Land uses allocation as key to city's environmental improvement

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1   ABSTRACT

Greek cities today expand, extended in the Urban Web, in a way that maximizes market's profits without taking into consideration the ecological consequences that will be caused in the urban environment via the created circulatory flows.

The phenomenon that is often observed, is that big cities residents

- must often travel long distances in order to cover their needs or
- must travel to specific city's areas where function over-concentration is observed creating circulatory congestion.

This paper's aim is the investigation of land uses allocation effect in the urban microclimate via the circulatory flows that are caused by cities residents, in order to satisfy their needs. As case study we will investigate a particularly environmentally overloaded region of Greece, the Attica's basin, in which more than the 50% of Greece's population is assembled.

This research aims to investigate these areas environmental problem and via the rationalization of urban activities allocation to propose:

- areal groups of functions in hierarchical networks,
- functions areal forms, and
- areal distribution in city's body,

that will minimize urban journeys and consequently , pollutants emission that is caused by vehicles, and will contribute in energy's consumption minimization.

2   ATTICA'S ROAD NETWORK.

The most recent census that took place in 1996 shows that there is a huge differentiation in road axes that are divided in seven categories according to the vehicles that use them daily. These categories are the following:

Road category	Number of vehicles that daily use this category	Number of building blocks that are daily crossed.	Percentage of Urban areas. (%)
1	50.000 and more	1.890	7
2	30.000-50.000	940	3
3	20.000-30.000	660	2
4	10.000-20.000	2.140	8
5	5.000-10.000	1.480	5
6	2.000-5.000	2.690	10
7	1-2.000	18.120	65

Fig. 1: Attica's road network

As we can realize from the above table, the majority of the building blocks is crossed by a small number of vehicles but also about 12% of the recorded area is crossed by an amount of vehicles that cause pollution problems. These roads allocation as they are categorized is shown in Figure 2. The central urban form of Athens that has been developed in radial form has been created by axes that serve a wide majority of population. Attica's residents travel through the basin's center that today faces the more serious environmental problems.

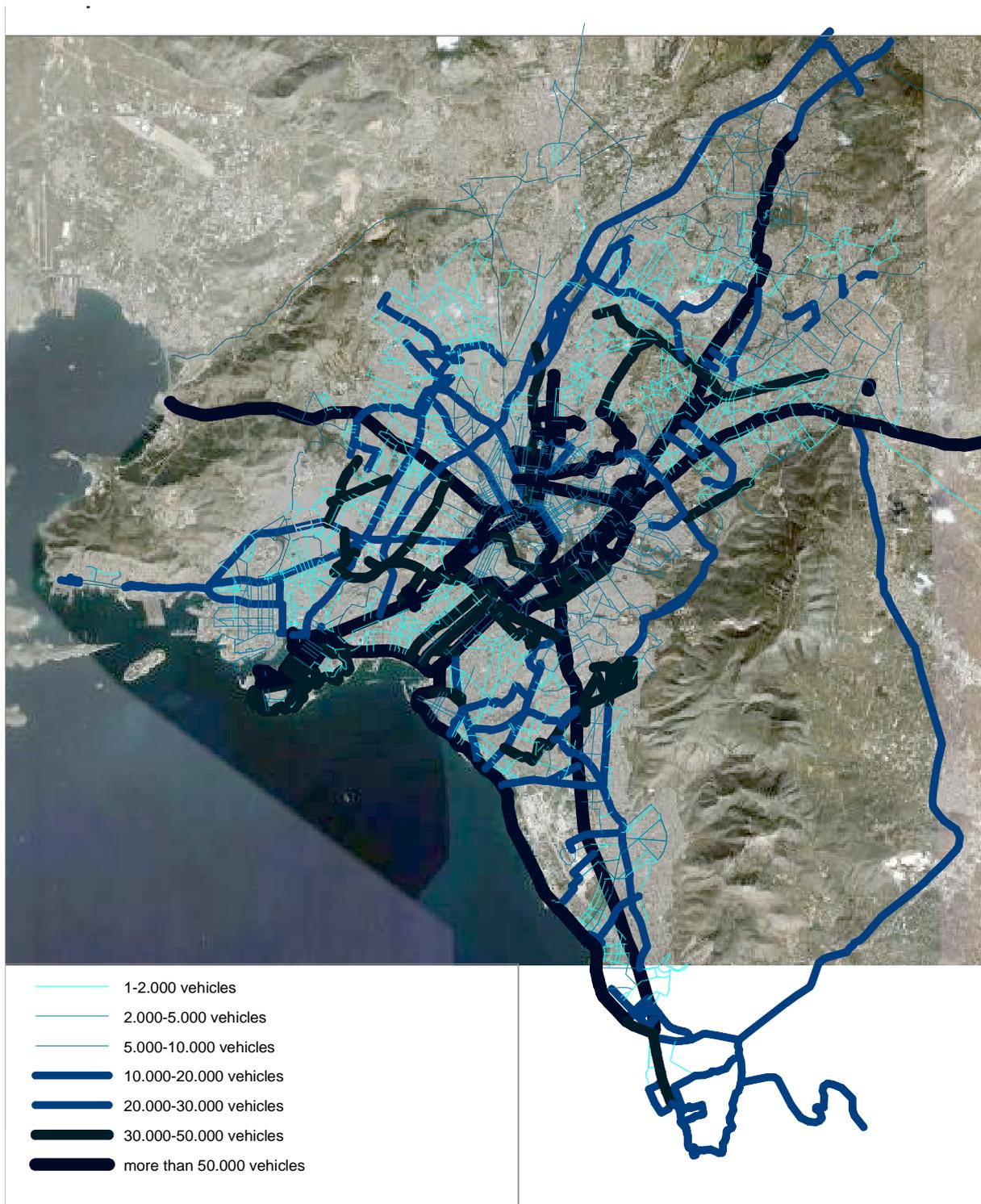| | 1-2.000 vehicles |
	2.000-5.000 vehicles
	5.000-10.000 vehicles
	10.000-20.000 vehicles
	20.000-30.000 vehicles
	30.000-50.000 vehicles
	more than 50.000 vehicles

Fig. 2: Attica's road network

Also, the fact that concentrated functions are allocated axially to the building blocks that are crossed by first and second category's axes has worsened the traffic congestion. Finally, we can conclude that except the radial axes, also axes near the center face the intense use of vehicles.

3 THE ALLOCATION OF RESIDENCE IN ATTICA'S BASIN

As Attica's basin consists an area that has been developing progressively since 1833 without planning, market forces are the main factor for its today status. Figure 3 shows the allocation of intense polulation as it was recorded by 2001 census.

The phenomenon that is faced is that:

- in central areas intense population is allocated at both sides of first and second category axes.

- as the distance from the center increases, population is allocated at both sides of axes of the rest categories[1]. These are the areas that initially were Attica's suburbs but through time have unified with the existing central areas, creating a coontinous urban tissue.t
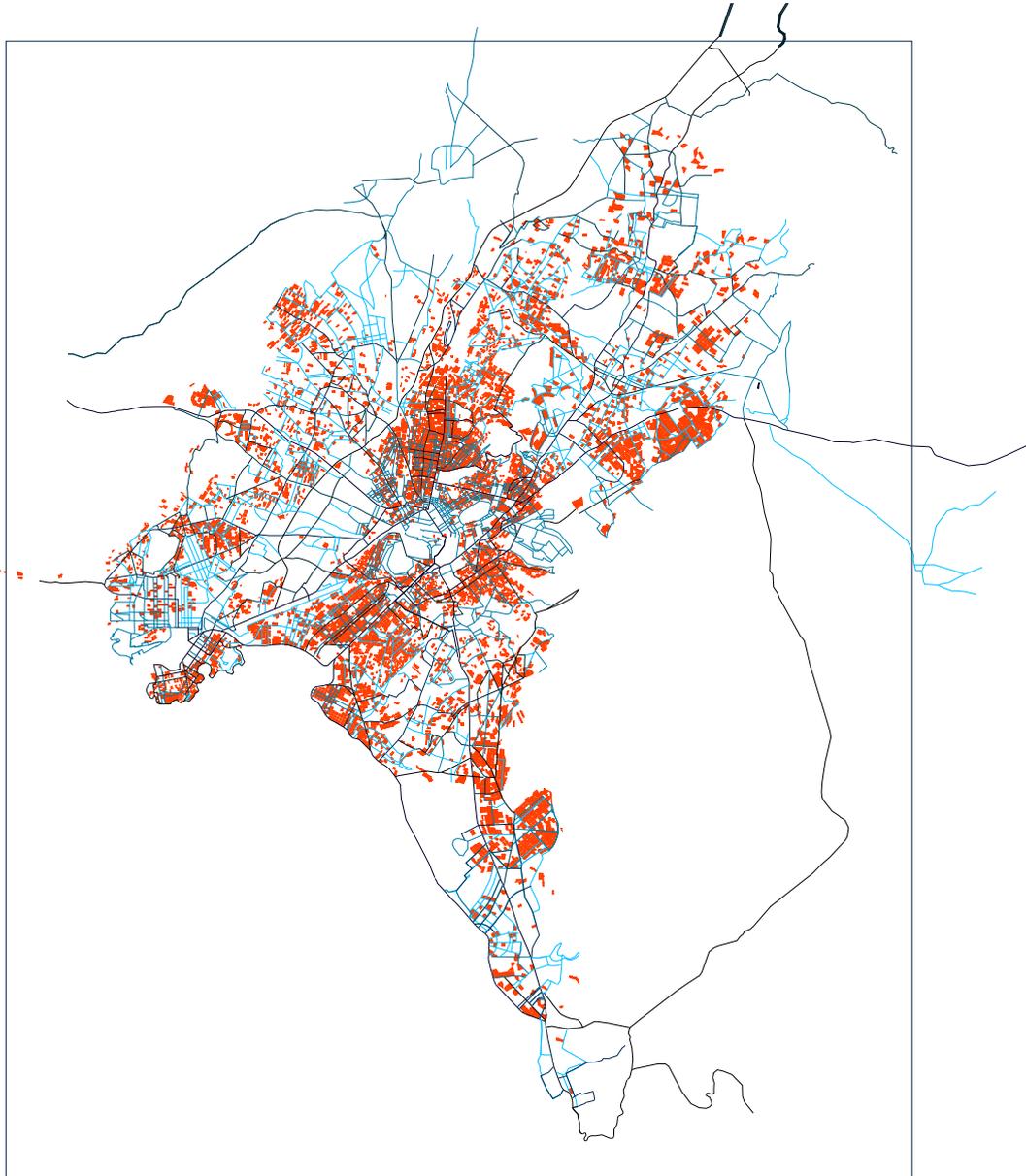

Fig.3.

Residence and road network in Attica.

The fact that intense residence has been recorded in central road axes areas is a reason for the creation of many urban journeys, (from home to work, recreation etc.) and additionally of traffic congestion, as the lack of parking areas makes many drivers park on the paving, decreasing the traffic lanes.

4   URBAN FUNCTIONS ALLOCATION, HIERARCHICAL NETWORKS AND AREAL FORMS.

As the Statistical Sevices of Greece have recorded 47 different functions we reveal the groups of functions as they co-operate in the urban web with the use of Principal Components Analysis[2]. This Analysis has grouped

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[1] more often the seventh category (1-2.000)

[2] The Principal Components Analysis seeks a linear combination of variables such that the maximum varianceis extracted from the variables.

• The Rotated Component Matrix determines what the components represent in relation with the variables.

• Loadings are the correlation coefficients between the variables and components.

the recorded activities in four groups where as we can see in figure 4, functions that are incompatible co-exist in the same building blocks, fact that has resulted from the existing legislation that encourages the mixture of uses.

Functions groups	Activities	Loadings	Eigenvalue	Cumulative %
1	Constructions	,766	10,53	20,25
	Clothing manufacture	,762		
	Restaurants and Hotels	,717		
	Households that occupy domestic personnel	,714		
	Retail trade of all goods except vehicles	,705		
	Manufacture of metallic products	,695		
	Industries of Furniture and goods of furnishing	,666		
	Land transports	,623		
	Industry of Food and drinks	,610		
	Vehicles trade	,590		
	Textile Industries	,571		
	Industries of products from tyre and plastic material	,567		
	Services	,564		
	Leather Industries	,526		
	Industries of not metal mining products	,505		
	Paper Industries	,490		
	Basic Metallurgic Industries	,488		
	Industries of Timber and Cork	,486		
	Wholesale trade of Litter and Clippings	,424		
	Recycling	,346		
	Manufacture of electric machines, appliances and remaining tyres	,291		
	Manufacture of Carrier means	,228		
2	Education	,732	9,7	18,65
	Financial services	,709		
	Medical and Sanitary Services	,693		
	Services of Recreation and Culture	,683		
	Information and technology services	,615		
	Printing, Publications and relevant activities	,615		
	Administration	,599		
	Transports services	,577		
	Wholesale Trade	,561		
	Insurances	,559		
	Communications	,552		
	Air transports	,550		
	Financial services	,521		
	Research	,466		
	Chemical industries	,423		
	Real Estate	,372		
	Organisations	,367		
	Tv and communication equipment manufacture	,278		
	Mobile renting	,249		
3	Office machines and computers Manufacture.	,446	2,09	4,02
	Equipment manufacture	,386		
	Manufacture of medical supplies	,374		
4	Sea transports	,642	1,75	3,36
	Transports equipment	,576		
	Tobacco industries	,524		

Fig. 4: Attica's basin Functional Structure.

• Varimax rotation is an orthogonal rotation of the factor axes to maximize the variance of the squared loadings of a component on all the variables in a component matrix, which has the effect of differentiatingthe original variables by extracted component. Each component will tend to have either large or small loadings of any particular variable.
• The % of Variance column gives the ratio, expressed as a percentage, of the variance accounted for by each component to the total variance in all of the variables.
• Each Eigenvalue for a given component measures the variance in all the variables which is accounted for by that component.
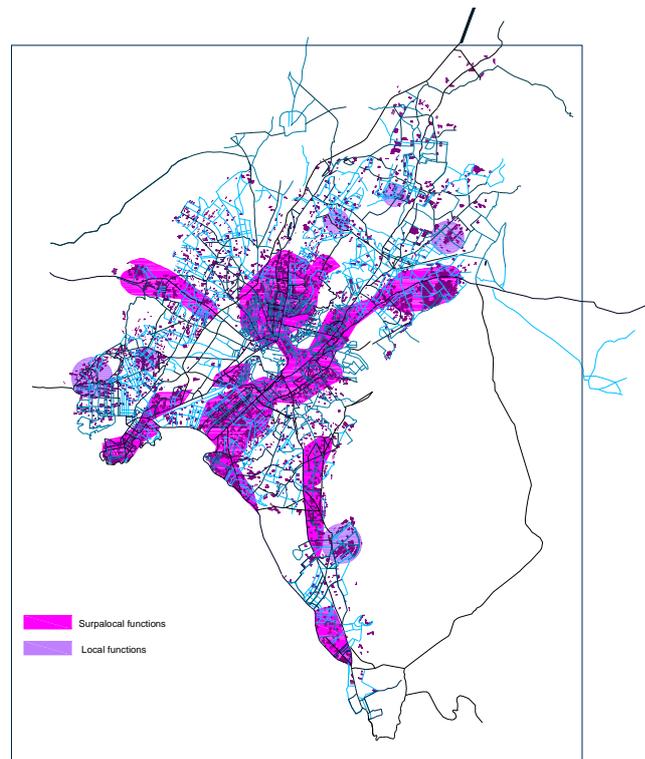
Fig. 5: Functions allocation and road network.

The allocation of these Function groups is shown in Fig.5.

As supralocal functions we define the functions that serve the wider area of their position, whereas local functions have a small serving radius.

We realise that there are two kinds of functions, depending on their size and allocation:

- Supralocal functions that are mainly allocated at both sides of the first category road axes. This is observed because these areas are daily crossed by many candidate customers so market forces impose their allocation in these specific city's areas.

- Local functions that are allocated in nucleous forms in areas with lower vehicles traffic in order to serve the "internal" of central axes areas.

Supralocal functions allocation causes a lot of daily journrneys not only by the employees of these activities but also by customers in order to cover their needs. The lack of these functions in "local center" areas that can be approached by public transportation means, is obvious and is the reason for the creation of traffic congestion.

5 THE CREATED URBAN JOURNEYS AND THEIR EFFECT IN URBAN MICROCLIMATE

As research of the Environment Ministry has shown, vehicles that travel in Athens basin, are continuously increasing. Also the fact that the urban web has been created without planning in its majority, have created high buildings, narrow roads and few open and green areas. All these facts have led to today's difficult microclimate status as intense atmosferic pollution has been recorded more intensively at the central areas. As pollution is effected by the geomorphology and the climatic condition, the mountains that sourround the basin in combination with the humidity and sunlight have resulted to high pollutants concentration.

The main air pollution problem in Attica is tropospheric ozone, a product of the combination of intense sunshine with considerable emissions of ozone precursors. Also there is a particulate matter with aerodynamic diameter less than 10 µm (PM10) that shows high concentrations.Pollutants emission is created by heat, industry and vehicles function. Figure 6 shows how fuel's consuption and accordingly pollutants emission has changed through the years. The policy of "moving" the industries away from urban areas has improved atmosferic quality whereas vehicles emissions are much higher and are the main cause for today's atmosferic problems.
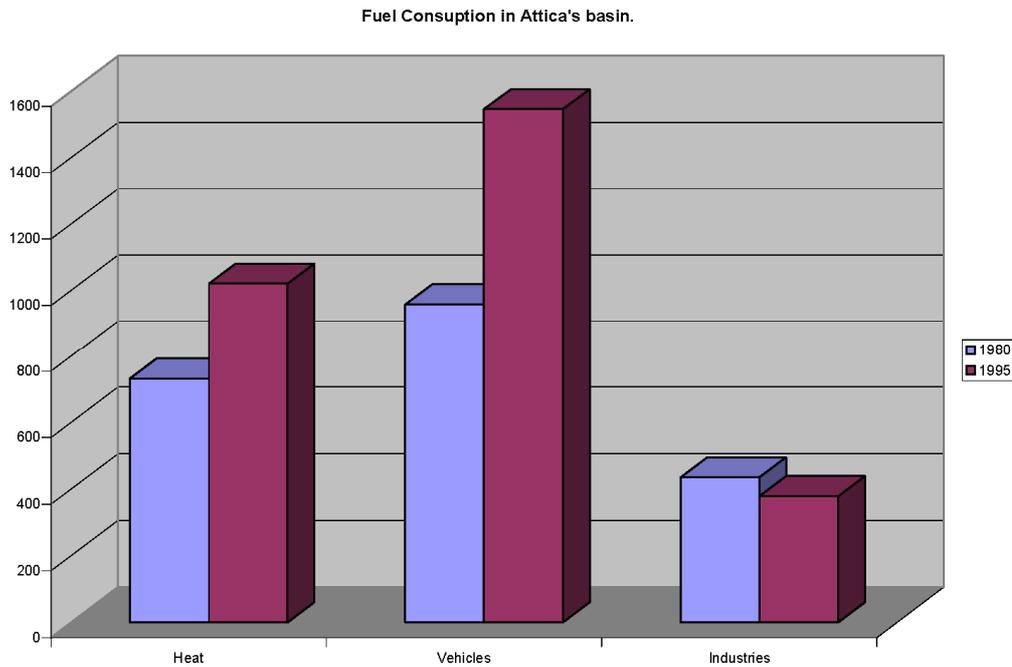
Fig. 6: Fuel consumption in Attica's basin.

Most of the Attica's urban journeys are "from home to work and reversely". Although the public transportation means (metro, tram) have succeded as they serve almost half a million of people everyday, still reserch shows that automobiles are "moving more". Planning can decrease these flows

- by encouraging the scattered allocation of functions and
- the creation of subcenters that can serve local needs, in order to minimise journeys to central traffic overloaded areas.

6 THE RATIONALIZATION OF URBAN ACTIVITIES

Regarding to the relation of land uses with the circulatory flows that create them and are caused by them we conclude that the key to the improvement of urban micro-climate will be the re-allocation of activities in order to reduce pollutants emissions.

This will result by the minimization of circulatory flows. As research has revealed the daily traffic congestion is caused mainly because the activities are allocated on axes which cover simultaneously also wayside and supralocal function. The observed contradictory functional and traffic status accumulatively overloads the Basin's urban process resulting its minimum ecological behaviour, because the consumed energy and the emitted pollutants are increased.

The first priority is the decentralisation of activities that "attract" journeys and the creation of "satellite" sub-centres. The second solution will result from the creation of axes that will reduce vehicles urban journeys. The lack of oblique axes of high circulatory intensity is obvious, fact that causes city's traffic status problems in Attica's basin, and this because these oblique flows are served (due to urban tissue deficiency) by low intensity local road axes.

We realize that circulatory flows will be reduced with the creation of "rings" that will serve flows round city's centre avoiding crossing the central area that has the biggest pollution problems. So, the creation of an External ring and of a smaller Internal ring with the essential junctions that would link the radial axes with the centre is proposed (Figure 7).
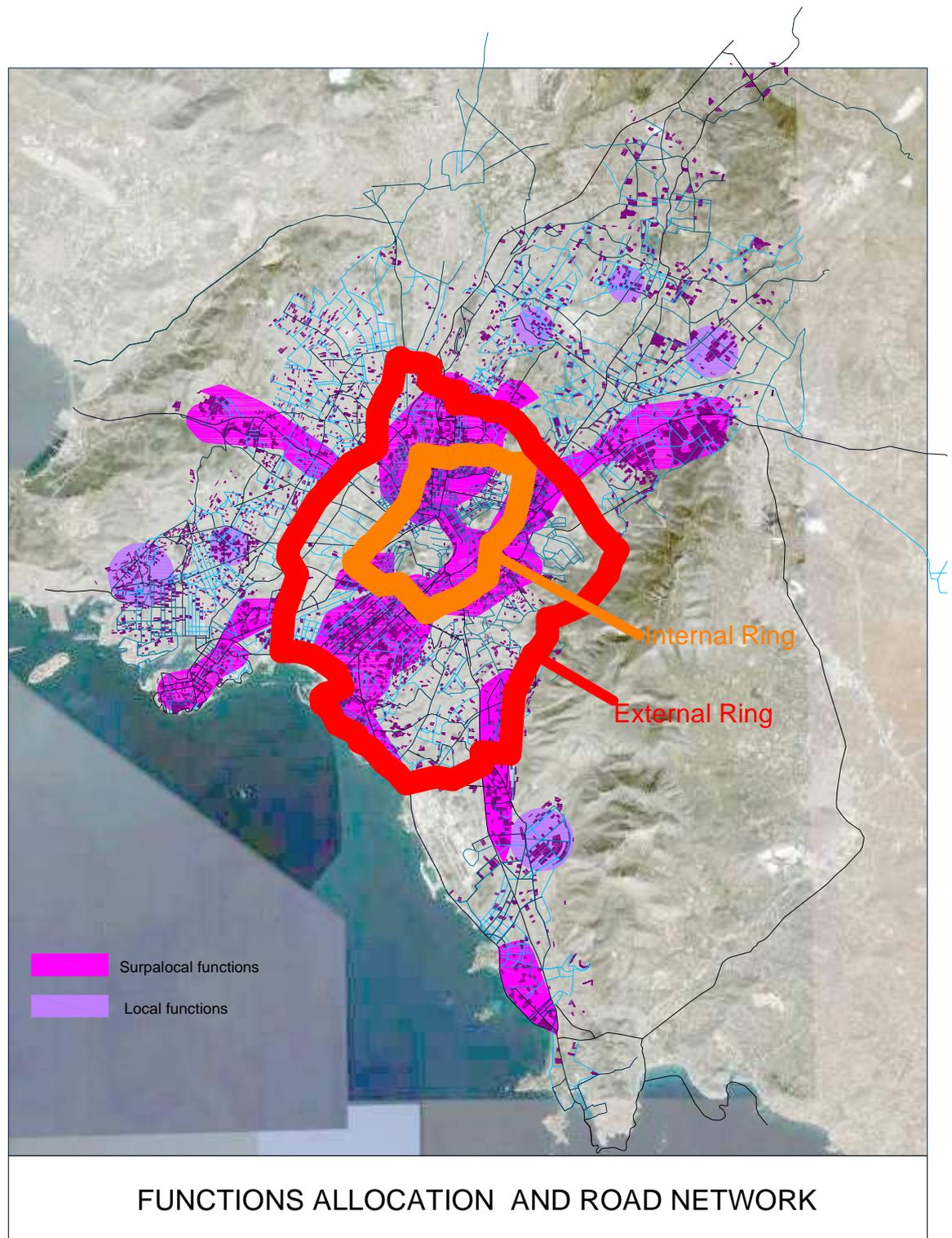
Fig. 7: Proposed circulatory rings.

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