Hierarchical Data Dissemination Scheme for Large Scale Sensor Networks

Anand Visvanathan and Jitender Deogun
Department of Computer Science and Engg, University of Nebraska at Lincoln
Jong-Hoon Youn
Department of Computer Science, University of Nebraska at Omaha

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Outline

- Introduction
- Hierarchical data dissemination schemes (HDDS)
  - Basic scheme
  - FDDD (Fully Distinct Data Dissemination Hierarchy for each source)
  - FSDD (Fully Sharing Data Dissemination hierarchy)
  - LSDD (Limited Sharing Data Dissemination Hierarchy)
- Simulation
- Conclusion

Introduction

- Wireless sensor networks
  - ☑ a large number of sensors (stationary)
  - ☑ a few data collectors ,named "sinks"
  - ☑ Restriction : energy
  - ☑ sources have to build and maintain multihop routes toward sinks to report sensory data

Introduction
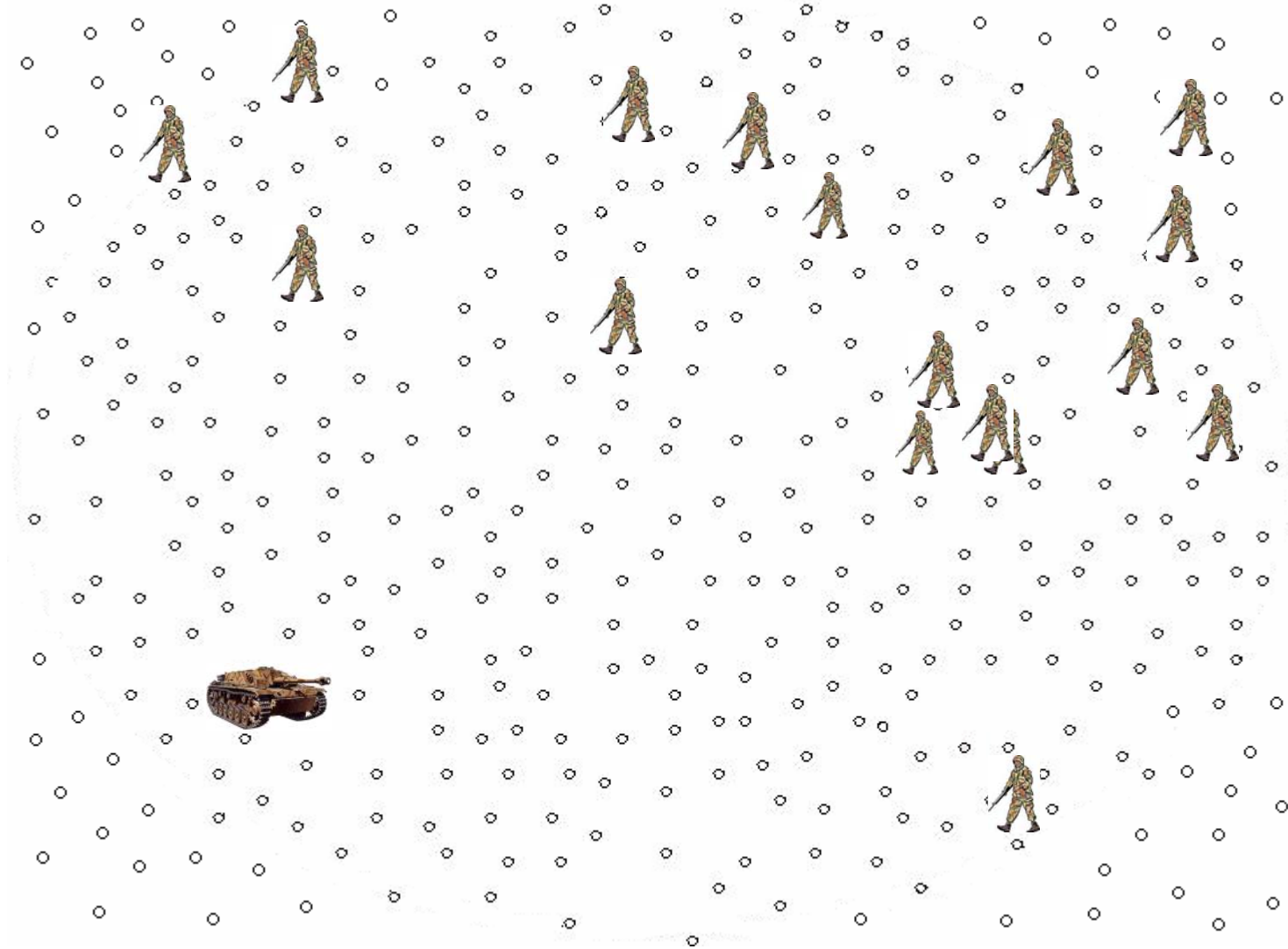
HDDS - assumptions

- Sensors are evenly and densely scattered over the sensor field
- All sensors are aware of their location
- Sensors are stationary but some of sinks may be mobile
- Sensors use simple greedy forwarding to deliver packets to destination
- the sensors may monitor different kinds of stimuli and the mobile sinks are interested in one or more of these stimuli.

HDDS - overview

- Basic scheme
  - a non-uniform gird can be constructed to disseminate data based on sink density without any prior information about the position of the sinks.
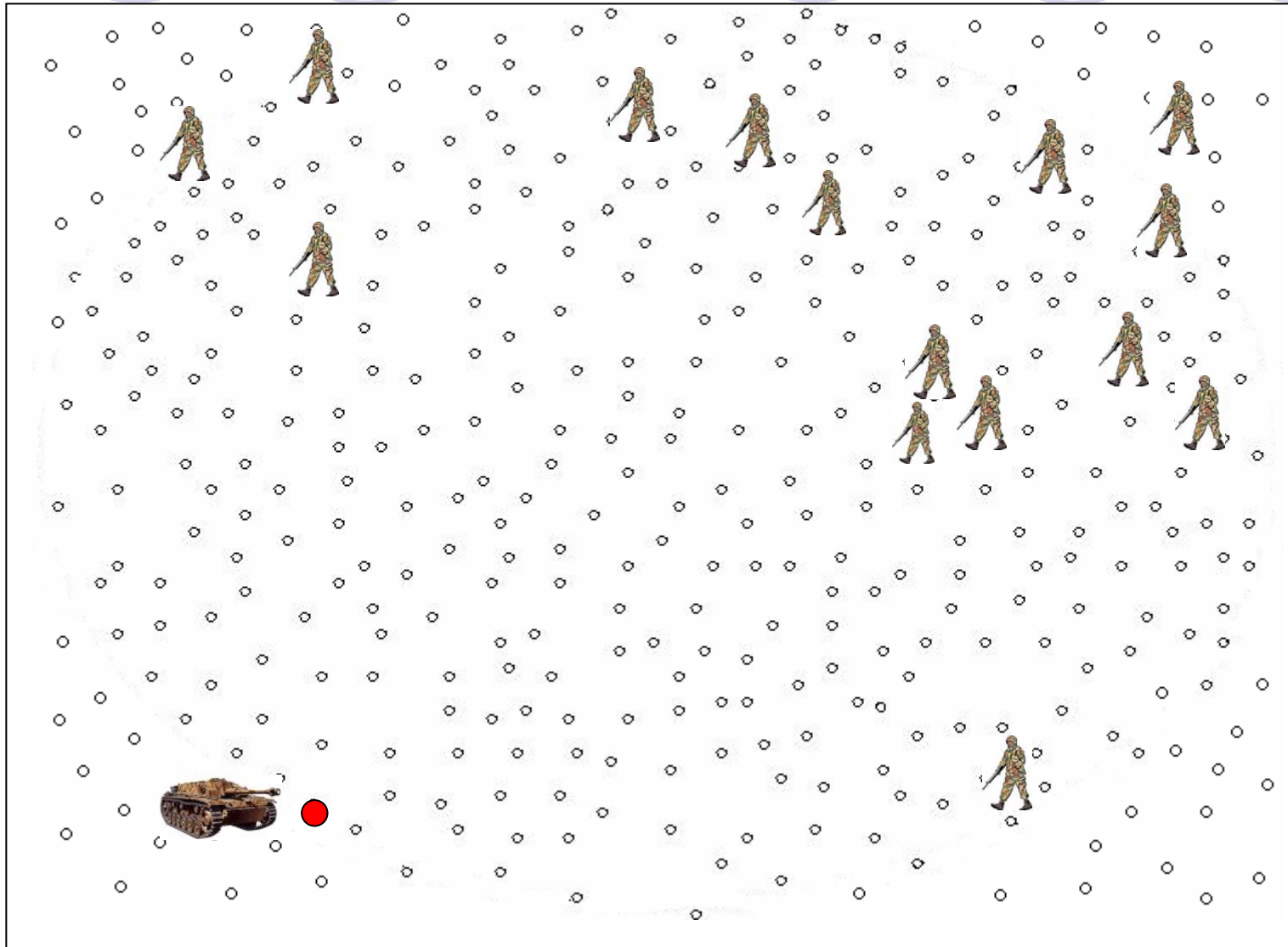- Three schemes for data dissemination
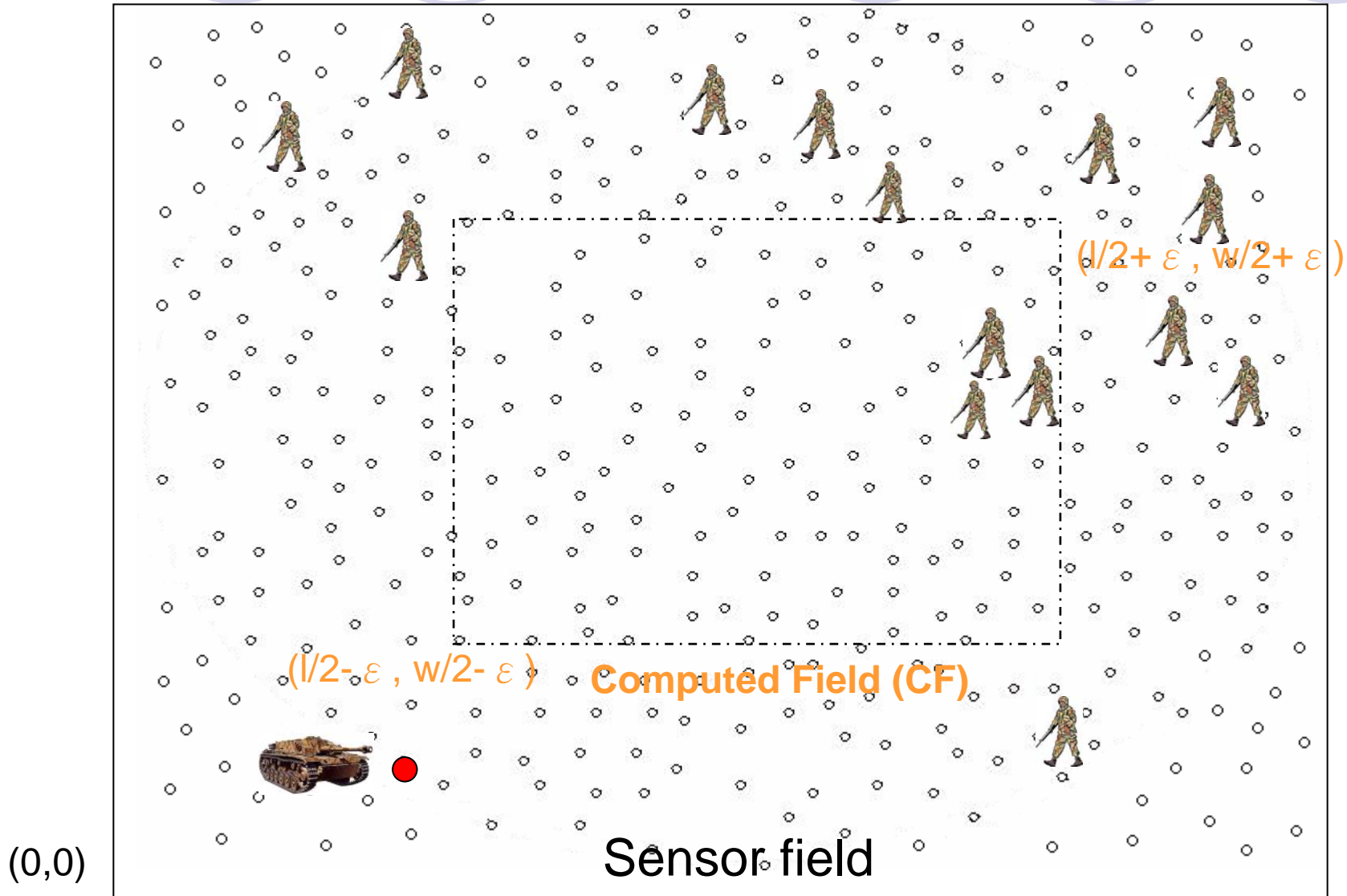 - FDDD
  - FSDD
  - LSDD

HDDS - basic scheme
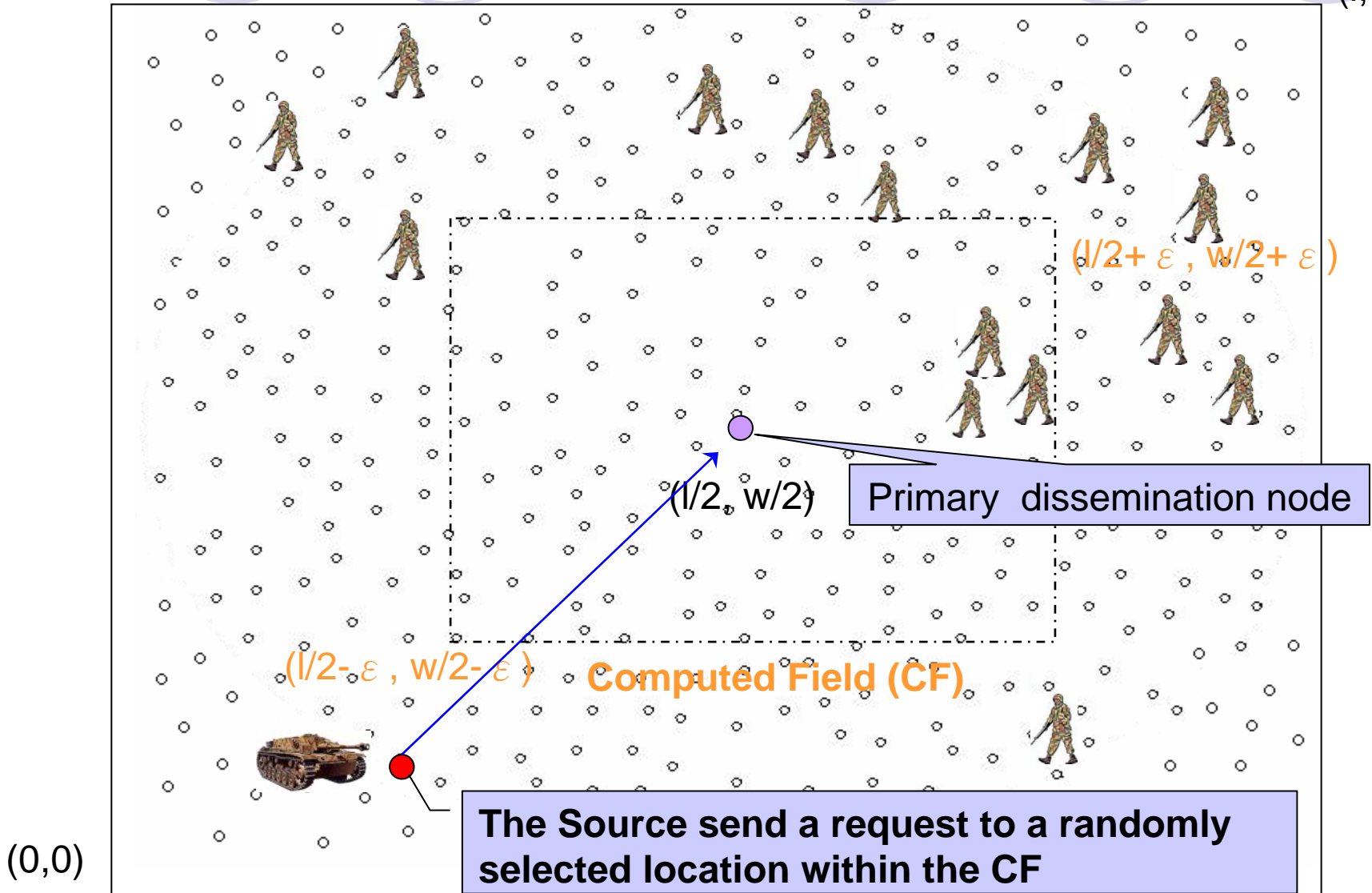
HDDS - basic scheme

(l, w)

$(l/2+ \varepsilon , w/2+ \varepsilon)$
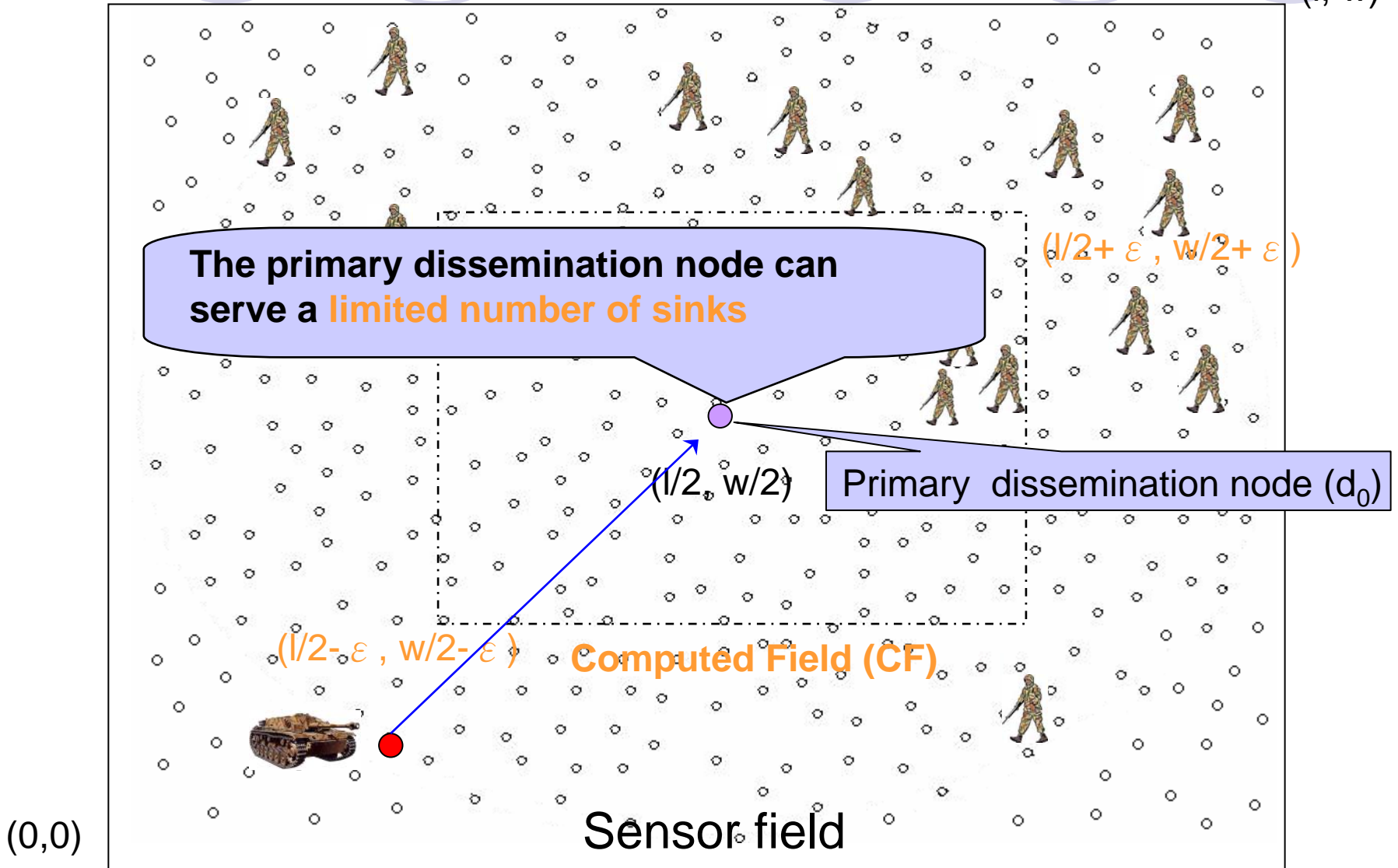
$(l/2- \varepsilon , w/2- \varepsilon)$ **Computed Field (CF)**

(0,0)

Sensor field

HDDS - basic scheme

(l, w)

$(l/2+\varepsilon, w/2+\varepsilon)$

(l/2, w/2)

Primary dissemination node

$(l/2-\varepsilon, w/2-\varepsilon)$ **Computed Field (CF)**

(0,0)

The Source send a request to a randomly selected location within the CF

(l, w)

(l/2+ ε , w/2+ ε)

The primary dissemination node can serve a limited number of sinks

(l/2, w/2)

Primary dissemination node (d_0)

(l/2- ε , w/2- ε)   **Computed Field (CF)**

(0,0)

Sensor field

HDDS - basic scheme

(l, w)

Level 1 dissemination node(d_1)

(l/2, w/2)

Primary dissemination node (d_0)

(0,0)
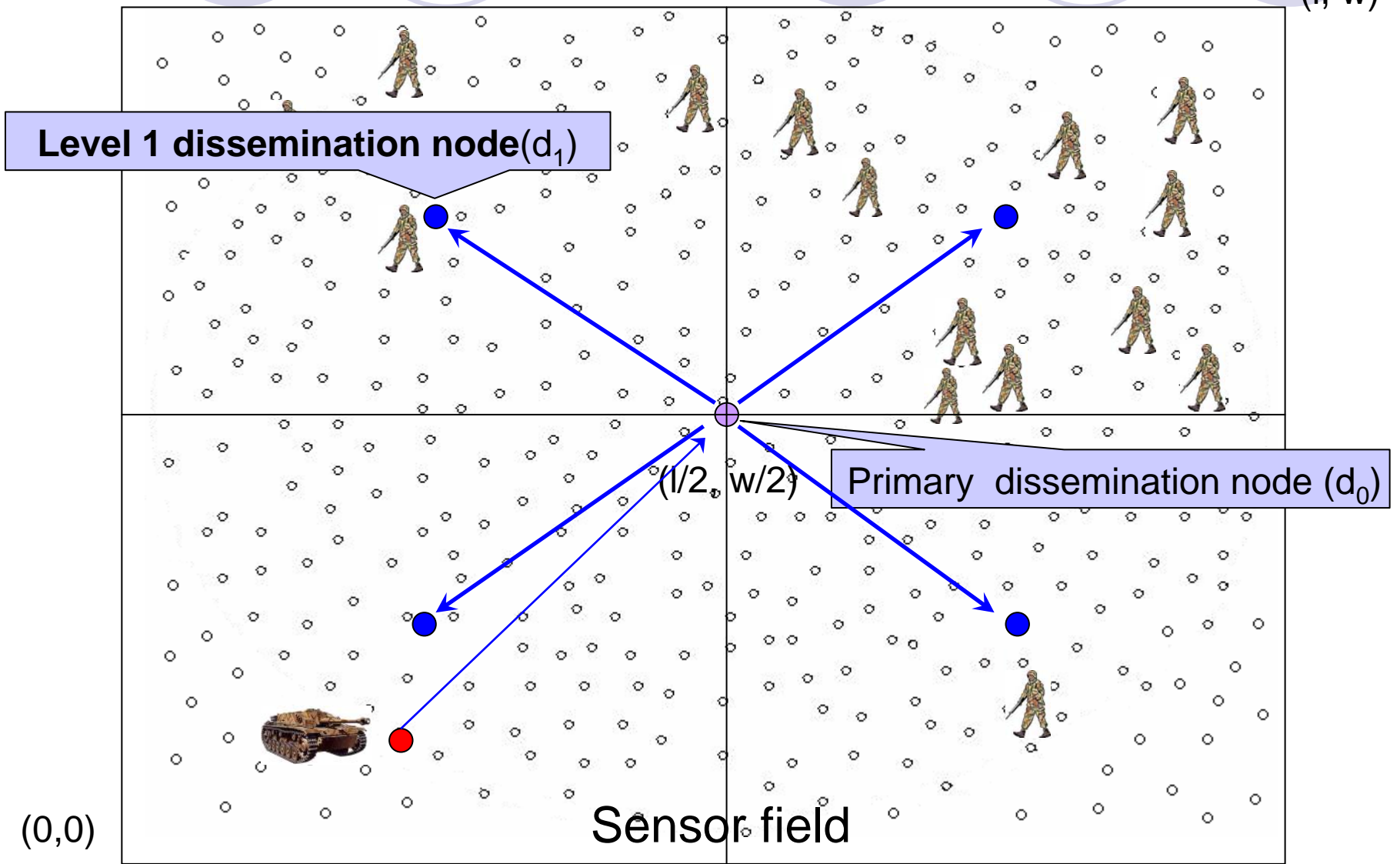
Sensor field

HDDS - basic scheme

Level 1 dissemination node(d_1)

Primary dissemination node (d_0)

Forwarding agent
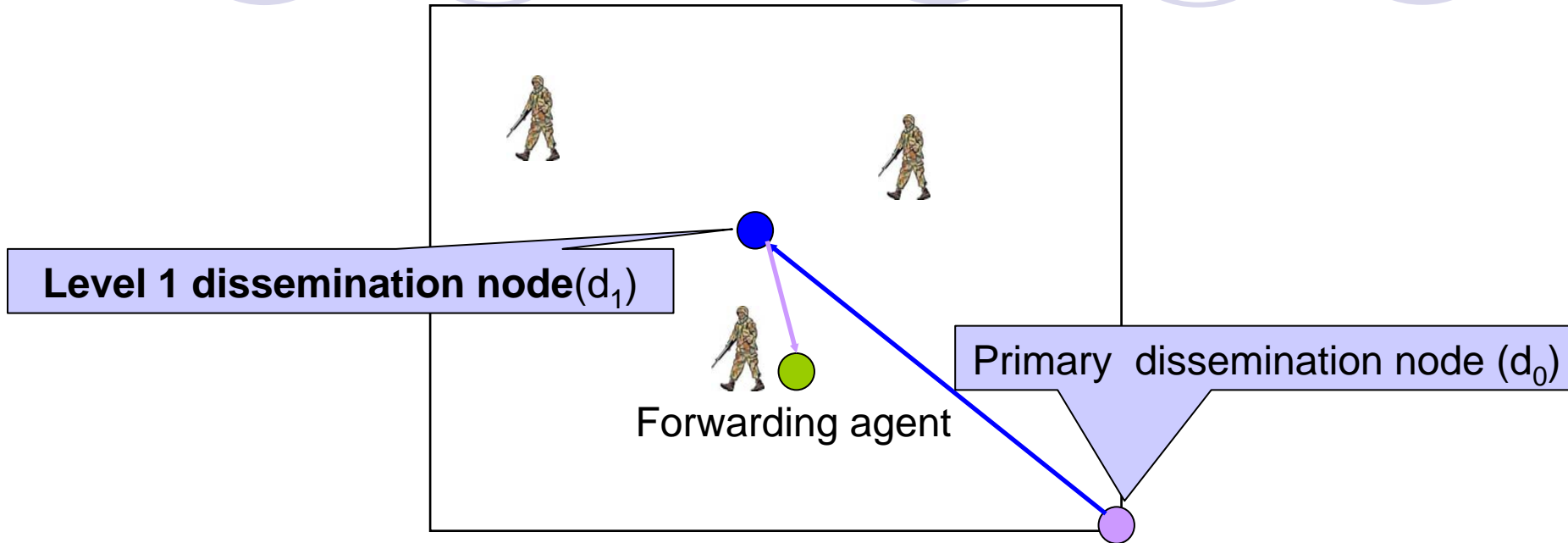
- **Level 1 dissemination node broadcasts message containing its location and coordinates of coverage area (1/4 sensor filed)**
- **The mobile sink receives the message, it replies with a subscription message that contains the location of its current forwarding agent**

HDDS - basic scheme

(l, w)

Level 2 dissemination node(d_2)

Level 1 dissemination node(d_1)

$(l/2, w/2)$

Primary dissemination node (d_0)

(0,0)

Sensor field
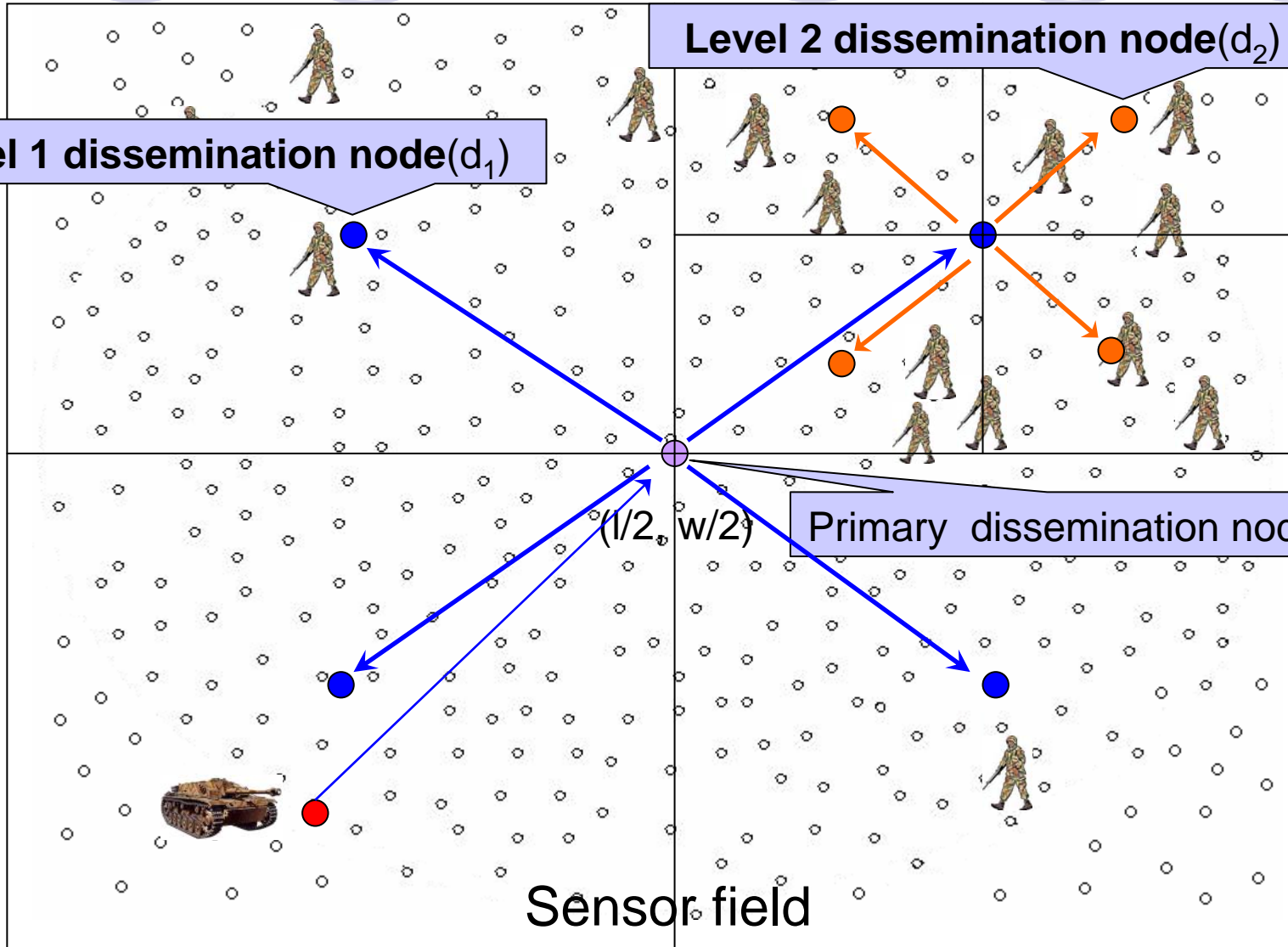
HDDS - FDDD

- FDDD (Fully Distinct Data Dissemination)
  - Use distinct data dissemination hierarchy for each source
  - Each source selects a new primary dissemination node within the CF
 - Each source may have a different set of nodes that facilitate forwarding of data

HDDS - FSDD

- FSDD (Fully Sharing Data Dissemination)
  - Use fully sharing data dissemination hierarchy for each source
  - The first primary dissemination node aggregates data

HDDS - FSDD

(l, w)

•The first primary dissemination node broadcasts a message within the CF
•All sensors within the CF know the primary dissemination node existence
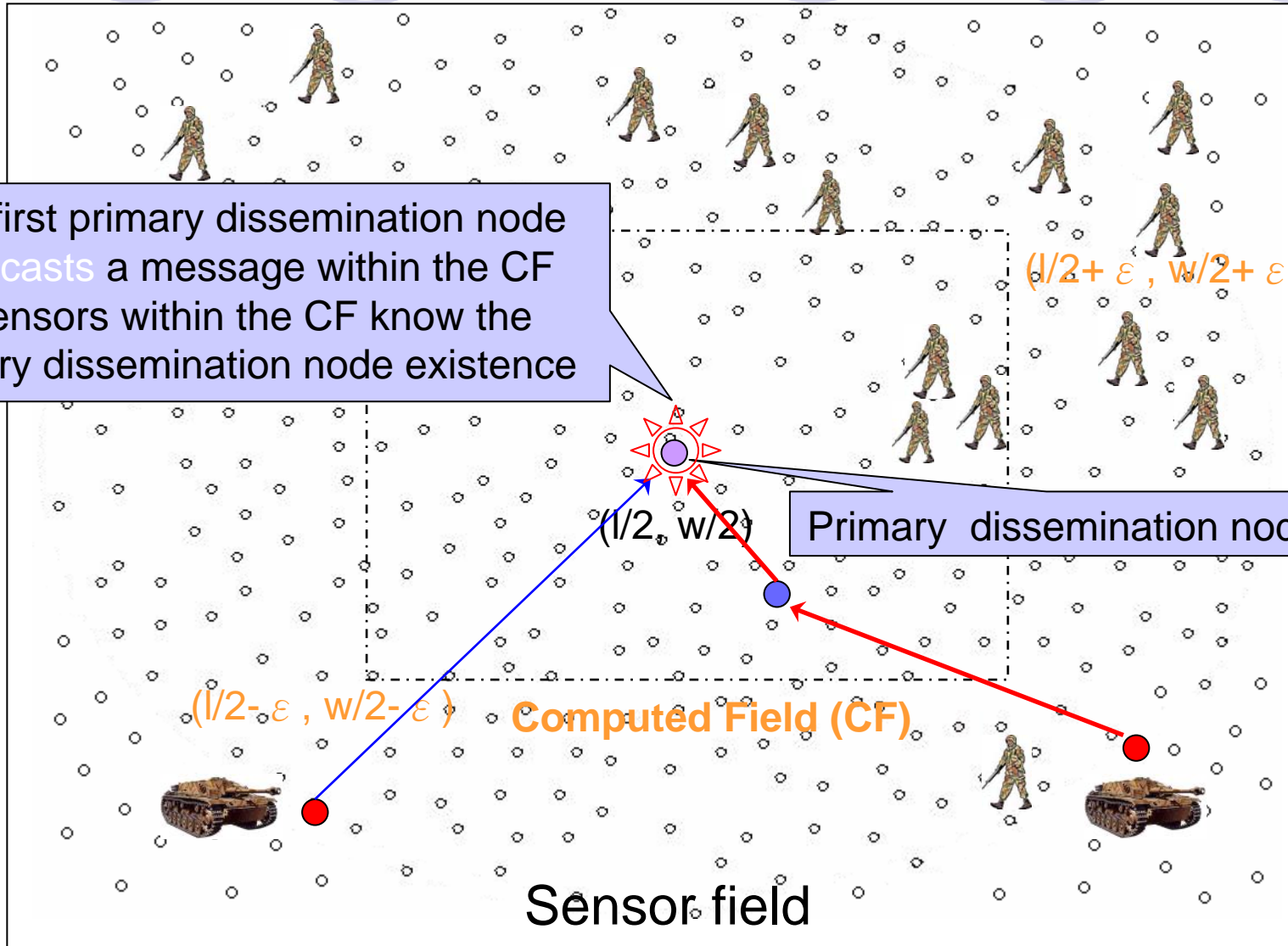
$(l/2+\varepsilon, w/2+\varepsilon)$

$(l/2, w/2)$

Primary dissemination node (d_0)

$(l/2-\varepsilon, w/2-\varepsilon)$ **Computed Field (CF)**

(0,0)

Sensor field

HDDS - LSDD

- LSDD (Limited Sharing Data Dissemination)
  - ○ Use limited sharing data dissemination hierarchy for each source
  - ○ A primary dissemination node can serve a limit number of sources

HDDS - LSDD

(l, w)

(l/2+ ε , w/2+ ε)

(l/2, w/2)

Primary dissemination node (d_0)

(l/2- ε , w/2- ε) **Computed Field (CF)**

(0,0)
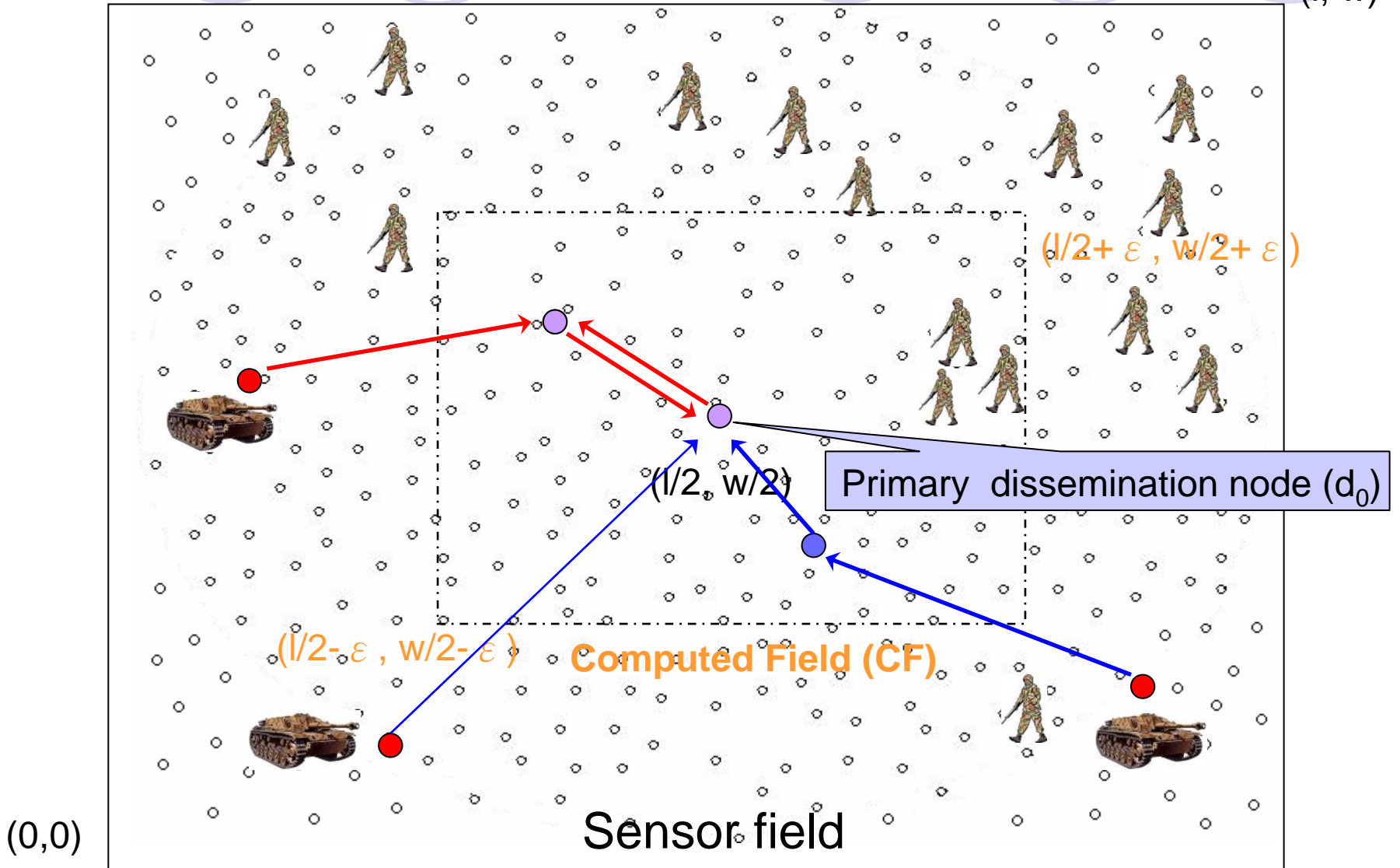
Sensor field

Simulation

- Ns-2 simulator
- 200 sensor nodes random deployment
- Sensor field : 2000m by 2000m
- 0.5% to 4% nodes are sources
- Each source node : 1 packet/s
- The number of sinks varies from 5 to 20

Simulation

Energy Consumption for 1 source
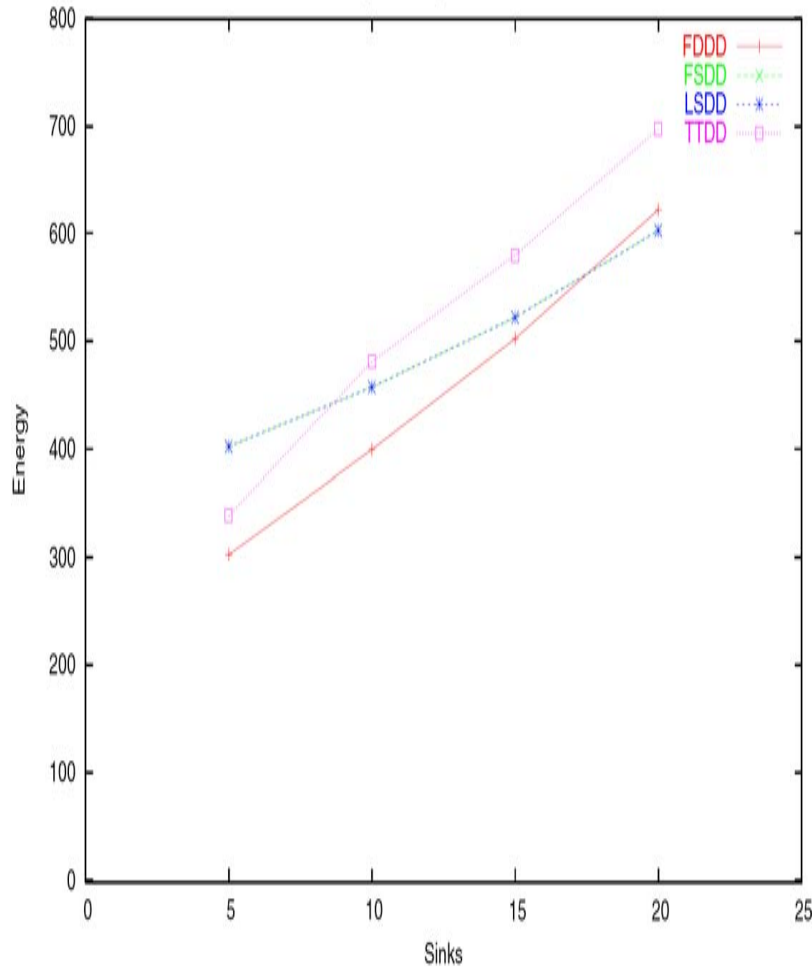
Energy Consumption for 4 sources
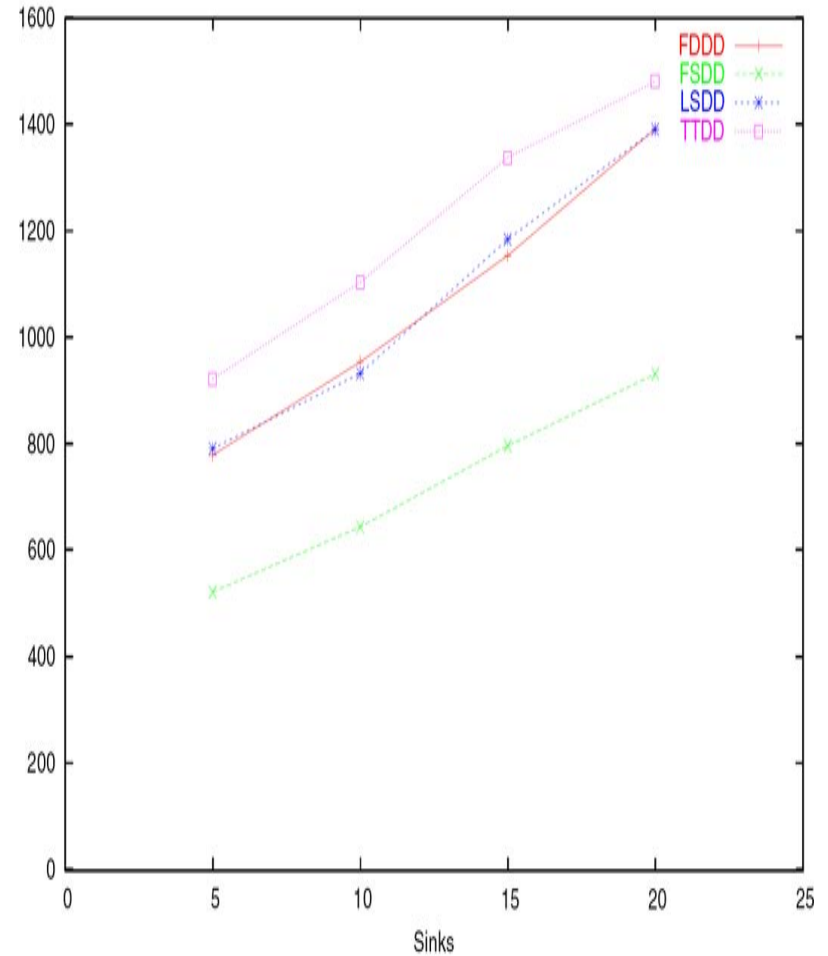
Energy Consumption variation by changing number of sources and sinks
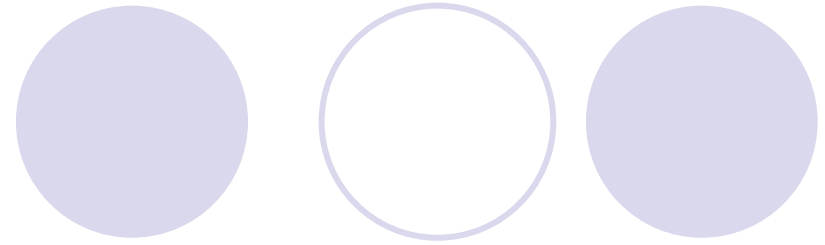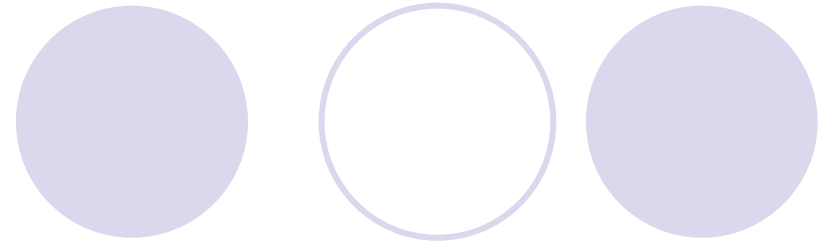
Simulation

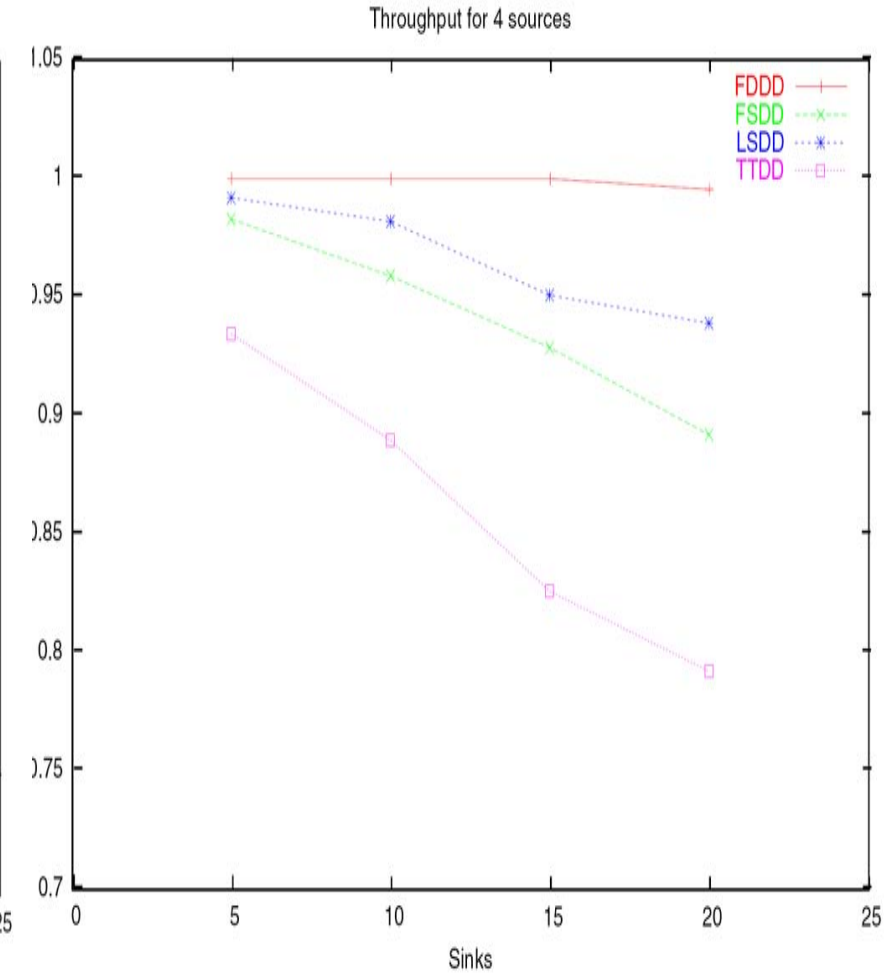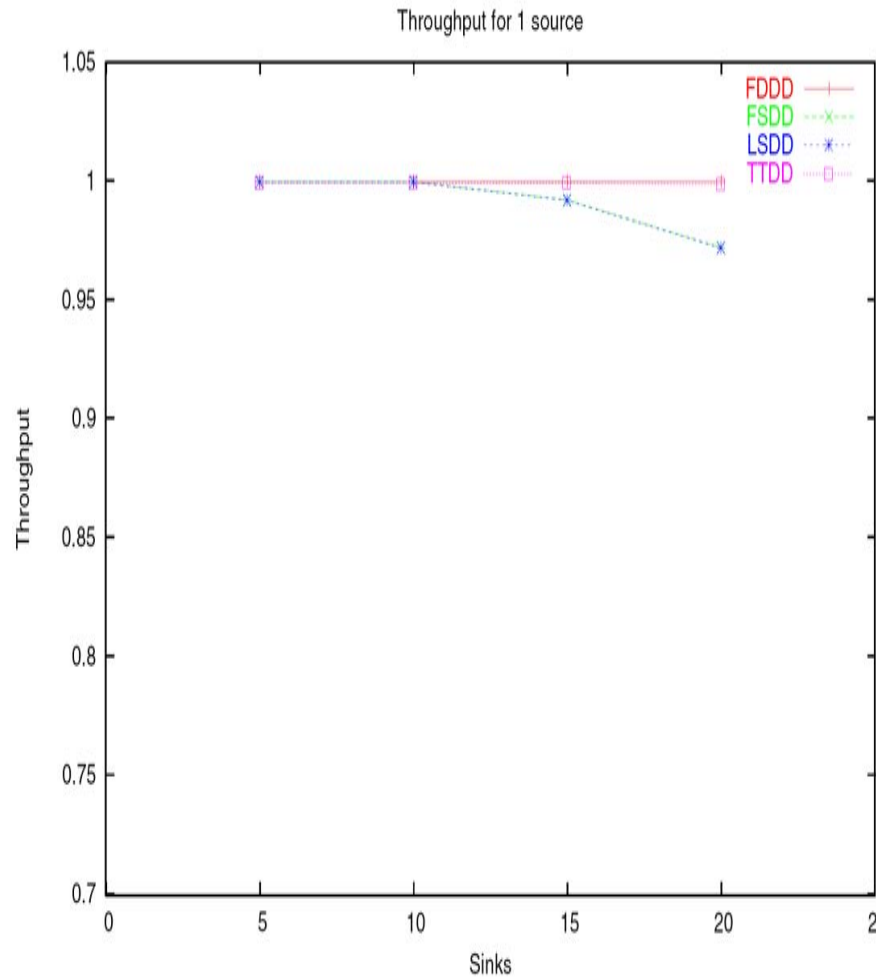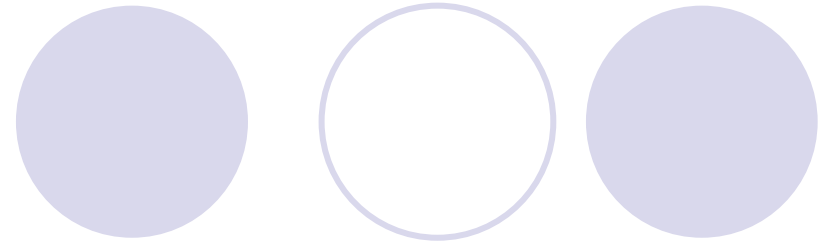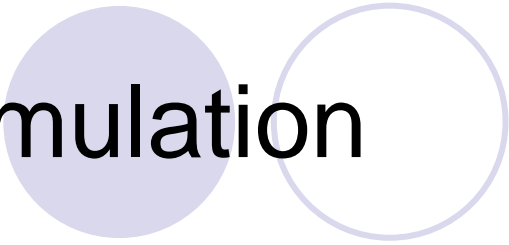Overhead for 1 source
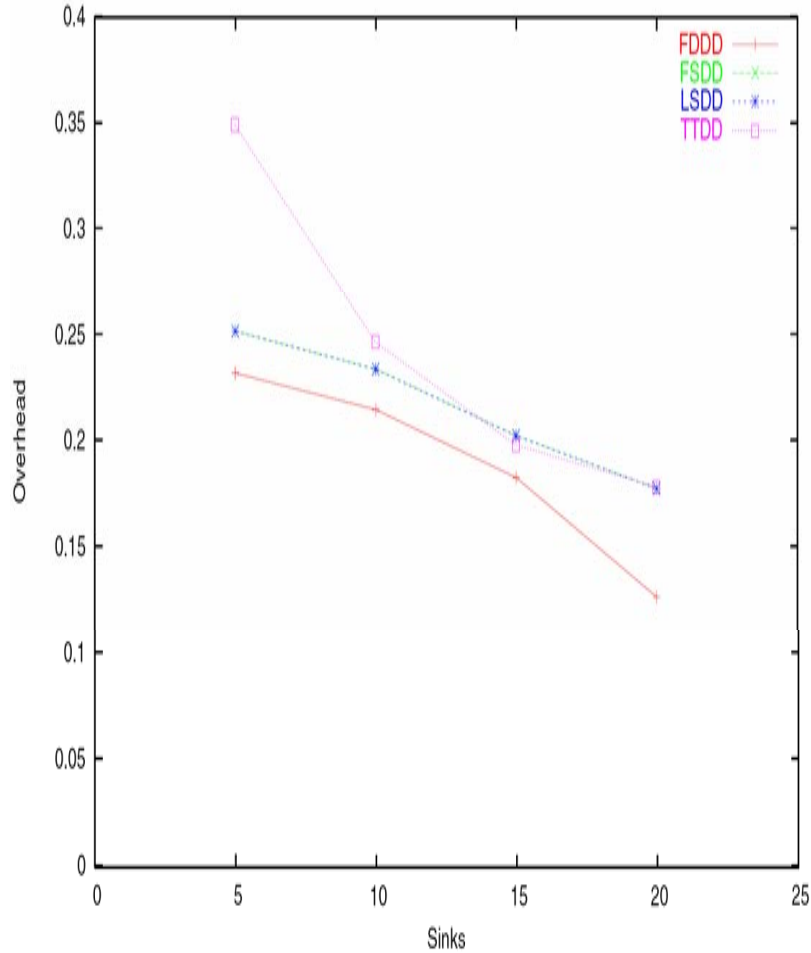
Overhead for 4 sources
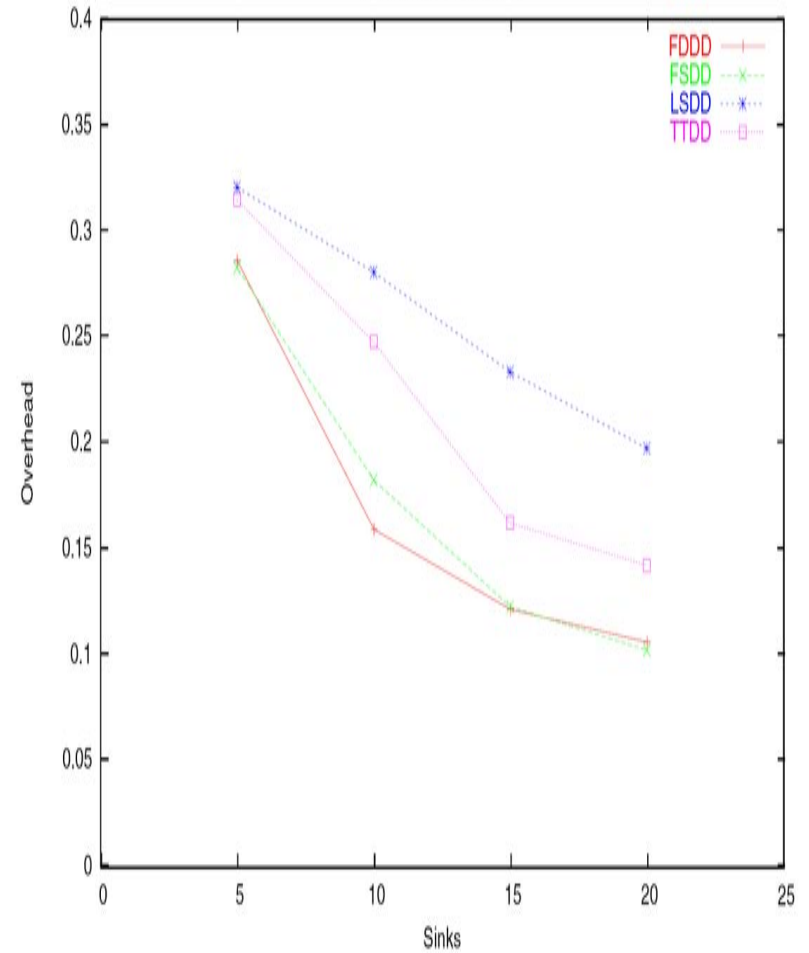
Overhead variation by changing number of sources and sinks
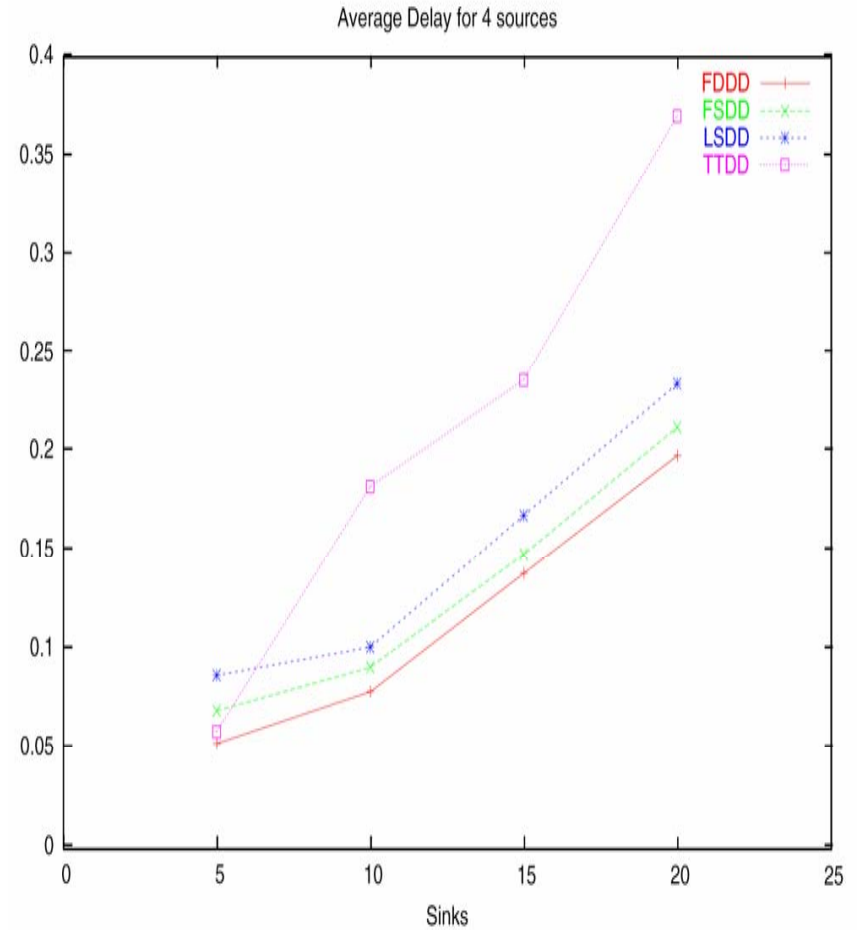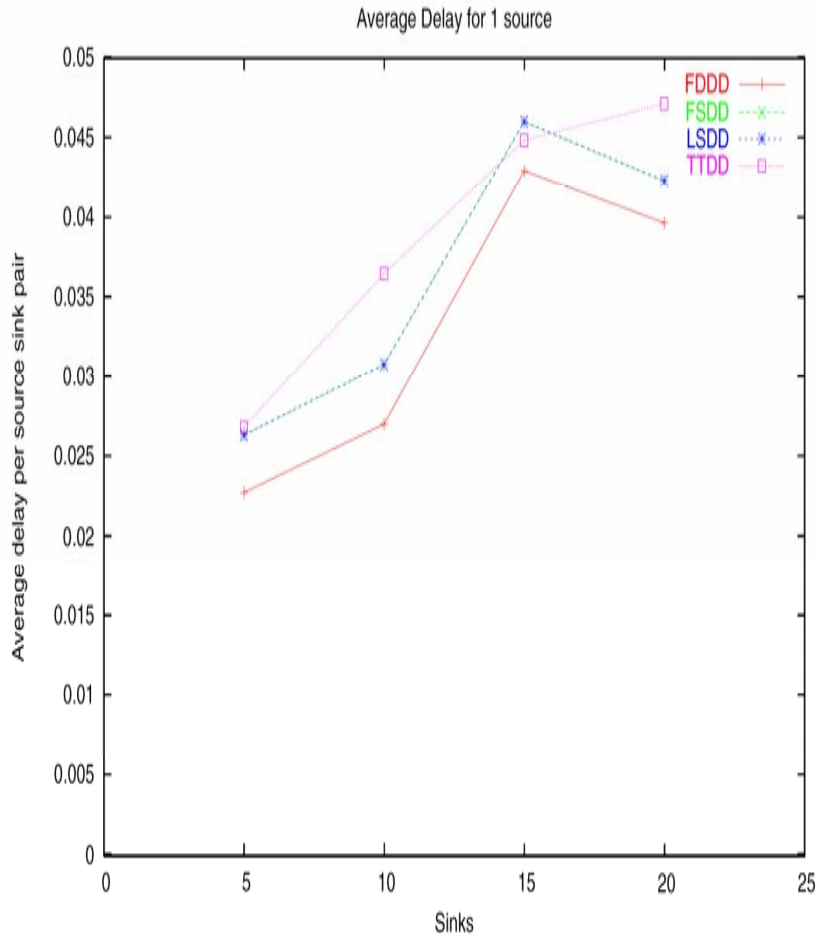
Simulation

Delay variation by changing number of sources and sinks

Simulation

Throughput for 1 source

Throughput for 4 sources

Throughput variation by changing number of sources and sinks

Conclusion

- Propose energy efficient schemes for data dissemination in sensor networks
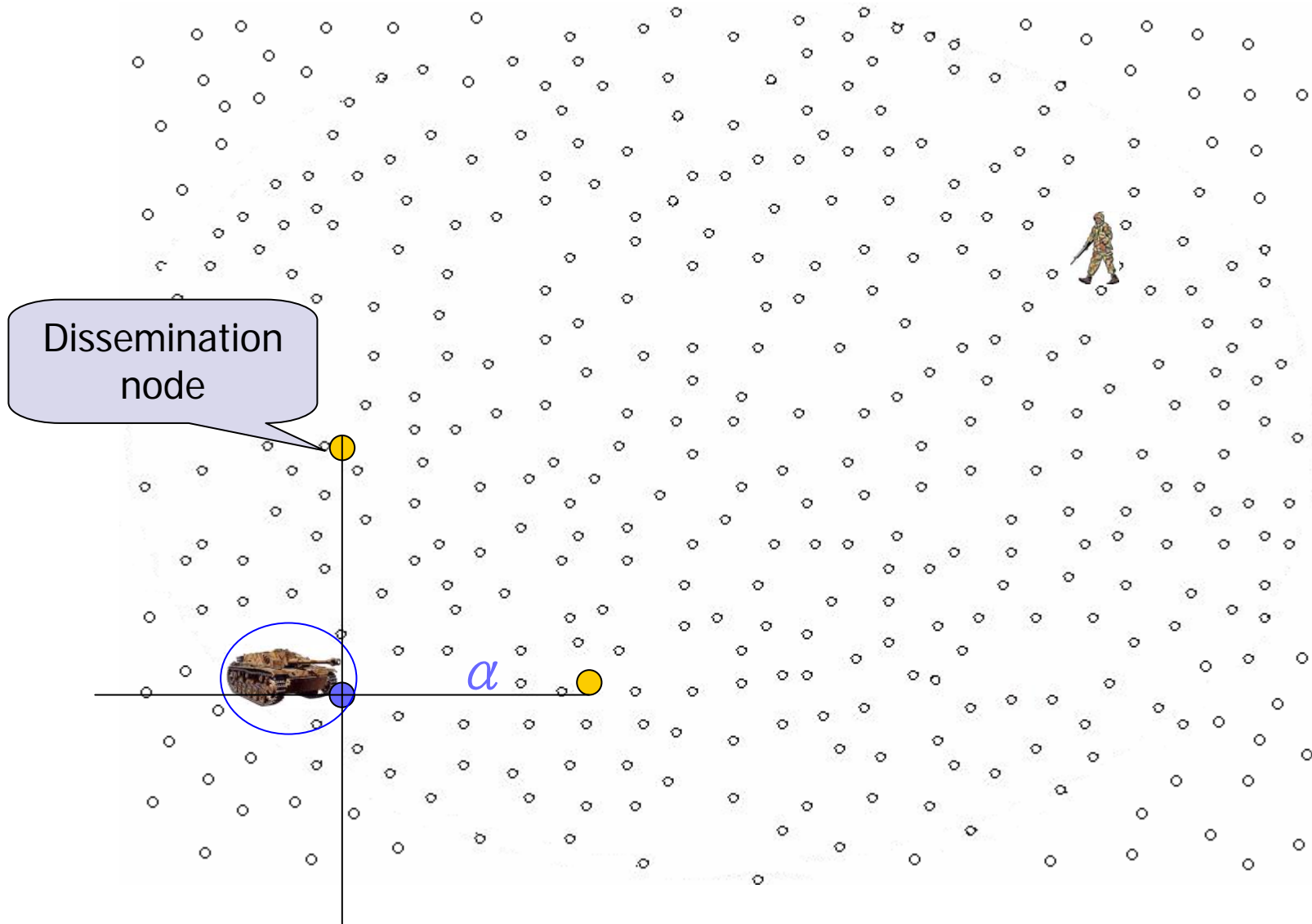- The non-uniform grid can be constructed to disseminate data based on sink density
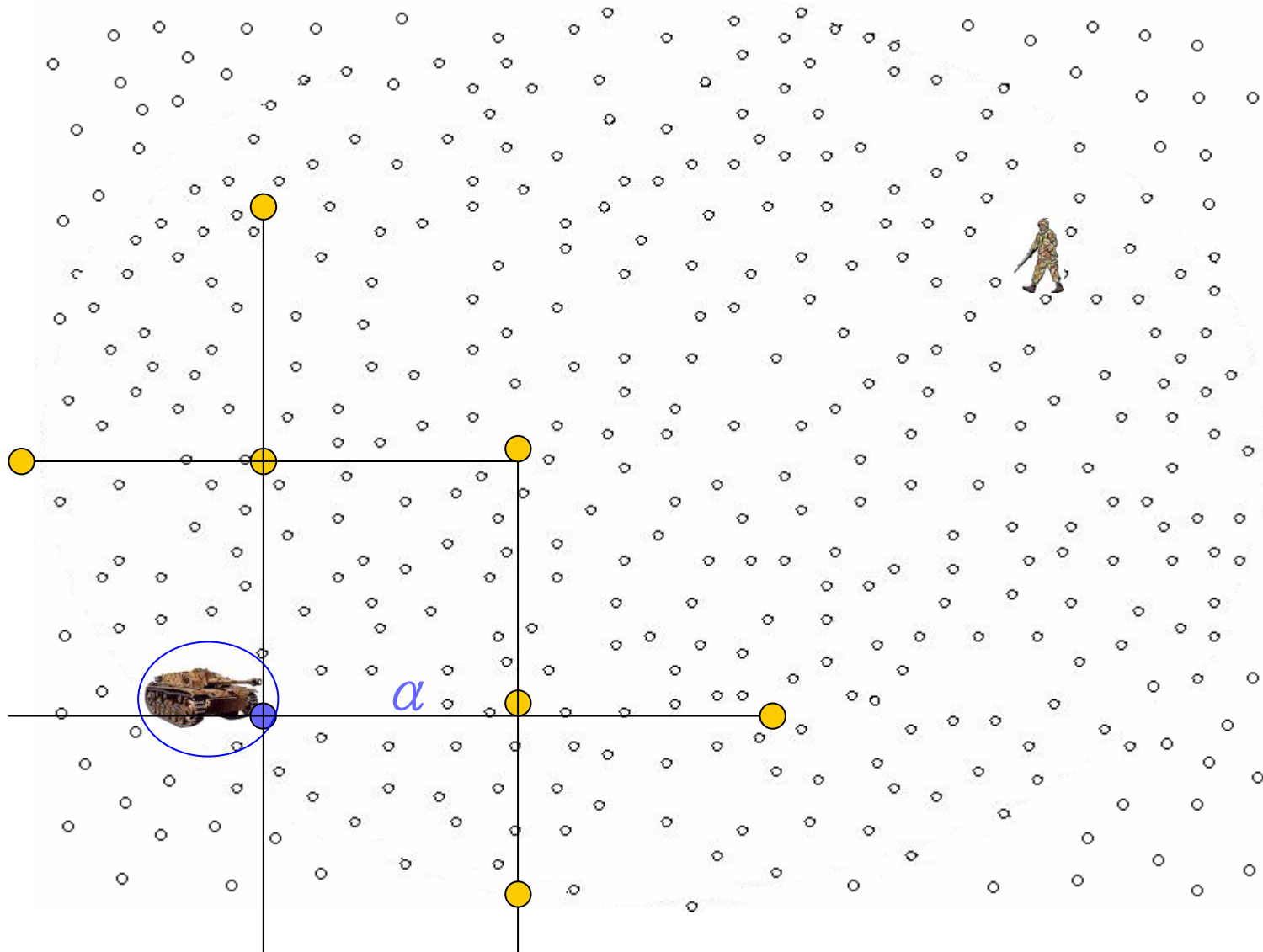
THANK YOU

TTDD
A Two-tier Data Dissemination Model

- F. Ye, H. Luo, J. Cheng, S. Lu, and L. Zhang. (UCLA) "A two-tier data dissemination model for large-scale wireless sensor networks" *Mobicom 2002*
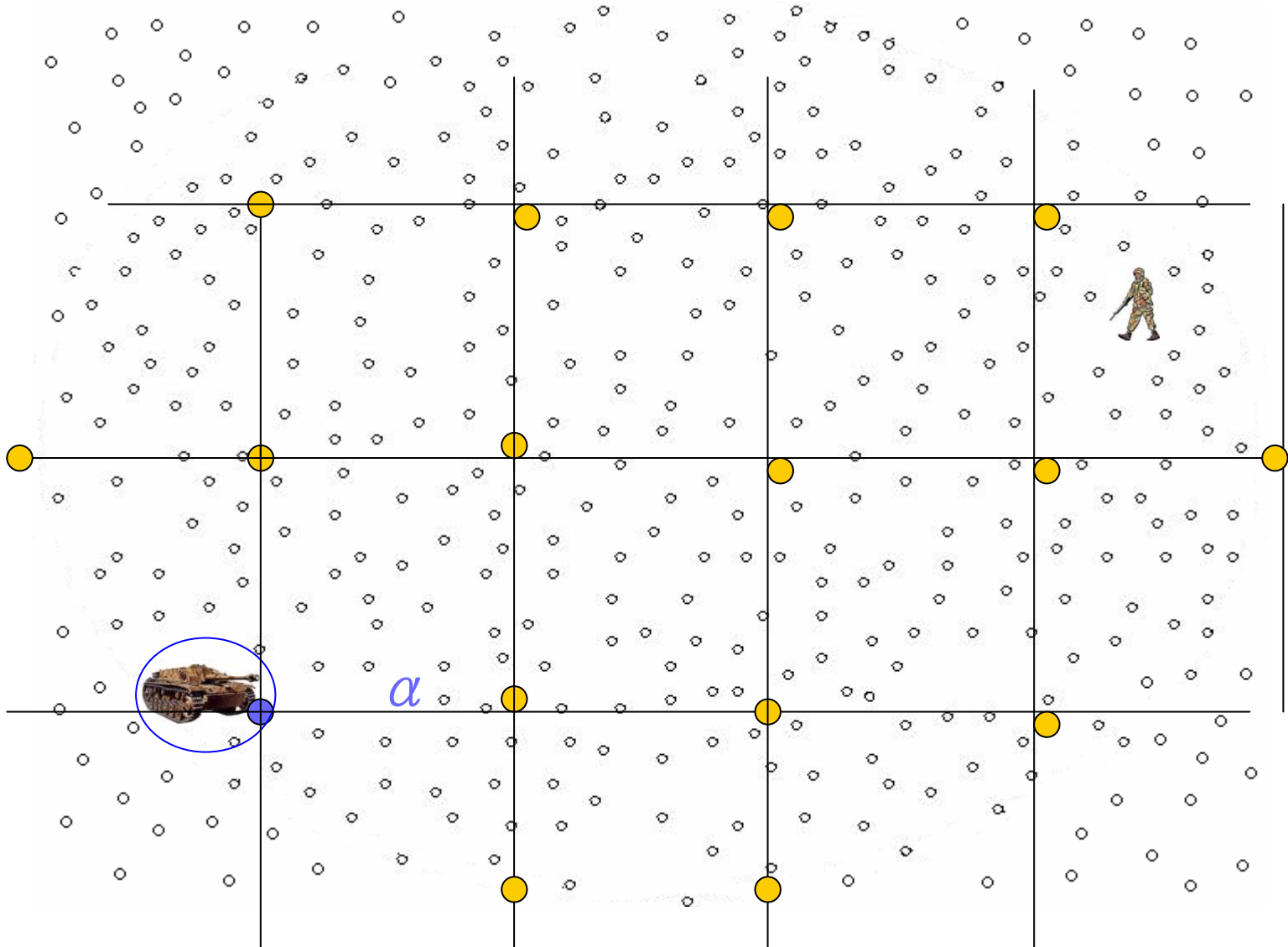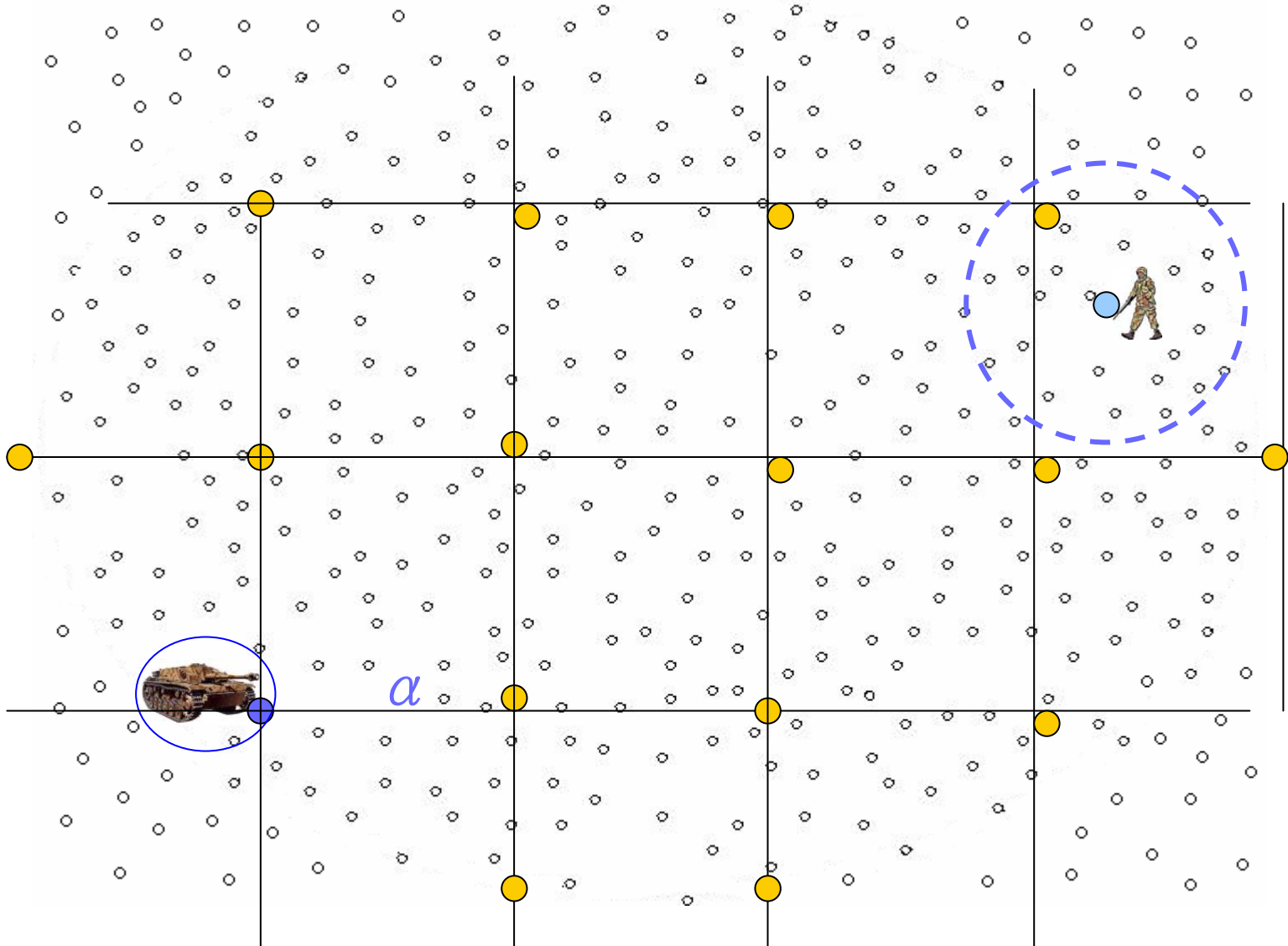
TTDD - Grid construction

Dissemination node

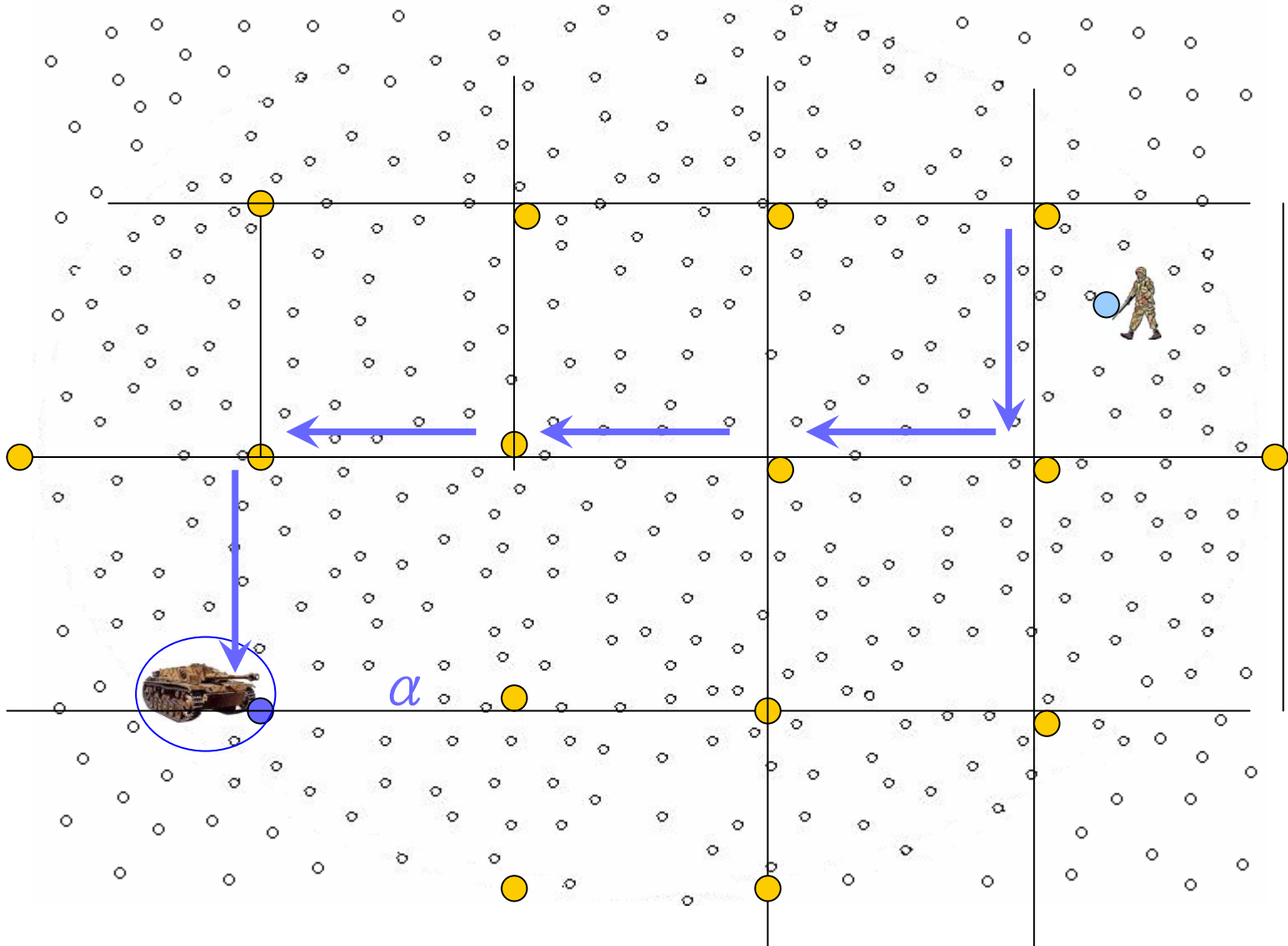α

TTDD - Grid construction

α
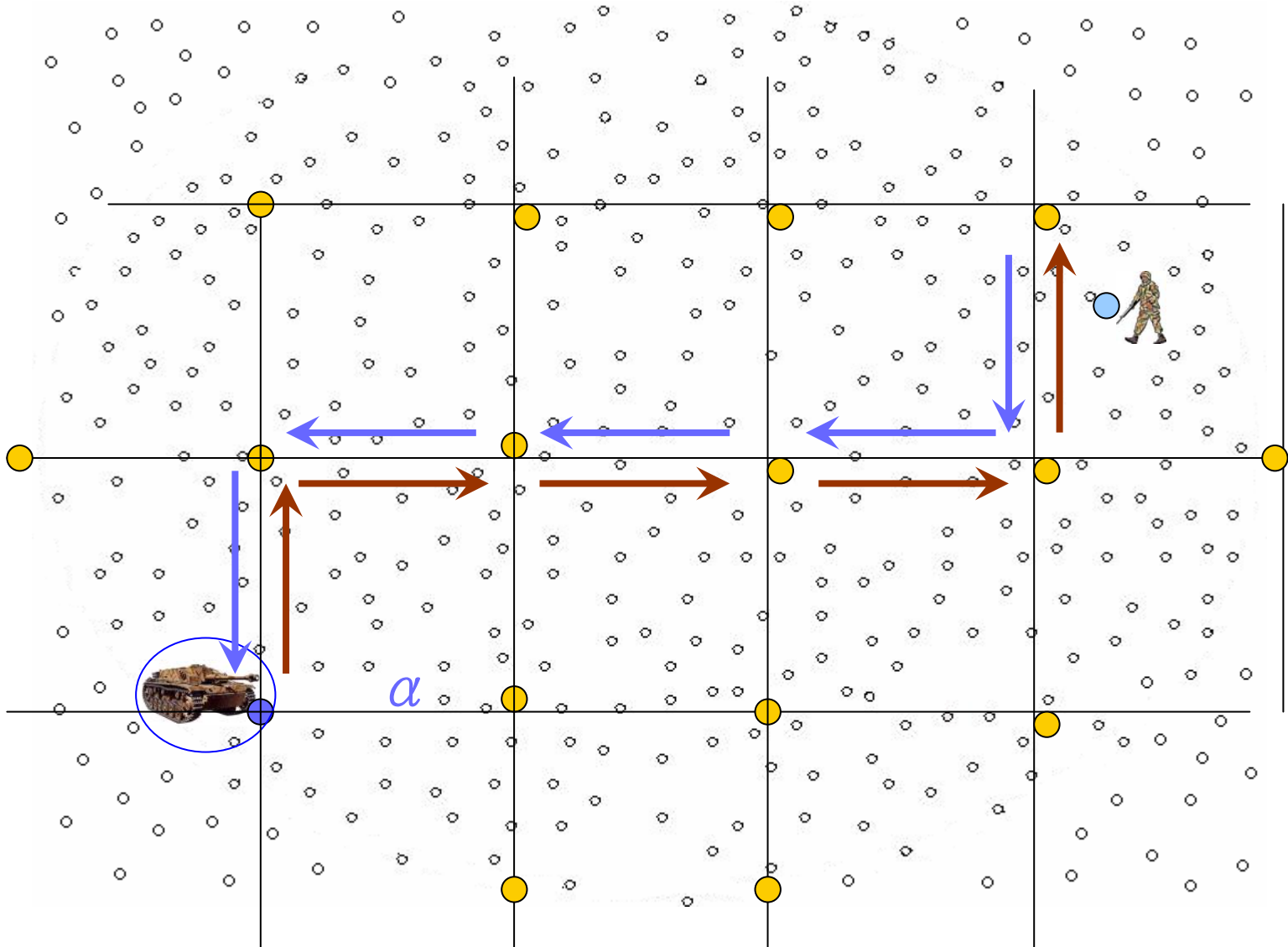
TTDD - Grid construction

α

TTDD - Two-Tier query and data forwarding

α

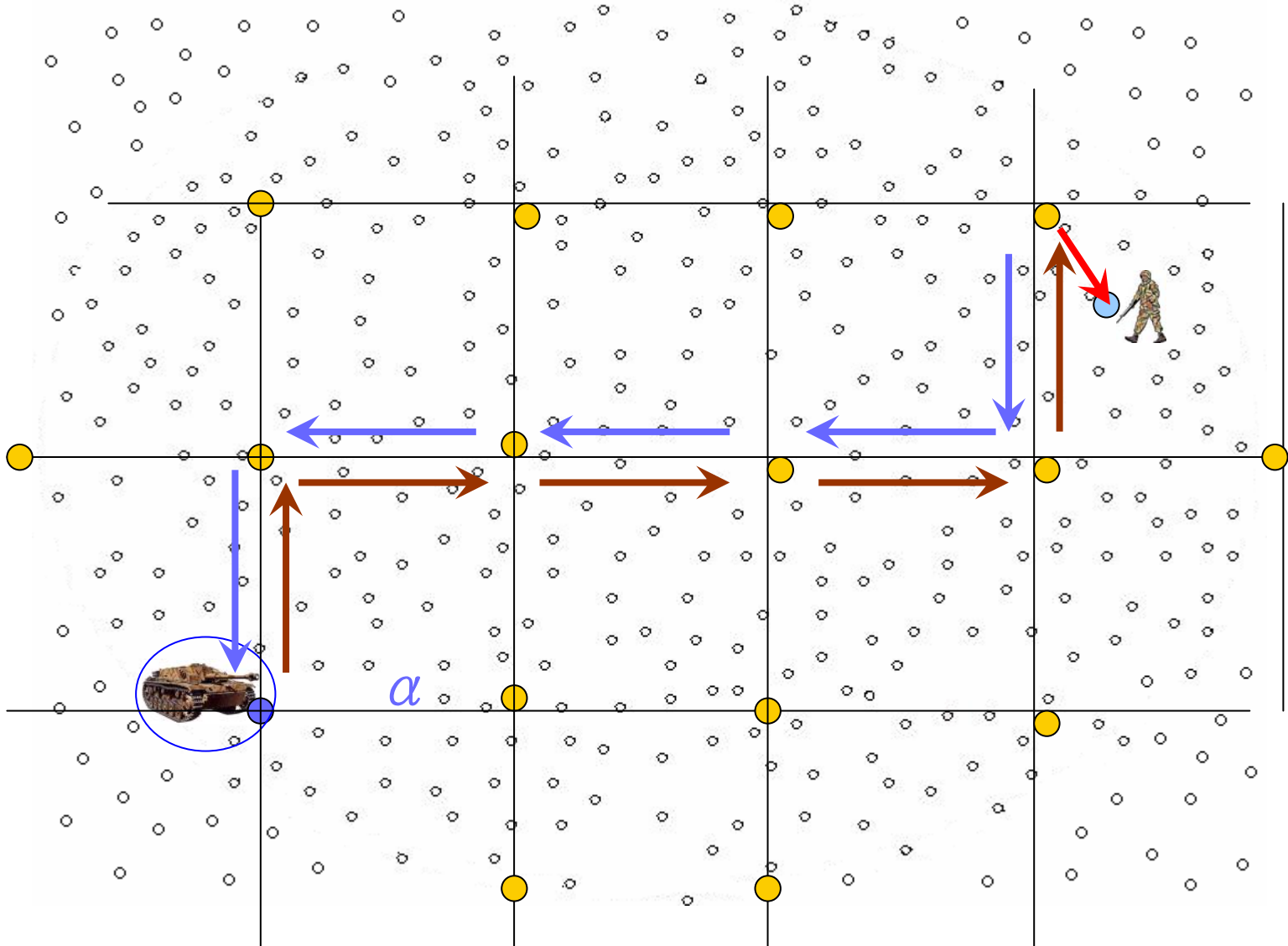# TTDD - Two-Tier query and data forwarding

α

TTDD - Two-Tier query and data forwarding

α

TTDD - Two-Tier query and data forwarding

α

TTDD - Conclusion

- Advantage
  - Construct & maintain a grid structure with low overhead
  - Can effectively deliver data from multiple sources to multiple mobile sinks
- Disadvantage
  - The grid construction and maintenance per each source leads to a considerable overhead
  - Routing overhead