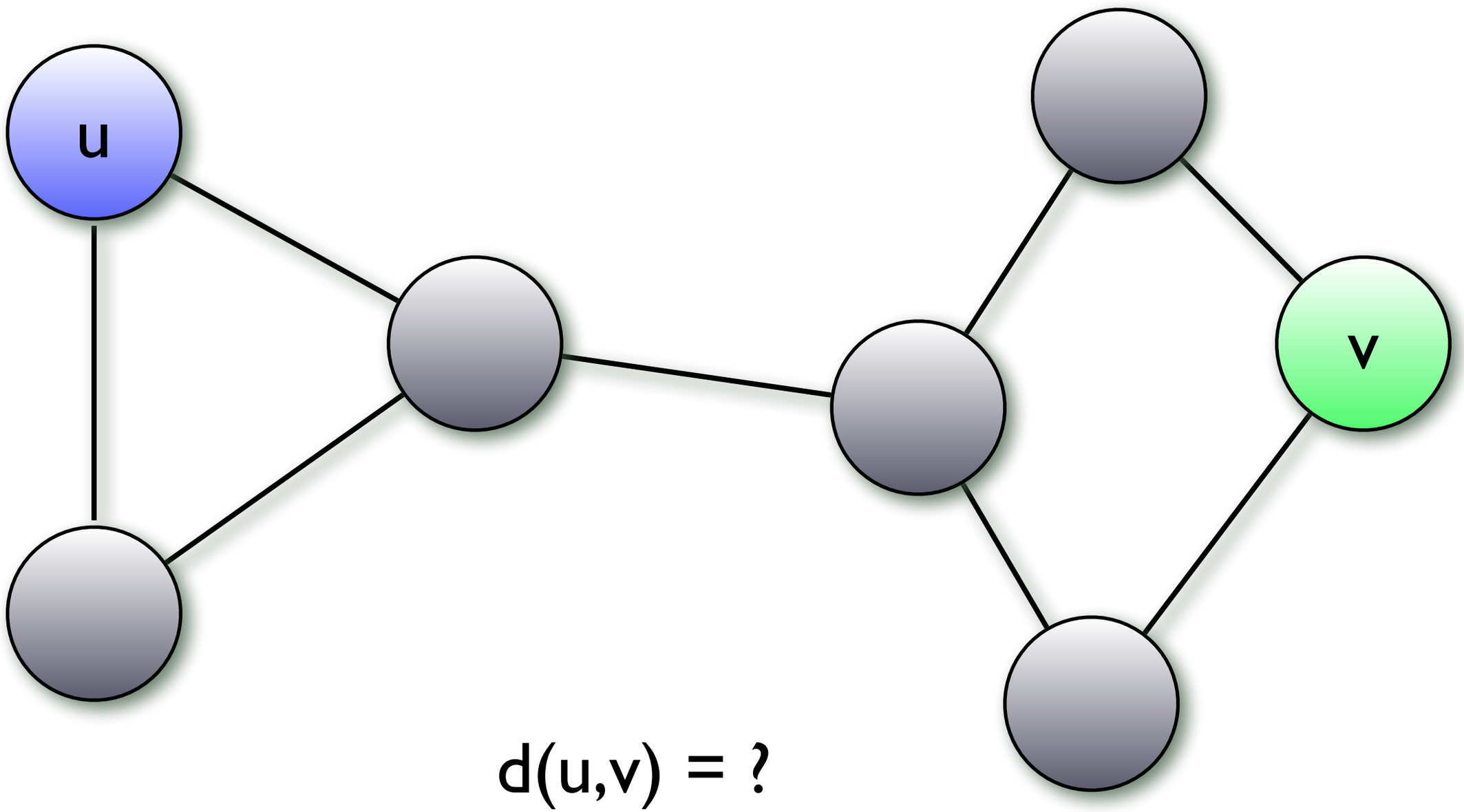
Network Models

Topology

Communication Graph

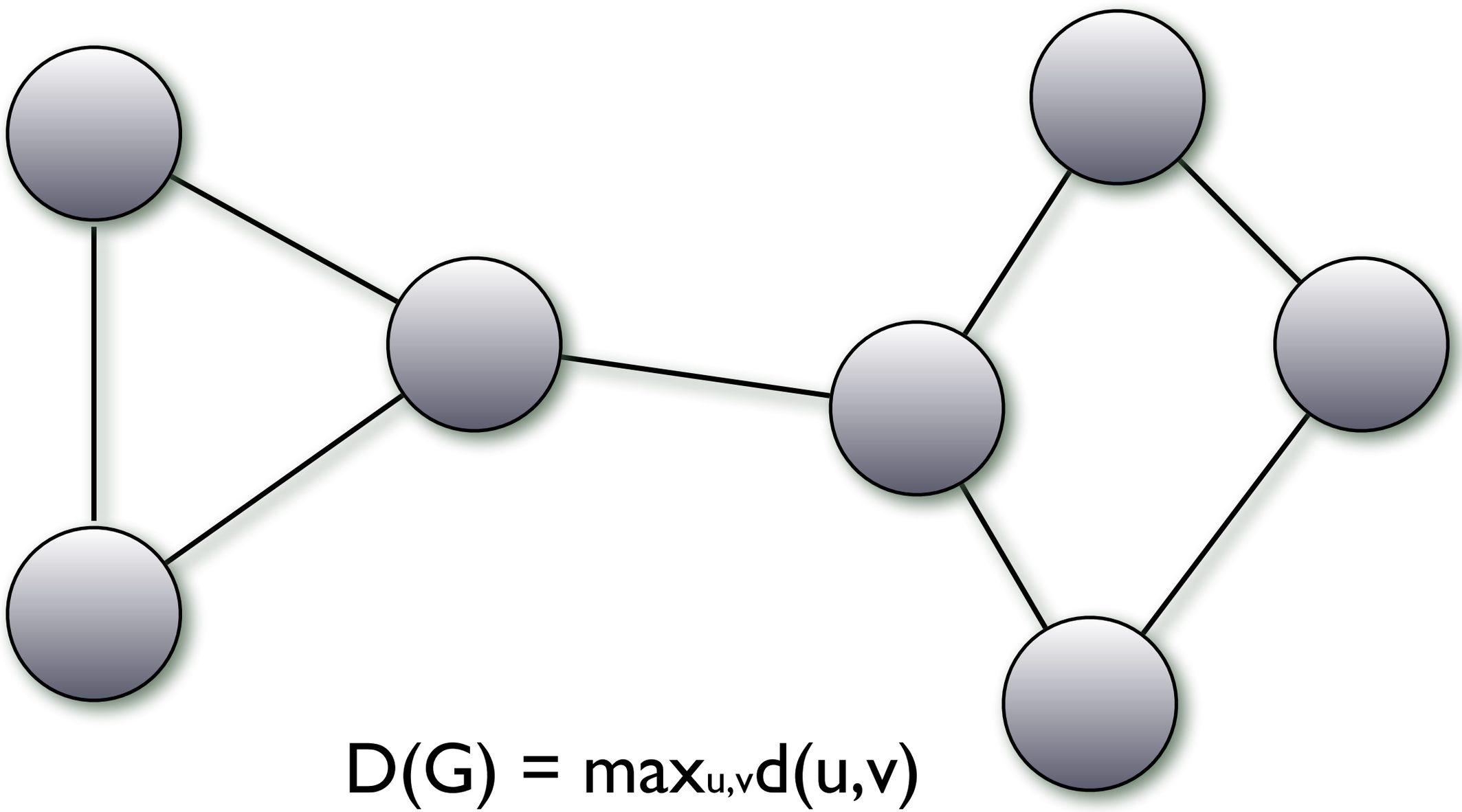
- G=(V,E) :V vertexes (nodes), E edges (links)
  - Distance
  - Diameter
  - Expansion (captures bottlenecks)

Distance



d(u,v) = ?

Diameter

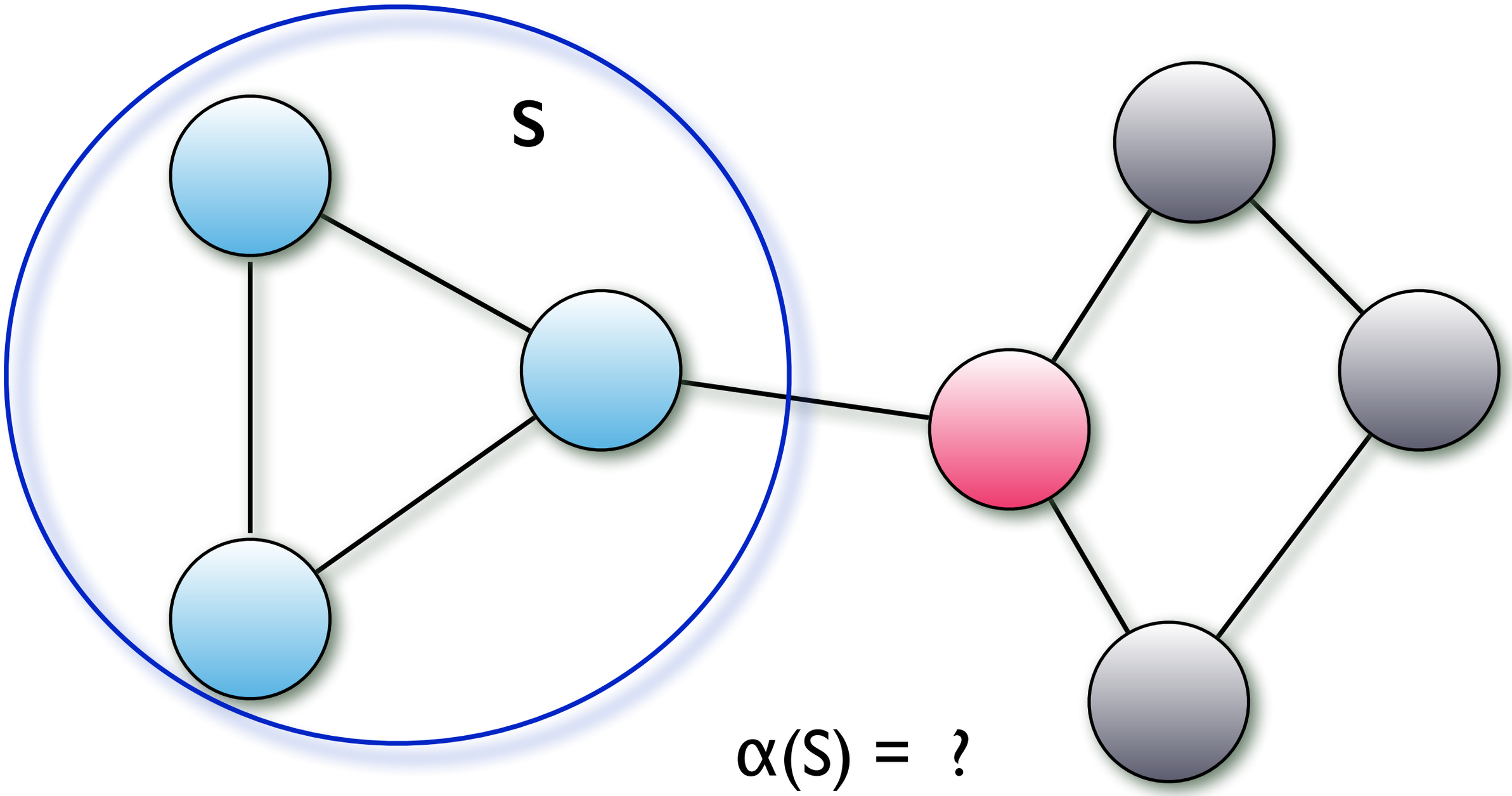


$$D(G) = \max_{u,v} d(u,v)$$

Expansion

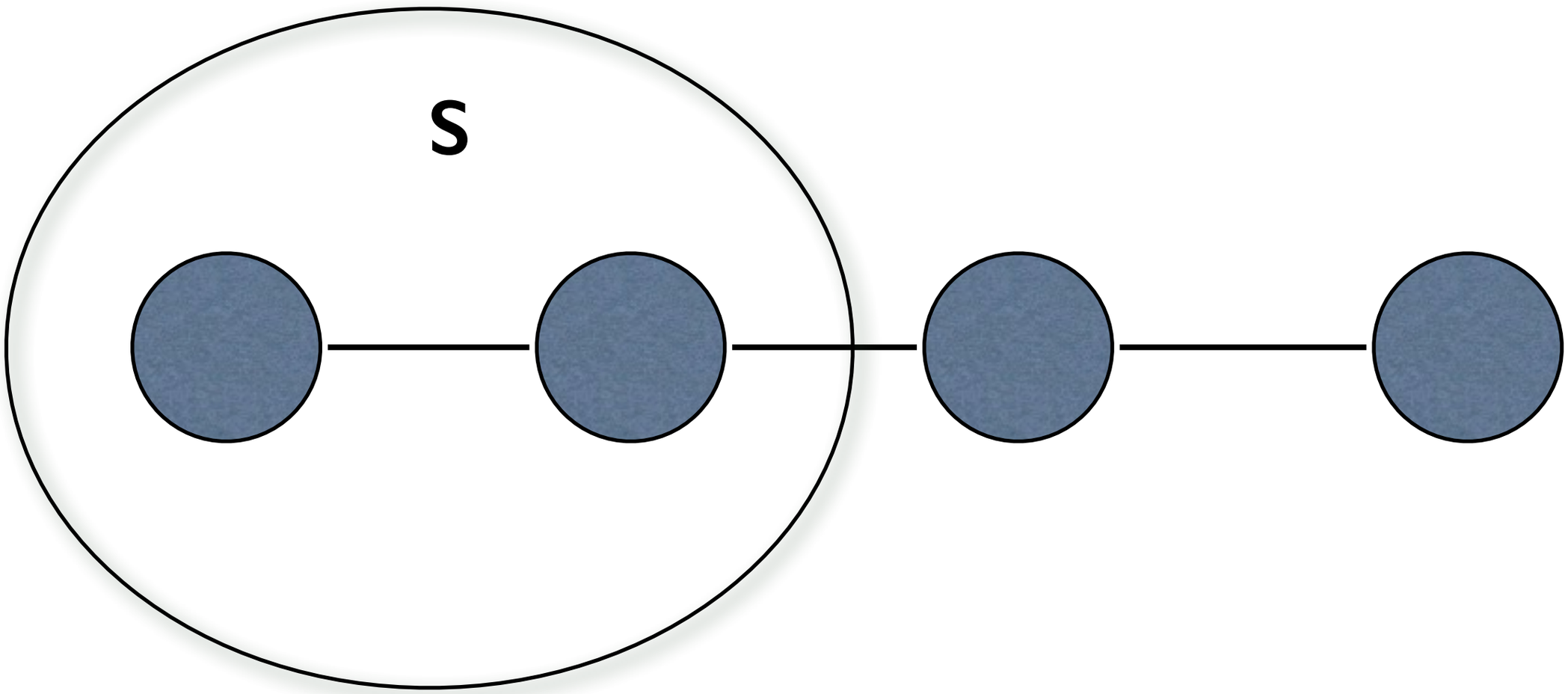
- $\Gamma(S)$ = neighbor set of S (S excluded)
- $\alpha(S) = |\Gamma(S)| / |S|$
- $\alpha(G) = \min_{S,|S| \le V/2} \alpha(S)$

Expansion



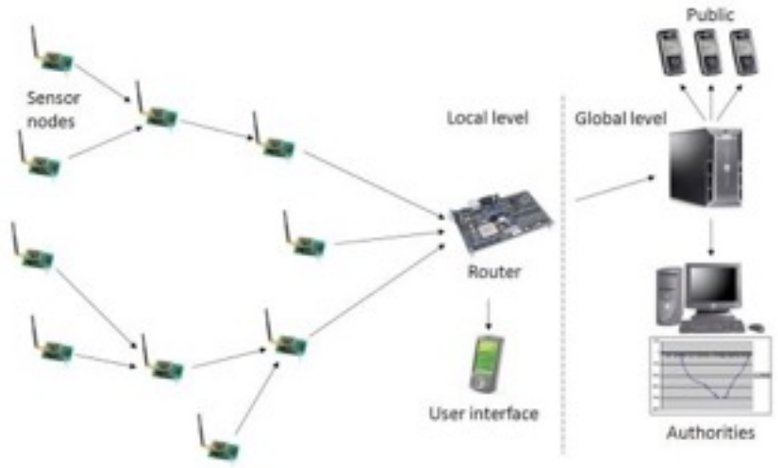
$\alpha(S) = \ ?$

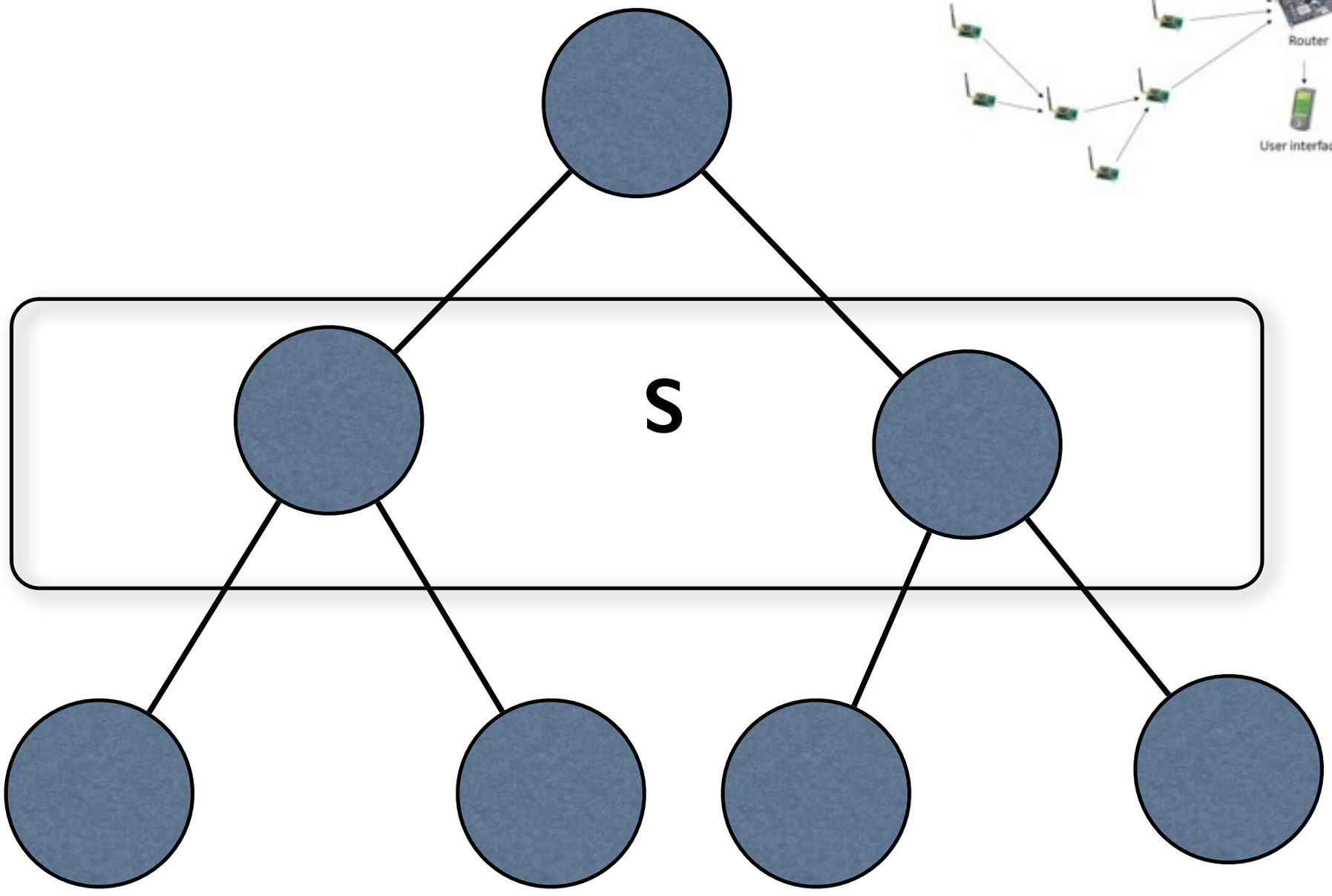
Lines



$\alpha(S) = \ ?$

Trees





$\alpha(S) = \ ?$

Taxonomy of topologies

- Unstructured (e.g. early P2P)
- Structured (e.g. DHT-based)
- Controled (e.g. wireless, sensor networks)

Execution Models

Synchronous

- Links delays are bounded
- A message sent by a process s to its neighbor u at pulse p of s must arrive at u before pulse p+1 of u
- Global clock

Asynchronous

- **No** global clock
- Links delays are finite
- Asynchronous to syncronous via «synchronizers»

LOCAL vs *CONGEST* vs *ASYNC*

LOCAL **-** *fully synchronous, messages of unlimited size, each processor acts based on the information received from up to k-hops.*

CONGEST **-** *synchronous or asynchronous, messages of size log(n)*

ASYNC - asynchronous,
no limitations on messages size

LOCAL execution

- Processors execute in rounds the loop :
  - send messages ⇨ message complexity
  - receive messages
  - local computation ⇨ local computation complexity
- Number of rounds till termination ⇨ time complexity