et Caillau, Fronsac, Néac, Montagne, Lussac, Saint Cibard, Puisseguin, Castillon la Bataille,	-

		Saint Magnes de Castillon, Saint Laurent des Combes, Saint Christophe des Bardes	
Arcachon	-	La Teste de Buch	-
Langon	-	Mazeres, Bazas	-
Pauillac	-	Saint Estèphe, Saint Julien Beychevelle	-

Figure 4 : Area of Multi-commune Cohesion – 2006



Légende

-  0
-  ICM primaires
-  ICM secondaires



0

60 Kilomètres

c. Some urban planning and transport choices for the Gironde department: a prospective approach

The Gironde territory is subject to powerful demographic and land use pressure that completely upsets the major traffic flows and the balance of territories inside the department. Depending on the strategies adopted for transport and urban planning, and the combinations thereof, we shall see that certain choices can render territorial balances more vulnerable. We have chosen to give precedence to the transport strategy over the urban planning strategy.

We start by defining two scenarios for the transport strategy. The TER and Trans' Gironde networks are of limited efficiency: a 45-minute travel radius from centre city Bordeaux using a modal public transport system scarcely exceeds the limits of the agglomeration. If we take into account the time lost in transit changes and waiting, which can be longer at certain times of day, this radius is reduced even further. However, the intercity networks are not the only source of difficulties in PT links between communes in the Gironde department. The public transport network in the agglomeration of Bordeaux has other shortcomings: once we leave the corridors served by the tramway, the possibilities of finding a quick link to a destination in the Bordeaux agglomeration are reduced. In order to develop a network of public transport, the department needs to free itself from these constraints and limits. Hence the need to increase the current PT offer, but also to improve the quality and inter-connectability of the services provided. Two options can be retained:

- a scenario with a hierarchical system of serving priority centres: increasing the speed and efficiency of the network by applying a system of priority status for certain stations and stops, thus enabling the Bordeaux agglomeration to increase its attraction radius. This scenario could be summed up as "Faster/Farther".
- a scenario with a generalised system to serve all stops stations in the urbanised territory: increasing the efficiency of the public transport network

by eliminating or minimising transit changes, augmenting the number of urban stations or stops, extending secondary and tertiary branches of the public transport network in the metropolitan area. This scenario could be summed up as "Territorial accessibility".

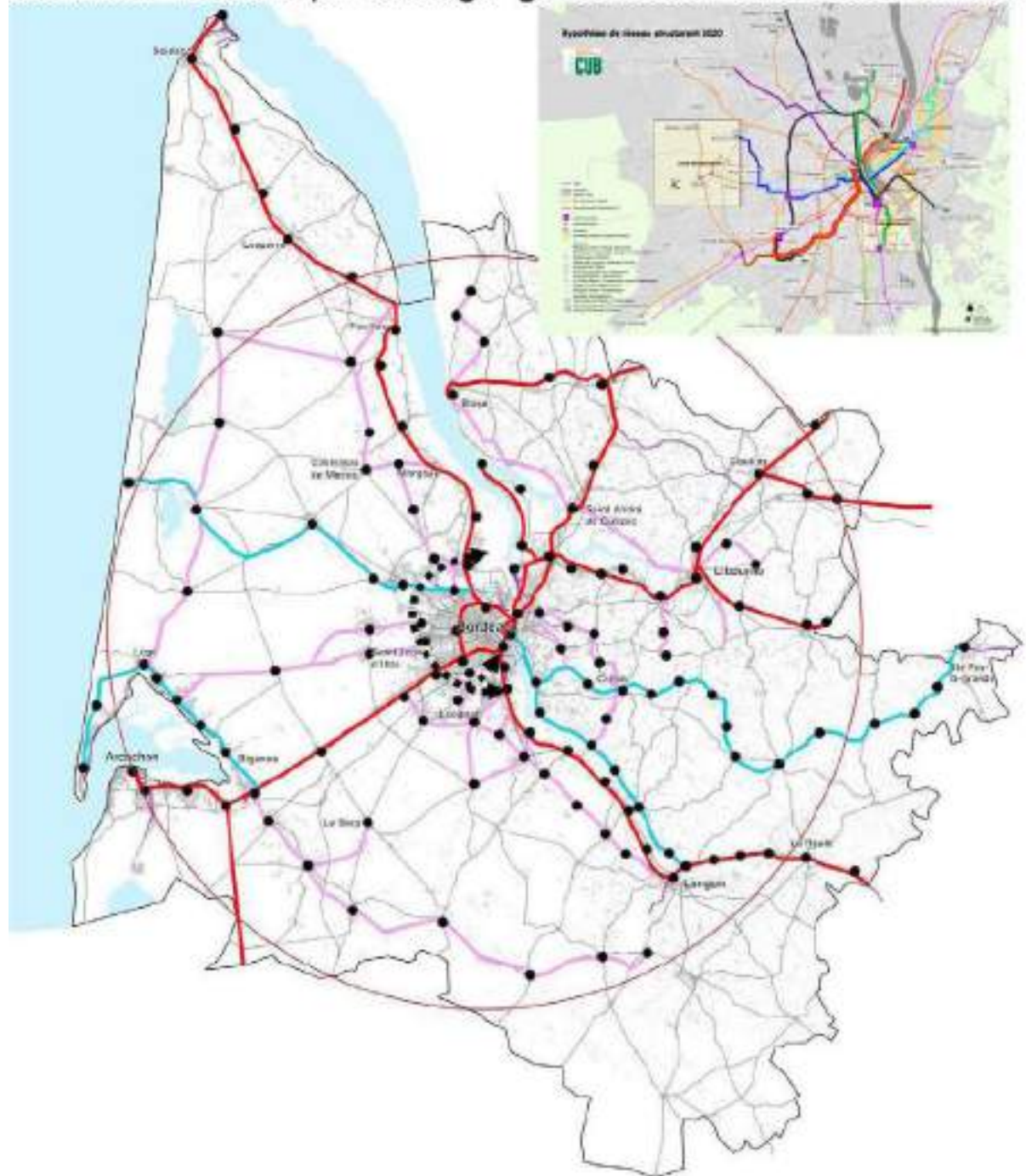
These two logics are complementary and non-exclusive: the efficiency of the public transport service depends on a combination of the two scenarios.

Two principles can be applied to organise PT networks regardless of the scenario retained:

- enhanced exchanges between the Bordeaux agglomeration and the rest of the department
- improved meshing of the urban tramway system inside the agglomeration

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 Pour un scénario de transports collectifs, quels scénarios de développement urbain?
 Approche comparée sur les agglomérations de Bordeaux, Coimbra, Karlsruhe.

Scénario 2 "Desserte par cabotage" généralisée à l'ensemble du territoire

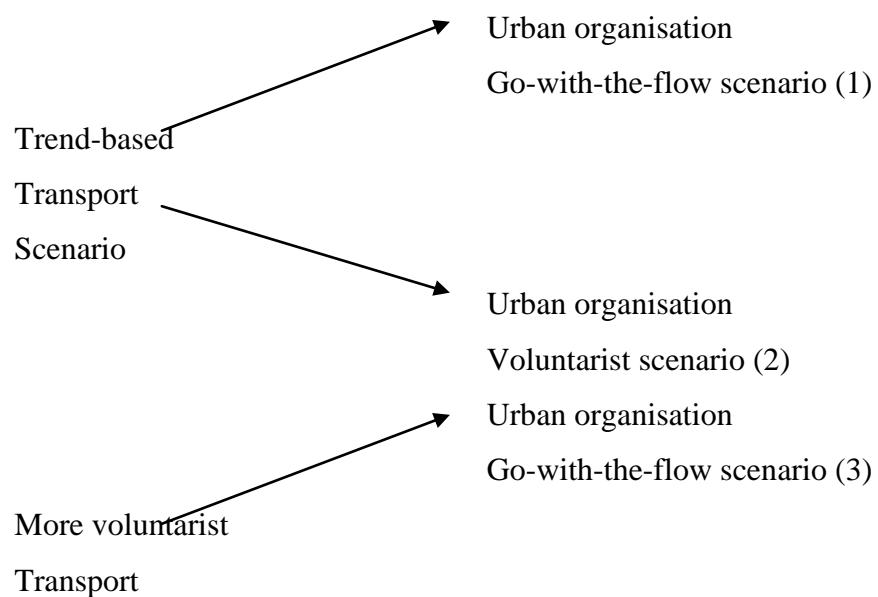


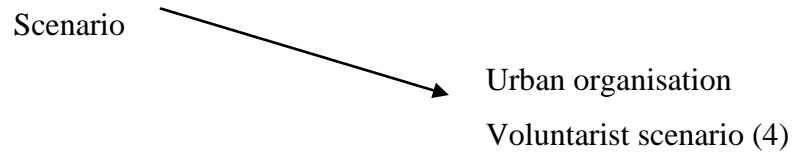
- 50 km - aire métropolitaine de Bordeaux
- Ligne TC s'appuyant sur le réseau ferroviaire existant
- Voie ferrée réactivée ou créée
- Nouveau réseau TC structurant
- ↔ Liason TC de périphérie à périphérie

Urban planning choices reflect these transport issues and influence the structuration of the Gironde territory:

- a "go-with-the-flow" scenario: continuing the urbanisation movement without any particular re-evaluation or urban renewal, continuing the current public transport development policy, fragmented political control, lack of cohesive public action, little or no change in the centre-periphery dichotomy
- a voluntarist "Rhineland" scenario: organising the territory into an urban necklace in which public transport (particularly tram-train) acts as a channel for urban development (development supported by public transport policies, public policies for reorientation and urban renewal in and near the leading centralities, train station neighbourhoods, TCSP corridors). This generates secondary urban agglomerations which themselves produce polarities; we can distinguish two approaches, one aiming at residential zones, the other targeting service centres.

The type of territory provides a framework for the elaboration of two possible scenarios for territorial structuration combining transport and urban organisation.





"Go-with-the-flow" urban organisation corresponds to a progressive disconnection between the networks and the underlying urban infrastructures. It is characterised by the absence of an ambitious development policy that prioritizes train station neighbourhoods and the corridors served by the PT. Paradoxically, developing the PT offer would favour the risk of urban sprawl and the occupation-based segmentation of territories by forcing households to reside in increasingly remote zones while continuing to access central activity hubs via effective PT services.

Voluntarist urban organisation (centralities, intermodality, exchange centres) corresponds to the creation of effective urban support systems around the PT networks. The subcentres served by PT being reinforced by urban development and priority densification policies implemented around centralities and train station neighbourhoods, thus rendering polarities relatively independent with regard to the city centre.

We can infer the consequences of urban development choices in function of the retained public transport scenario.

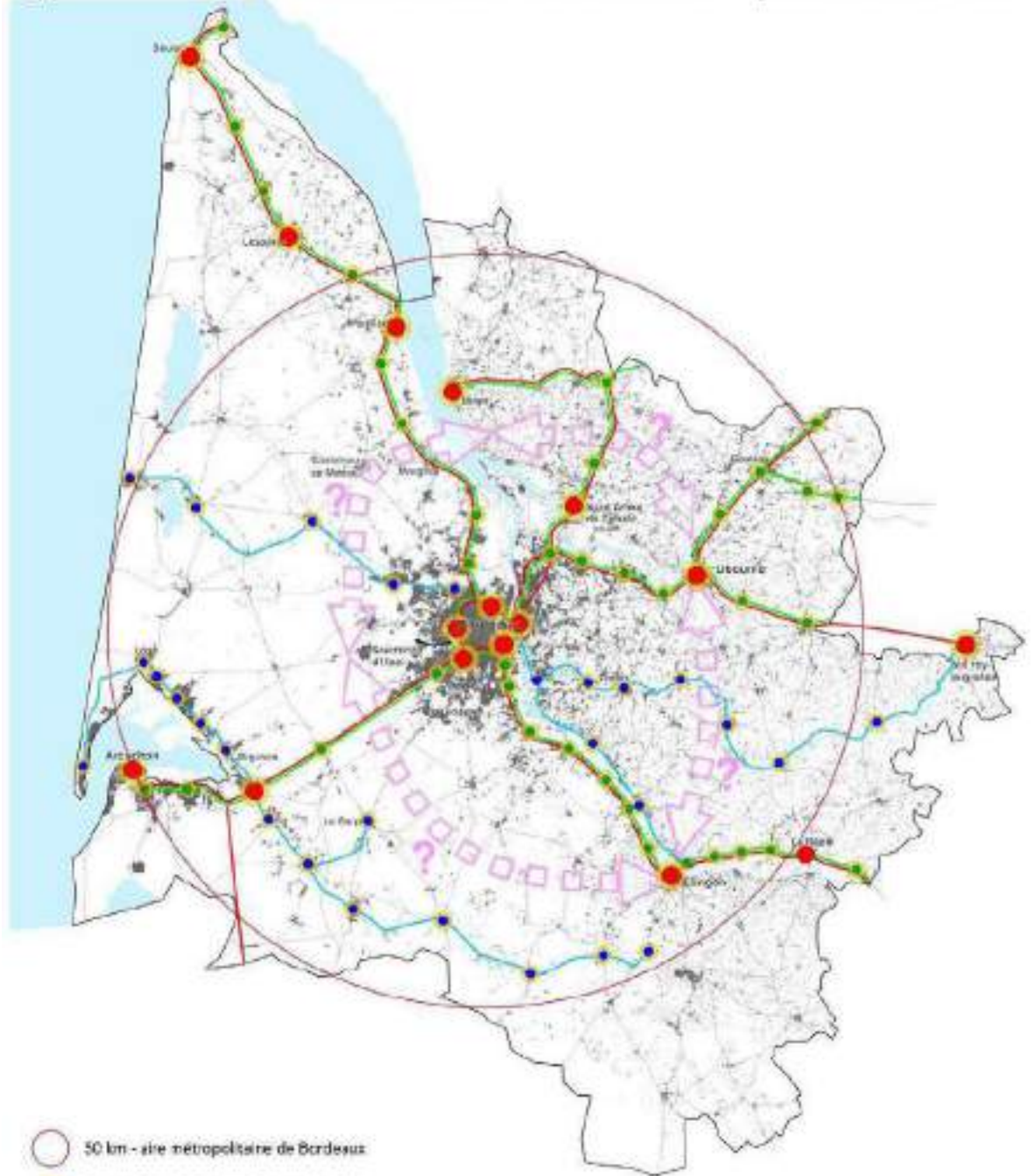
(1) The Rhineland process associated with a hierarchical service









Densification takes place primarily around the polarities constituted by stations served by express inter-city trains. Secondary densification zones are identified around other stations and stops. Outside of these territories, urban expansion is neutralised. This urban policy can be used to curb urban sprawl but also to reinforce the main centralities in the territory. For this development model, the priority centralities would be Soulac, Lesparre, Pauillac, Arcachon, Biganos, La Réole,

Langon, Sainte Foy la Grande, Libourne, Blaye, Saint André de Cubzac and the Bordeaux agglomeration. This model is hierarchical: the Bordeaux agglomeration continues to be the main centrality and the subcentres all converge toward it via a radial public transport network. This model thus asserts a **monocentric** vision of the Bordeaux metropolitan area, dominated both demographically and economically by the agglomeration toward which the mobility system converges.

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 Pour un scénario de transports collectifs, quels scénarios de développement urbain?
 Approche comparée sur les agglomérations de Bordeaux, Coimbra, Karlsruhe.

Hypothèse d'urbanisation associée au scénario 1 : "processus Rhénan"



-  50 km - aire métropolitaine de Bordeaux
-  Zone de densification urbaine principale
-  Zone de densification urbaine secondaire
-  Desserte express interurbaine
-  Autre desserte TER
-  Réactivation/Création de lignes périurbaines
-  Principe de contournement ferroviaire
-  Prolongement TCSP vers aéroport

a'urba.

agence d'urbanisme
 Bordeaux Métropole



2007

Plan de l'aire métropolitaine de Bordeaux

(2) Urban dispersion associated with a hierarchical PT service

Densification takes place around the existing urban cores but not primarily around stations or stops in the public transport network. All built-up zones may be terrains for densification, particularly in a close radius around stations and stops served by public transport. The main centralities of the territory (centres, areas and nodes) are no longer the subject of priority densification in the territory: this model is thus a-hierarchical by virtue of the absence of consultation between the urban players. The main result of this model is the dispersion of dwellings around the stations and stops in the public transport network: it is an "**leap-frog**" model.

(3) The Rhineland process associated with a detailed PT service to the territory

Densification takes place primarily around stations or stops in the public transport network. Because the network is close-knit, more stations and stops will be densified. The urban development model nevertheless remains hierarchical. The network converges toward the large agglomerations in the territory (Bordeaux, Arcachon and Libourne) and the subcentres (Gujan Mestras, Sainte Foy la Grande, La Réole, Langon, Coutras, Lesparre, Blaye, Saint André de Cubzac). It would be logical to expect an increase in their power of attraction and their centralising capacity. Even if the Bordeaux agglomeration were to continue to exert a powerful influence, it would be part of a **multi-polar** development model.

(4) Urban dispersion associated with a detailed PT service to the territory

Urban extension develops through densification around stations and stops but also through urban dispersion beyond these. Because the transport network is close-knit

and dense in the region of the three main agglomerations, we can expect conurbations to form and extend around these agglomerations. This development model is characterised by "**urban sprawl**".

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Hypothèse d'urbanisation associée au scénario 1 : "dispersion urbaine"

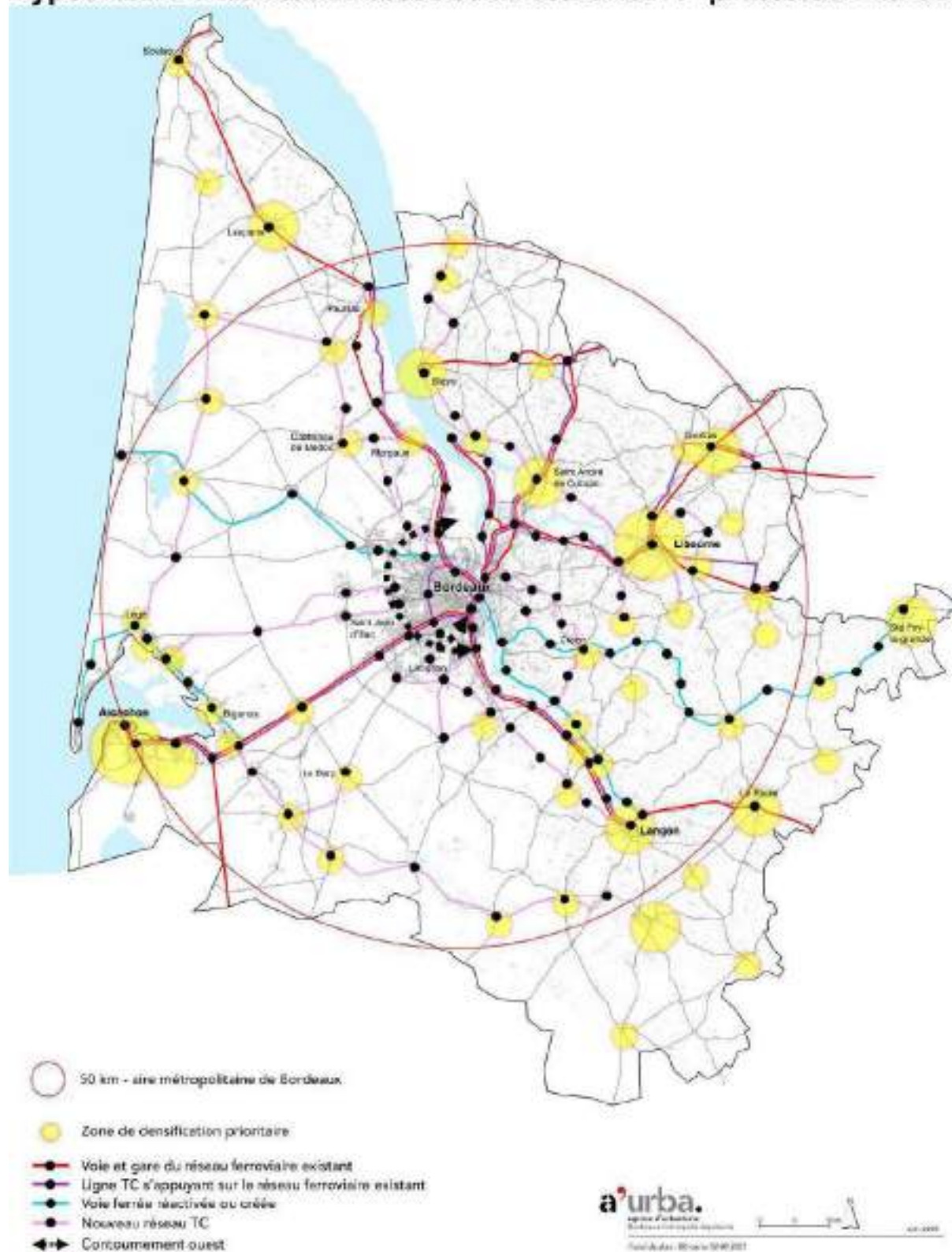


Appel à projet PUCA "Lieux Flux Réseau dans la ville des services"

Pour un scénario de transports collectifs, quels scénarios de développement urbain?

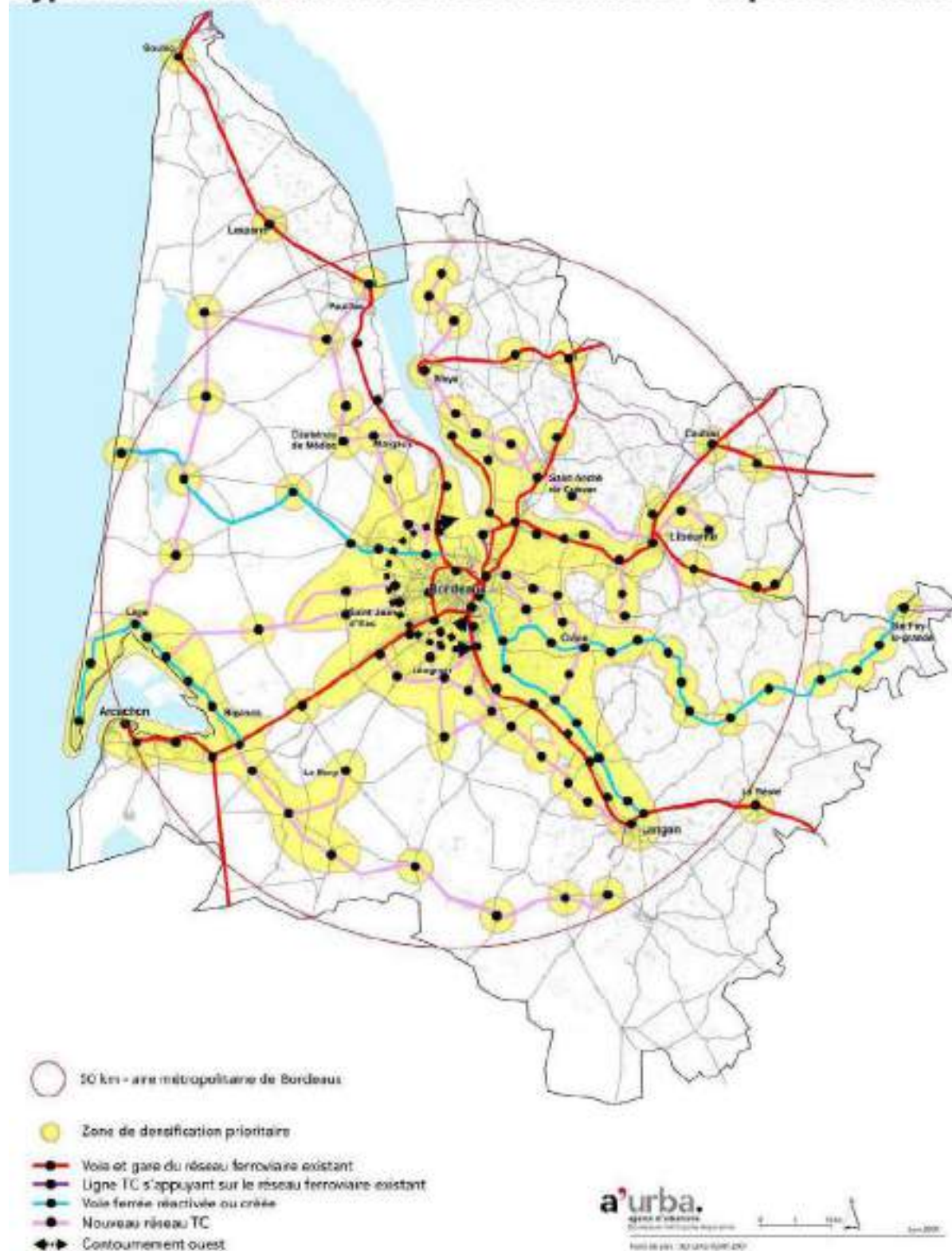
Approche comparée sur les agglomérations de Bordeaux, Coimbra, Karlsruhe.

Hypothèse d'urbanisation associée au scénario 2 : "processus Rhénan"



Appel à projet PUCA "Lieux Flux Réseau dans la ville des services"
 Pour un scénario de transports collectifs, quels scénarios de développement urbain?
 Approche comparée sur les agglomérations de Bordeaux, Coimbra, Karlsruhe.

Hypothèse d'urbanisation associée au scénario 2 : "dispersion urbaine"



We would like to explain the densification of urban blots on the prospective maps. This process makes it easier to observe the urban phenomena that characterise the different development models: "monocentric", "leap-frog", "multi-polar" and "urban sprawl" development.

Our study thus enables us to demonstrate that there is no ideal strategy for transport or urban planning. In reality, it all depends on the how they are combined: a transport strategy will be effective for a given urban strategy in relation to previously established development targets, but could be completely ineffective for another urban strategy. We wish to stress yet again that the two transport scenarios described in this study are not opposed to each other but perfectly complementary.

CONCLUSION

We find centrality at agglomeration levels greater than the commune and which concentrate economic activity and employment and attract the main flows of commuters. If centrality is not diluted in the metropolization process, we still find risks linked to the extensive and intensive increase in mobility.

Development choices for transport services and the associated urban planning are thus determining factors for the future development of the Gironde. We can infer two complementary types of policy recommendations from these observations: one for the public transport system, the other for economic development. Local decision-makers are thus faced with two main choices for each policy.

For the transport system:

- to serve the whole urban area population settlements;
- to serve the main subcentres.

The "egalitarian" approach enables workers to settle anywhere in the surrounding countryside whilst having close access to the public transport system, whereas the "hierarchical" approach serves more remote places in less time (thus eliminating geographical and time constraints).

For economic development:

- to concentrate and densify activities in the principal subcentres;
- to enlarge and spread activities all over the urban area.

In other words, if policy-makers prioritize a "concentrated approach", this implies a constraining planning decision. If policy-makers prioritize the "spread approach", this implies that the land-use market will have a strong influence on the location of economic activities

By combining these two choices, four consequences can be inferred:

1. development of urban-sprawl;
2. leap-frog urban development;
3. concentration around the CBD;
4. distribution around the principal subcentres.