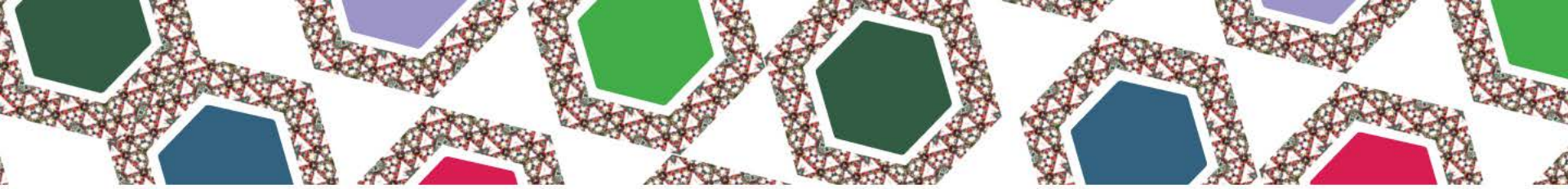


ITU Kaleidoscope 2013
Building Sustainable Communities

System design and numerical analysis of adaptive resource discovery in wireless application networks

Wei Liu, Nishio Takayuki, Ryoichi Shinkuma
Graduate school of Informatics ,
Kyoto university, Japan
liu@cube.kuee.kyoto-u.ac.jp

Kyoto, Japan
22-24 April 2013

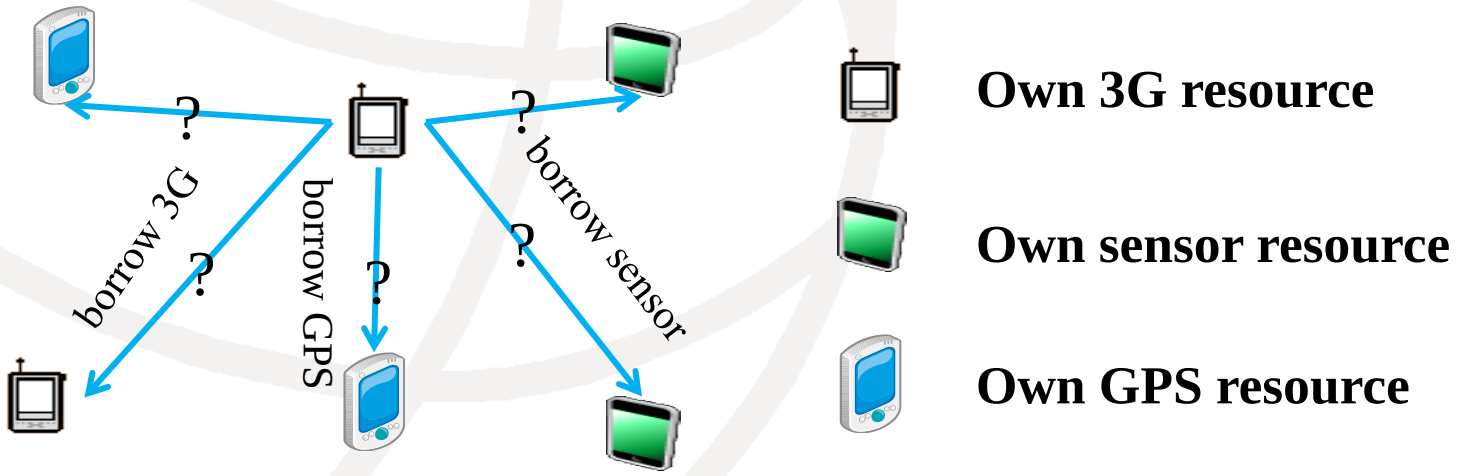
Outlines

- Background and application scenario
- System model and problem definition
- Proposed resource discovery method
  - Resource discovery modes
  - Resource Information availability (RIA)
  - Heuristic method
- Numerical evaluation
- Conclusion

1. Background and application scenario

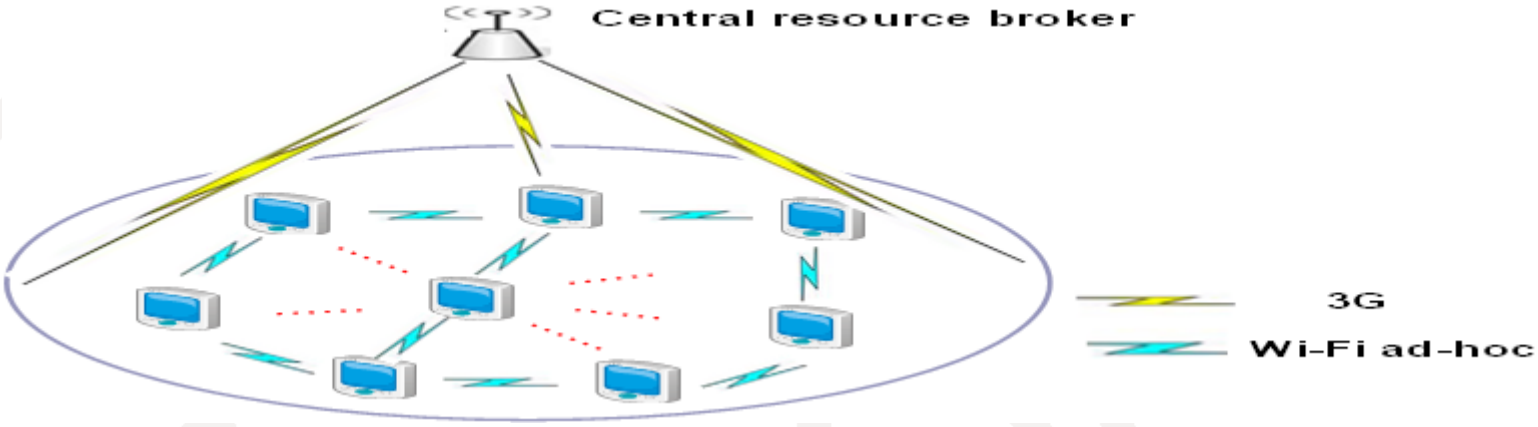
Background and scenario

- 1 Modern mobile devices own many kinds of resources - High energy cost.
- 2 Resources in distributed devices can be utilized opportunistically (wireless application networks).
- 3 Resource sharing in the wireless application networks aims at enhancing functionality and improving performance of a single device.



2. System model and problem definition

System model and problem definition



1. 3G cellular: Long-range, high energy consumption
2 . WLAN ad-hoc: Short-range, low energy consumption

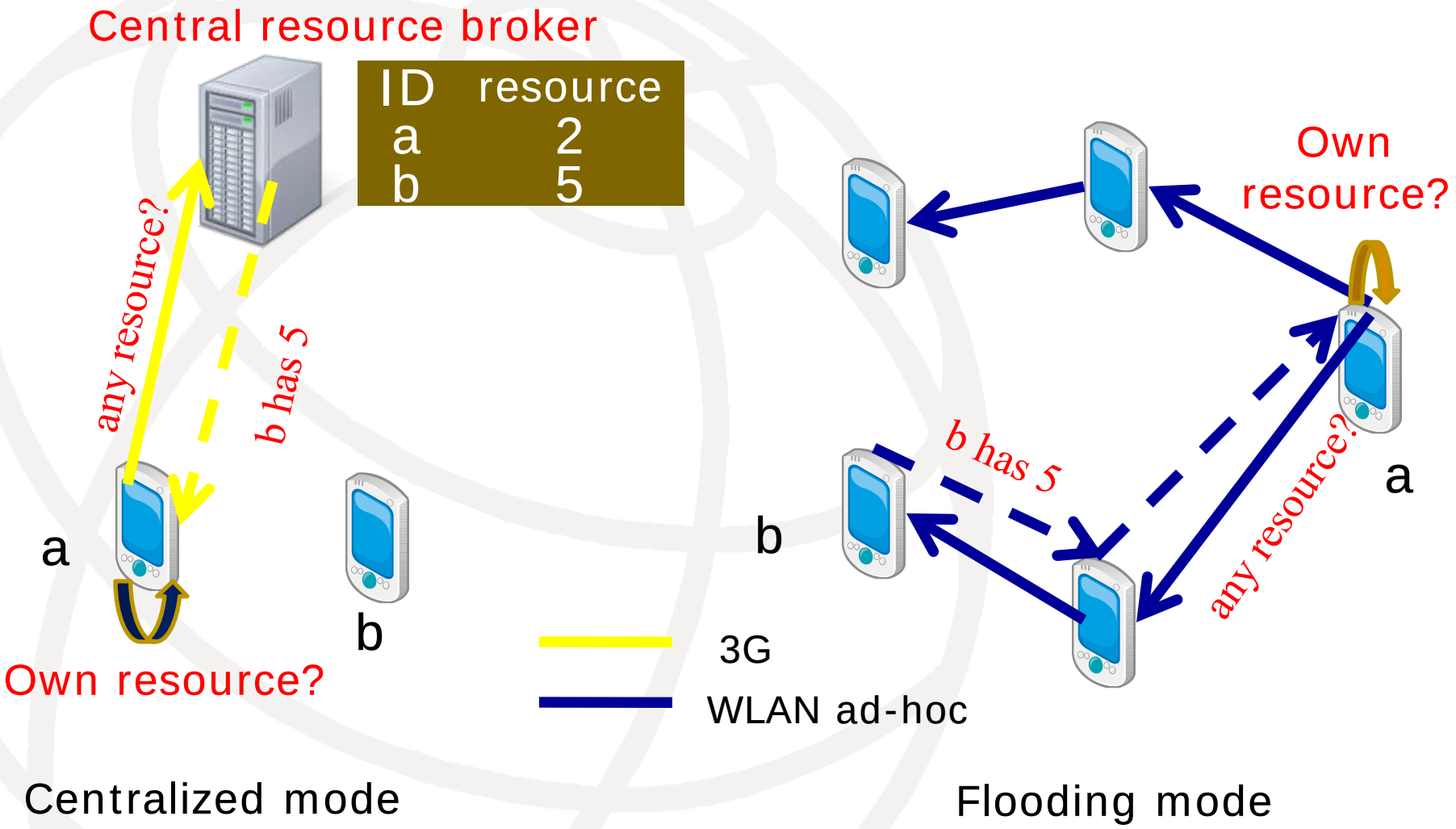
Problem definition:

Objective: Minimize energy consumption in resource discovery process

Constraint: E[Resource Information Availability] $\geq R_{thresh}$

3. Proposed resource discovery method

Resource discovery modes



Resource information availability (RIA) definition

Available resource changes:

1 Allocating and releasing resource for task from itself

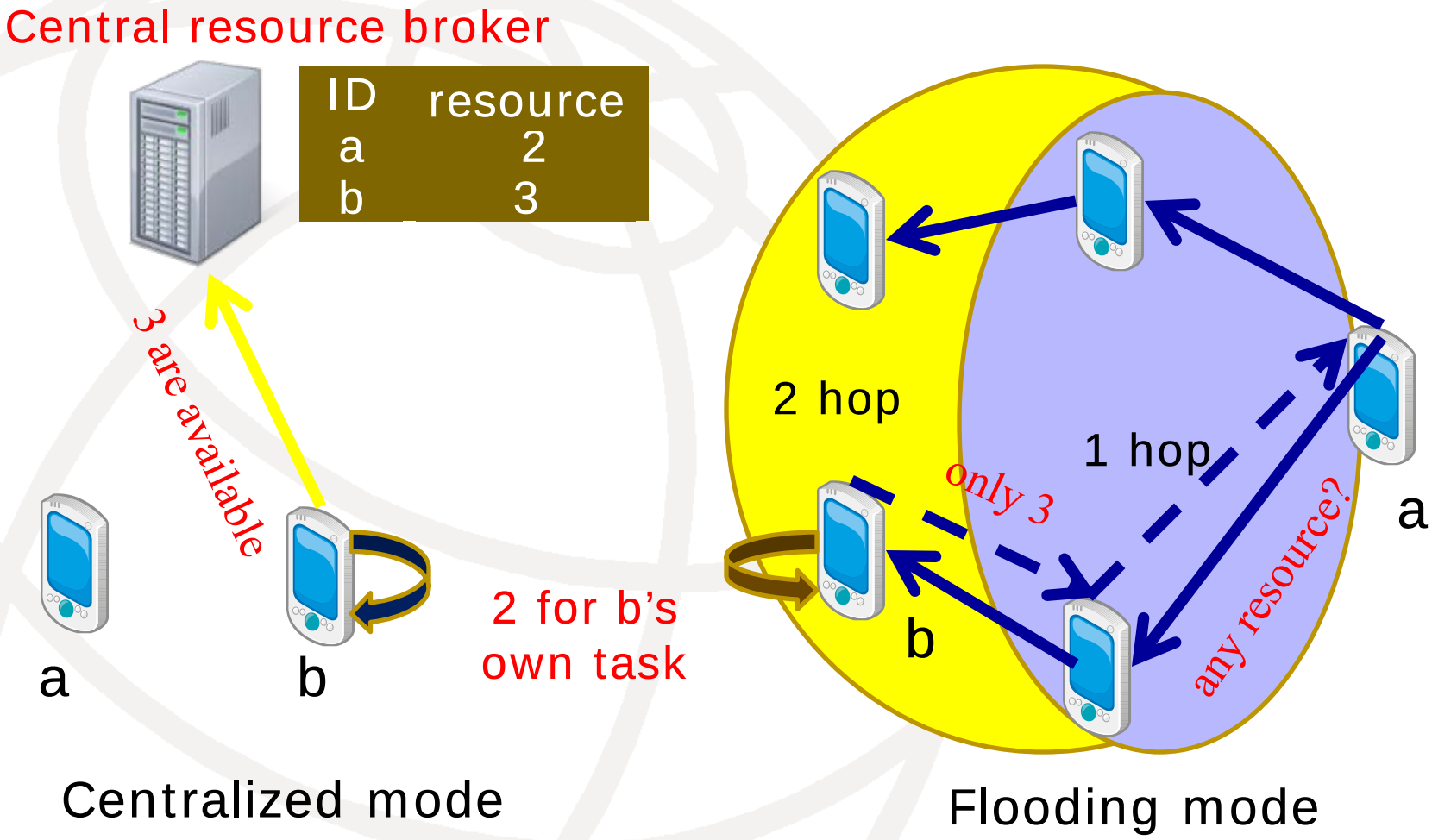
2 Allocating and releasing resource for task from other nodes

Resource information availability (RIA):

The possibility that the response to a request includes all available resource information accurately.

① Correctness ② Coverage

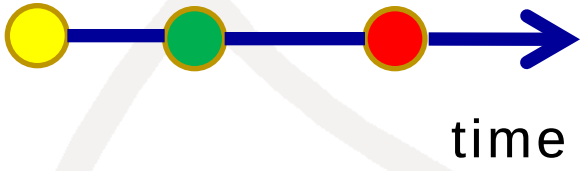
RIA Maintainence



RIA VS Energy consumption

Centralized mode

To save energy, wait for a period of time before updating.



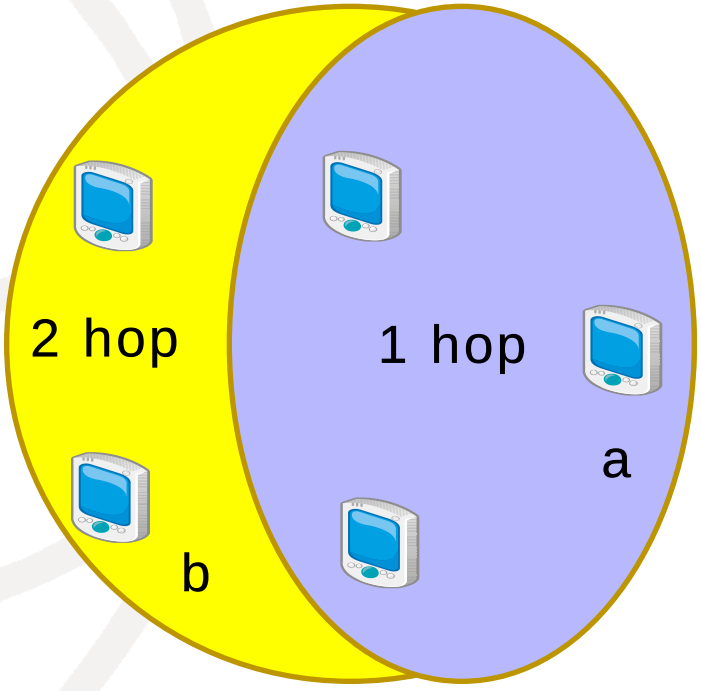
Last updating

Available resource changed

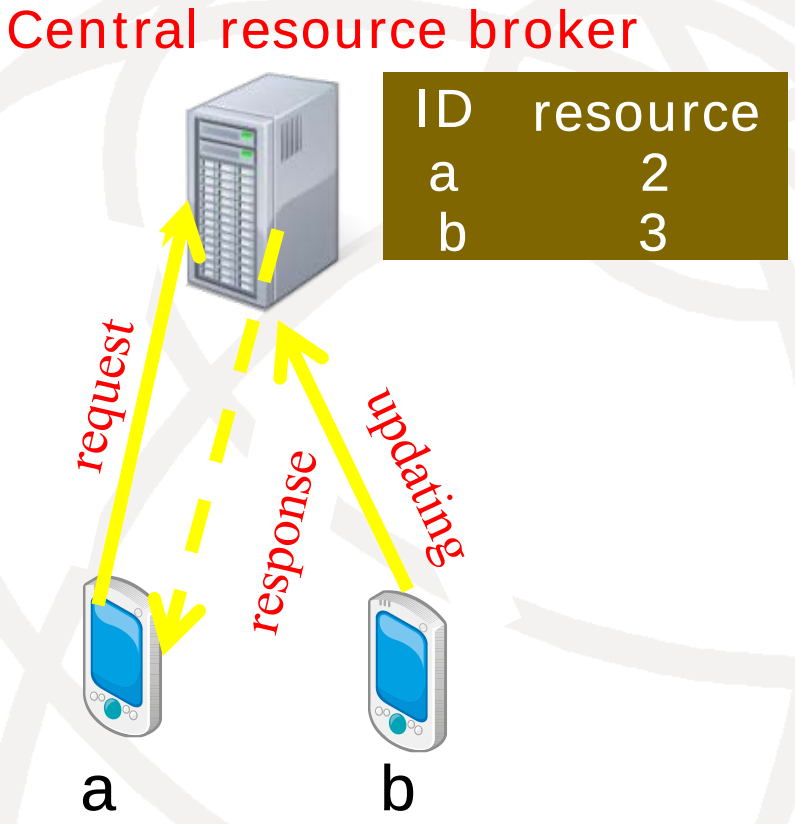
Next updating

Flooding mode

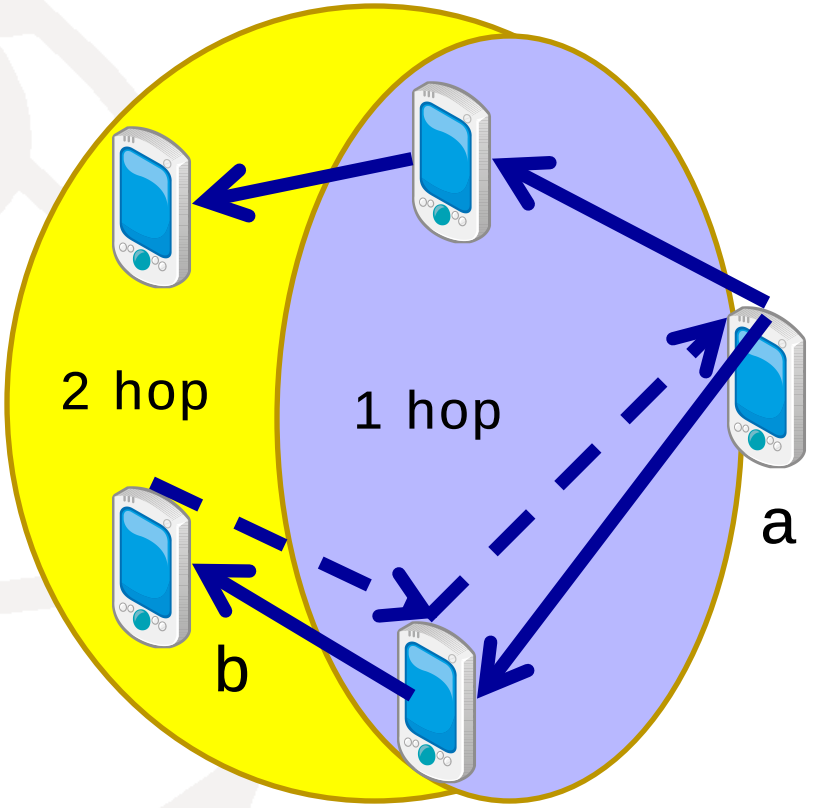
To save energy, adopt smaller TTL values.



Energy consumption factors



C(request, response, updating)



F(request, response, TTL)

Proposed resource discovery method

Key idea:

Transform between centralized and flooding discovery strategies according to network status to save energy consumption.

Heuristic method:

(1) Time is divided into discrete time slots.

(2) At the end of every time slot, all nodes send three statistics to the central resource broker.

① Number of resource requests to other nodes

② Average number of responses for each request

③ Number of RIA updating

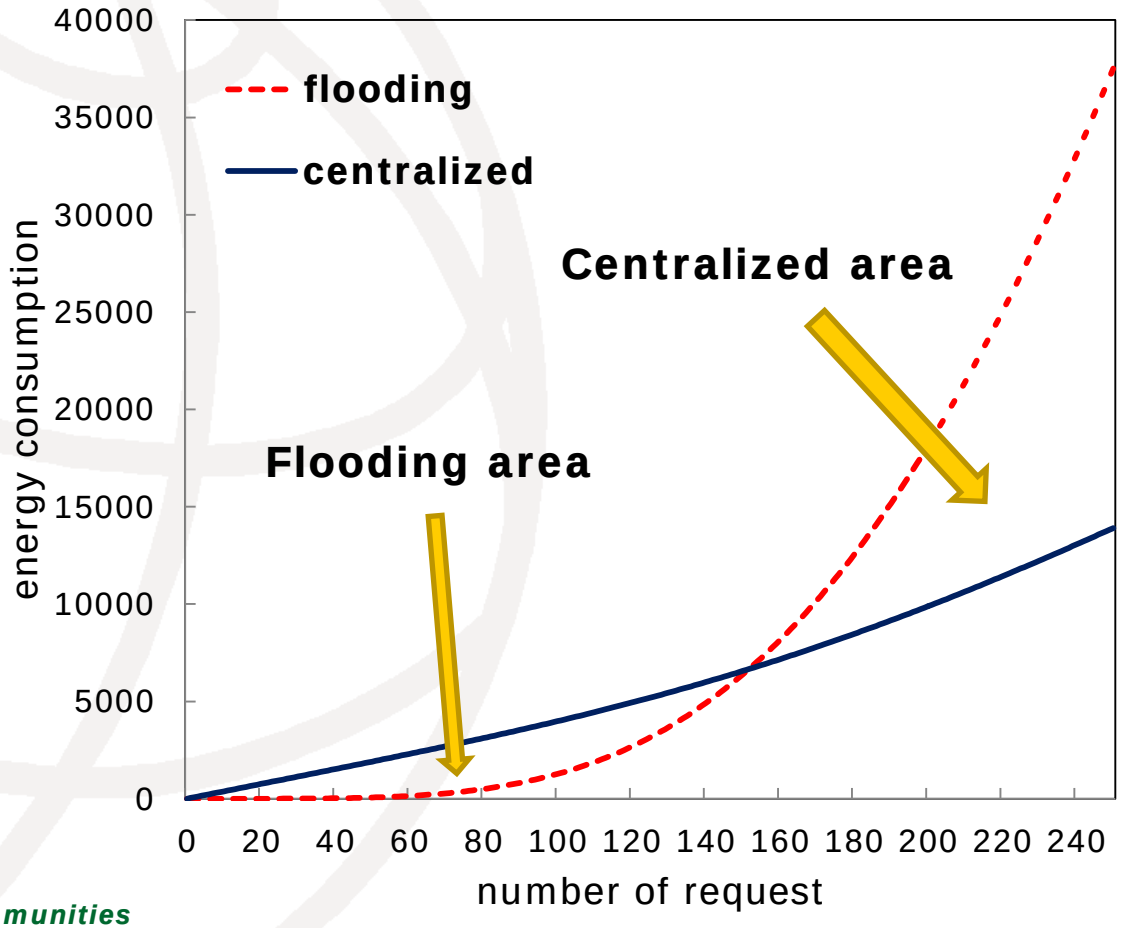
(3) Central resource broker chooses the strategy that is assumed to be energy efficient in the next time slot and notify all nodes.

4. Numerical evaluation

Scenario and parameters

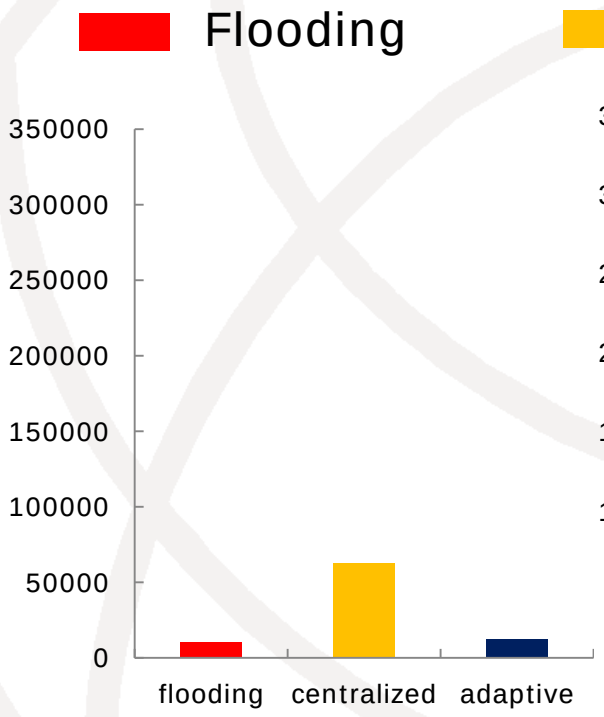
- Nodes are distributed in a rectangular area uniformly. They can discover resource through both 3G and WLAN ad-hoc networks.

parameter	value
Space area	1000m*1000m
Nodes Number	100
WLAN ad-hoc range	250m
3G transmission energy	20
3G receiving energy	10
WLAN transmission energy	1
WLAN receiving energy	0.5

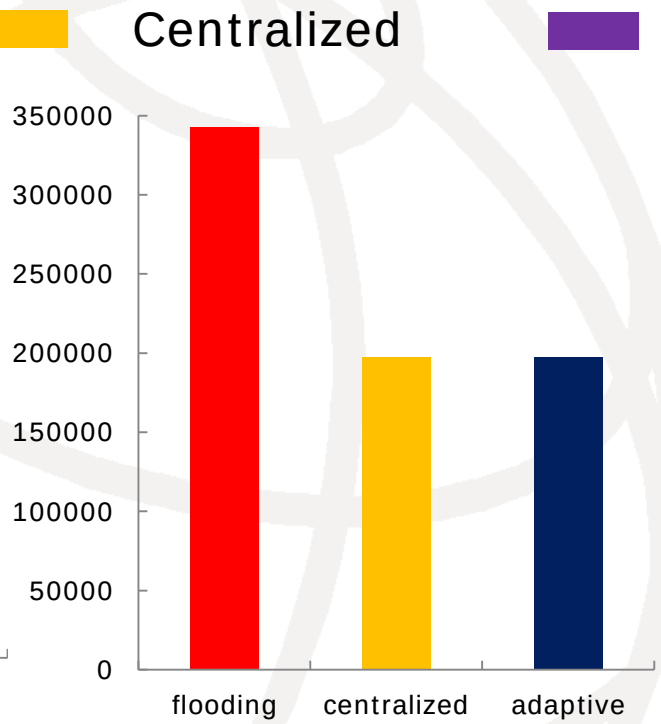


Performance in extreme situations

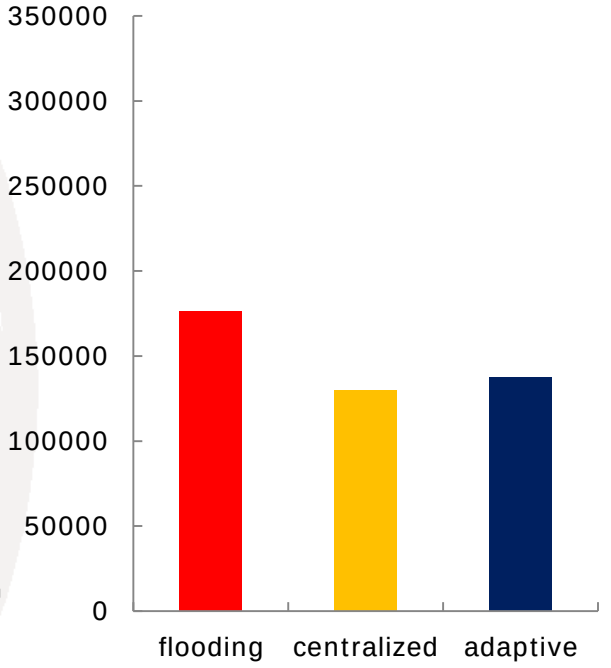
- When the network status keeps in a single area, the proposed method always performs near to the better choice.



Flooding area (FR)



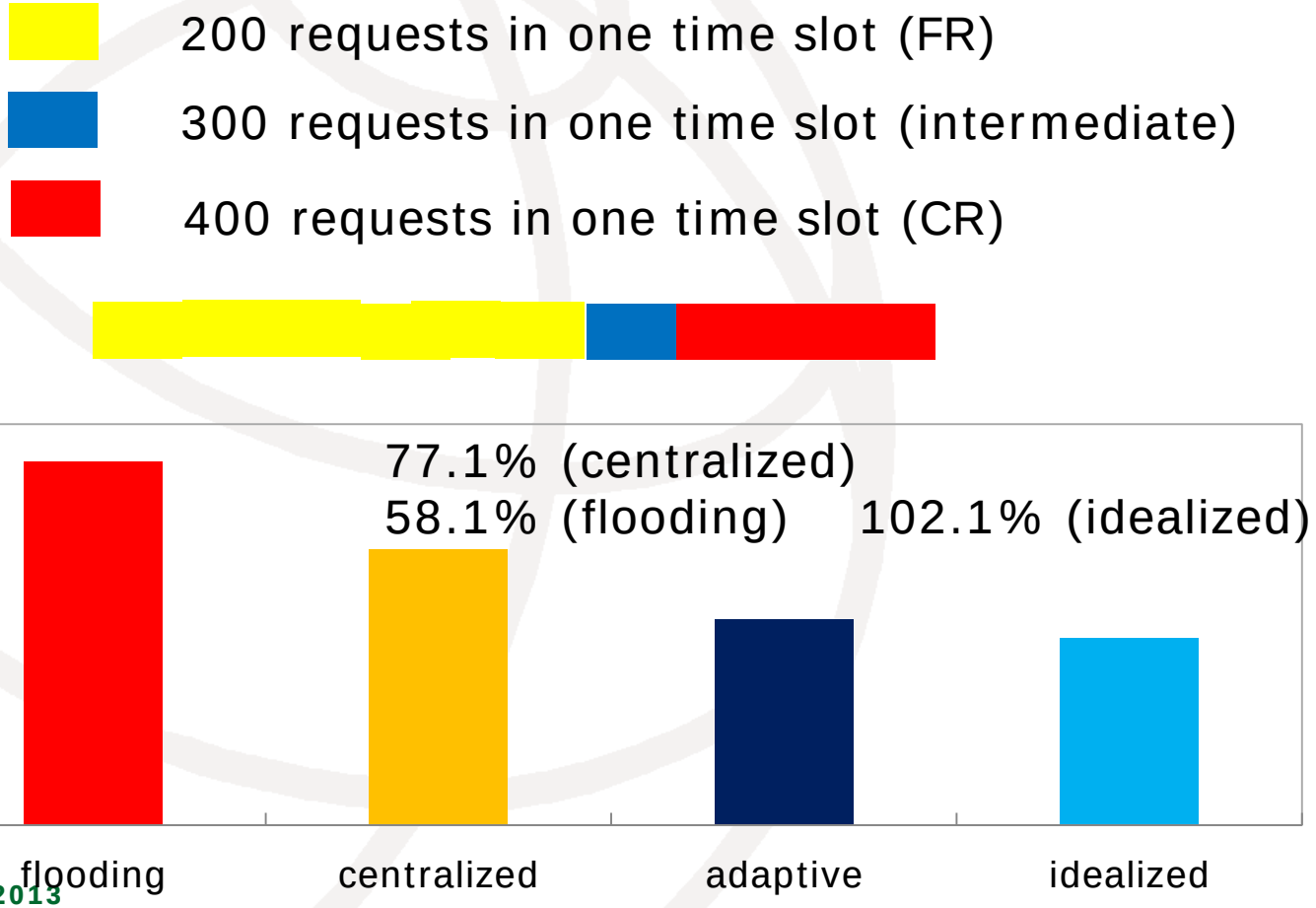
Centralized area (CR)



Fast oscillation
fast hopping between CR & FR

Performance in comprehensive example

- When the network status transforms between flooding and centralized areas, the proposed adaptive method performs better than both methods because of its adaptivity.



Conclusion

- 1 Introduce an adaptive resource discovery solution in wireless application networks. According to our best knowledge, the first proposition of adaptive discovery solution based on method transforming.
- 2 Theoretical analysis and heuristic method of the solution are given.
- 3 The efficiency of the proposed adaptive resource discovery solution was confirmed by extensive evaluations.

Thanks for your attention !

Wei Liu
Kyoto University, Kyoto, Japan
liu@cube.kuee.kyoto-u.ac.jp