DATAMAN
MOBILE COMPUTING LABORATORY

Localized Positioning in Ad Hoc Networks[1]

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[1]supported in part by DARPA and NSF

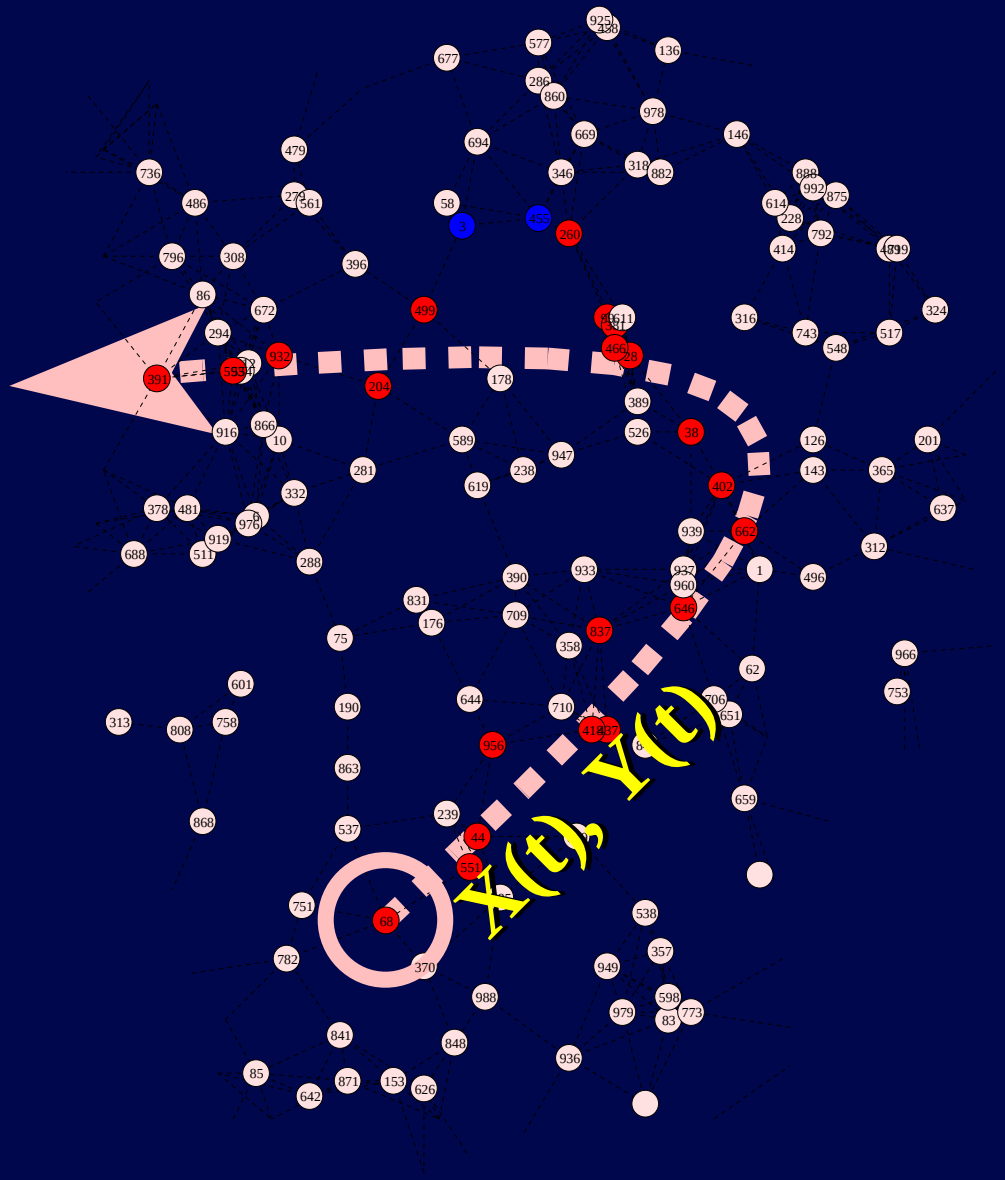
routing in ad hoc networks

- **node centric**
  - **proactive**
    DSDV [Perkins94]
  - **reactive**
    DSR [Johnson96],
    AODV [Perkins99]
- **data centric**
  - **diffusion** [Intanago00]
- **position centric**
  - **Cartesian** [Finn87],
    GPSR[Karp00]
  - **LAR** [Ko98]
  - **TBF** [Niculescu02]

- **position centric**
  - **better scalability**
  - **no routing tables**
  - **independent of mobility**
  - **dependent on a location database**

trajectory based forwarding

- Cartesian+source based routing
- **forward along curves**
- “continuous” routes
- assumptions
  - dense network
  - GPS enabled

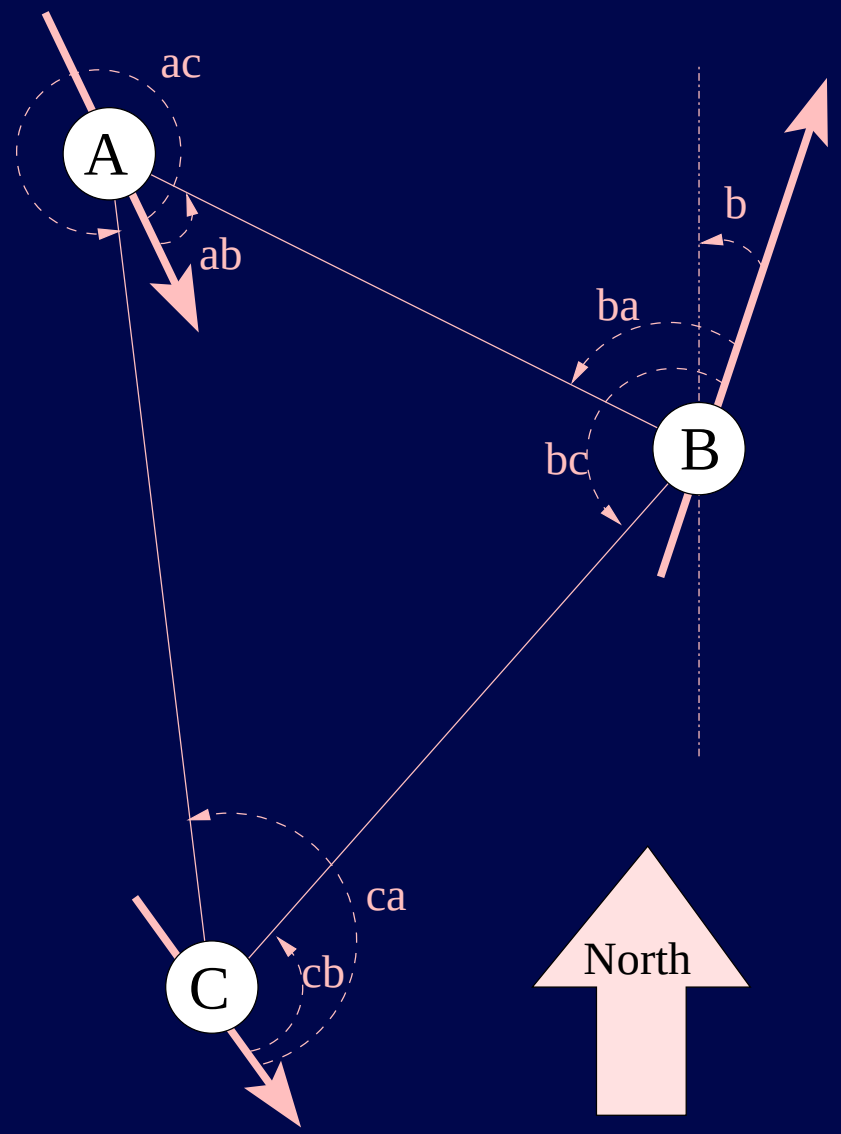


- **GPS is not available in each node**
  - **LOS - indoors**
  - **cost, power, size**
- **solutions (distributed)**
  - **infrastructure based**
    - **grid of beacons** [Bulusu00]
    - **Cricket** [Priyantha00,01]
  - **infrastructure free**
    - **SPA** [Capkun01]
    - **APS** [Niculescu01]
    - **AhLOS** [Savvides01]
    - **large scale collaboration**

local positioning system (LPS)

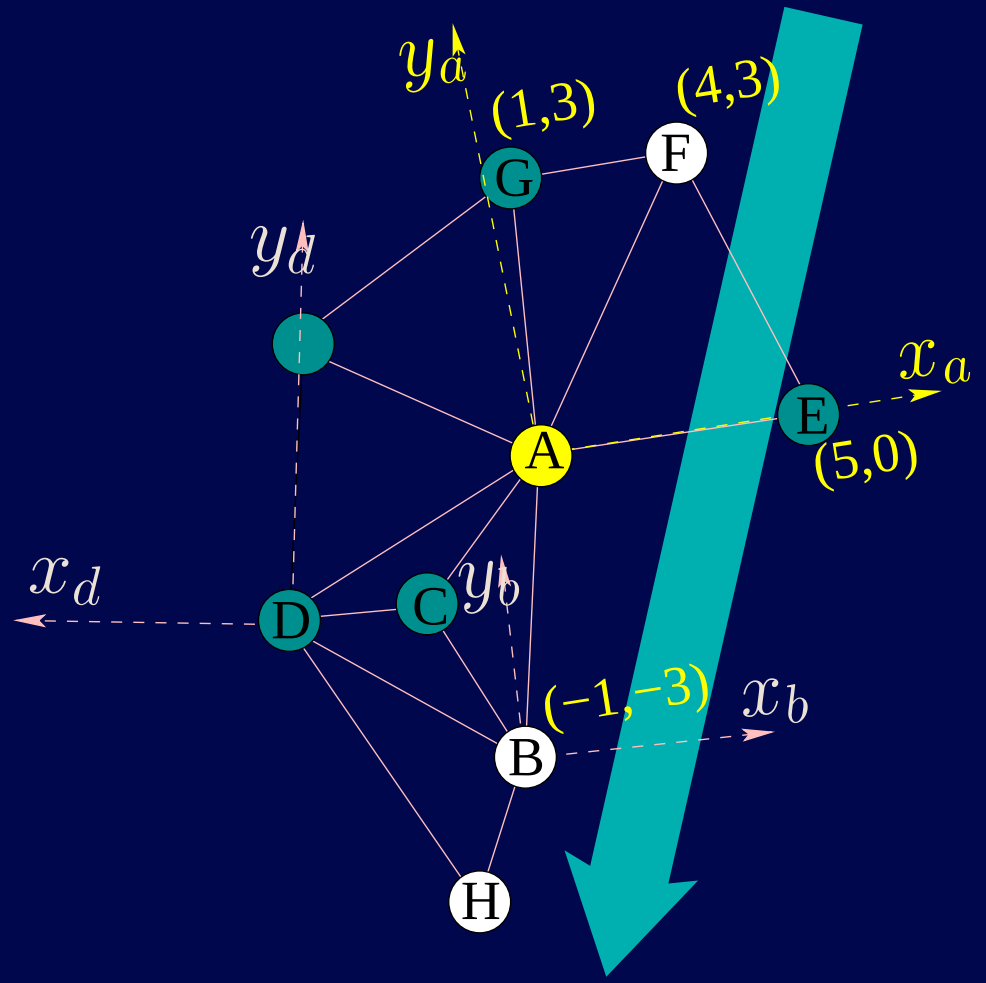
- **localized** collaboration
  - **on demand** - only participating nodes
  - **lazy** -
  - **relative** - to the source node
- **no GPS in the network**, but
- use available capabilities
  - ranging
  - AoA (angle of arrival)
  - compass
  - accelerometer

node capabilities

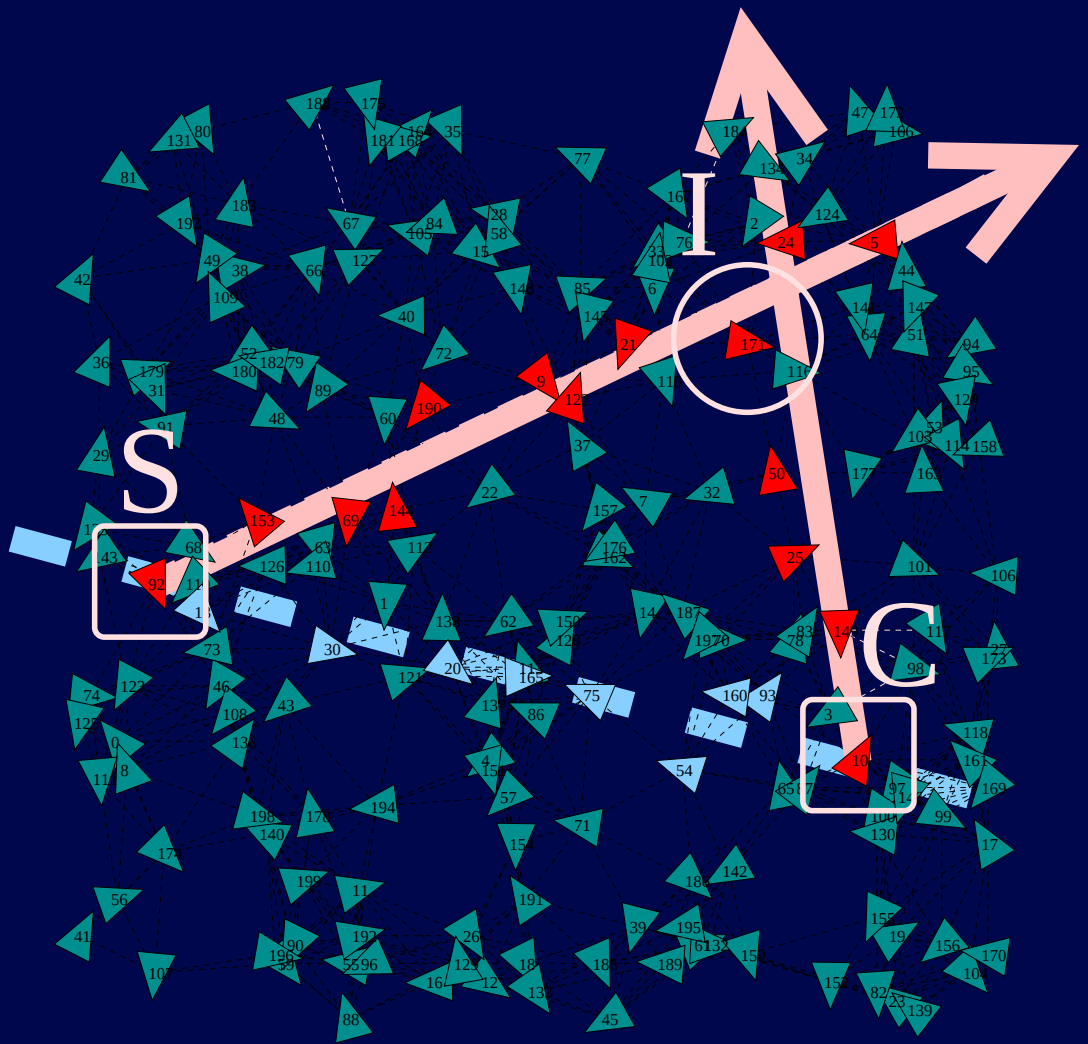


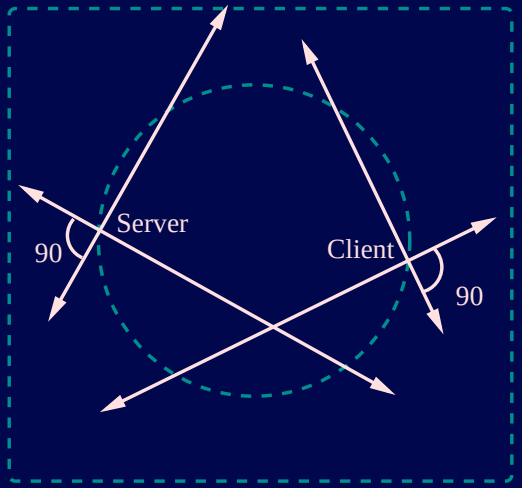
LPS - basic idea

- nodes build local coordinate systems (CS)
-
  - localized procedure
  - independent
  - randomly oriented
- align CS on the fly
- all nodes work in the CS of the source

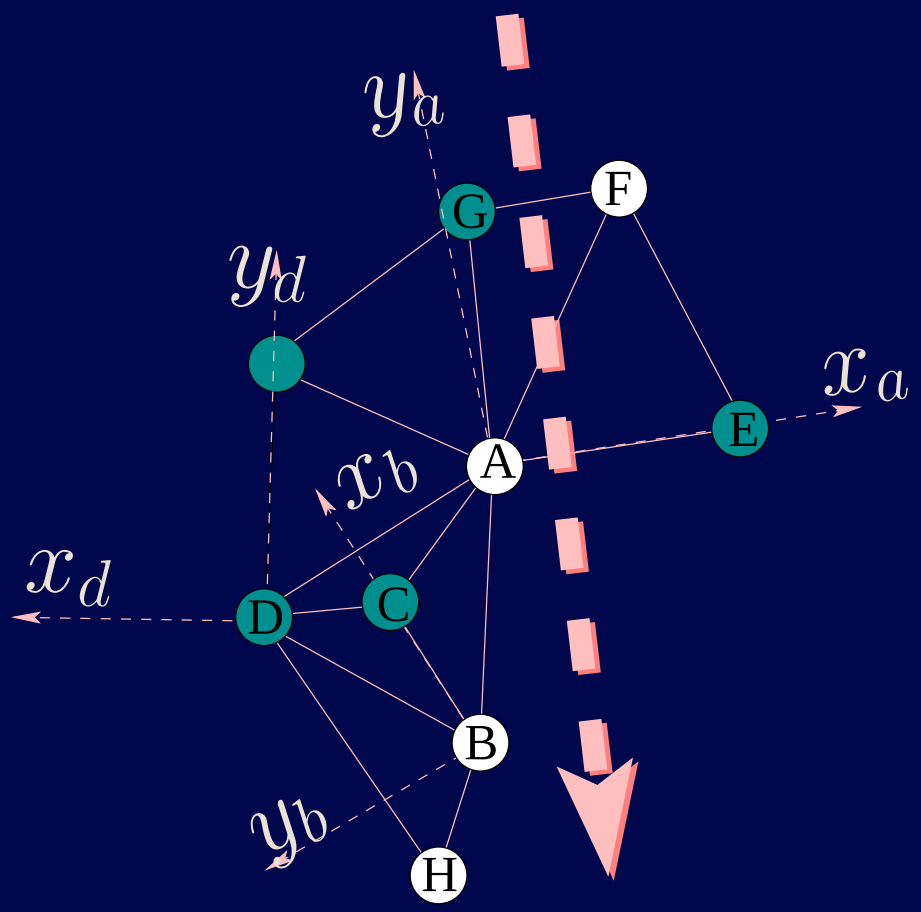


LPS example: discovery





registration



- registration = alignment of CS
- uses
  - capabilities (ranging, AOA, ...)
  - common neighbors
- given coordinates of:
  - A, B, C, $and\, D$ in both systems S_a and S_b
  - **find** $M_{a \to b}$, such that $X_b = X_a M_{a \to b}$, where $X = A, B, C, D$

overhead

Capability	Transformations
Range	**T, R, M**
AoA	**T, R, S, (M)**
AoA+Compass	**T, S, (M)**
AoA+Range+Compass	T, (M)

$$M_{A,B} = \begin{bmatrix} sr_1 & sr_2 & t_x \\ sr_3 & sr_4 & t_y \\ 0 & 0 & 1 \end{bmatrix}$$

- **packet overhead**
  - **coordinates of common nodes**
  - **transformation matrix**
- **depends on capabilities**
- **static networks → reduced overhead**
- **CPU overhead**
  - **registration**
  - **translation**

Local Positioning System(LPS)

- no GPS in the network
- need some capabilities
  - ranging, AoA, compass, accelerometer
- positioning
  - localized
  - on demand
  - relative - in the CS of the source
- better in static networks

thank you

Q & A

summary

- routing in dense networks
- TBF outline
- positioning problem
- goals outline
- LPS
  - node capabilities
  - basic idea
  - LPS example
  - registration
  - overhead
- LPS summary