Mobile Agent Middleware for Sensor Networks: An Application Case Study

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Mobile Computing Laboratory

Agilla Middleware

Node (1,1)   Node (2,1)

migrate
remote access

Agents
Neighbors | Tuplespace
Agilla Middleware
TinyOS
MICA2 Mote

Agents
Tuplespace | Neighbors
Agilla Middleware
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MICA2 Mote

• Mobile agents increase a network's flexibility
  • Proactively moves and clones across nodes
  • Adapts to unexpected circumstances
  • New agents can always be injected
• Middleware simplifies development providing
  • a high-level agent abstraction and language
  • context discovery
  • multi-hop geographic forwarding

Agent Architecture

Stack
Pointer
0 8-bit
1
n

16-Bit Registers
ID
PC
Condition

Heap
0 32-bit
1
11

Stack-based to reduce code size

Agilla Programming Language

```
1:  BEGIN       pushn fir
2:              pushc 1
3:              out // insert fire tuple
4:  BLINK       pushc 25
5:              putled // toggle red LED
6:              pushc 1
7:              sleep
8:              rjump BLINK
```

Clone (2,6)

Clone (4,6) Clone (5,7)

Move (3,5)

Move (2,4)
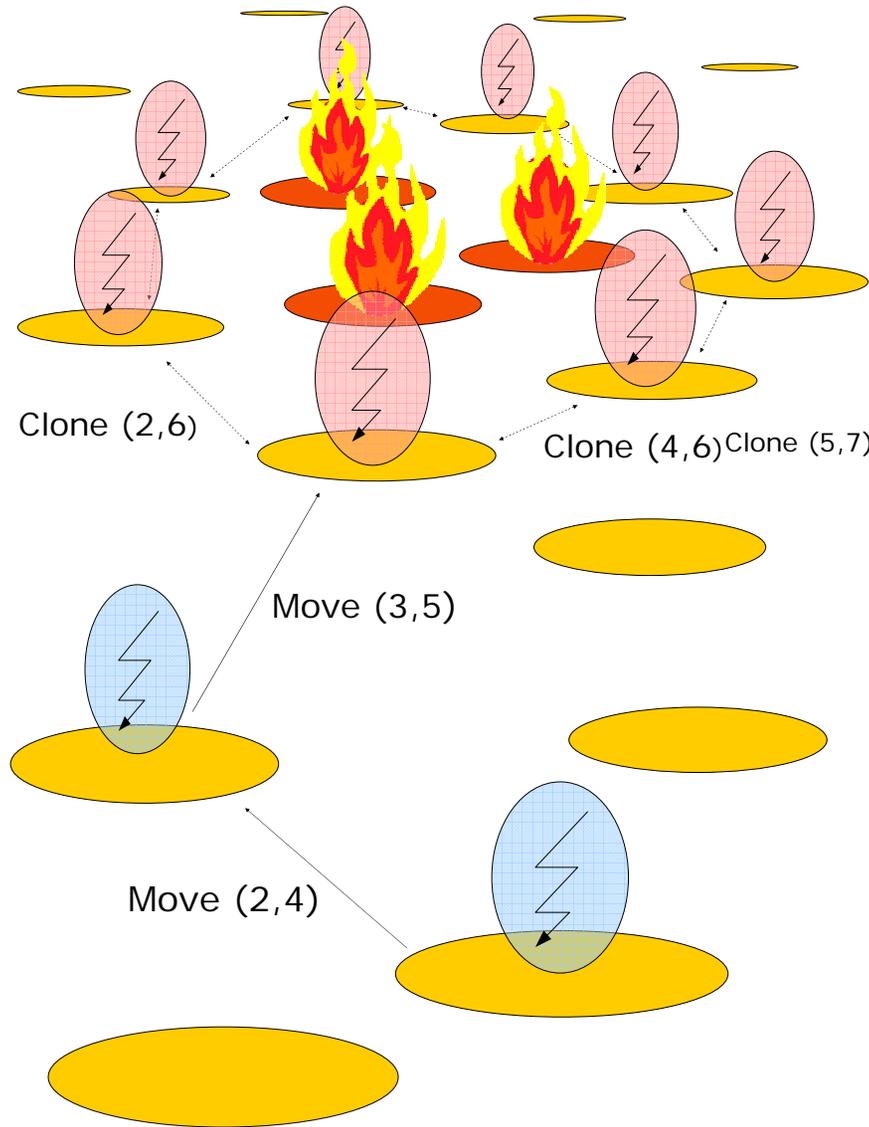
Mobile agents swarm around a fire forming a perimeter

Fire Tracking using Mobile Agents

• Initially patrol the network looking for fire (fire encoded by a tuple in the tuple space)
• Upon finding fire, enter tracking mode
  • periodically check status of neighbors
  • clone to all neighbors in fire's vicinity
  • die if its node catches on fire

Experimental Setup

5x5 network of Mica2 Motes

Experimental Results

Static Fire Tests: Percent Perimeter Formation vs. Time

Static Fire

Percent Perimeter Formation Over Time Using Dynamic Fire

Epidemically Spreading Fire