

# Structuring Urban Transport Networks: How Network Planning contributes to a better Distribution of Space

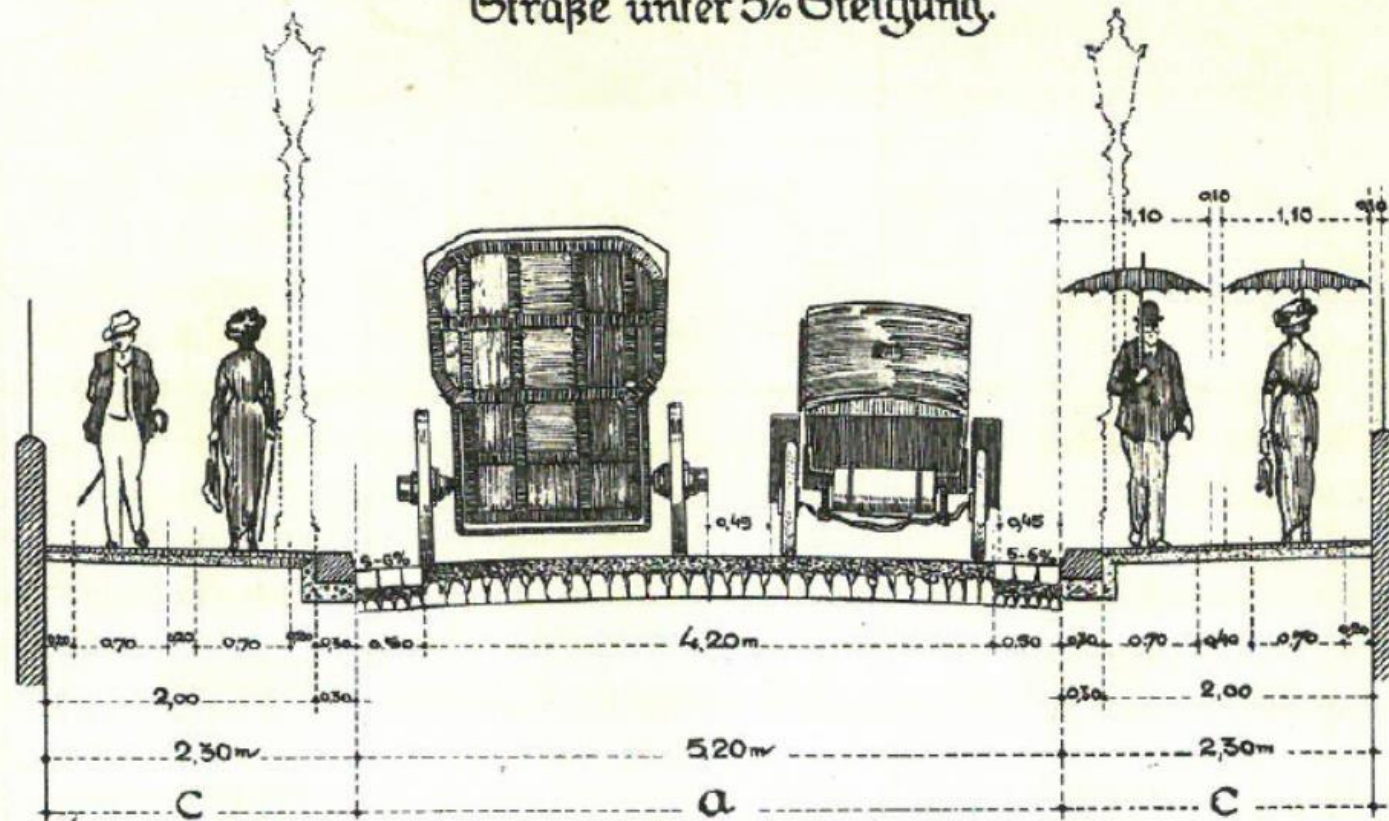
Cities for Mobility  
20 June 2023

Prof. Dr.-Ing. Markus Friedrich

# Urban Space

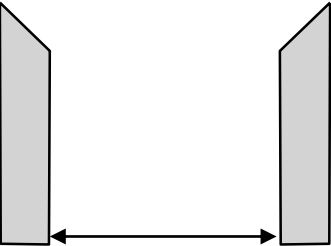
## D: Minimal-Straßenbreite.

Straße unter 5% Steigung.

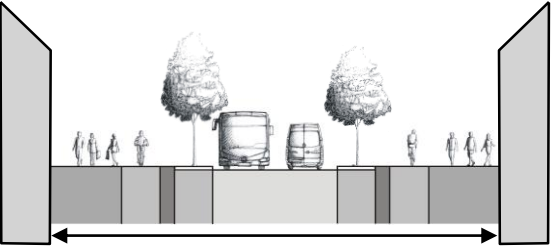


Soure: Scheuermann (1915): Wichtige Grundfragen bei neuzeitlicher Gestaltung von Stadtstraßen  
Important fundamental issues in modern design of urban roads

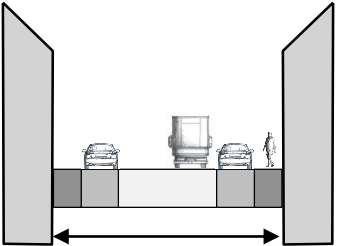
# Urban Space



# Urban Space and Transport Supply

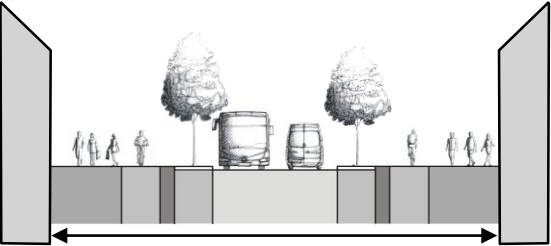


Urban Space

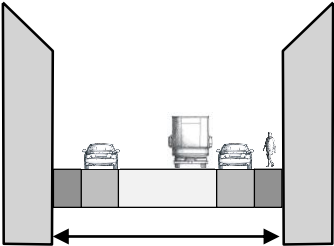


Urban Space

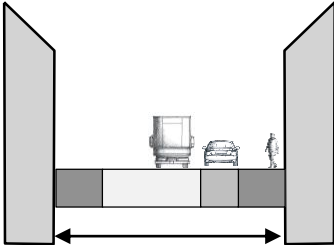
# Urban Space and Transport Supply



Urban Space



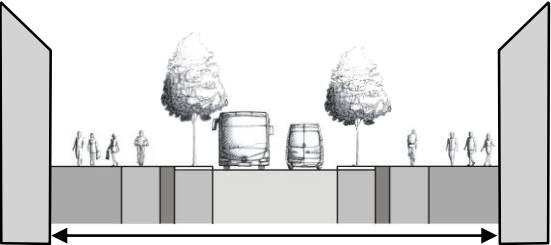
Urban Space



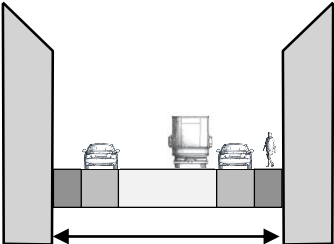
Urban Space

# Urban Space and Transport Supply

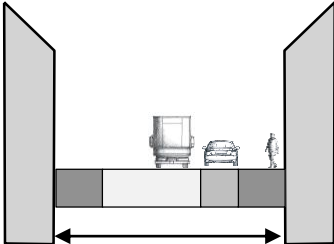
## Street Transport Way



Urban Space



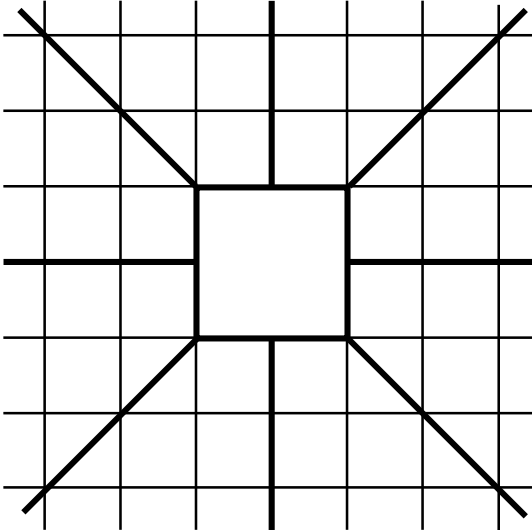
Urban Space



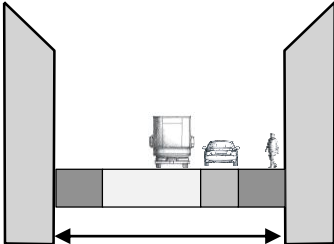
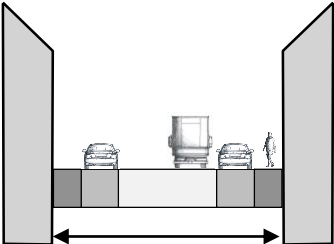
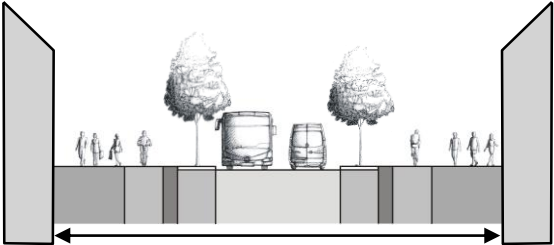
Urban Space

# Urban Space and Transport Supply

## Transport Network



## Street Transport Way



# Urban Space and Transport Supply

**Transport  
Supply**

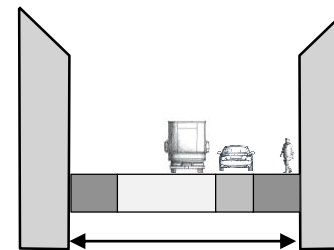
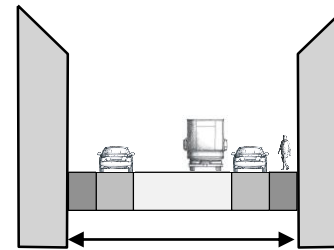
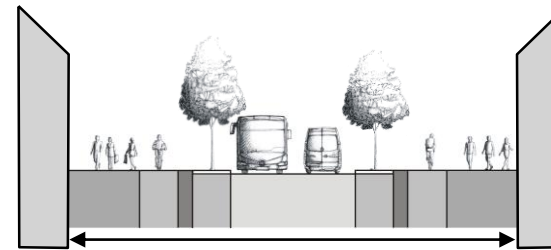
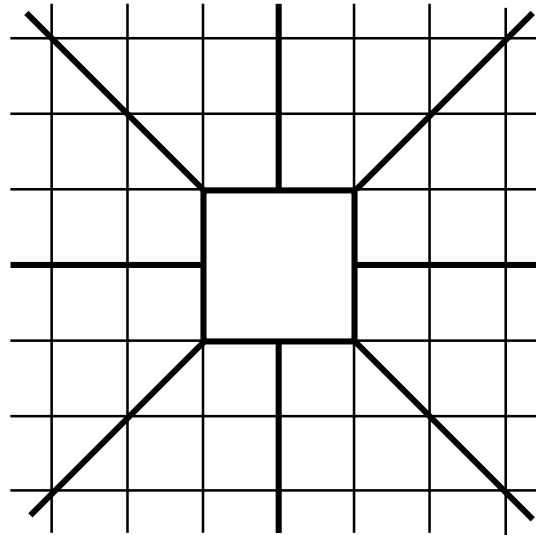
=

**Transport  
Network**

+

**Street  
Transport Way**

- + Transit Lines
- + Traffic Light
- + Fares / Tolls
- + ...





# Urban Space and Transport Supply

Transport  
Supply

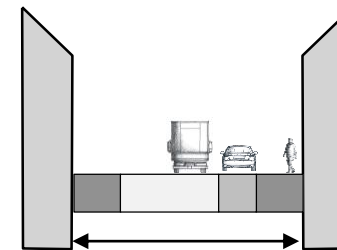
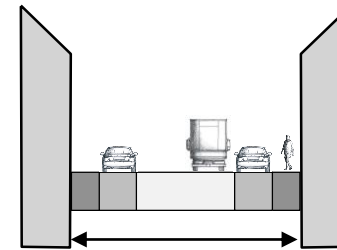
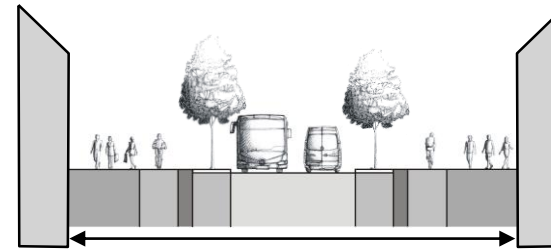
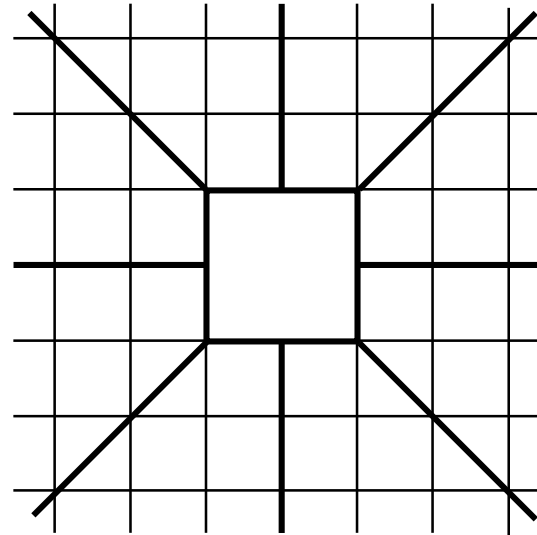
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Transport  
Network

+

Street  
Transport Way

+ Transit Lines  
+ Traffic Light  
+ Fares / Tolls  
+ ...



given:

- transport network
- urban space

# Urban Space and Transport Supply

Transport  
Supply

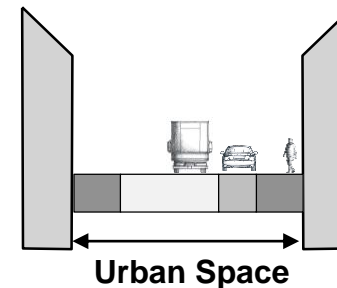
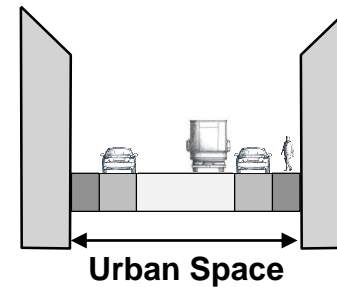
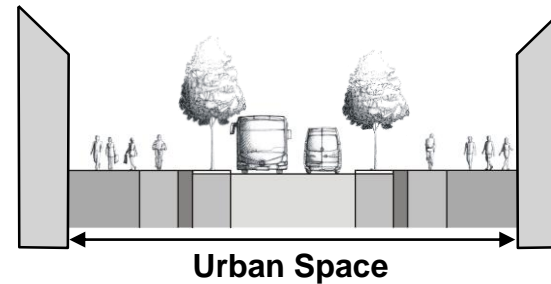
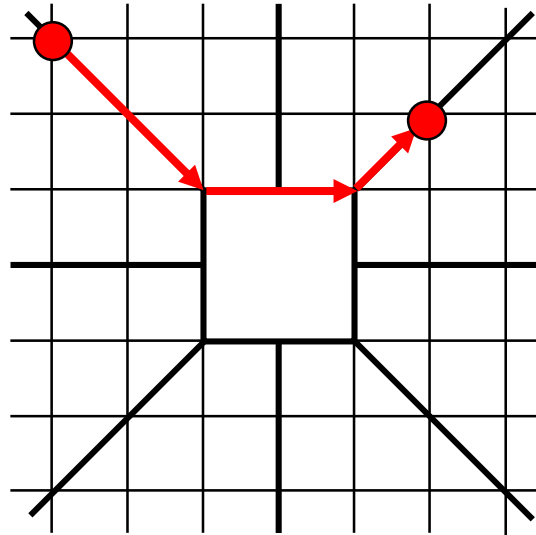
=

Transport  
Network

+

Street  
Transport Way

+ Transit Lines  
+ Traffic Light  
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+ ...



given:

- transport network
- urban space

wanted:

1. desirable distribution of urban space
2. decent service quality for connecting places

# Urban Space and Transport Supply

Transport  
Supply

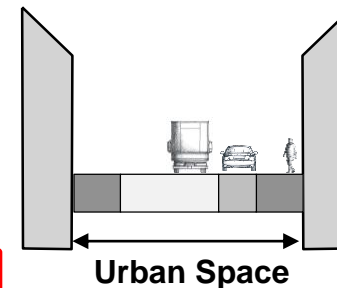
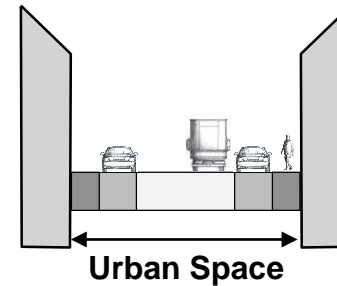
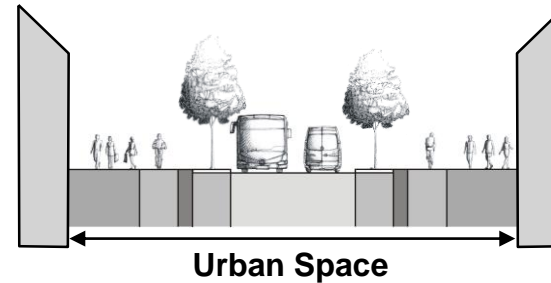
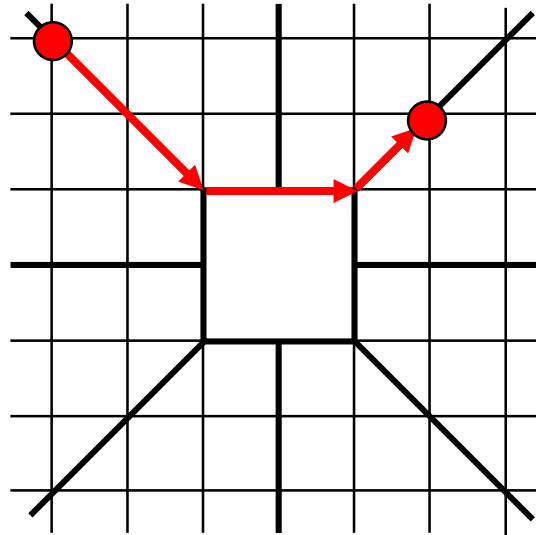
=

Transport  
Network

+

Street  
Transport Way

+ Transit Lines  
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+ ...



given:

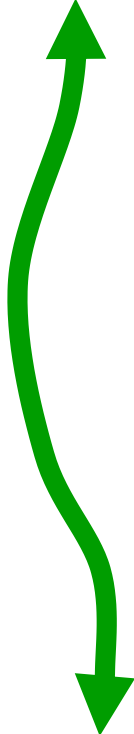
- transport network
- urban space

wanted:

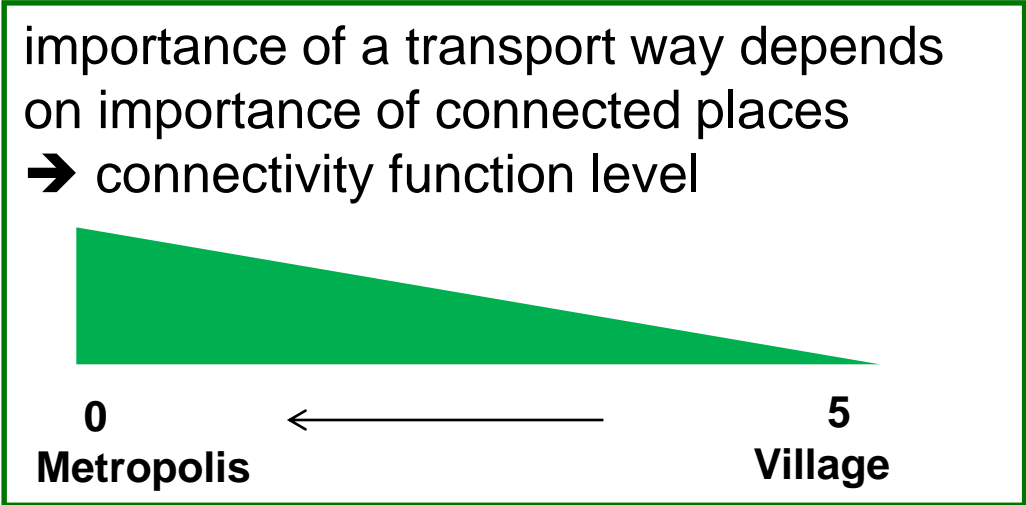
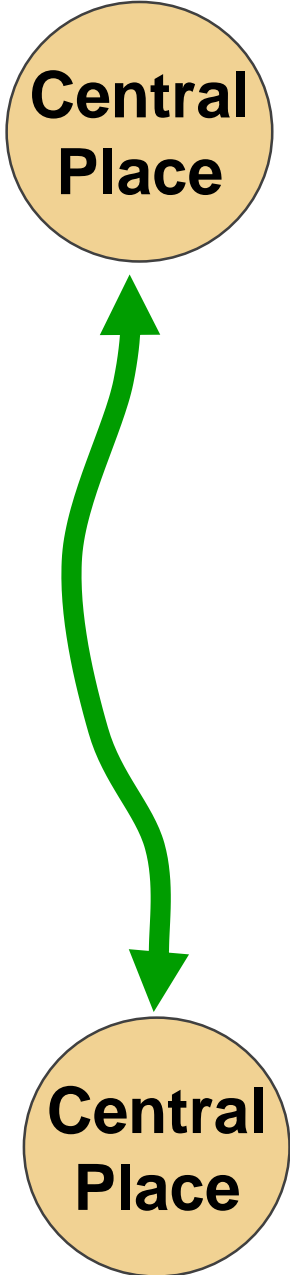
1. decent service quality for connecting places
2. desirable distribution of urban space



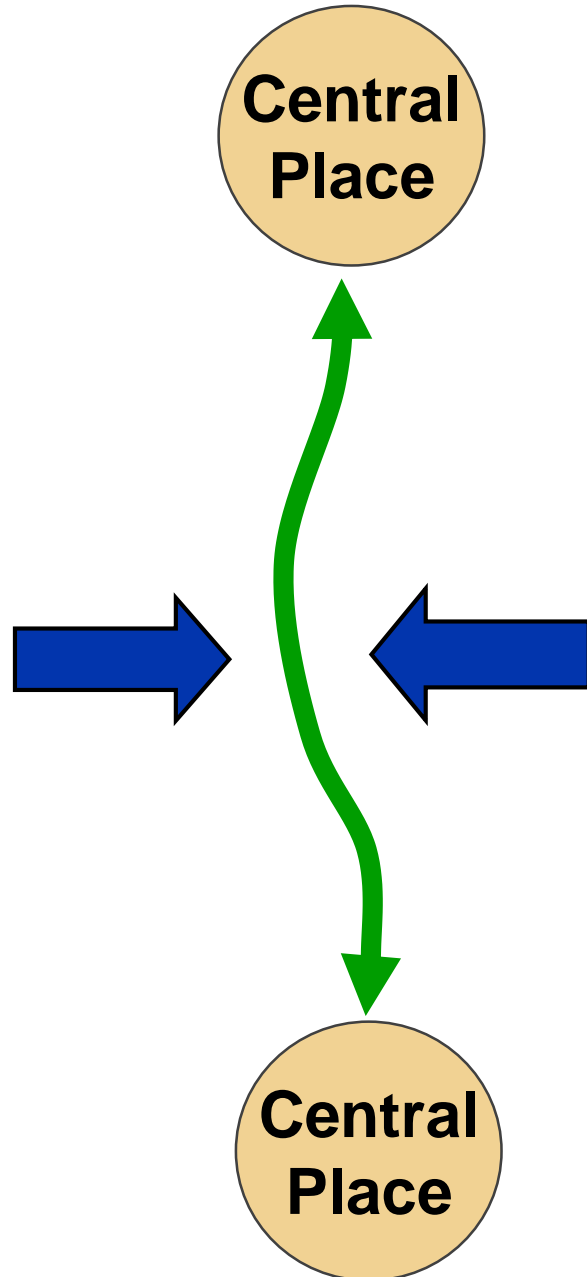
# Principles of Network Structuring



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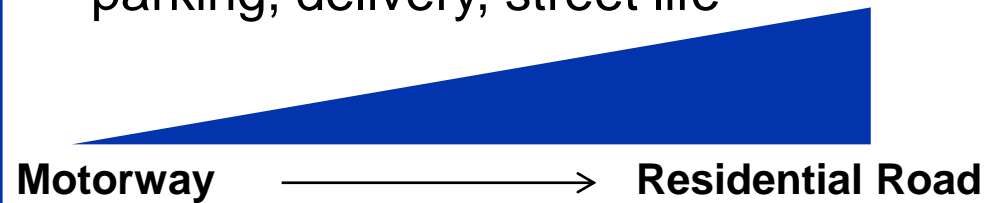


importance of a transport way depends on importance of connected places  
→ connectivity function level

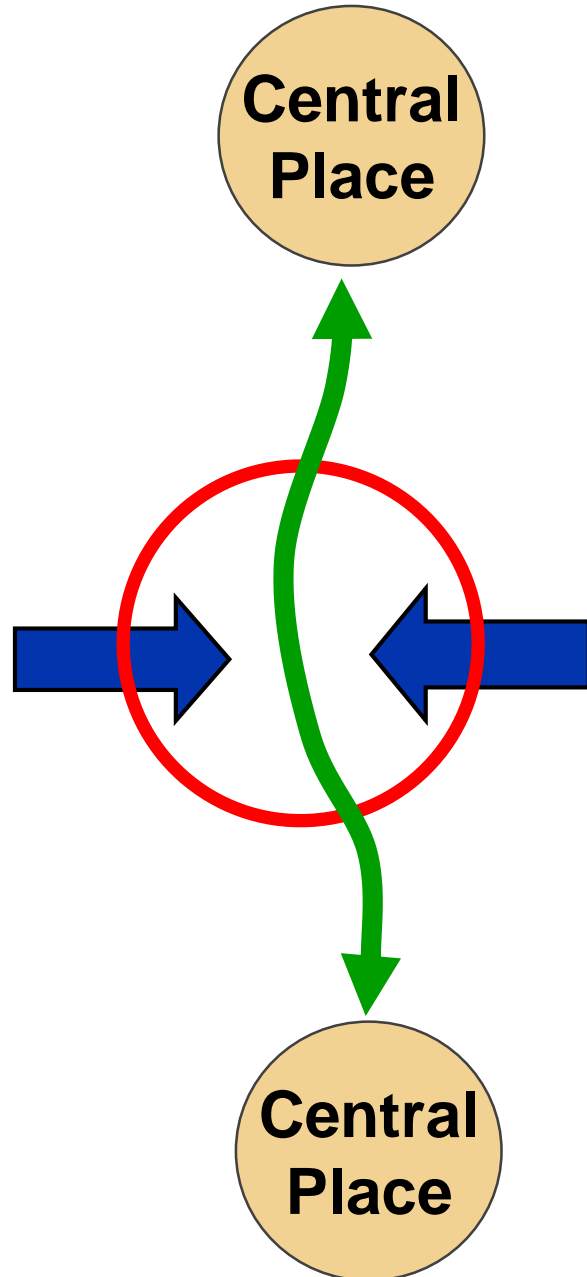


requirements of surroundings determine the function of a transport way

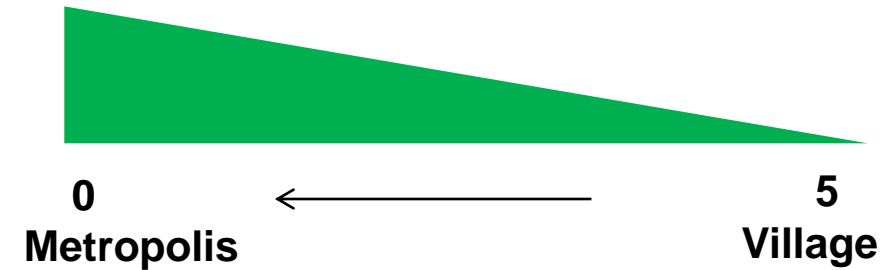
- connection function
- service function: access to houses parking, delivery, street life



# Principles of Network Structuring

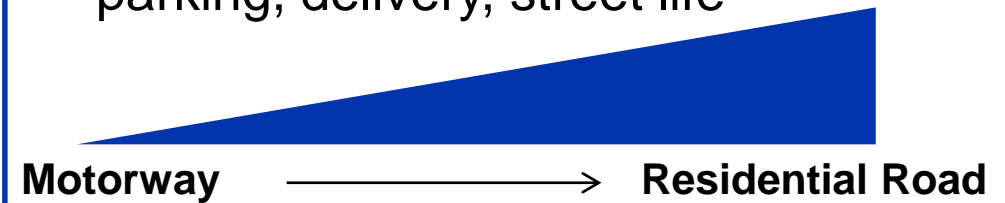


importance of a transport way depends on importance of connected places  
→ connectivity function level



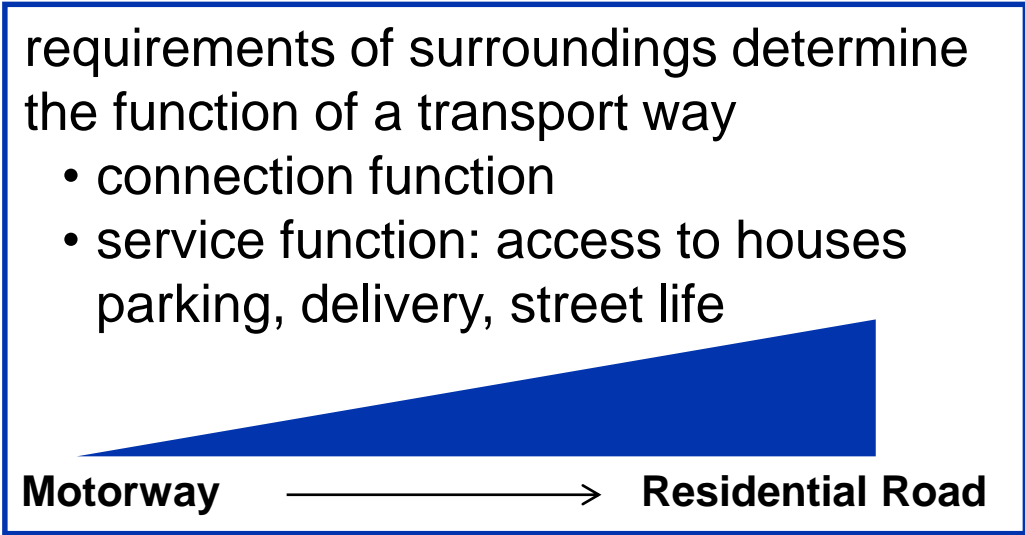
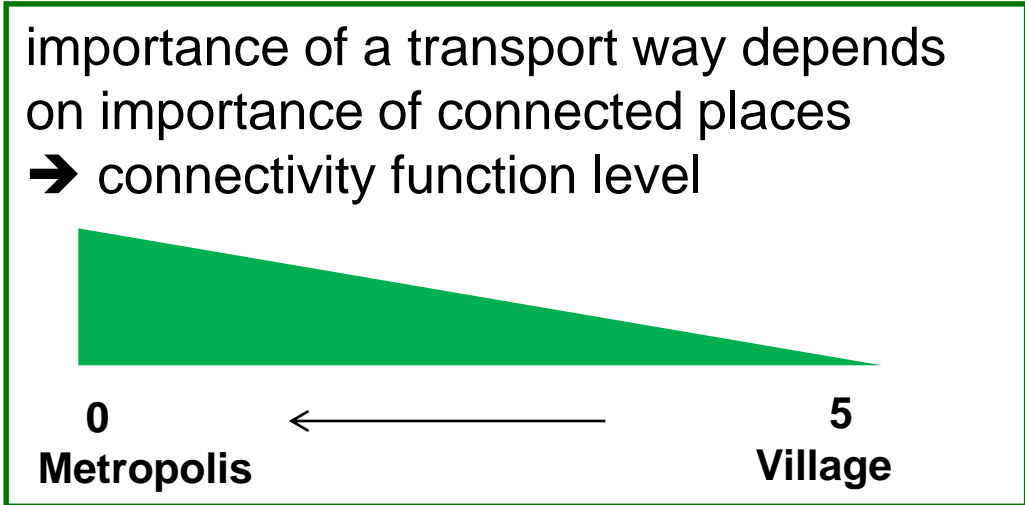
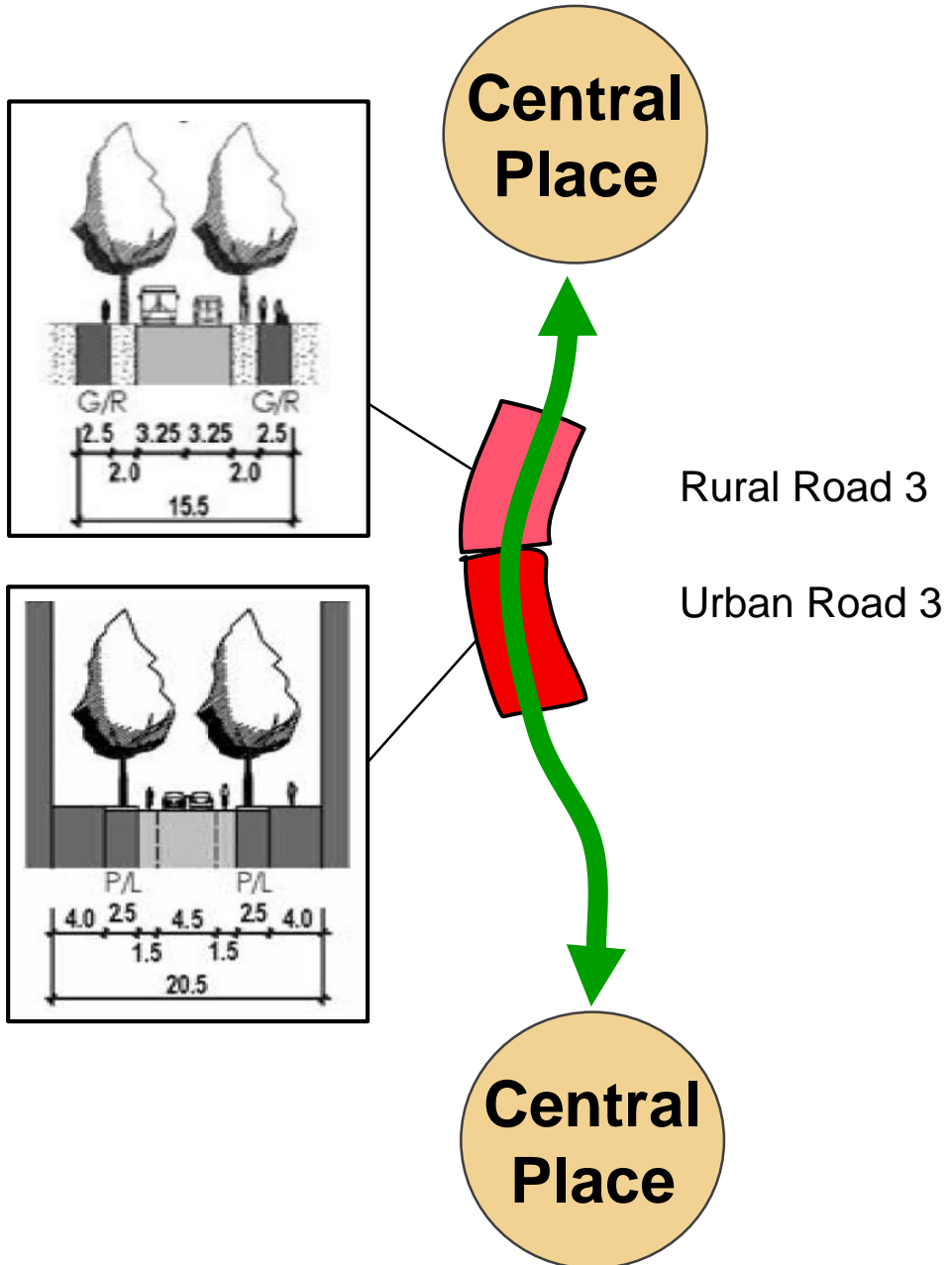
requirements of surroundings determine the function of a transport way

- connection function
- service function: access to houses parking, delivery, street life



$\Sigma$  = transport way category

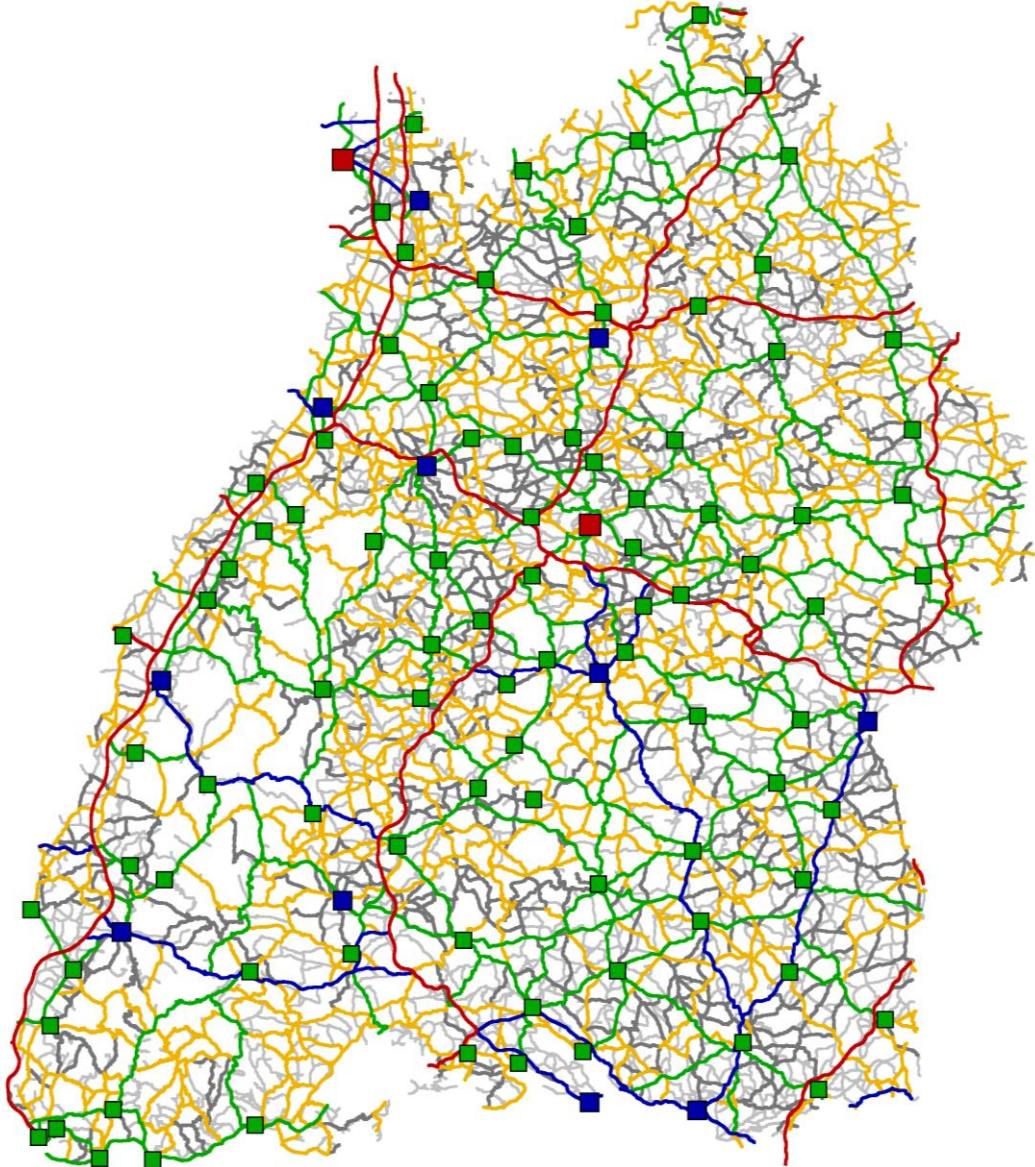
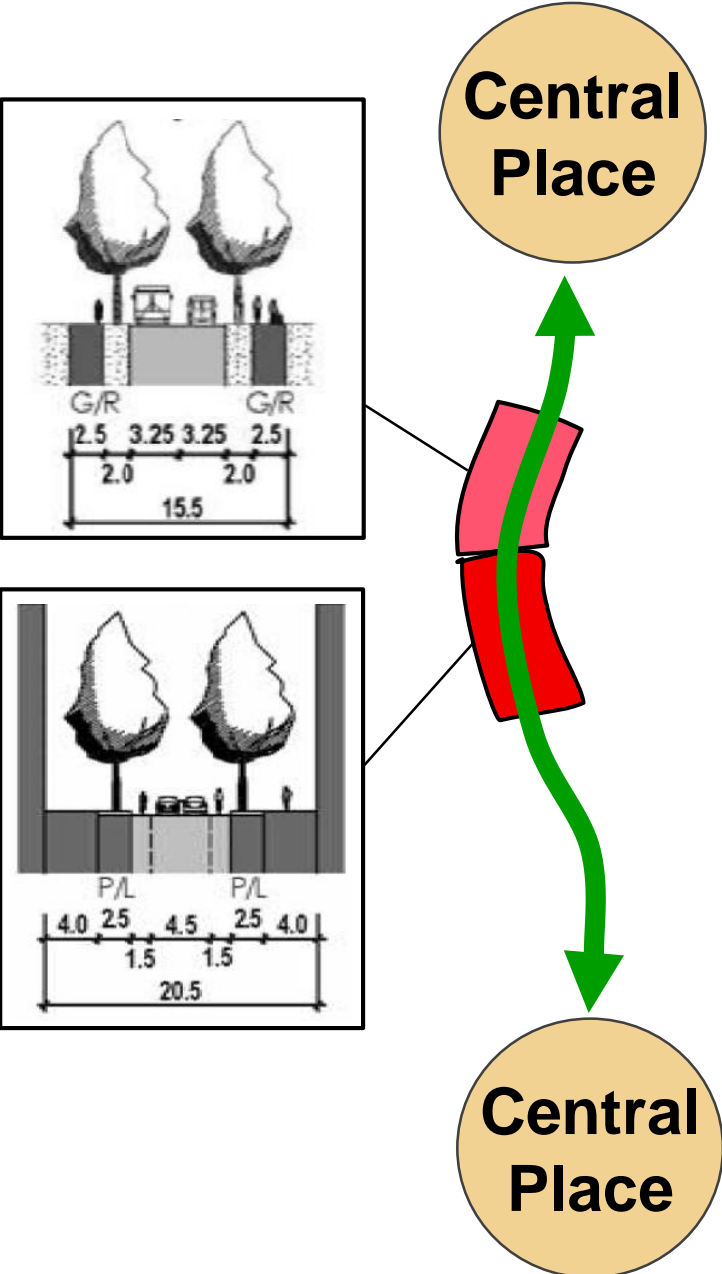
# Principles of Network Structuring



$\Sigma$  = transport way category



# Problem: We are very good in Structuring interurban Networks for Cars

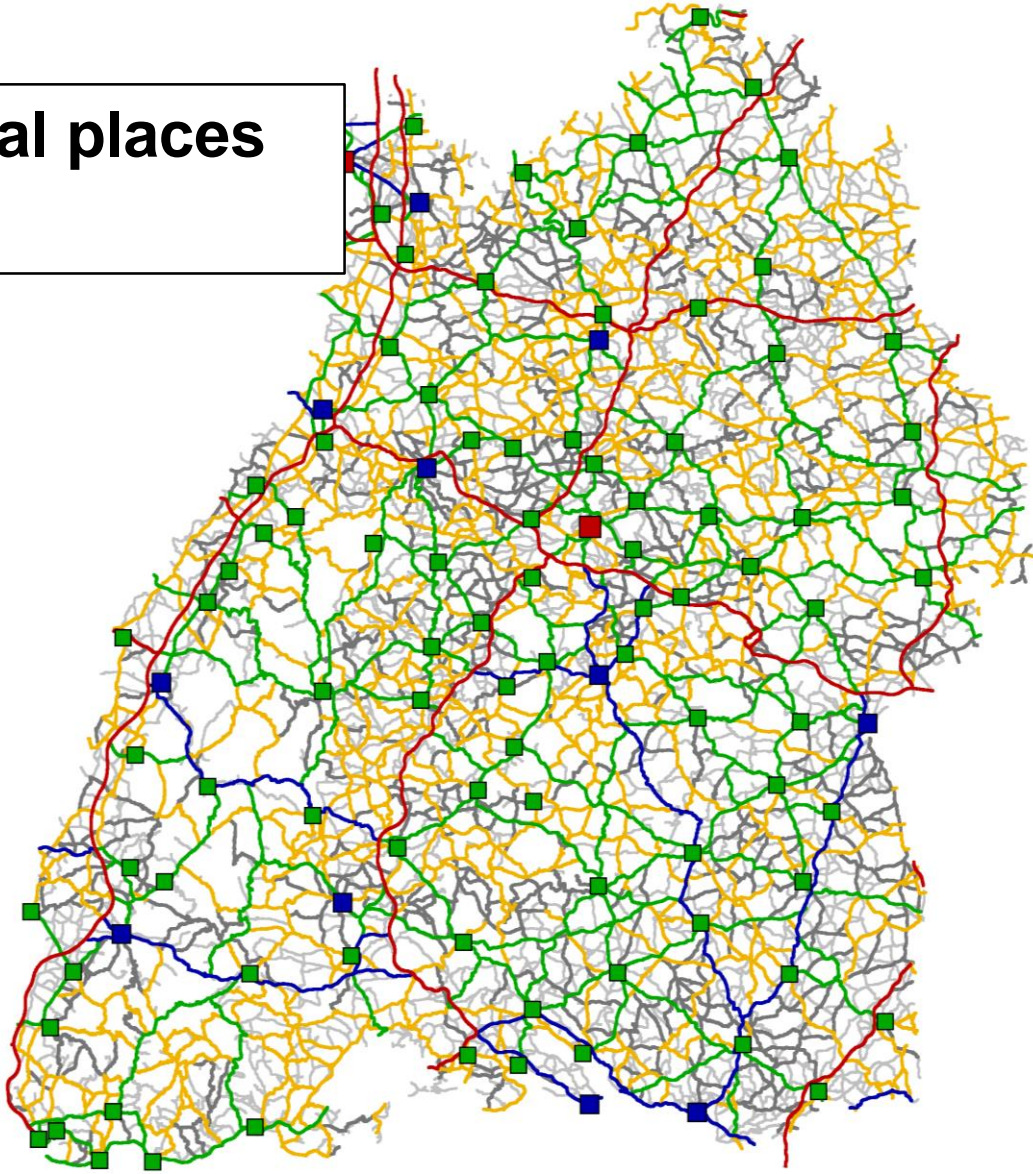
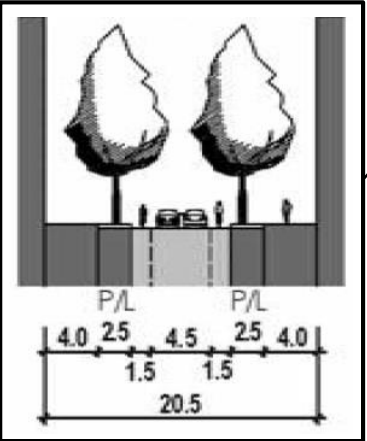
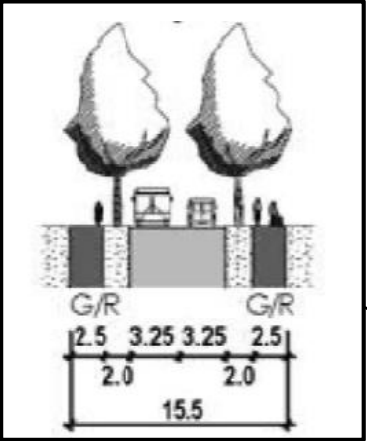


# Problem: We are very good in Structuring interurban Networks for Cars

Central Place

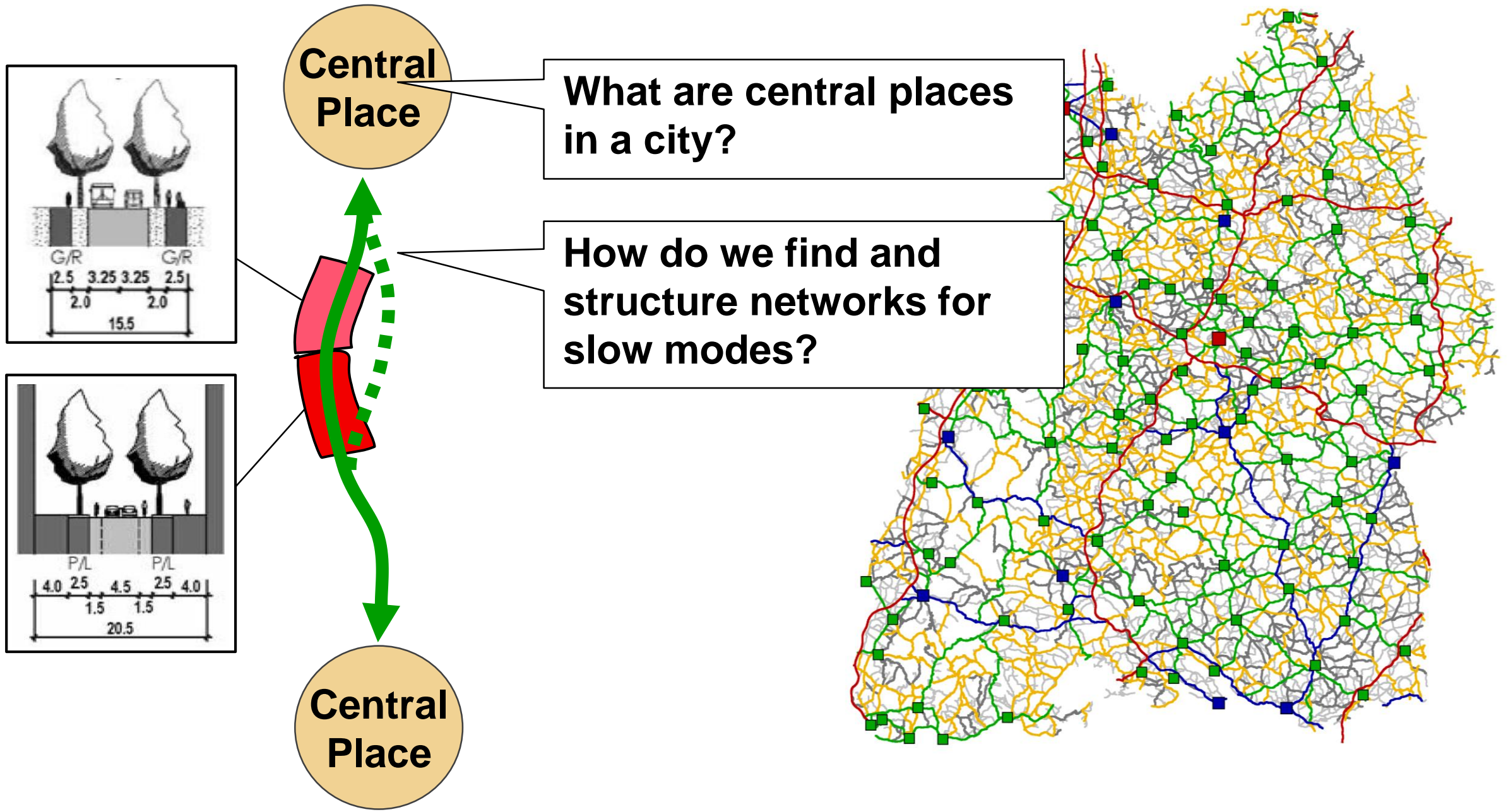
What are central places in a city?

Central Place

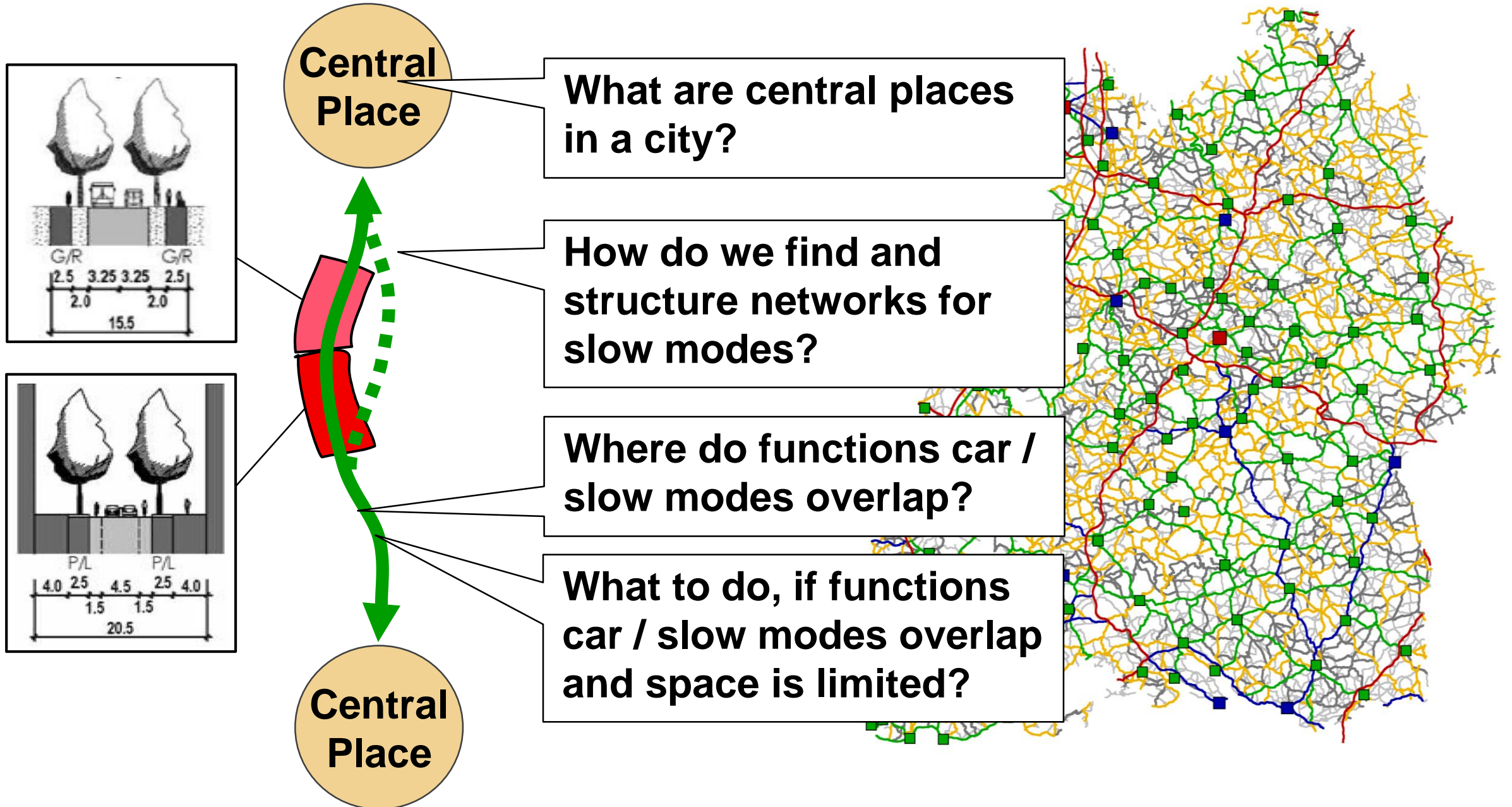




# Problem: We are very good in Structuring interurban Networks for Cars



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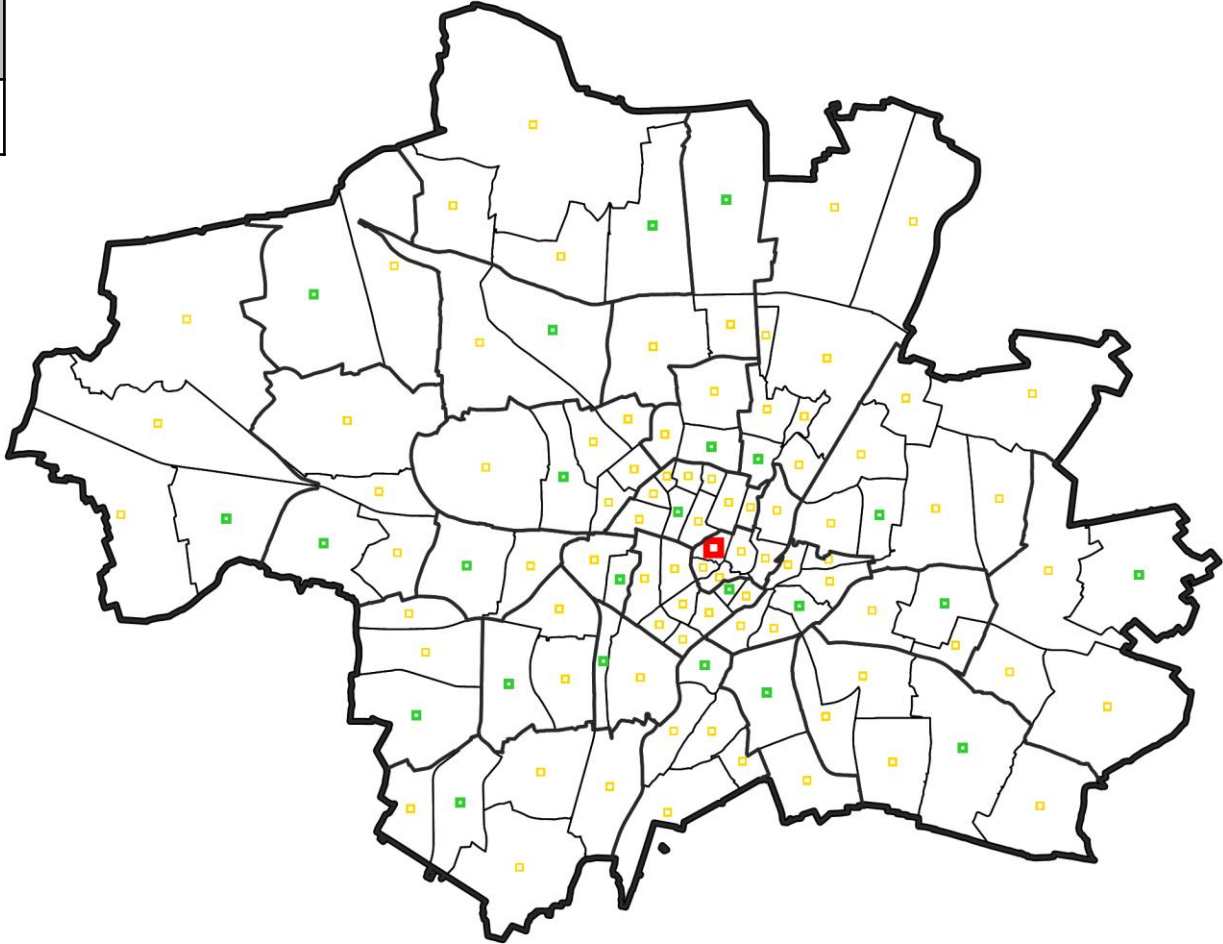
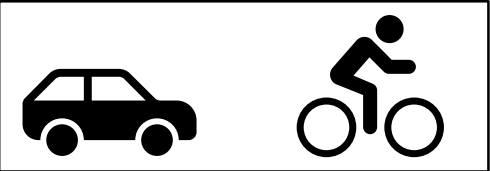






# Structuring Transport Networks: Central Places

City	Urban Districts	Urban Quarters
Munich	25	108






What are central places in a city?



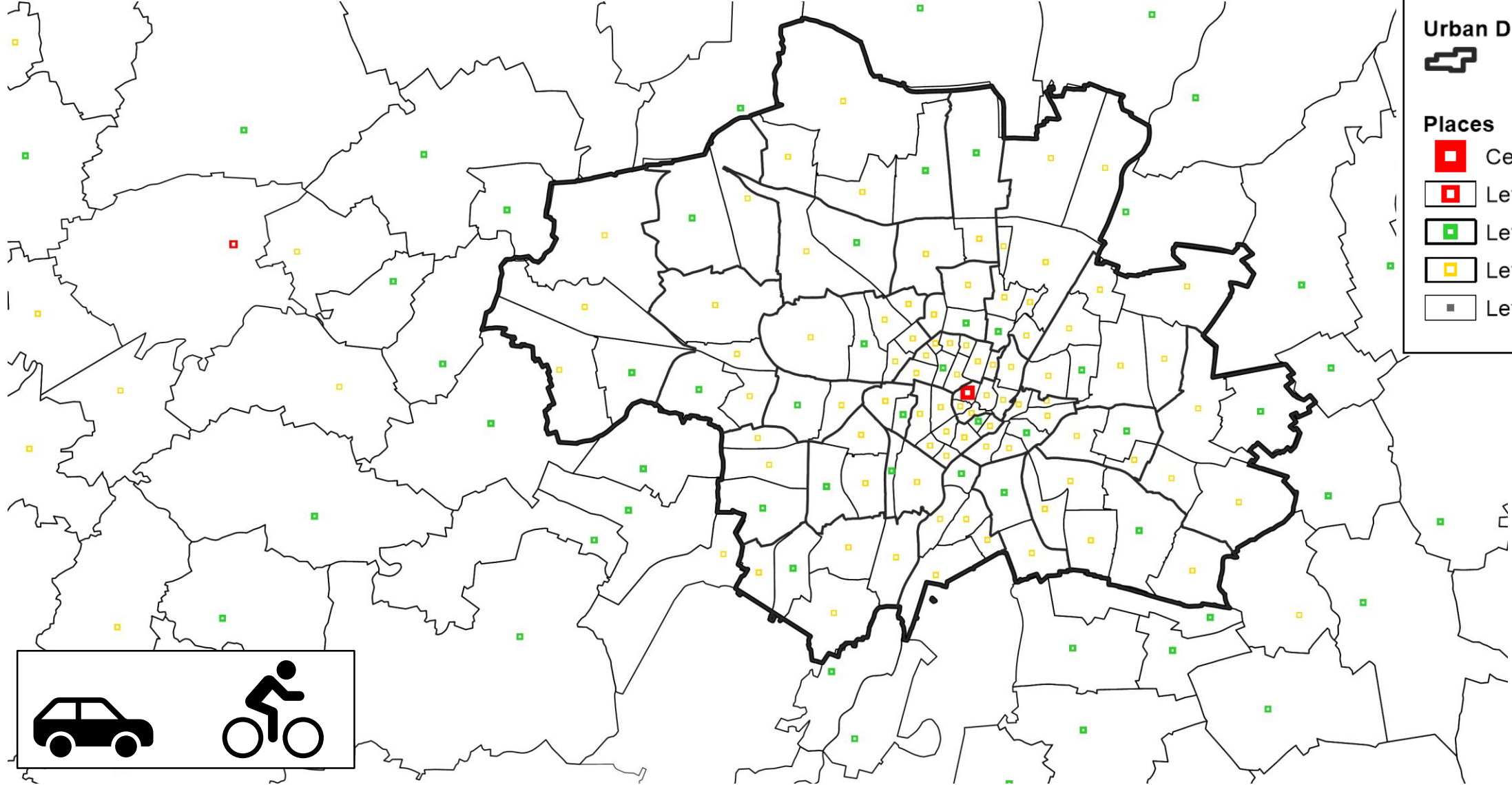
**City Limits**  


**Urban District**  


**Places**

-  Center
-  Level 0-2
-  Level 3
-  Level 4
-  Level 5

# Structuring Transport Networks: Central Places

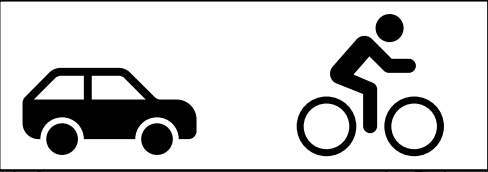


**City Limits**

**Urban District**

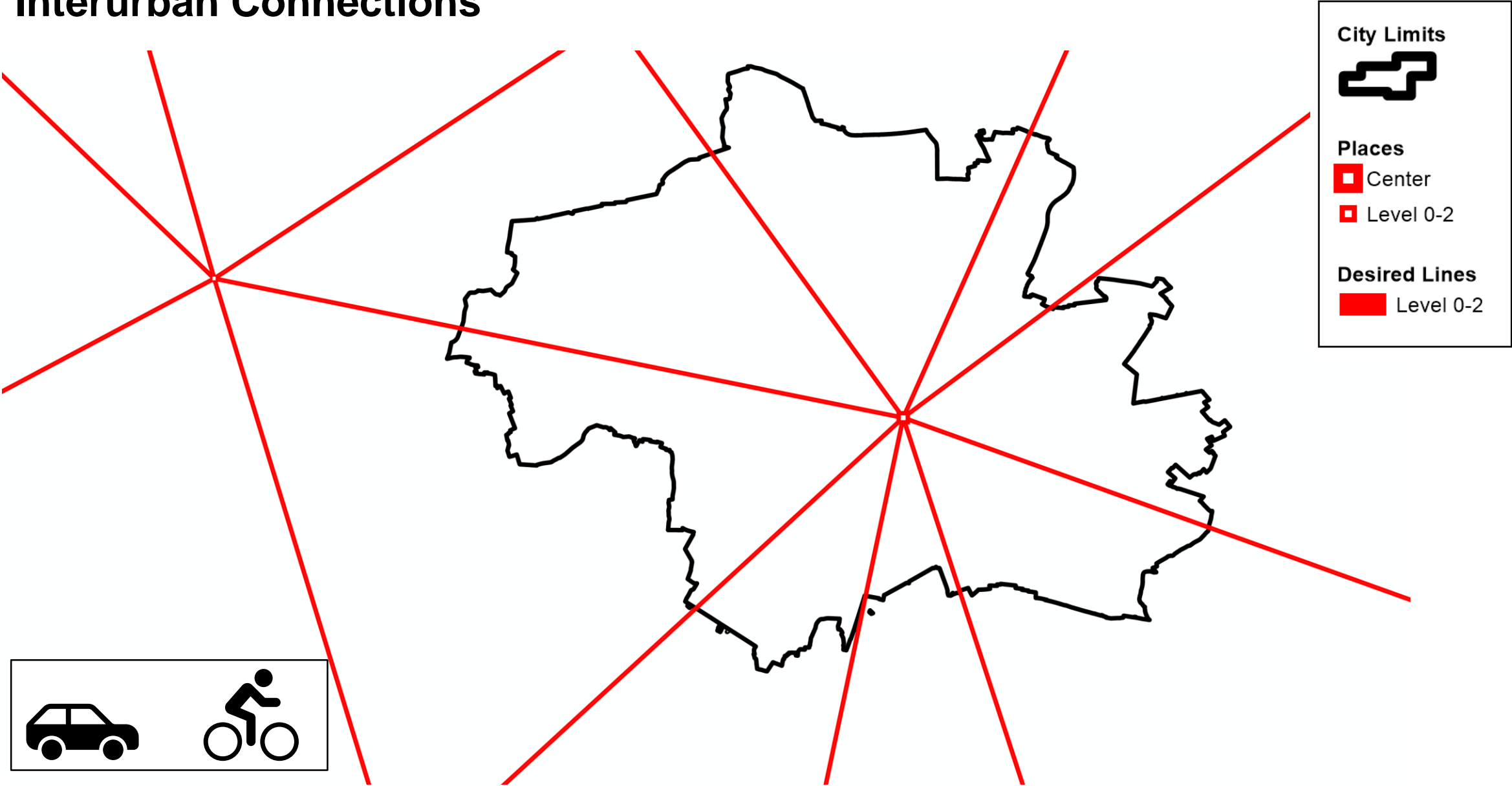
**Places**

- Center
- Level 0-2
- Level 3
- Level 4
- Level 5



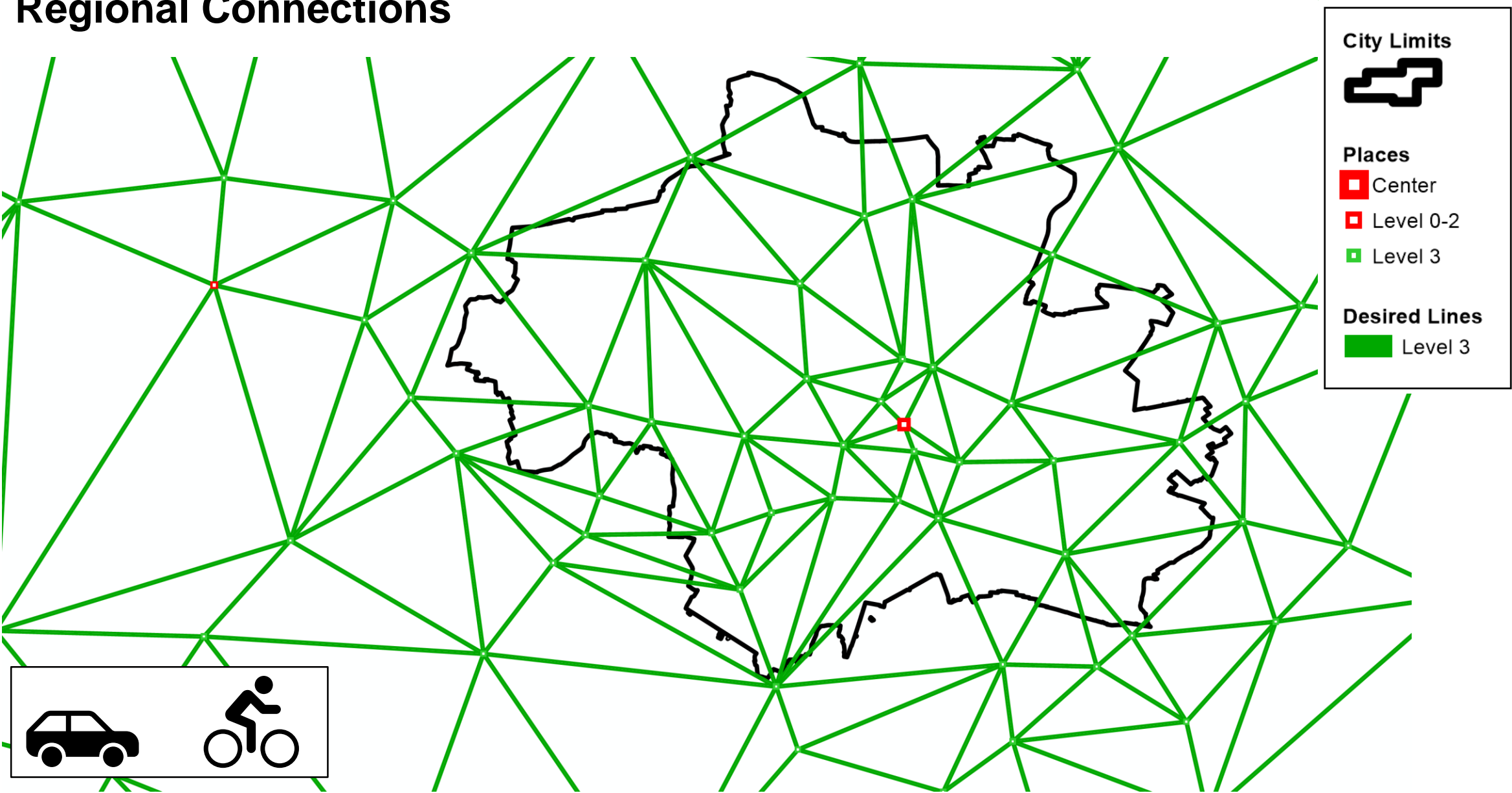
# Structuring Transport Networks: Desired Lines with Hierarchy Level $\leq 2$

## Interurban Connections



# Structuring Transport Networks: Desired Lines with Hierarchy Level 3

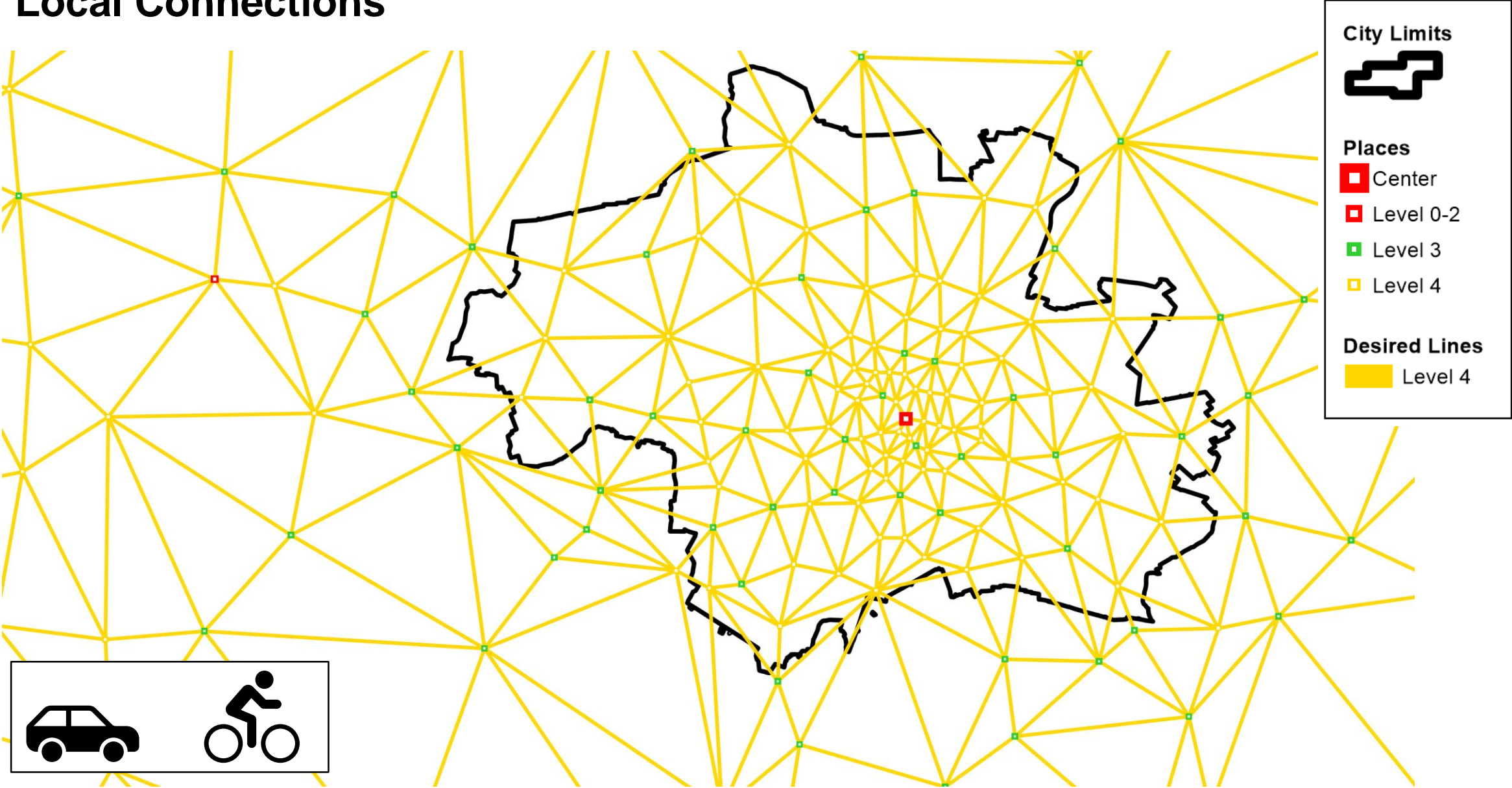
## Regional Connections



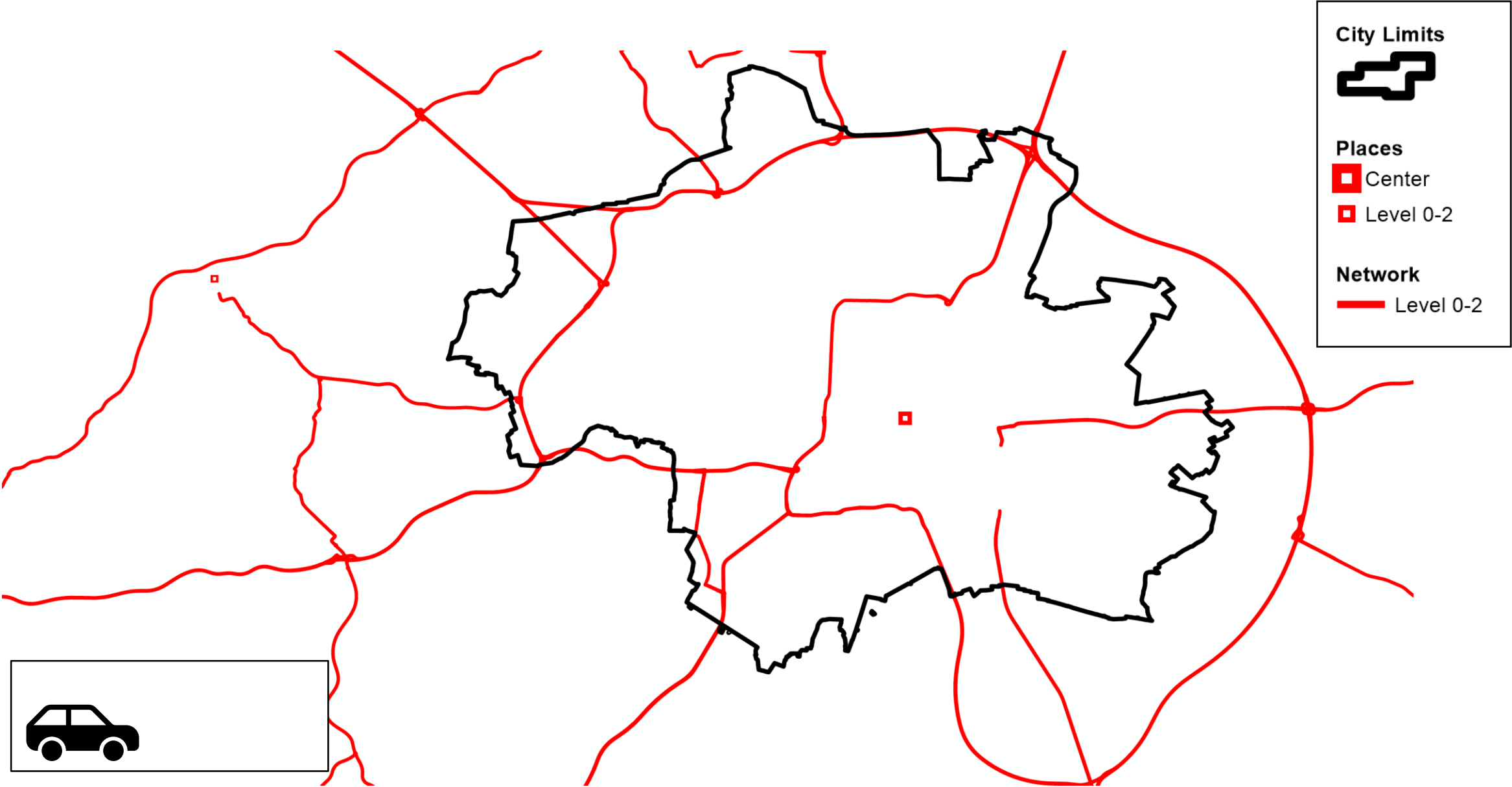


# Structuring Transport Networks: Desired Lines with Hierarchy Level 4

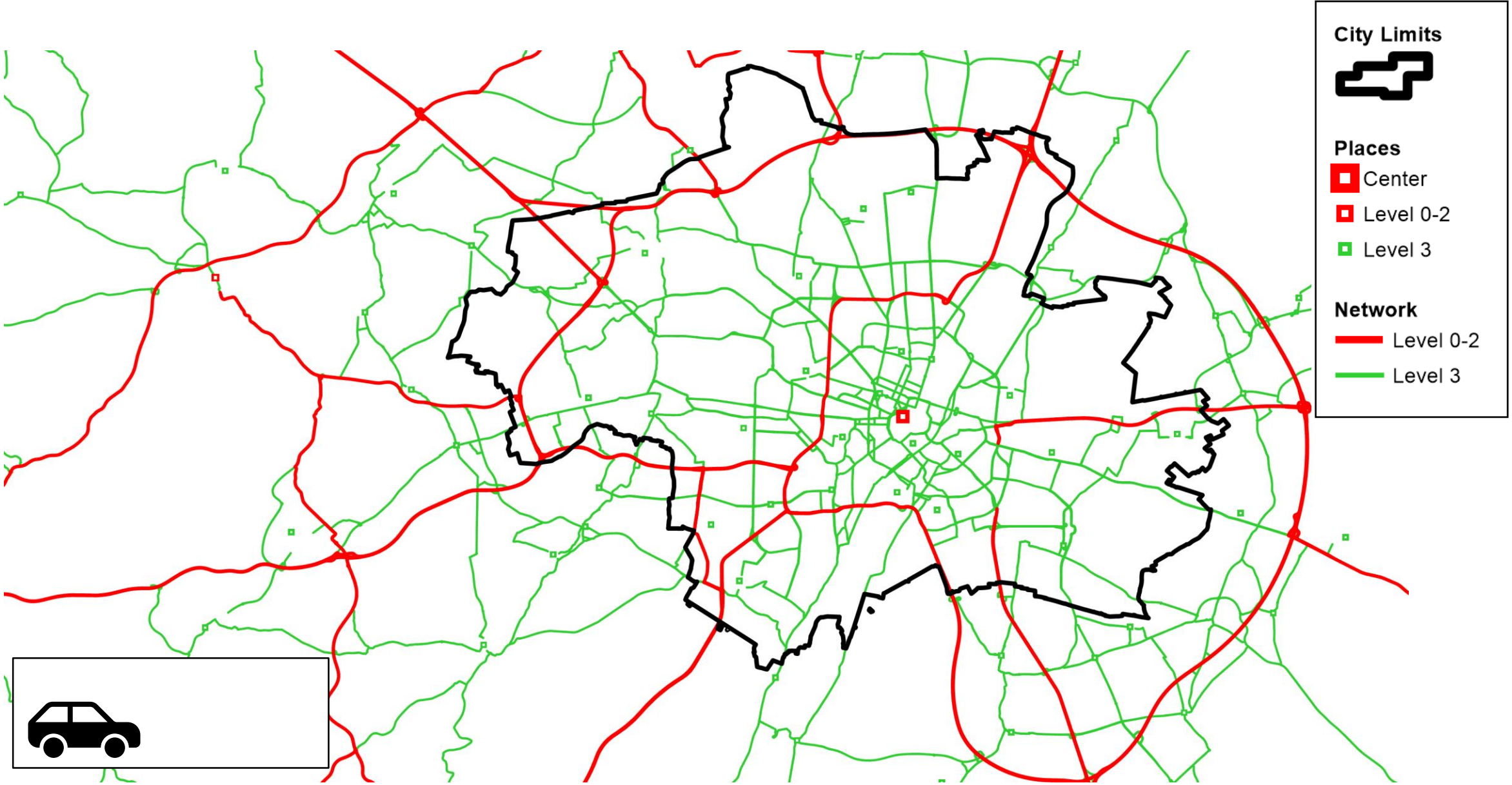
## Local Connections



# Structuring Transport Networks: Auto Network with Hierarchy Level $\leq 2$

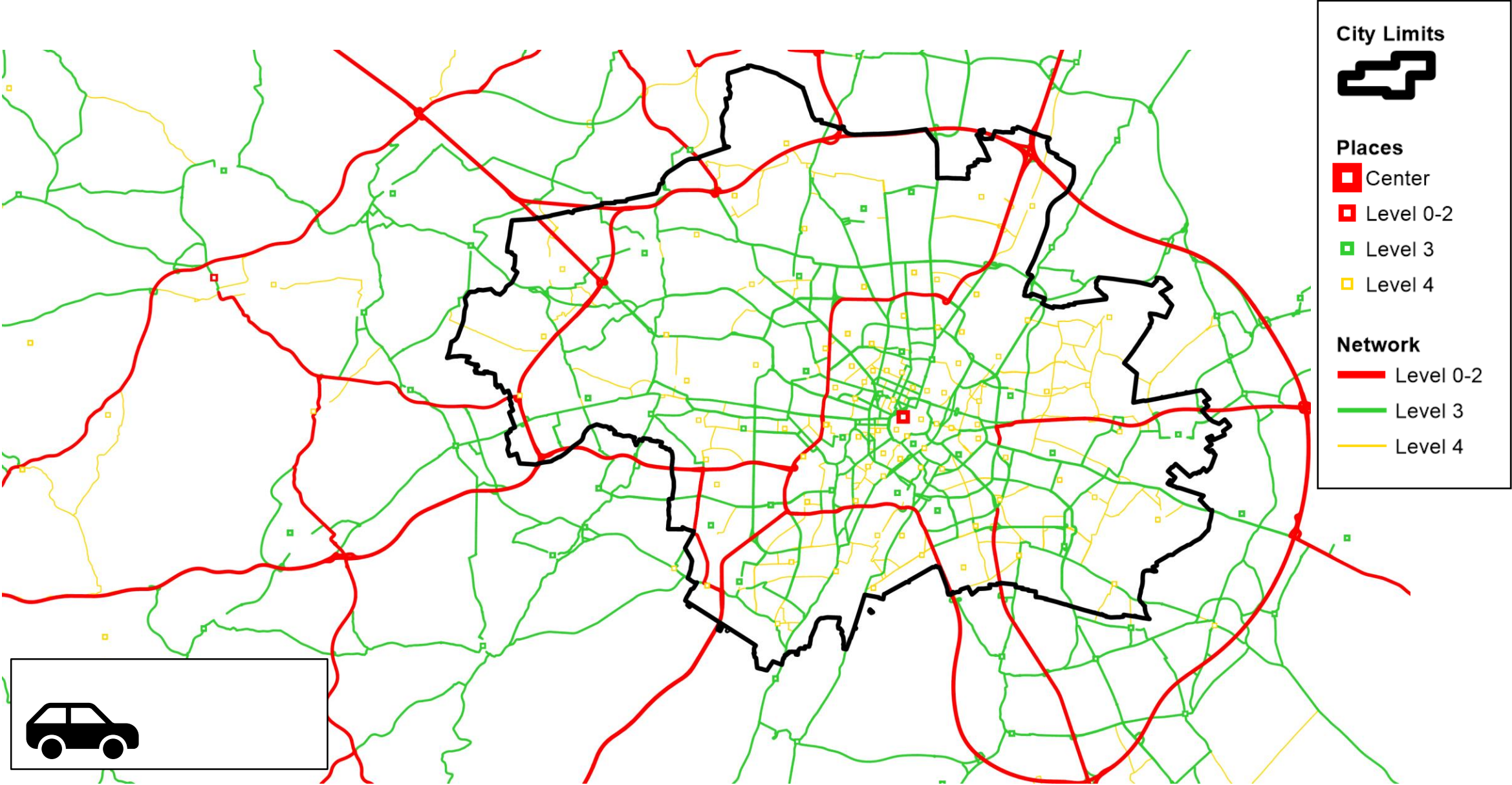


# Structuring Transport Networks: Auto Network with Hierarchy Level $\leq 3$





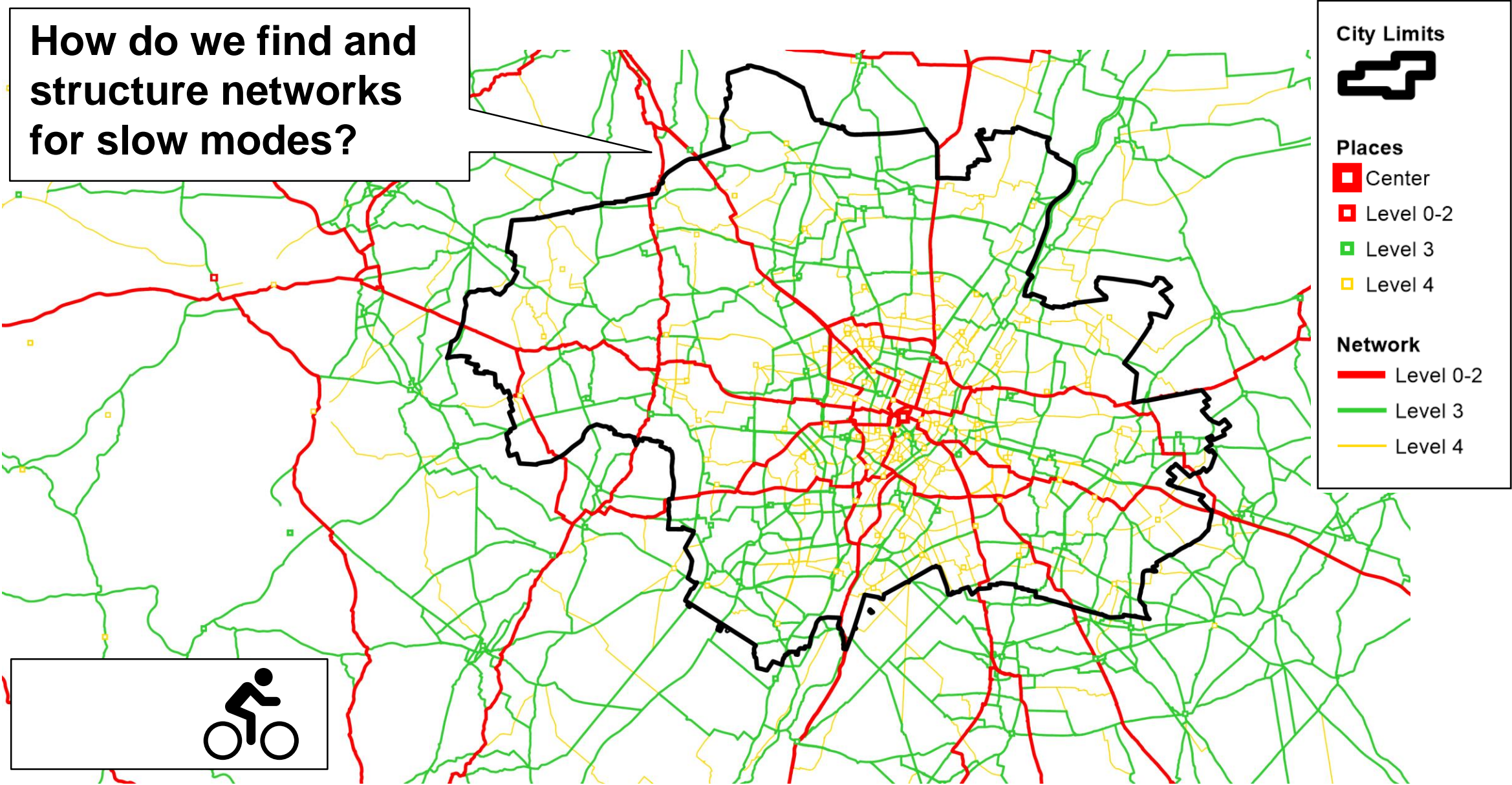
# Structuring Transport Networks: Auto Network with Hierarchy Level $\leq 4$





# Structuring Transport Networks: Bike Network with Hierarchy Level $\leq 4$

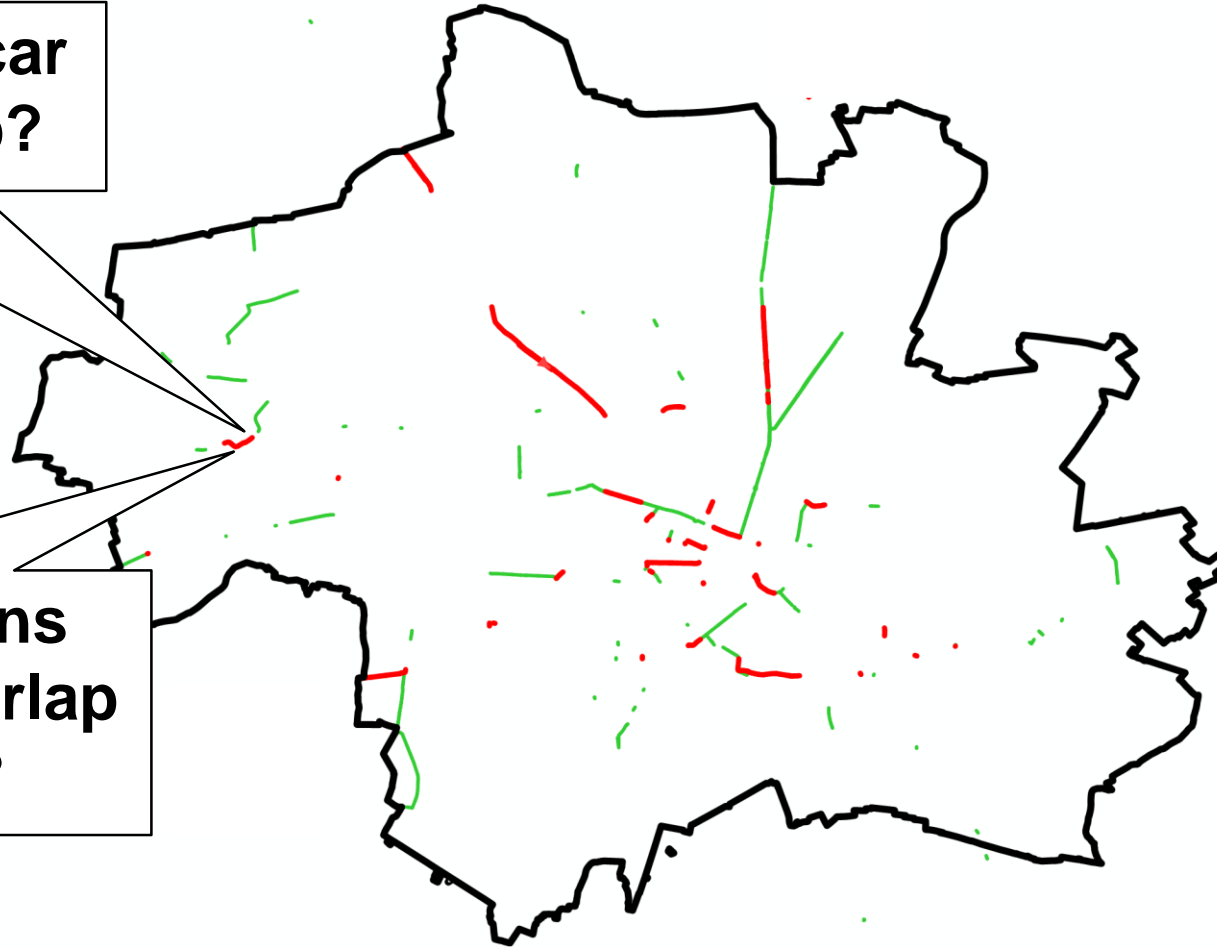
How do we find and structure networks for slow modes?



# Structuring Transport Networks: Conflict Bike and Car

**Where do functions car / slow modes overlap?**

**What to do, if functions car / slow modes overlap and space is limited?**



City Limits



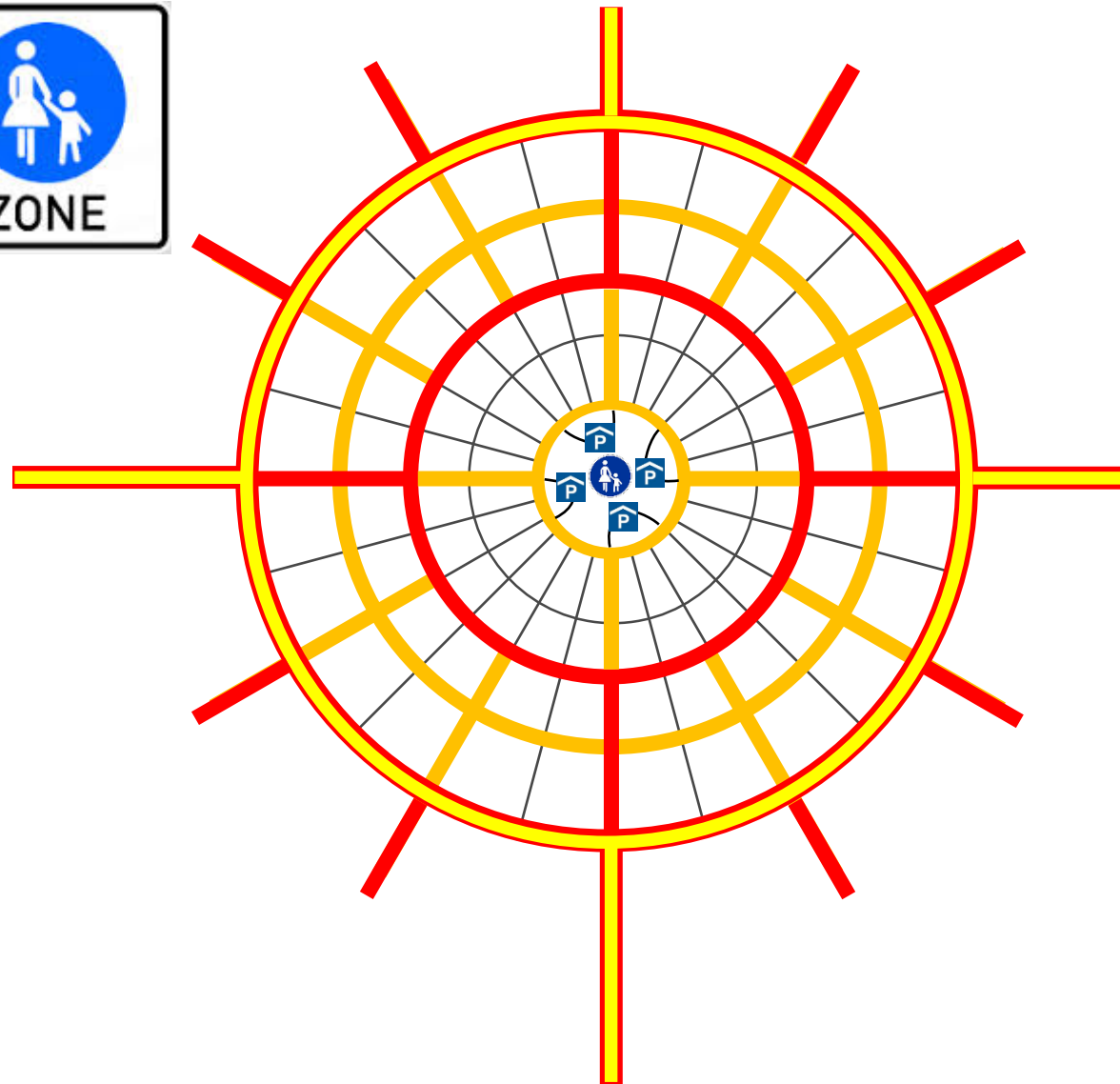
Network

Level 0-2


Level 3

Level 4


# Transport Network Design – Practice of the last 50 years




0. Order Network   
 $v \geq 100$  km/h  
Motorway  
Function: National connections

1. Order Network   
 $v = 60-80$  km/h  
Primary road  
Function: Regional connections



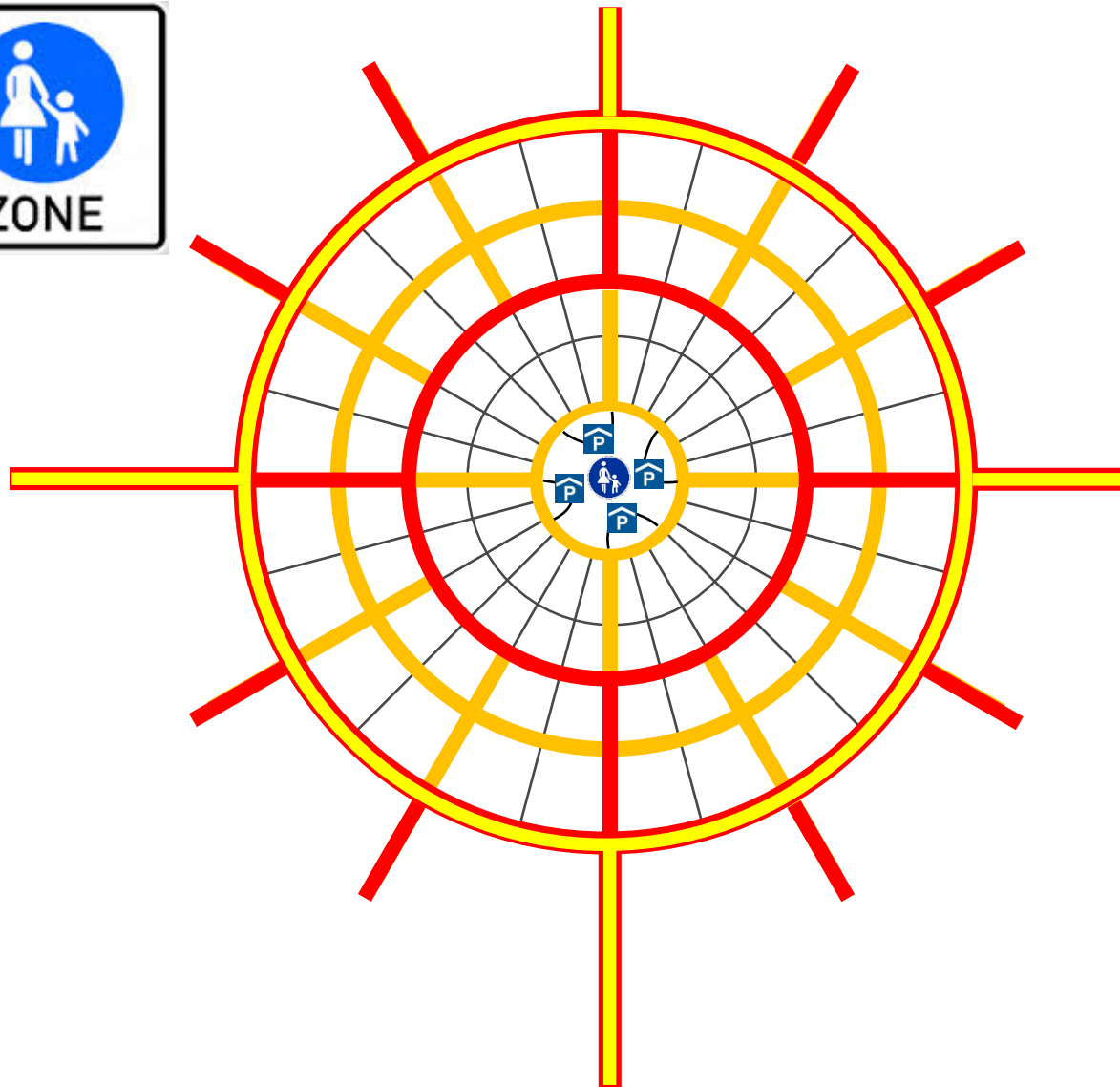
2. Order Network   
 $v = 50$  km/h  
Secondary road  
Function: Urban connections





3. Order Network   
 $v = 30$  km/h  
Local road  
Service Function




# Transport Network Design – Practice of the last 50 years




0. Order Network   
 $v \geq 100$  km/h  
Motorway  
Function: National connections

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 $v = 60-80$  km/h  
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Secondary road  
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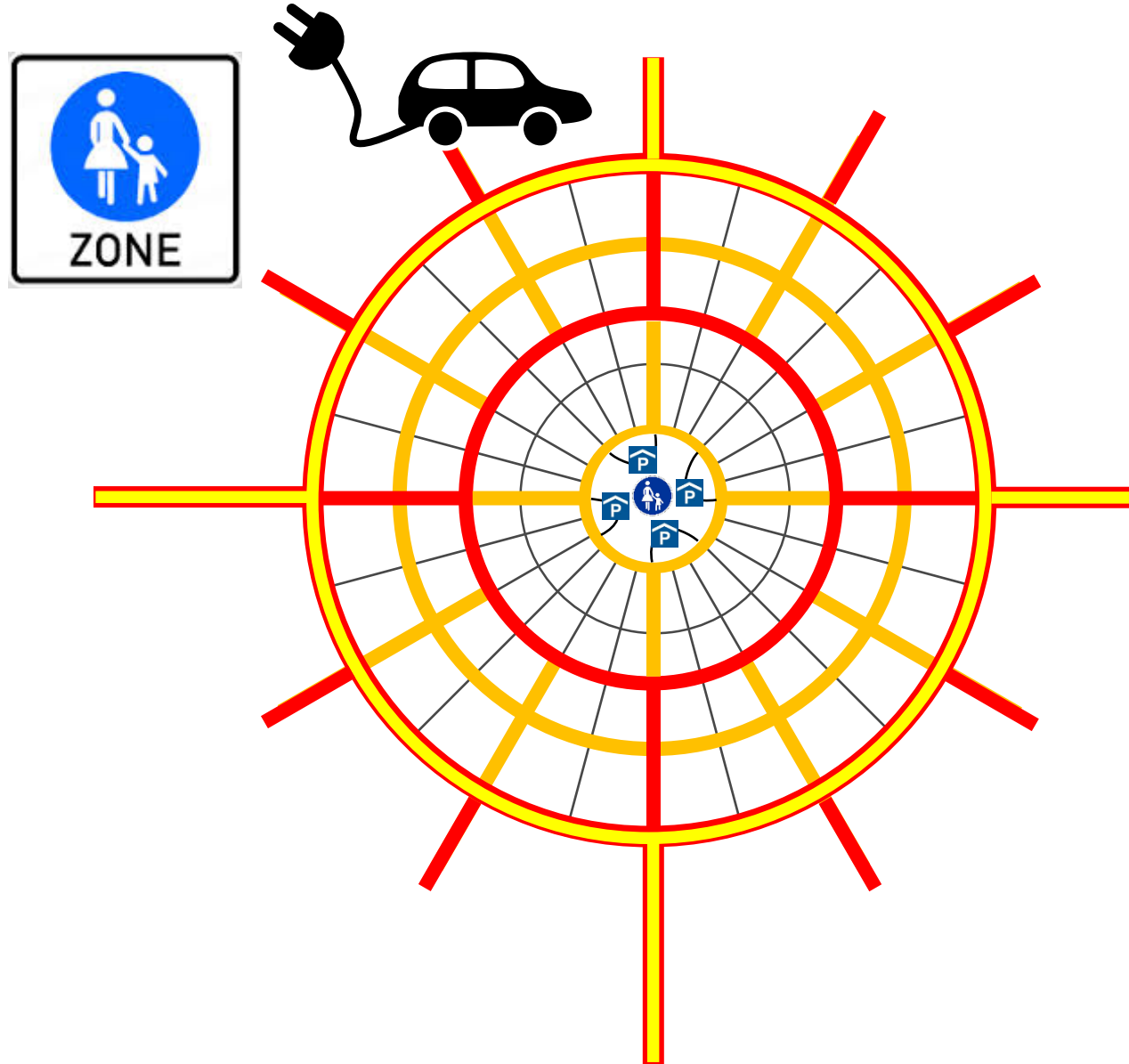
3. Order Network   
 $v = 30$  km/h  
Local road  
Service Function






➔ leads to fragmented and incomplete bike networks





# Transport Network Design – Target Vision for 20xx



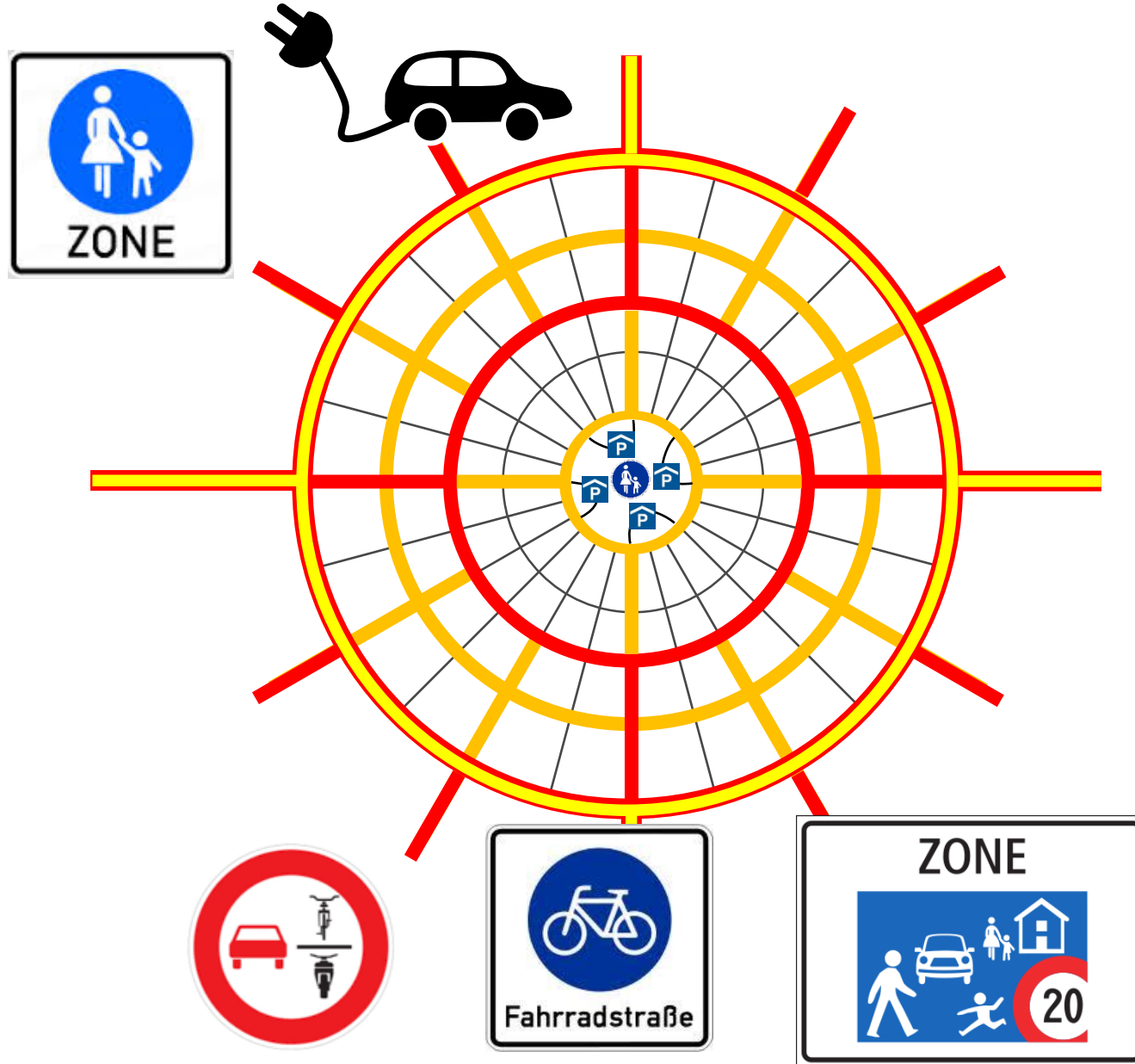
0. Order Network   
 $v \geq 100$  km/h  
Motorway  
Function: National connections


1. Order Network   
 $v = 60$  **50** km/h  
Primary road  
Function: Regional connections 


2. Order Network   
 $v = 50$  **30-40** km/h  
Secondary road  
Function: Urban connections

3. Order Network   
 $v = 30$  **20-25** km/h  
Local road, Priority Bike and Walk  
Service Function


# Transport Network Design – Target Vision for 20xx




0. Order Network   
 $v \geq 100$  km/h  
Motorway  
Function: National connections

1. Order Network   
 $v = 60$  **50** km/h  
Primary road  
Function: Regional connections



2. Order Network   
 $v = 50$  **30-40** km/h  
Secondary road  
Function: Urban connections

3. Order Network   
 $v = 30$  **20-25** km/h  
Local road, Priority Bike and Walk  
Service Function

# Transport Network Design – Target Vision for 20xx



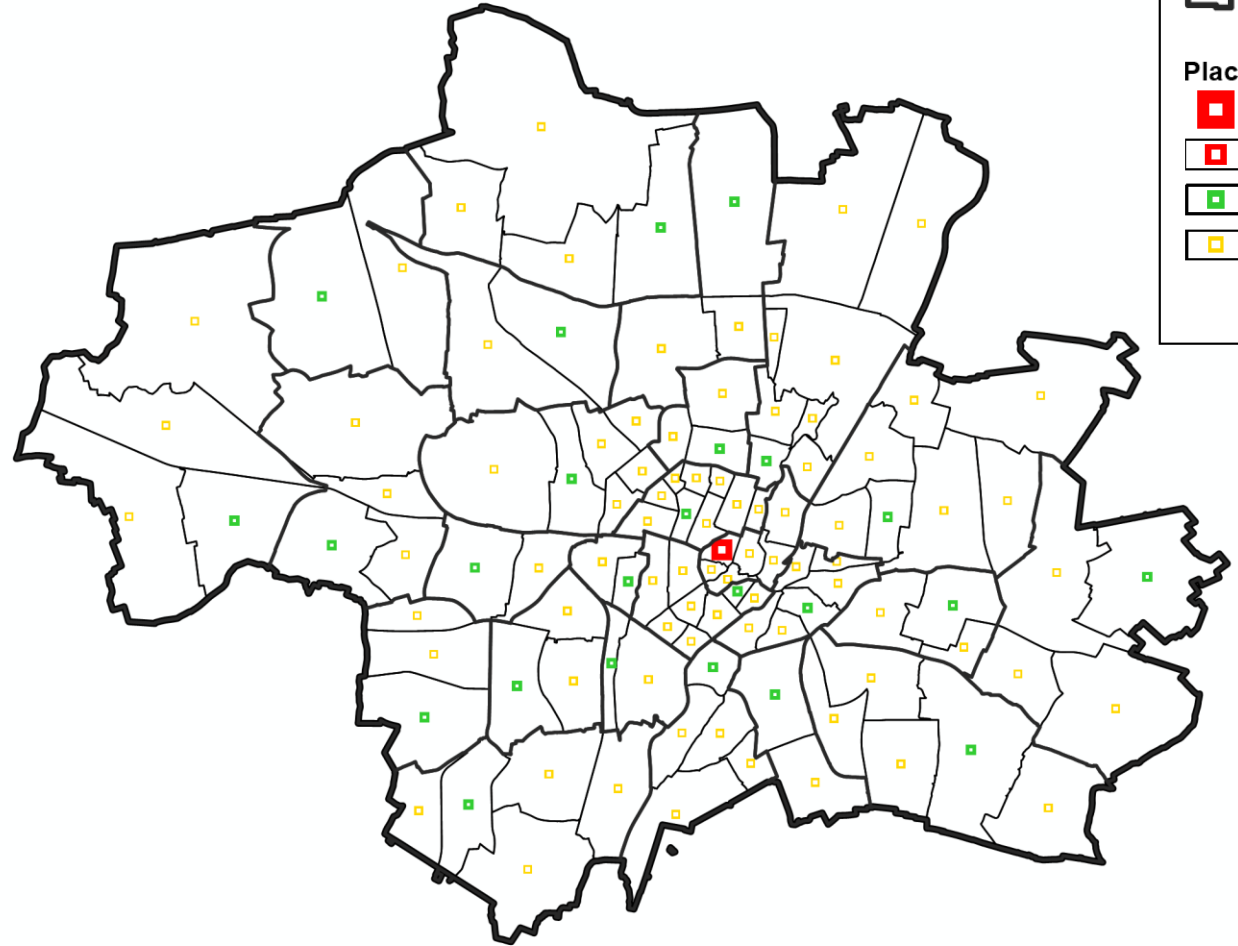
Esslingen, Hindenburgstraße



Stuttgart, Silberburgstraße

# Urban Central Places from Urban Districts and Urban Quarters

City	Urban Districts	Urban Quarters
Hamburg	7	103
Munich	25	108
Stuttgart	23	152



City Limits



Urban District



Places

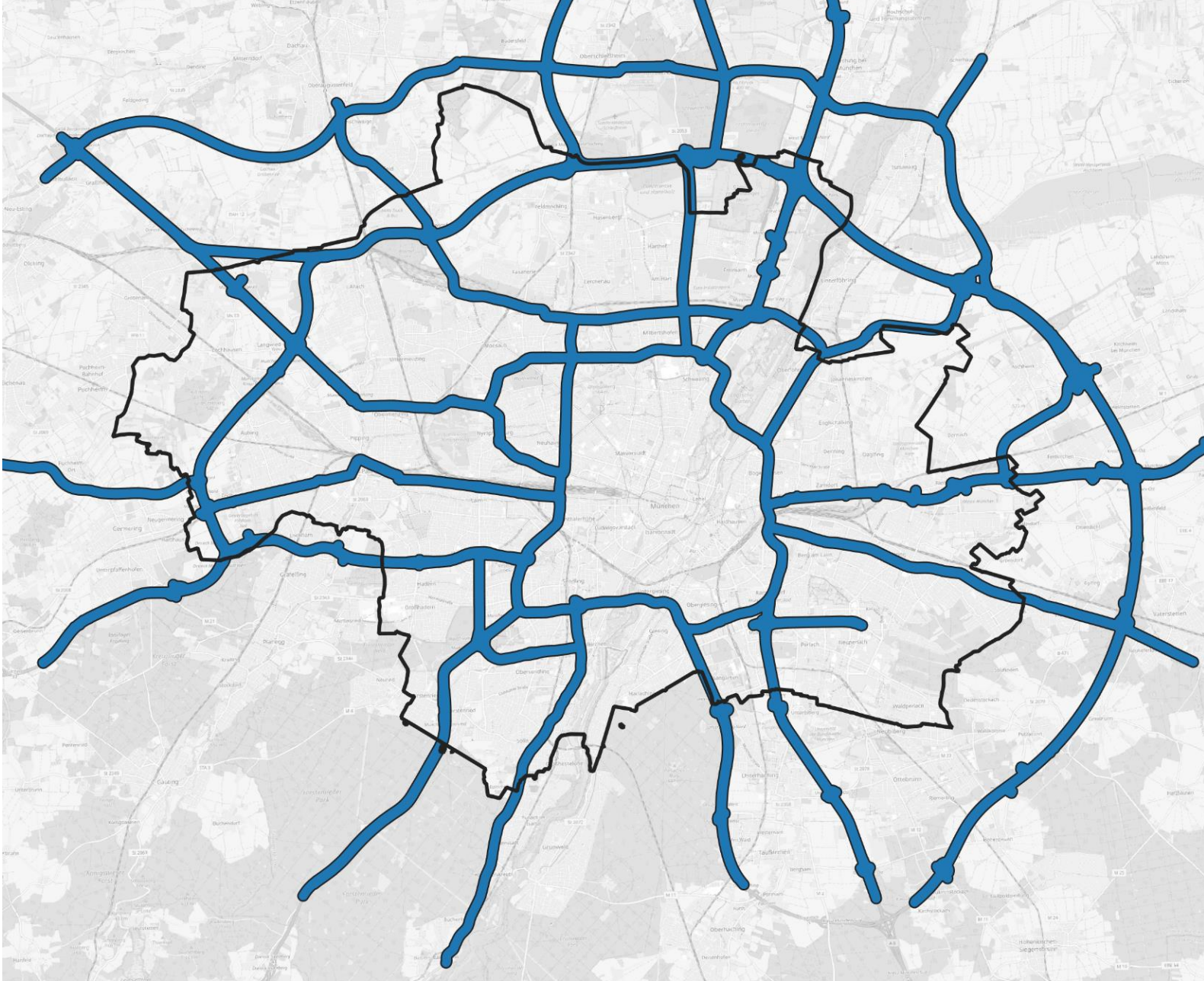
-  Center
-  Level 0-2
-  Level 3
-  Level 4

**What are central places in a city?**



# Urban Central Places: from the Road Network

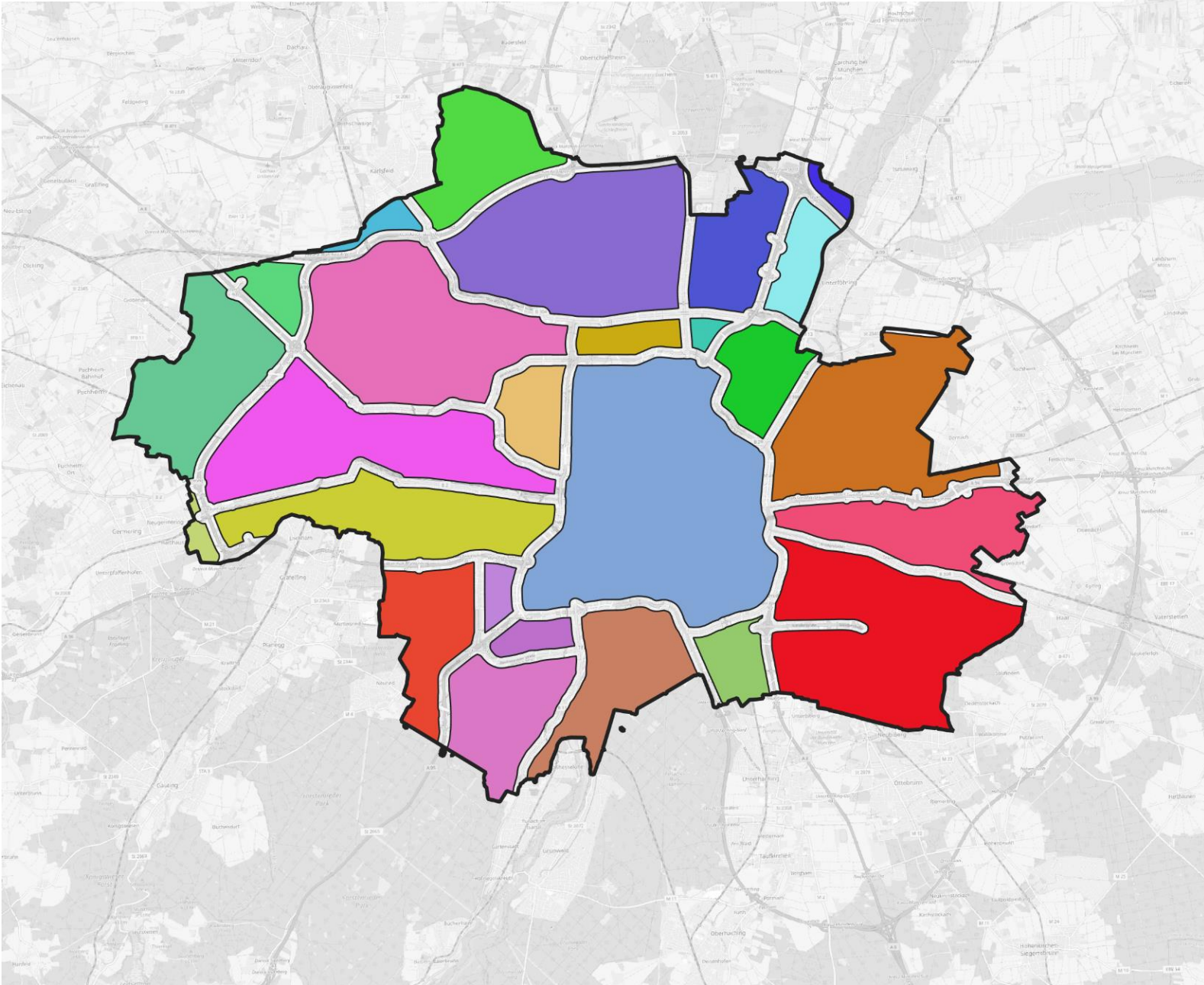
Primary Roads





# Urban Central Places: Traffic Blocks from the Primary Road Network

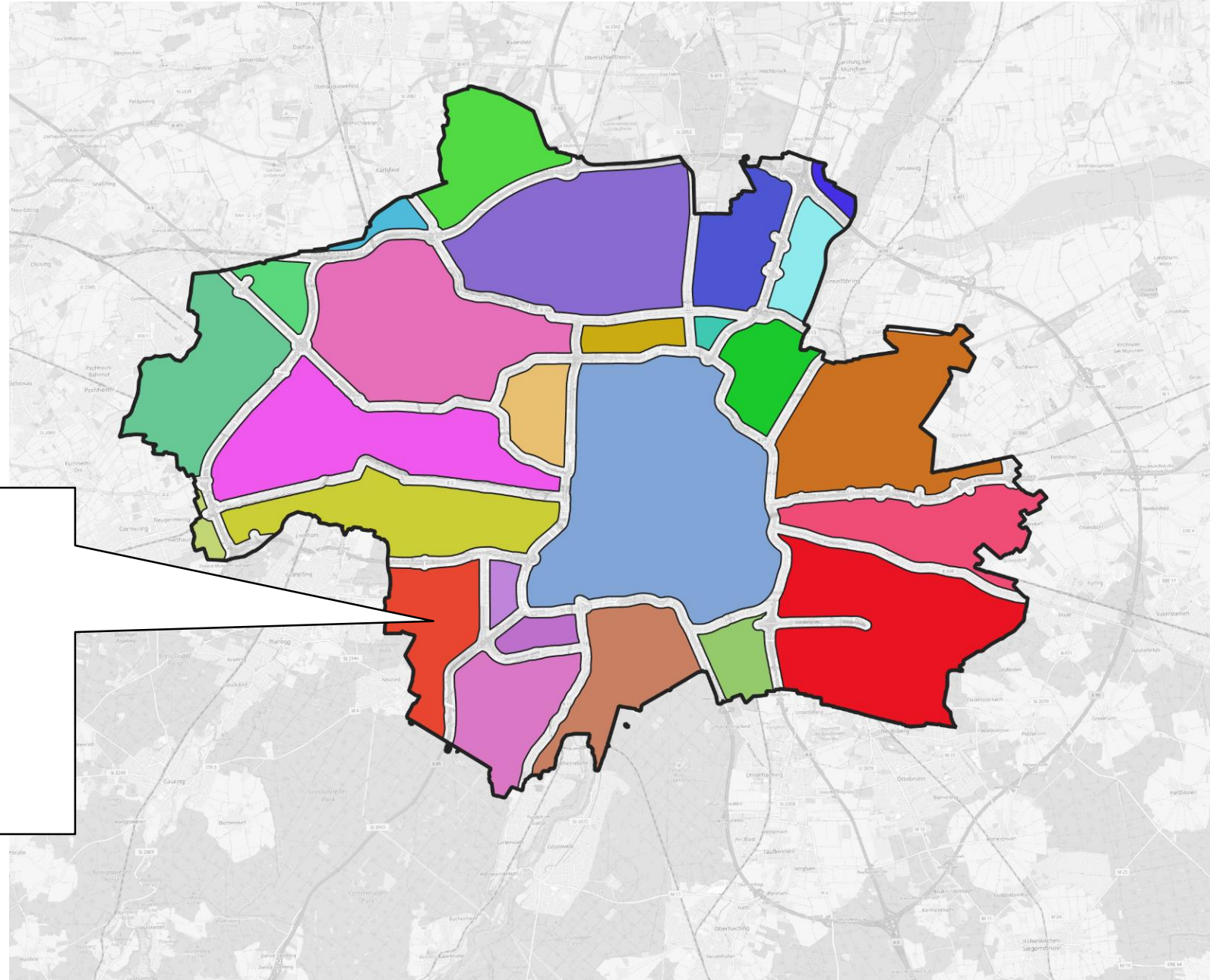
City	Urban Districts	Urban Quarters	Traffic Blocks Primary
Munich	25	108	26



Map: OpenStreetMap contributors

# Urban Central Places: Traffic Blocks from the Primary Road Network

City	Urban Districts	Urban Quarters	Traffic Blocks Primary
Munich	25	108	26



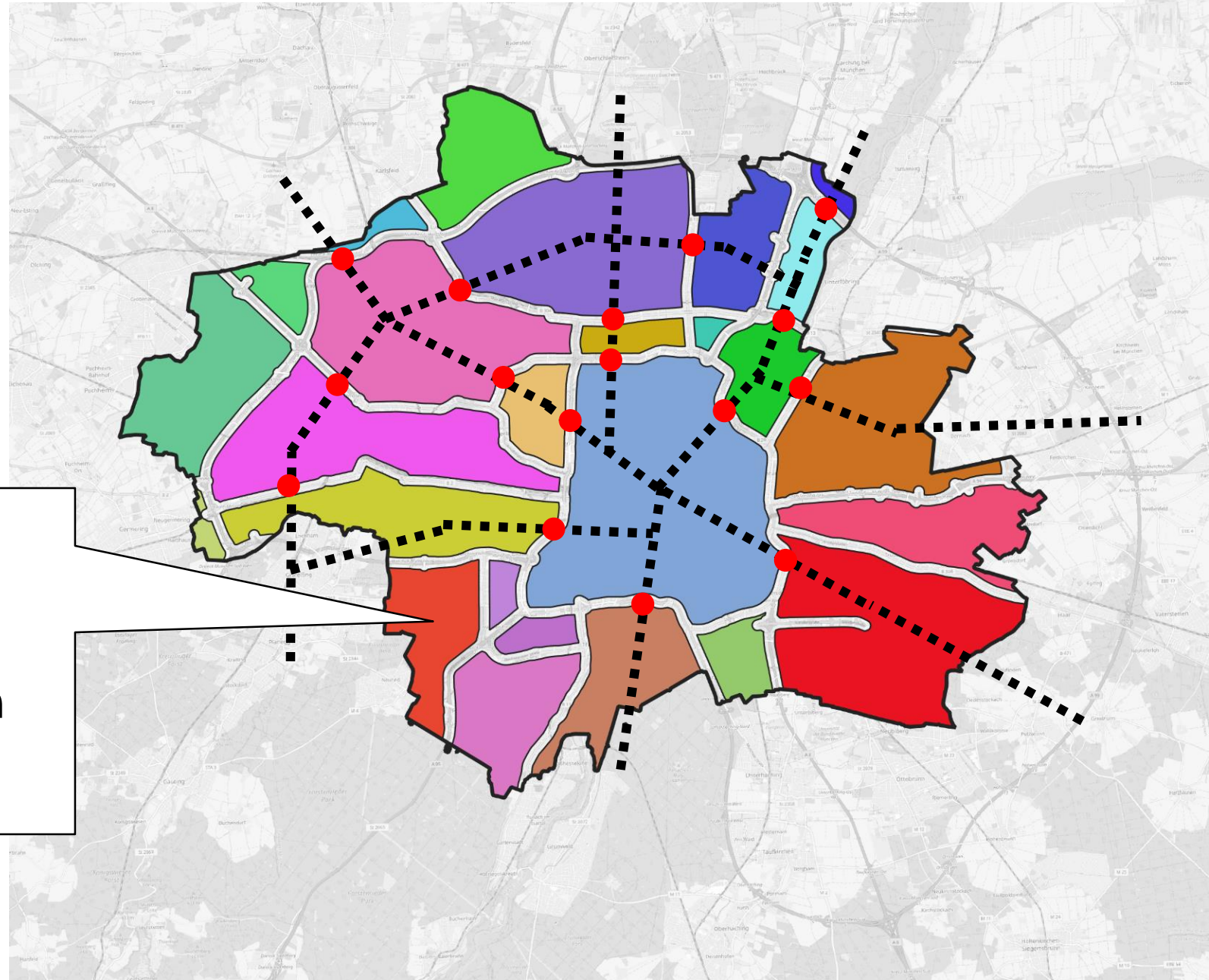
## Traffic Block “Primary”

- Area without regional through traffic



# Urban Central Places: Traffic Blocks from the Primary Road Network

City	Urban Districts	Urban Quarters	Traffic Blocks Primary
Munich	25	108	26



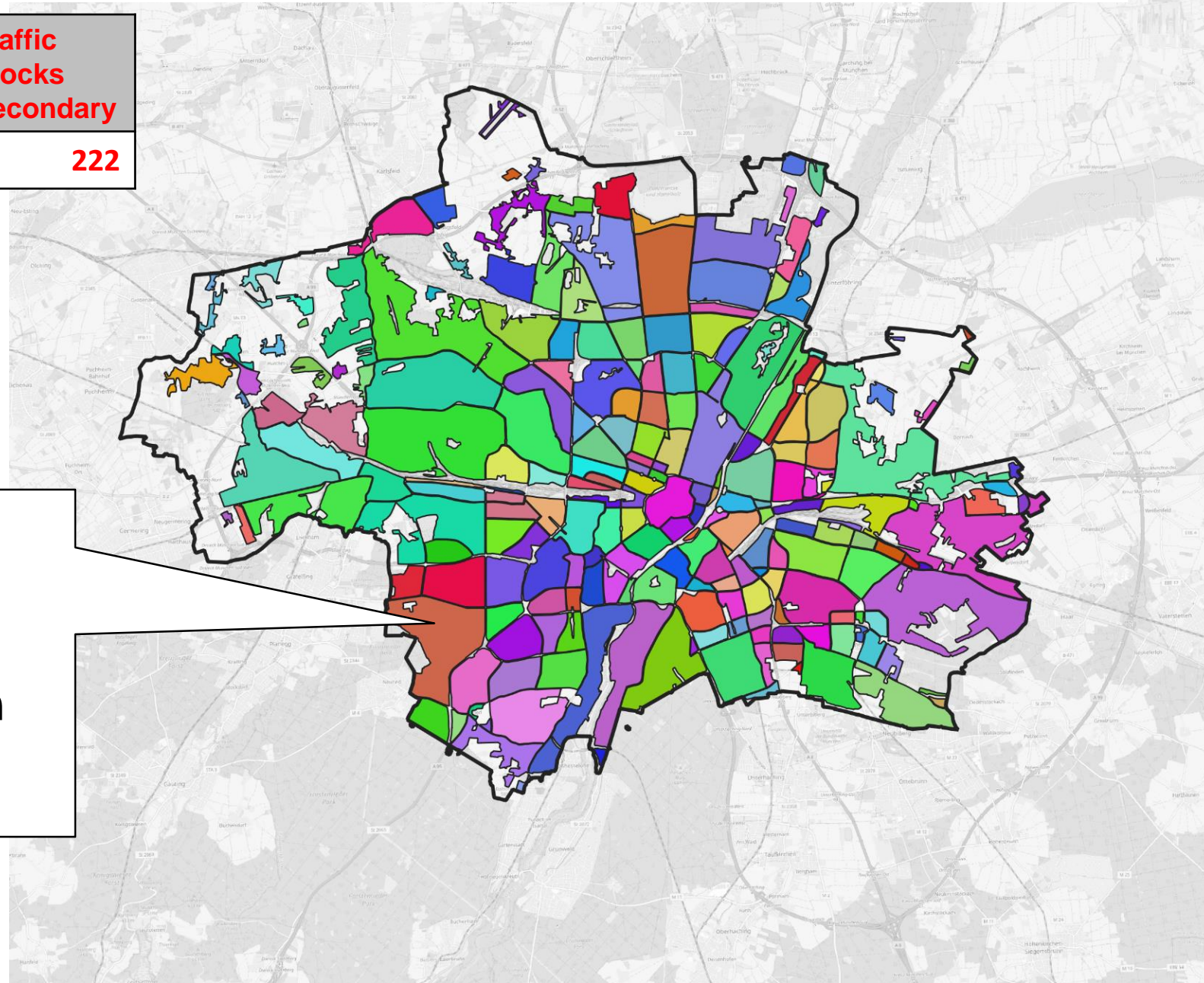
## Traffic Block “Primary”

- Area without regional through traffic
- Blocks are connected with regional bike network



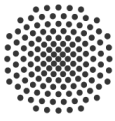
# Urban Central Places: Traffic Blocks from the Secondary Road Network

City	Urban Districts	Urban Quarters	Traffic Blocks Primary	Traffic Blocks Secondary
Munich	25	108	26	222



## Traffic Block “Secondary”

- Area without local through traffic
- Blocks are connected with local bike network



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20 June 2023

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