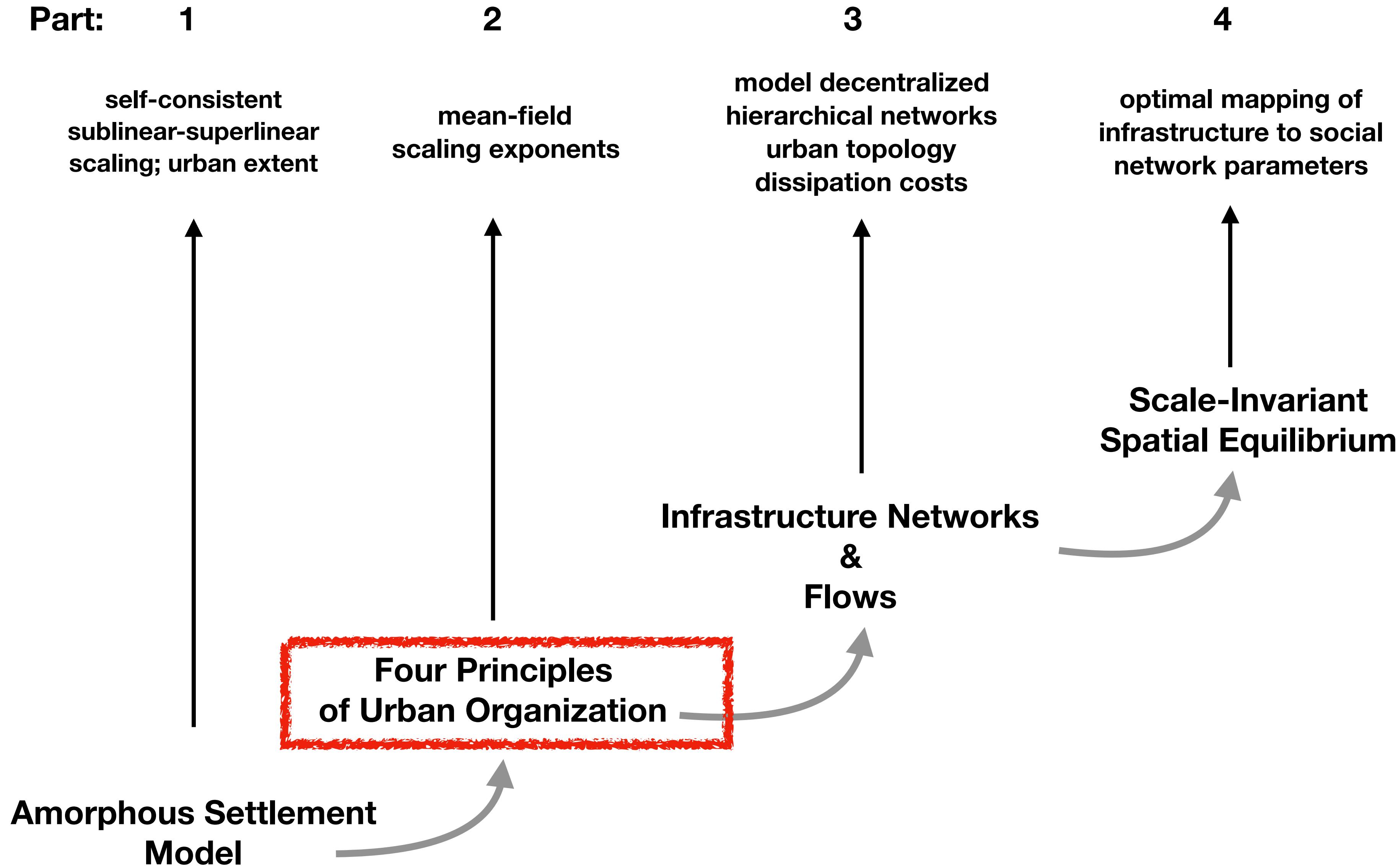


Lecture 7

Network Models of Cities

7.1 Scaling of Infrastructure Networks and Urban Built Spaces

Urban Scaling Theory



Four Principles of Urban Organization

-
- 1) Cities are mixing populations (networks) over built space and time Jacobs, Wirth, Burgess
- 2) Personal effort is limited Park, Milgram, Zahavi, Simon
- 3) City infrastructure as decentralized but hierarchical networks Alexander ←
- 4) Socioeconomic products of cities are the result of interactions, Jacobs ←
subject to spatial costs Alonso ←

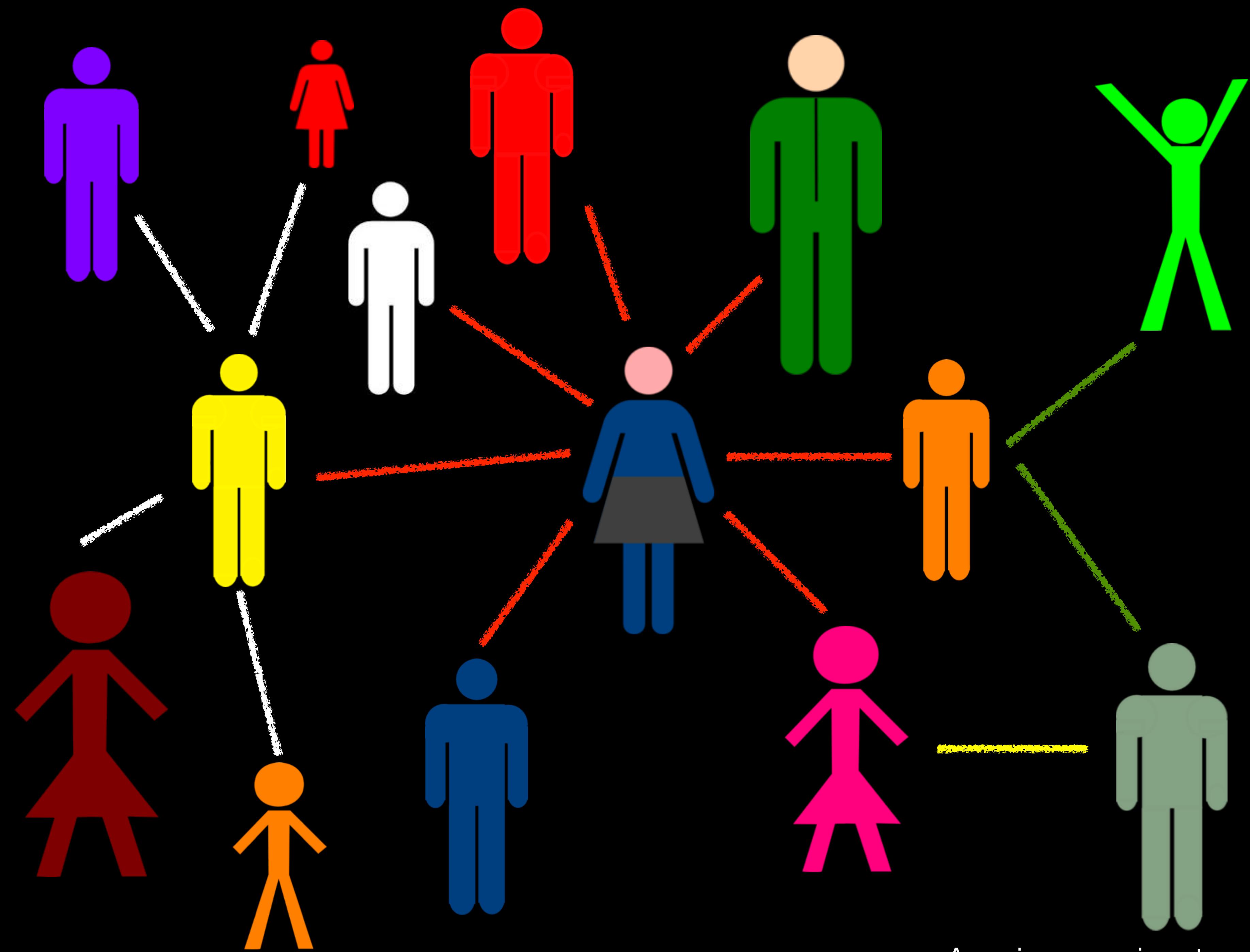
already in the amorphous model, but more to come...

Let's make a network theory of all this ...

People interacting over the built environment: fast (people, ~days) and slow (infrastructure, ~decade) time scales

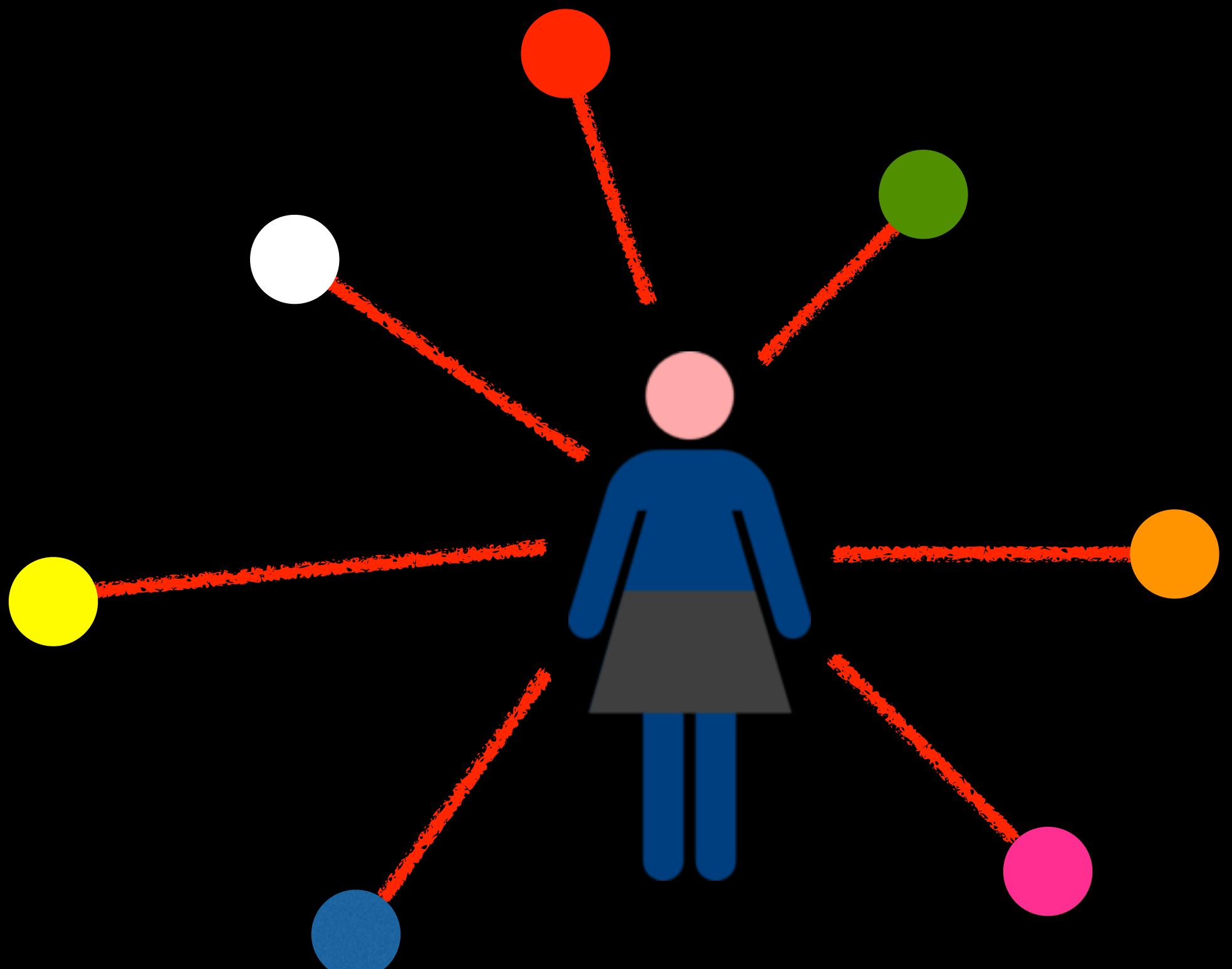


note now that spaces are structured, not amorphous: we need to understand the nature of their networks



IUS Fig 3.10

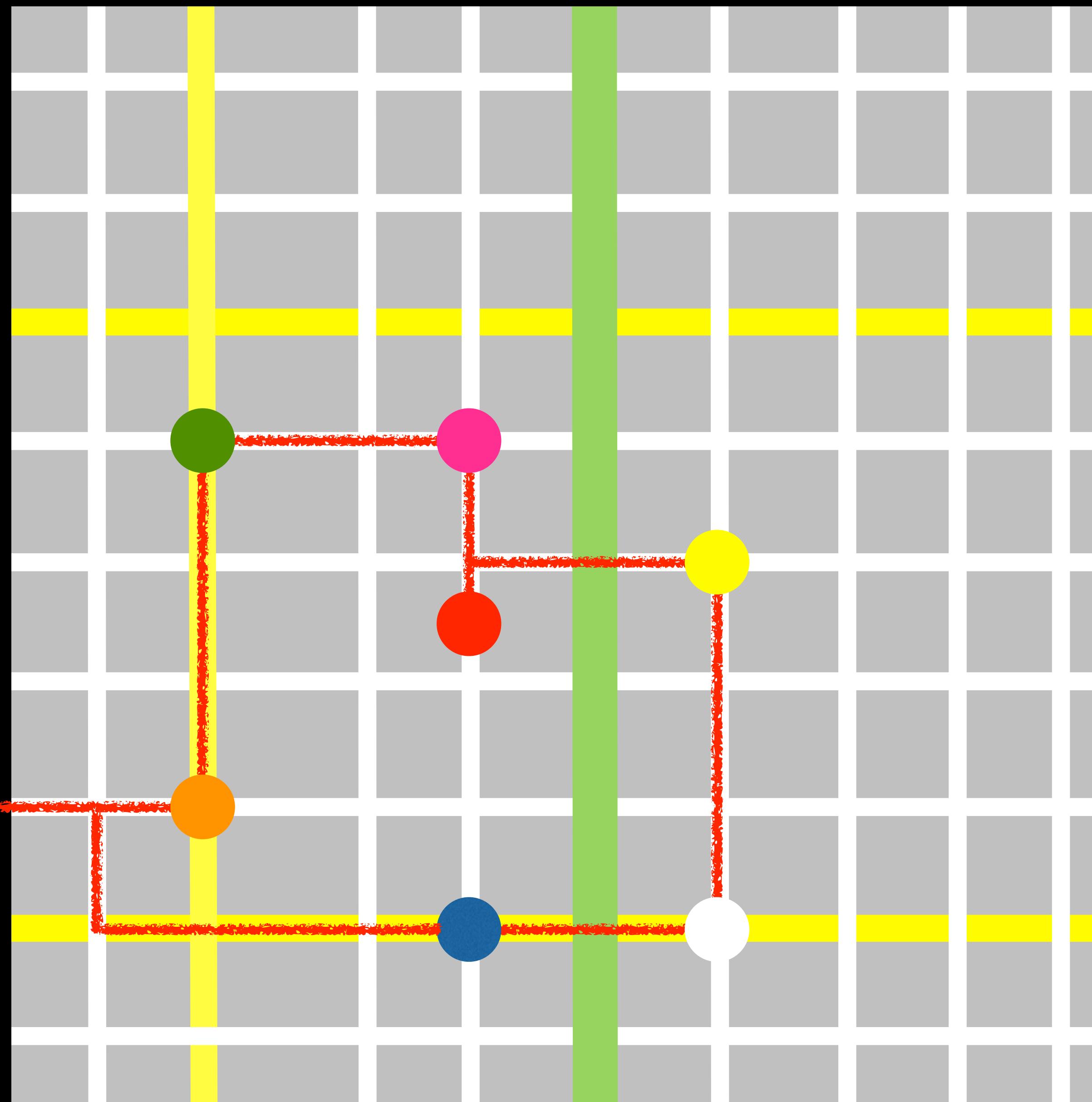
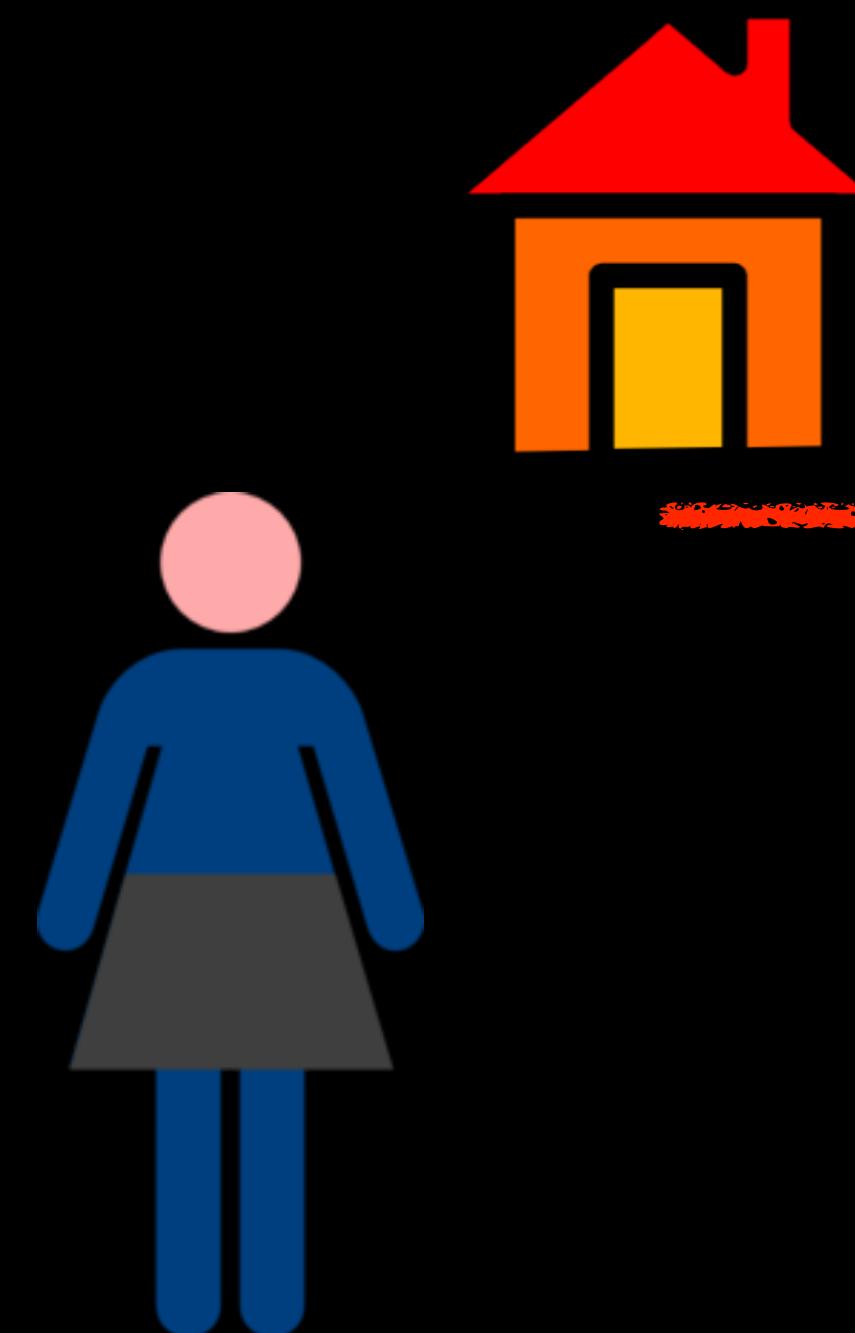
A socioeconomic network of diverse people



IUS Fig 3.10

...can be abstracted in terms of an “ego-network”

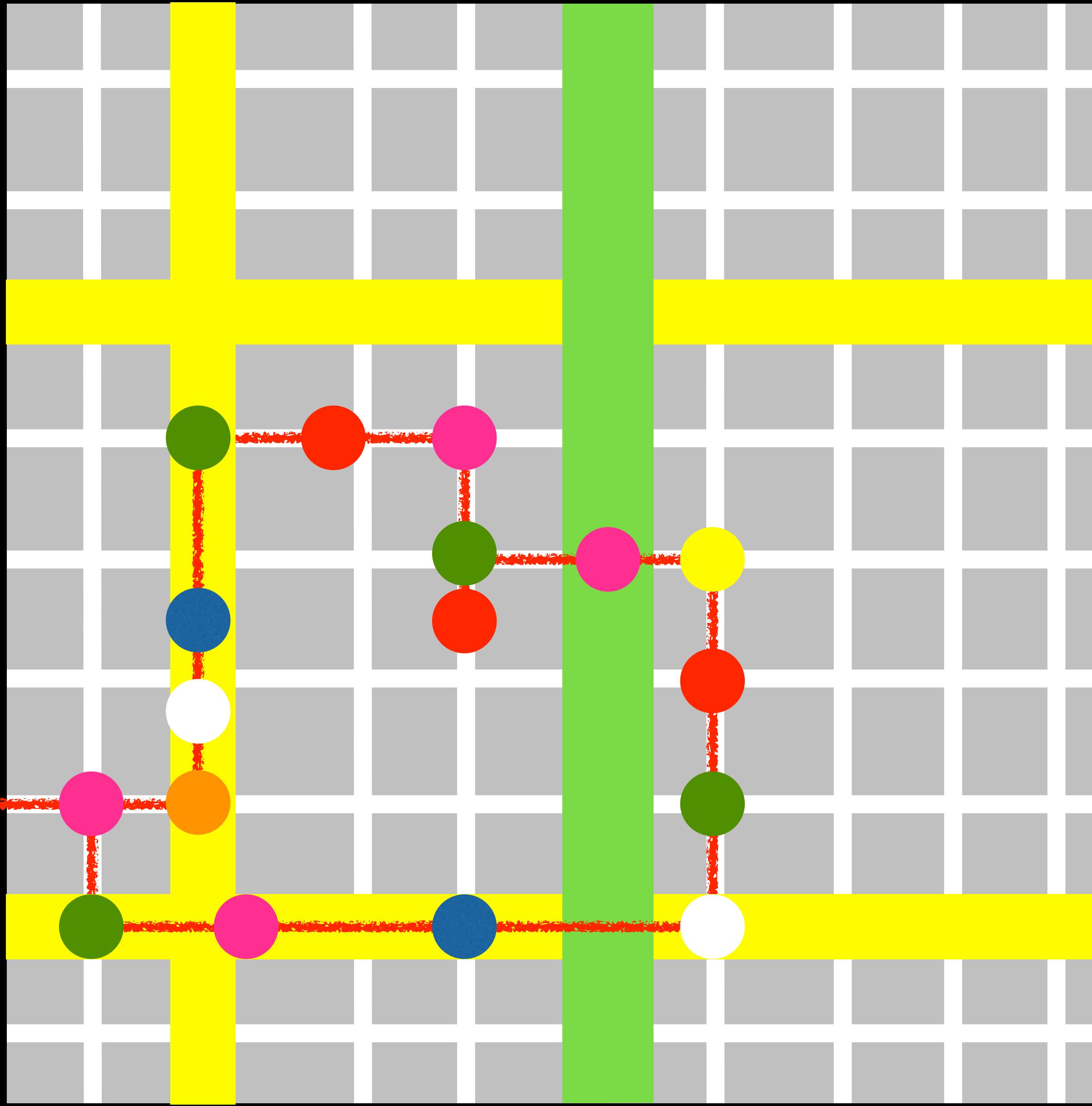
Health
Love
Money
Education
Fun
Food
Services



IUS Fig 3.10

...which is embedded in spacetime via life paths (time geography)

Health
Love
Money
Education
Fun
Food
Services



IUS Fig 3.10

...which is embedded in spacetime via life paths, which meet more events in larger, denser, more heterogeneous cities

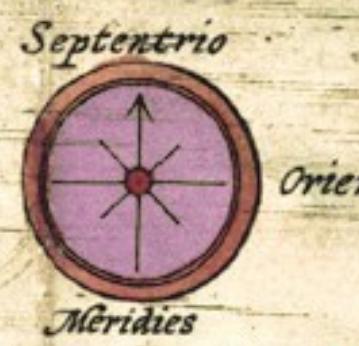
The Structure of Built Spaces in Cities

Streets and City Blocks also form networks

OLISSIPPO quæ nunc Lisboa, ciuitas amplissima Lusitanie, ad Tagum. totig
Orientis, et multarum Insularum Africæque et Americæ emporium nobilissimum.



121. Sacellum D.N. consolacionis
super portam ferri. 122. Templum
Janeti Antenii de Padua.
123. Templum Misericordiae.
124. Sacellum sancti Spiritus de alfonso.
125. Templum sancti Martini. 126
Templum sancti Blasii et sancte Lucie.
127. Templum sancti Ludouici.
128. Templum sancti Spiritus da pedreira.
129. Ermida D.N. do monte.



Septentrio
Occafus
Oriens
Meridies



Nonnulla alia.
130. Moles lapidum vulgo Cais da pedra.
131. Carcer priuata, ciuitatis vulgo tionga.
132. Domus manet. 133. Palatium
Ducis de Auguia. 134. Pala-
Ducis de Graganca. 135. Palatium
Marchionis de vila real. 136. Pala-
tium Comitis de Portalegre. 137. Pala-
tium Comitis de Redendo. 138. Pa-
latium Comitis de Linsare. 139. Praça
dos Canos. 140. Sacellum D.N. da
Palma. ⑧ Putei publici.



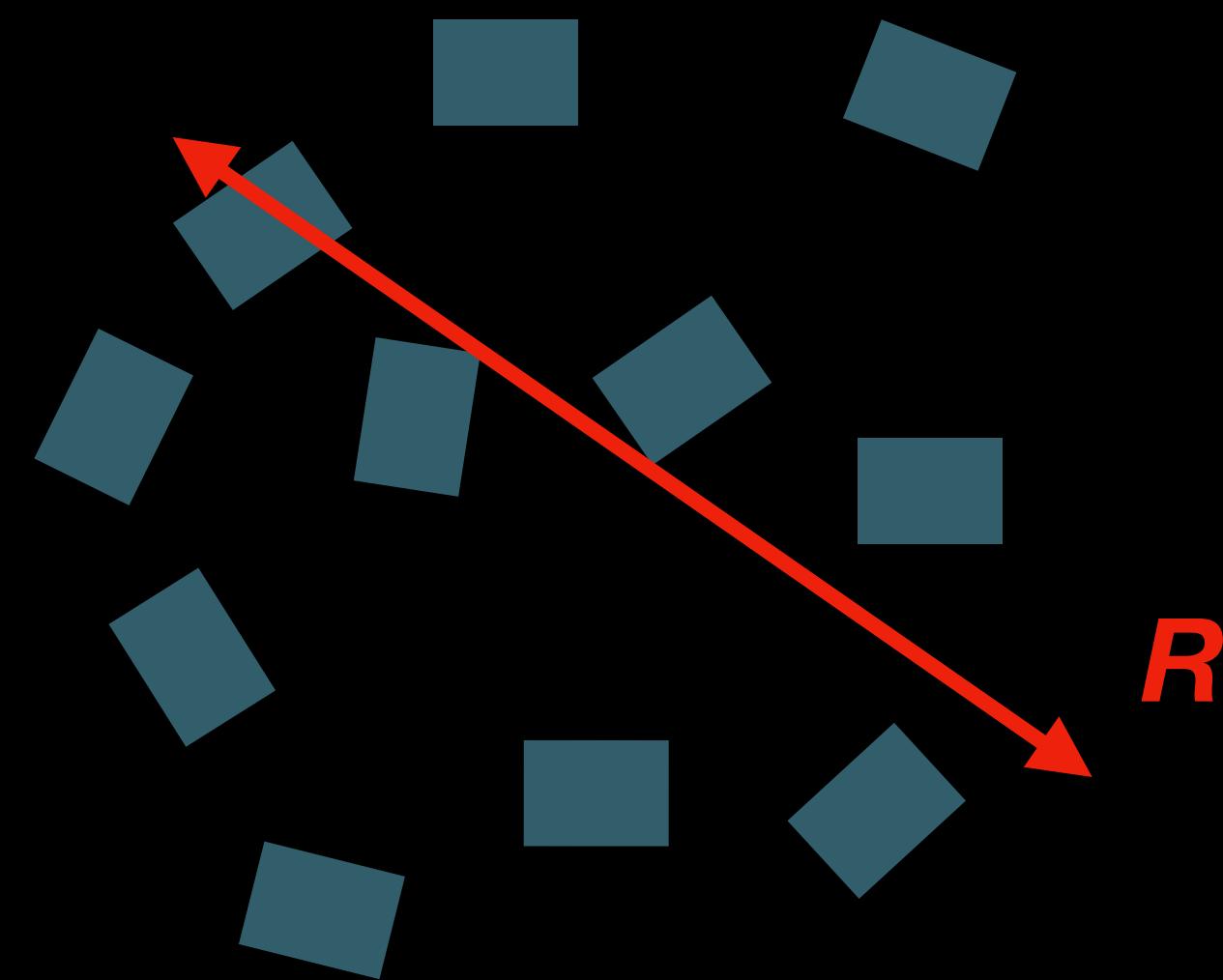




Shanghai credit:NASA

How does this work?

Amorphous Settlement

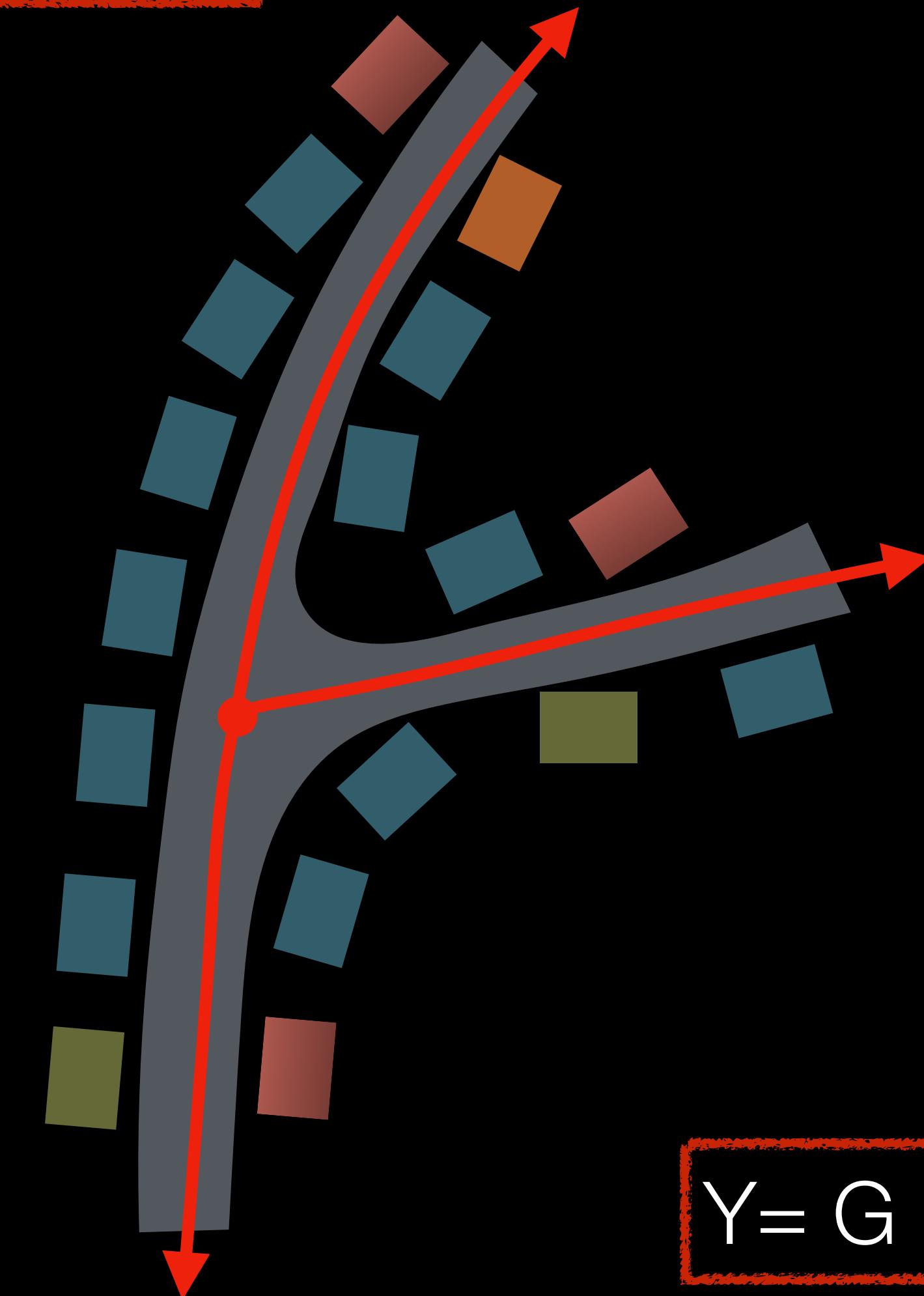


Decentralized Networks

The volume of infrastructure grows faster than land

$$A_n \sim d_A \quad N \sim N^{5/6} \quad d_A = (A/N)^{1/2}$$

$$\delta = \frac{1}{6}$$



Networked Settlement

$$Y = G \cdot N \cdot N/A_n \sim G \cdot N^{7/6}$$

Social interactions accelerate