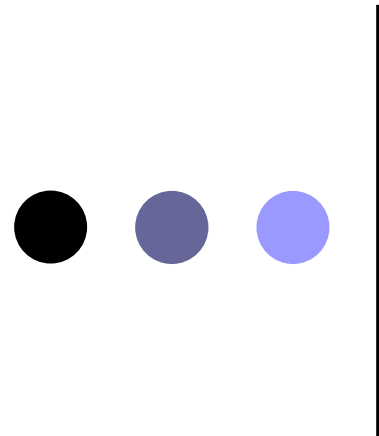




Design and implementation of P2P protocol for mobile phones

Hiromitsu SUMINO
NTT DoCoMo, Inc.



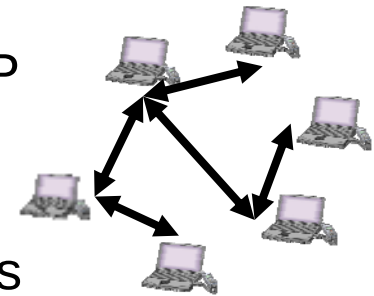
Outline

- Background & Motivation
- P2P networking platform
 - Architecture
 - Mobile phone support
 - Protocol for mobile phones
- Implementation
- Conclusion

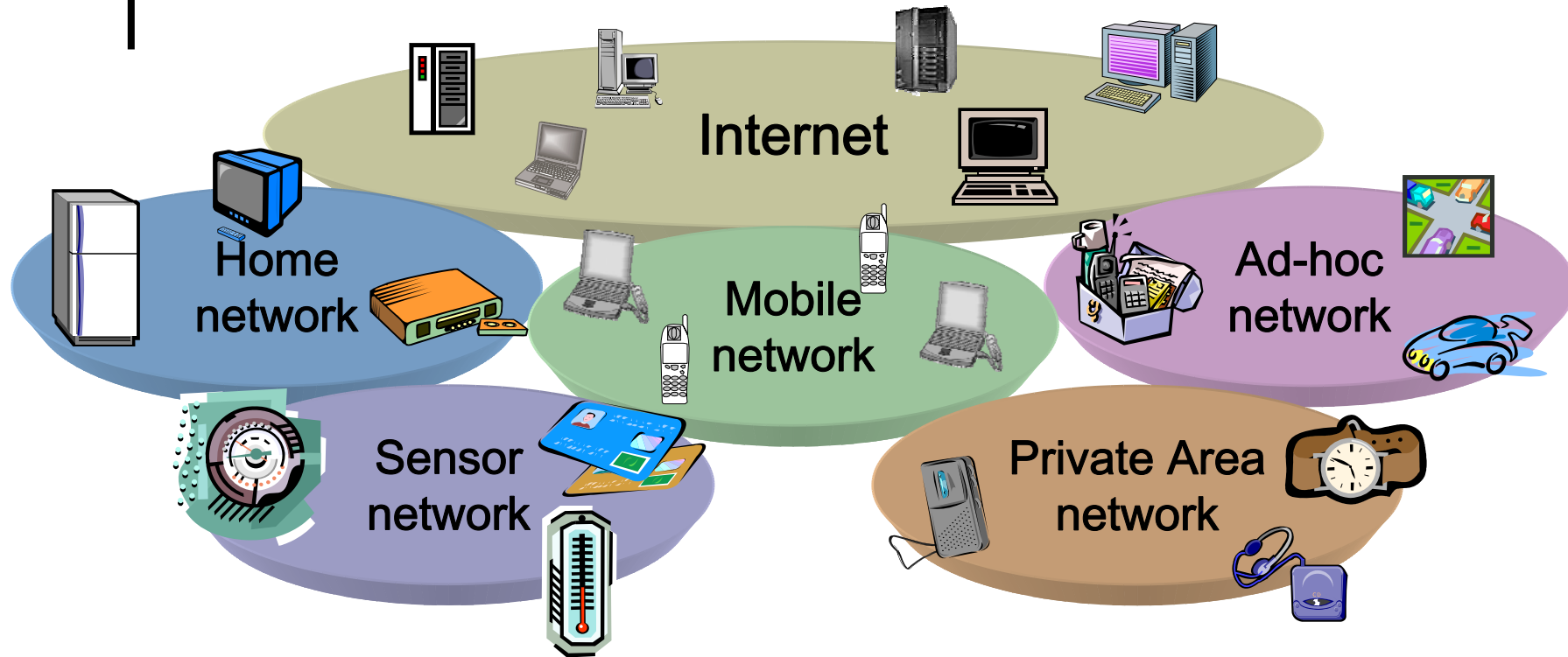
●●● | Background

- current P2P services

- P2P services such as Gnutella, Skype are widely used
 - VoIP, File sharing, Group ware, etc.
 - Implemented with their original protocols for P2P communication.
- General P2P platform which can be used for various applications
 - JXTA (SUN)
- **Current P2P applications are designed for using on the internet**
 - **Depend on IP network**

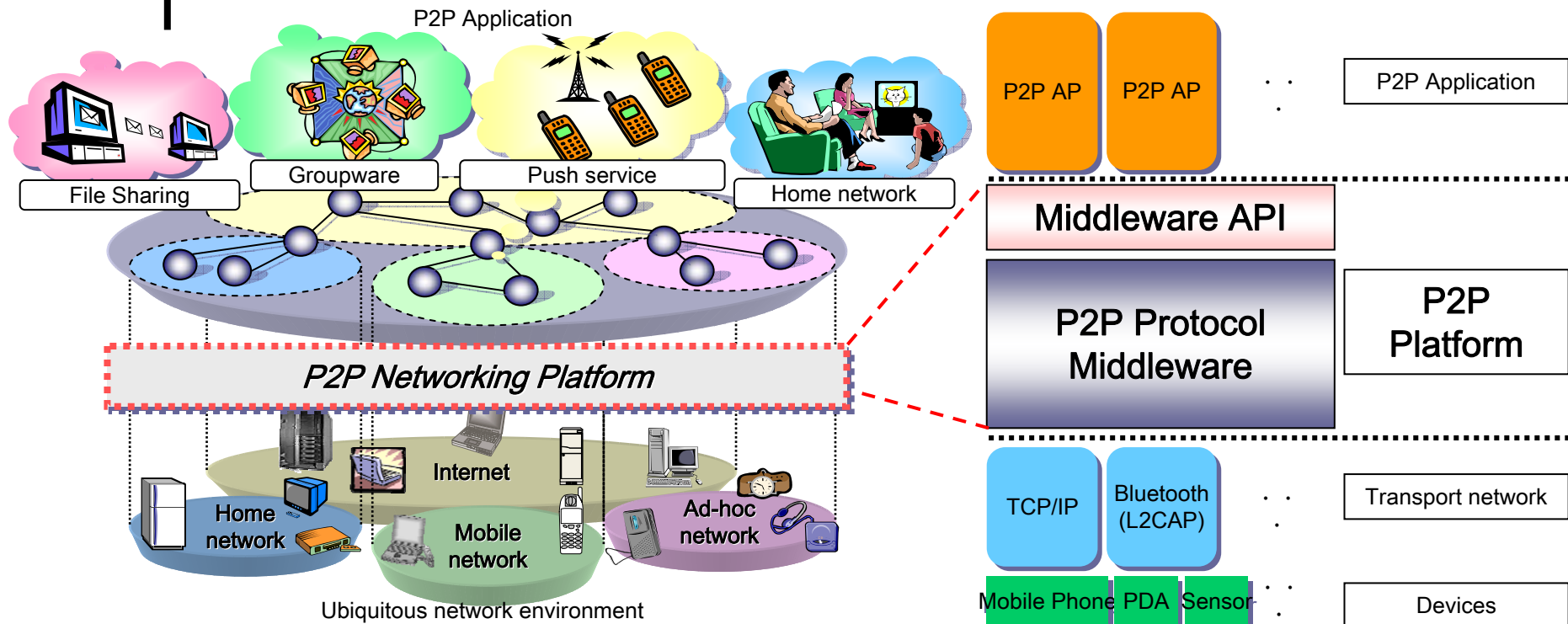


●●● Motivation



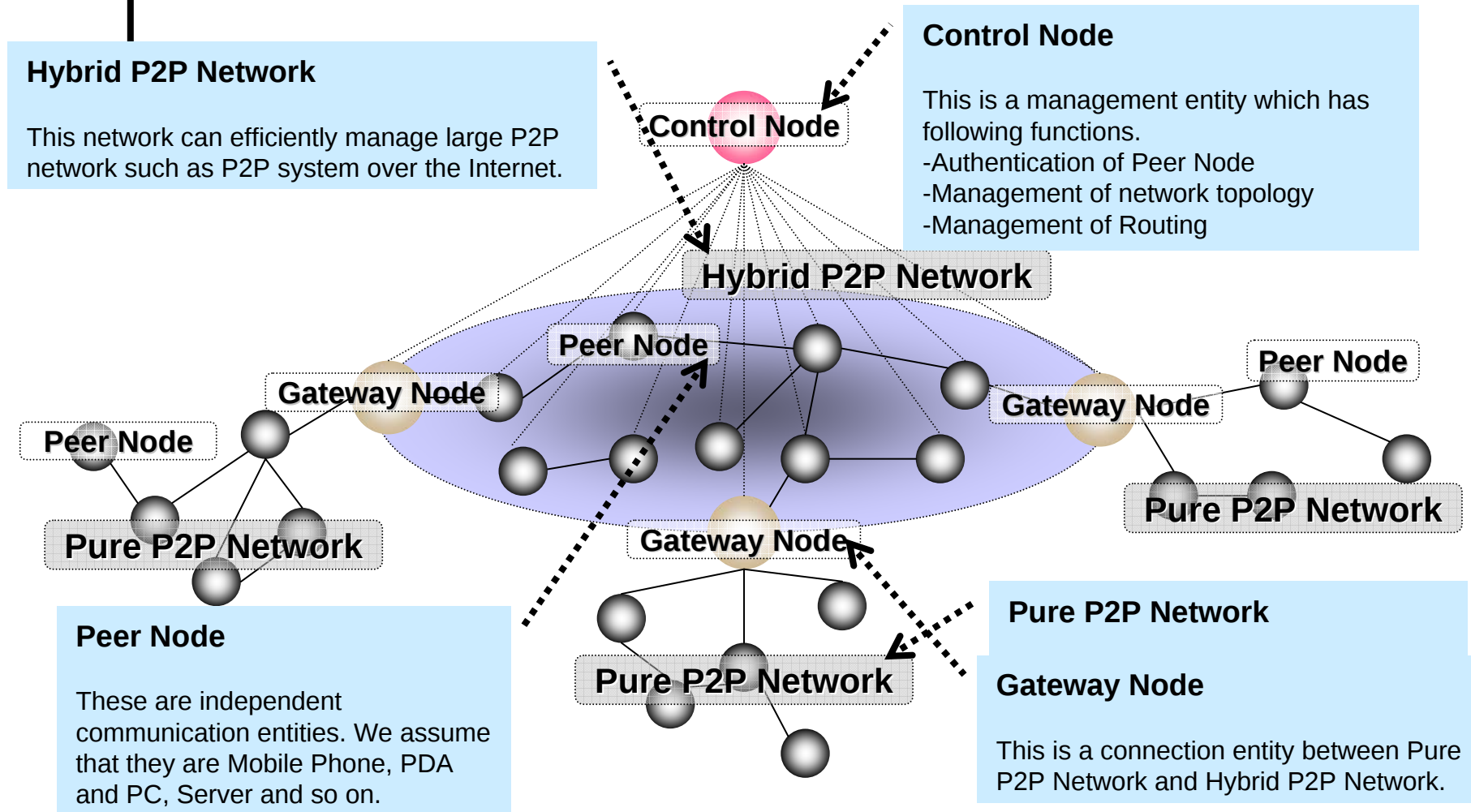
- Design a general P2P network architecture and protocols
 - Realize communication environment where various devices interconnect via various networks
 - Independent of P2P applications

Our Approach ~ P2P platform



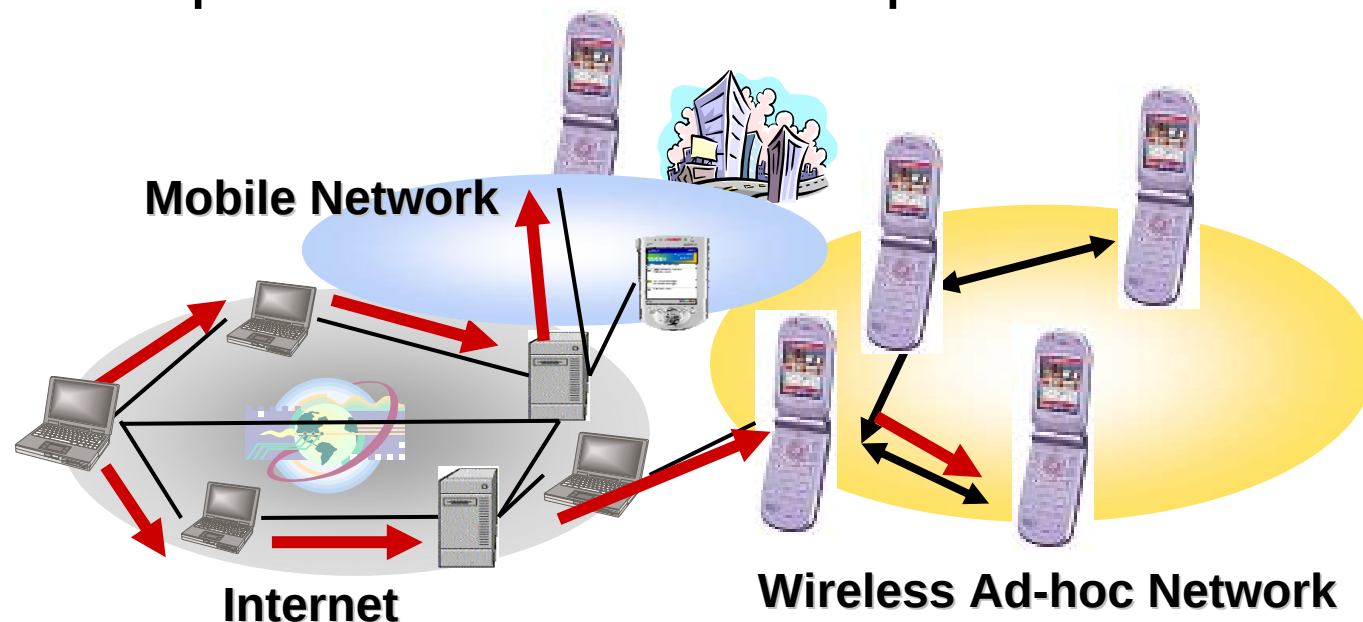
- Apply Peer-to-Peer communication to link heterogeneous network environments.
 - Realize Seamless connection between various devices via various networks
 - Independent of applications

P2P Platform - Architecture Overview



●●● Purpose of this study

- Apply our P2P platform to mobile phones
 - Design P2P protocol for mobile phone
 - Feasibility study by implementing the protocol on a mobile phone





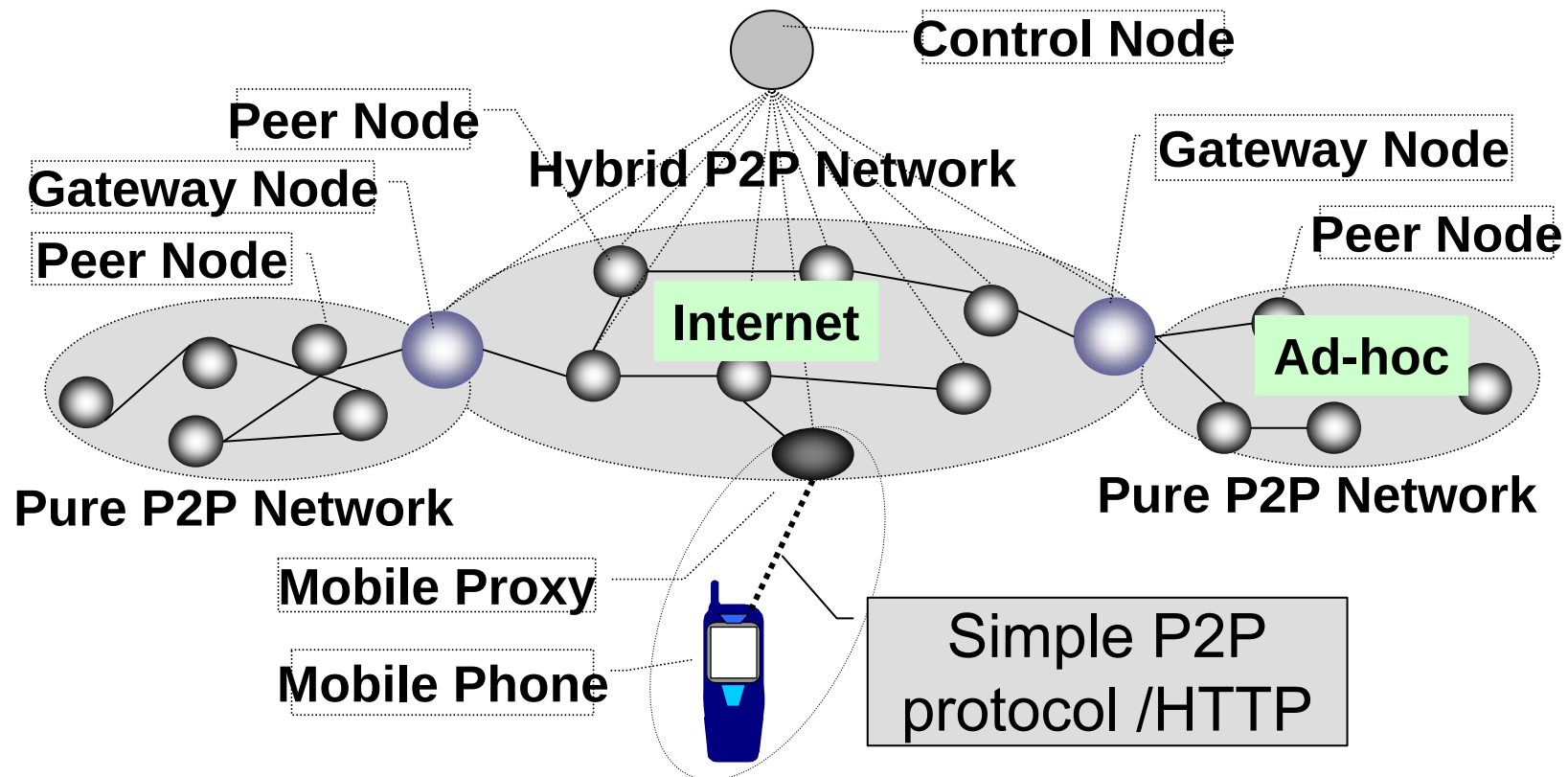
Communication with Mobile phone

- Communication over mobile networks
 - Most mobile phones supports only HTTP to access the Internet
- Local communication
 - Bluetooth, IrDA, W-LAN, etc.



Mobile phone support - over mobile networks

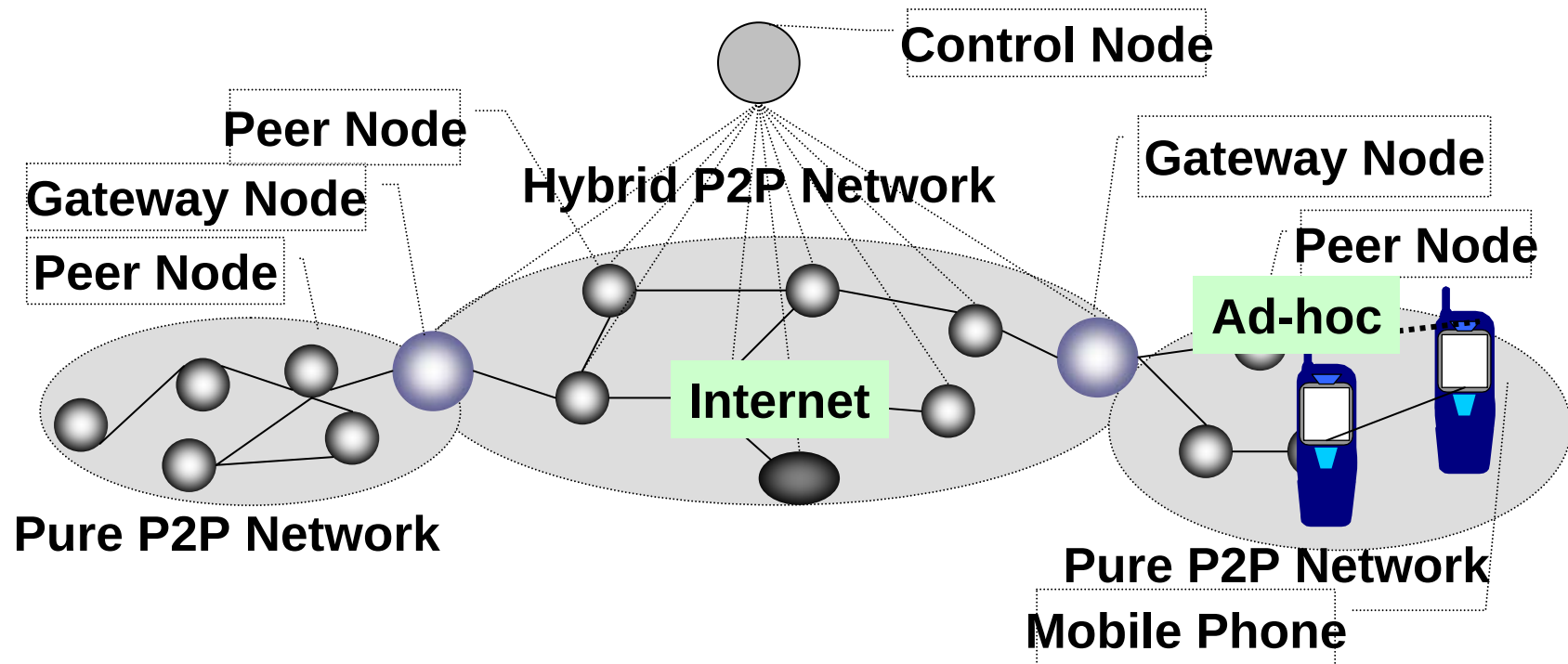
- Join the P2P network by way of proxy server





Support mobile phone - local communication

- communication on an ad-hoc environment
 - P2P communication between mobile phones
 - Communicate seamlessly across various networks



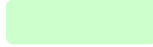


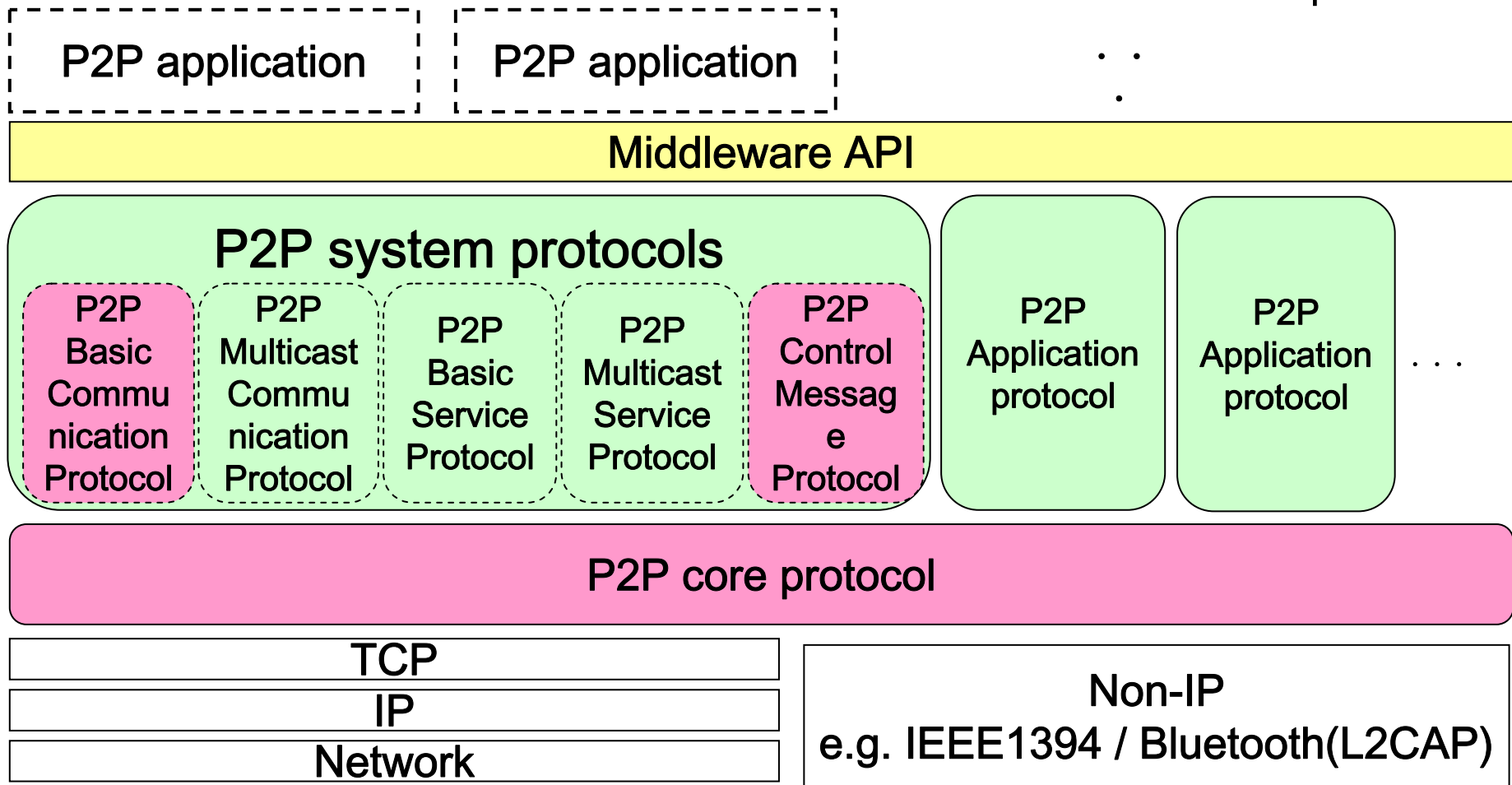
Protocol design

- Requirements for mobile phone

- Define simple profile of the P2P platform by
 - Extract minimum functions
 - Classify the protocol functions as option or mandatory

P2P Platform for mobile phone

 : Mandatory
 : Option





P2P Core Protocol (mandatory)

- **P2P Node naming**
 - **Uniqueness, network independent, privacy, etc.**
- **P2P Routing**
 - **Source routing using node name**
- **Communication type**
 - **unicast, multicast, broadcast**
- **Message type**
 - **Advertise, Request/Response**



P2P System protocols (mandatory)

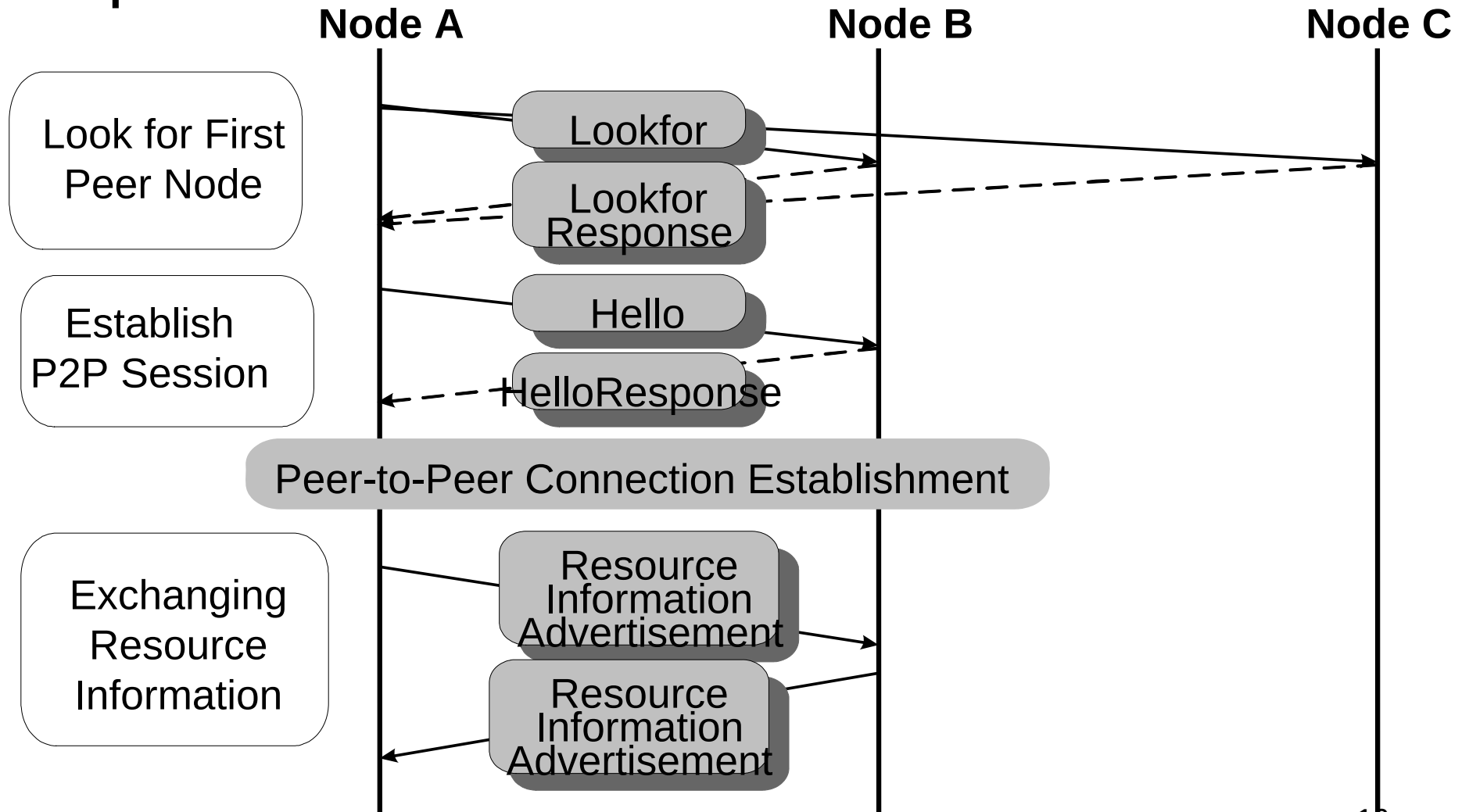
- **P2P session management**
 - **establish P2P session between nodes**
 - **Resource exchange**
- **P2P control message**
 - **Node discovery (first peer discovery)**
 - **Error report**
 - **Diagnose network topology**



P2P System protocols (Option)

- P2P multicast
 - join or leave multicast groups
 - Forward messages among a multicast group
- P2P Security
 - Node authentication
 - Signature
 - Message encryption
- Service Protocol
 - Network Control on hybrid P2P networks

●●● Message sequence





Message example

- access via Proxy

- The parameters of P2P protocol is converted to simple text format
- Embedded on the body of HTTP protocol

P2PFRM 92

Source: (node ID of the cellular phone)

MulticastGroupID: (destination multicast group ID)

ApplicationURI: http://www.mml.yrp.nttdocomo.co.jp/ED/2003/03/p2p_instantmsg_app

InstantMessage

UserMessage: Hello!

FRMEND



Message example

- ad-hoc

P2P
Core
Protocol
Paramet
ers

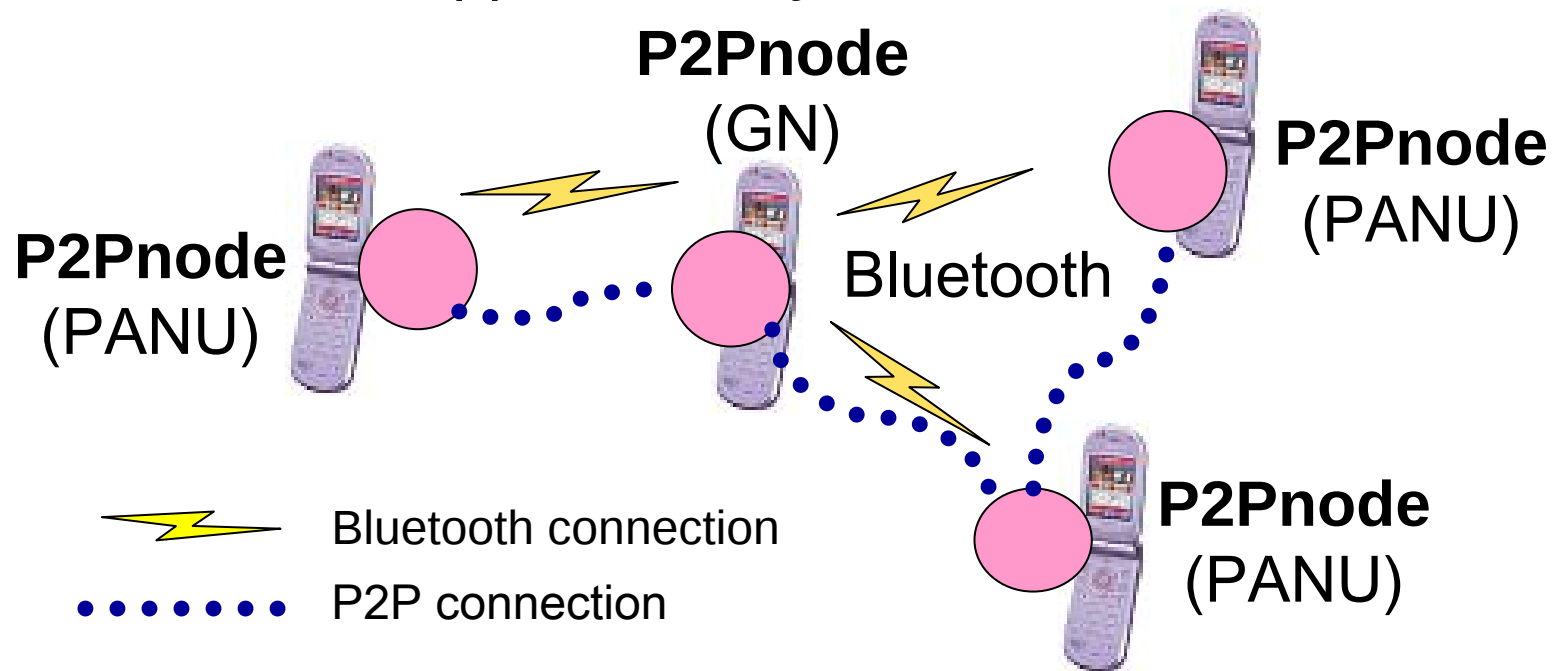
```
<Core xmlns="Namespace of P2P Core Protocol">
  <MsgType>Request</MsgType>
  <MsgID>12345.2002-12-20T16:15:32Z@968742ab-f9bb-
    4305-9900-f98e56f12352</MsgID>
  <Destination>
    <Target>874542ab-a5c6-4305-8745-f98e56f12547</Target>
  </Destination>
  <Source>968742ab-f9bb-4305-9900-f98e56f12352</Source>
  <ComType>Unicast</ComType>
  <MsgBody protocol="Namespace of P2P Communication Protocol">
```

P2P
System
Protocol
Paramet
ers

```
    <Hello xmlns="Namespace of P2P Communication Protocol">
      <Mode>Hybrid</Mode>
      <RequestedCapability>
        <ExtendedProtocol ID=1>MulticastCommunication</ExtendedProtocol>
        <ExtendedProtocol ID=2>MulticastService</ExtendedProtocol>
      </RequestedCapability>
    </Hello>
  </MsgBody>
</Core>
```

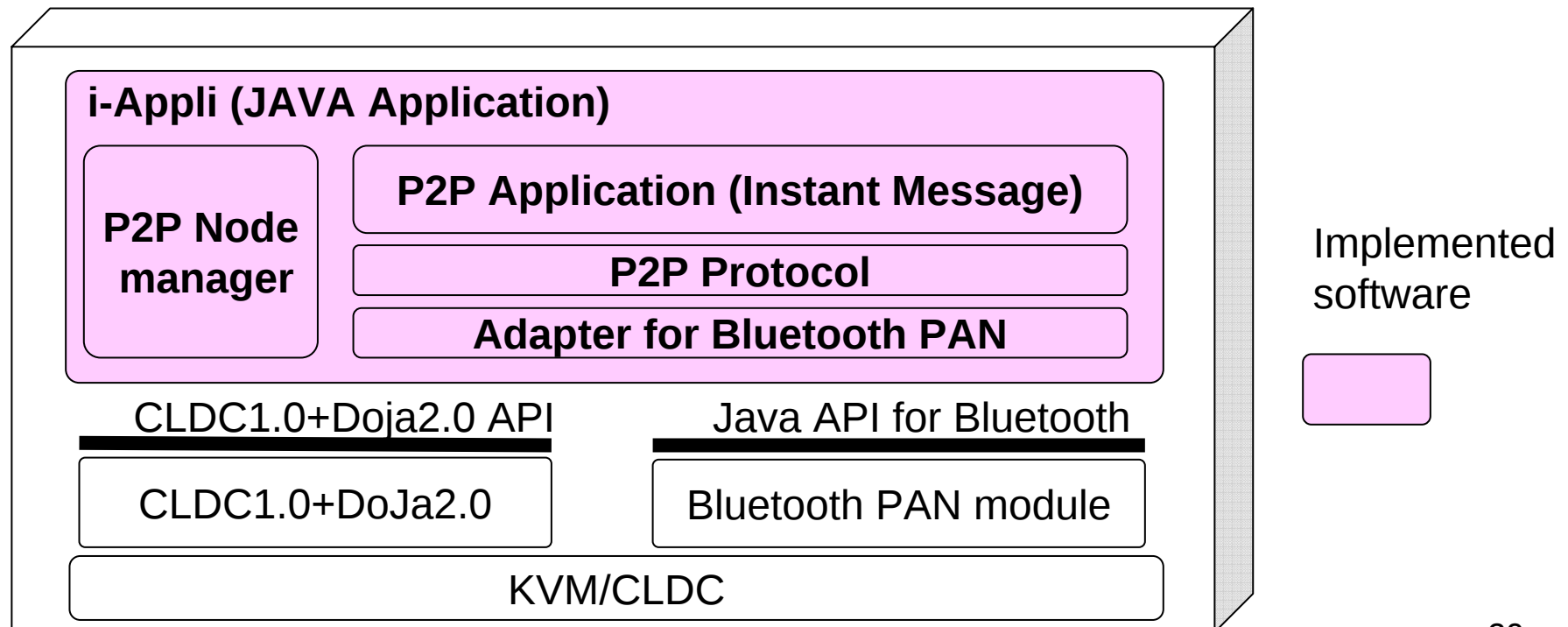
Implementation

- Bluetooth
 - Establish Bluetooth communication link with each mobile phones
- P2P Network
 - Construct application layer network



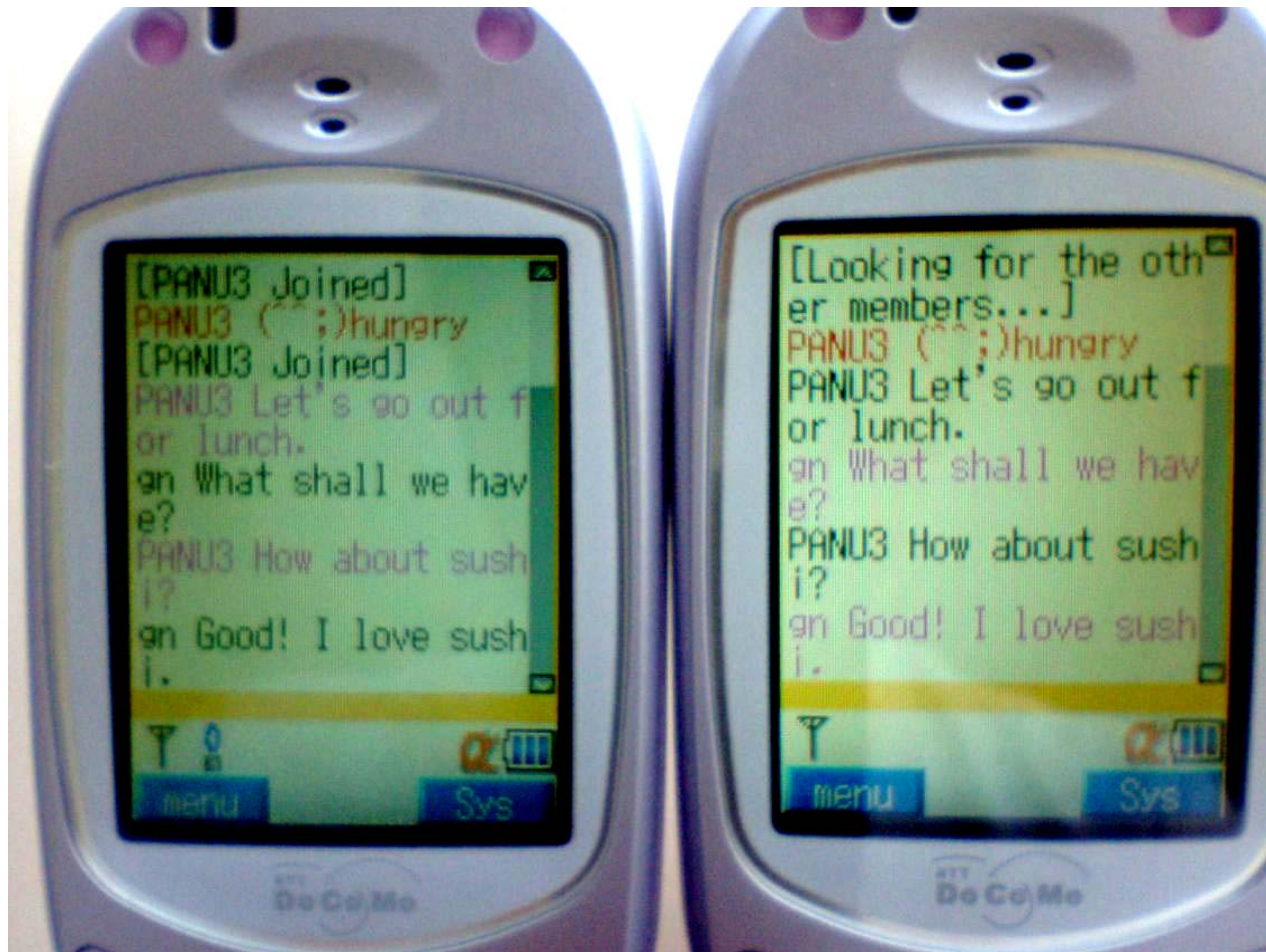
Implementation - software architecture

- Implemented P2P protocol and application as a JAVA application on a mobile phone
 - Use Bluetooth interface of Mobile phone



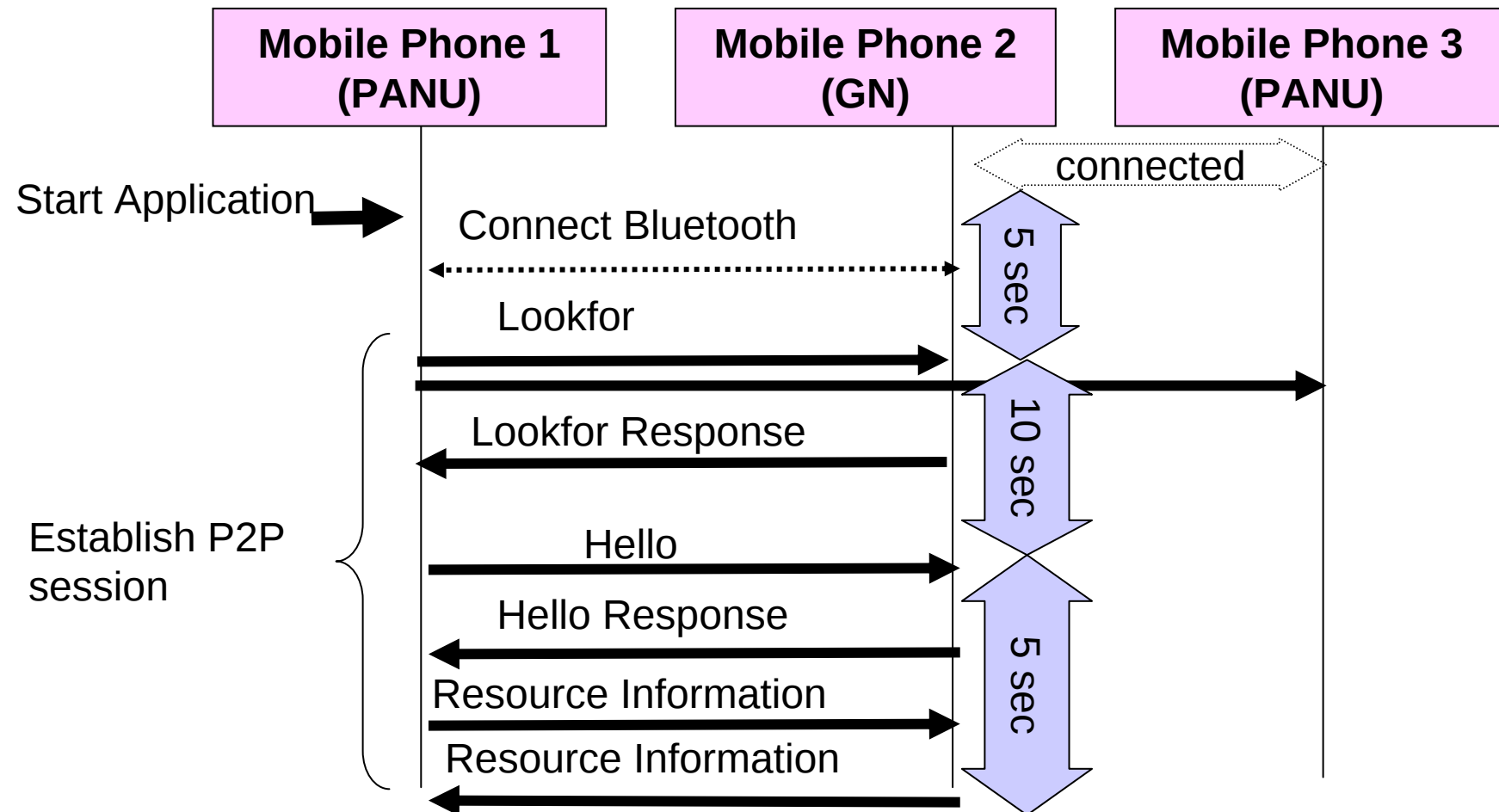
Implementation

- User Interface

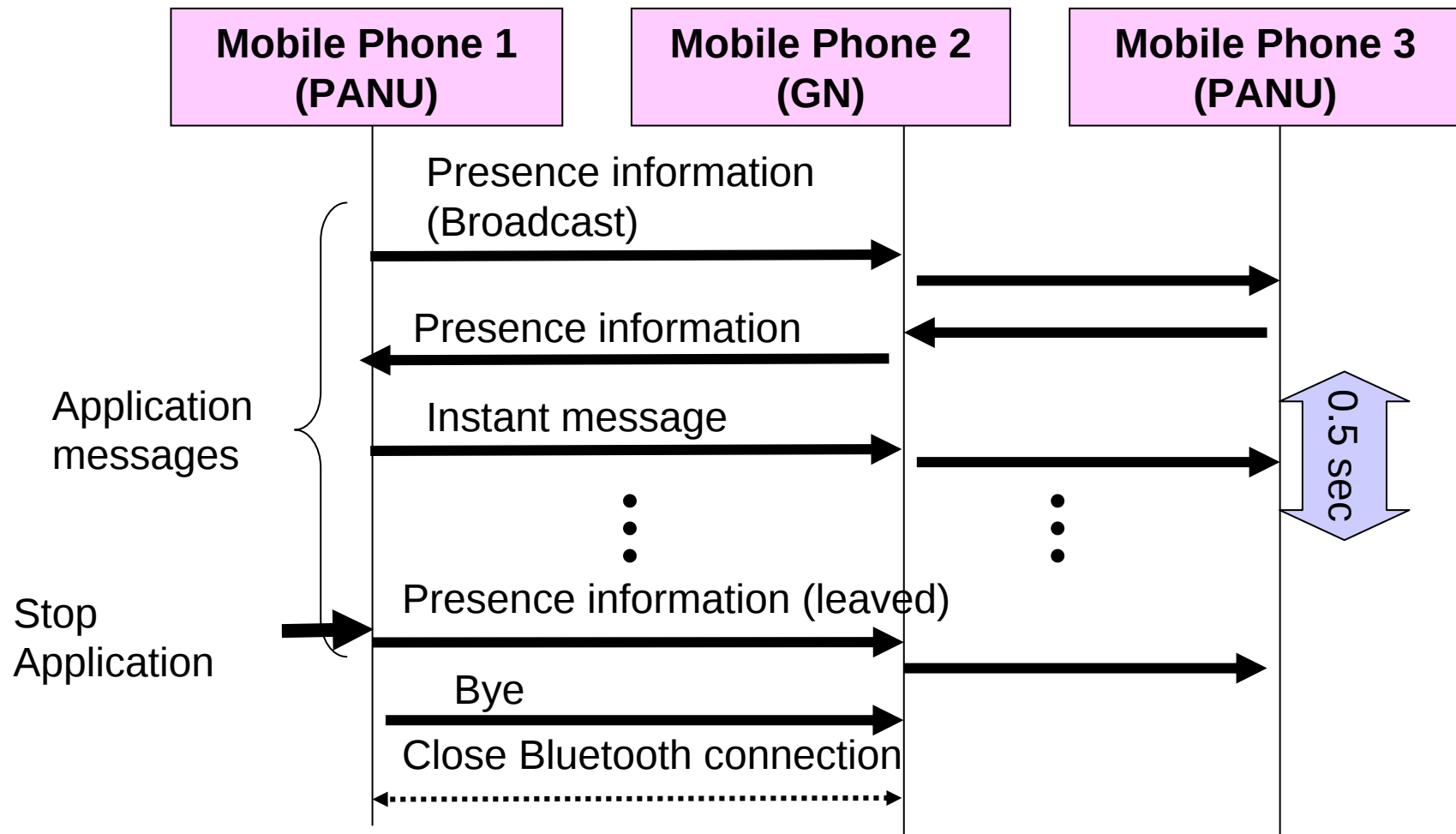


- Instant Message application
 - Presence service
 - Messaging service
- Supports Broadcast/Unicast message

●●● Message sequence (1/2)



●●● | Message sequence (2/2)



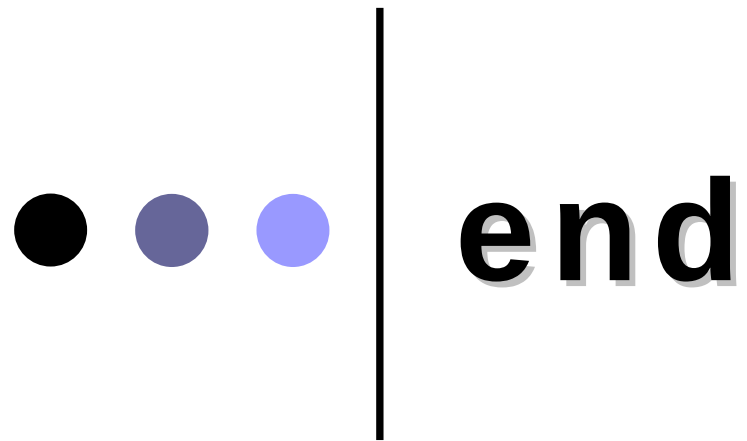


Conclusion

- Designed P2P protocol for mobile phones
 - Provide general P2P communication environment over the Heterogeneous Networks
- Implemented the P2P protocol and a P2P application on mobile phones

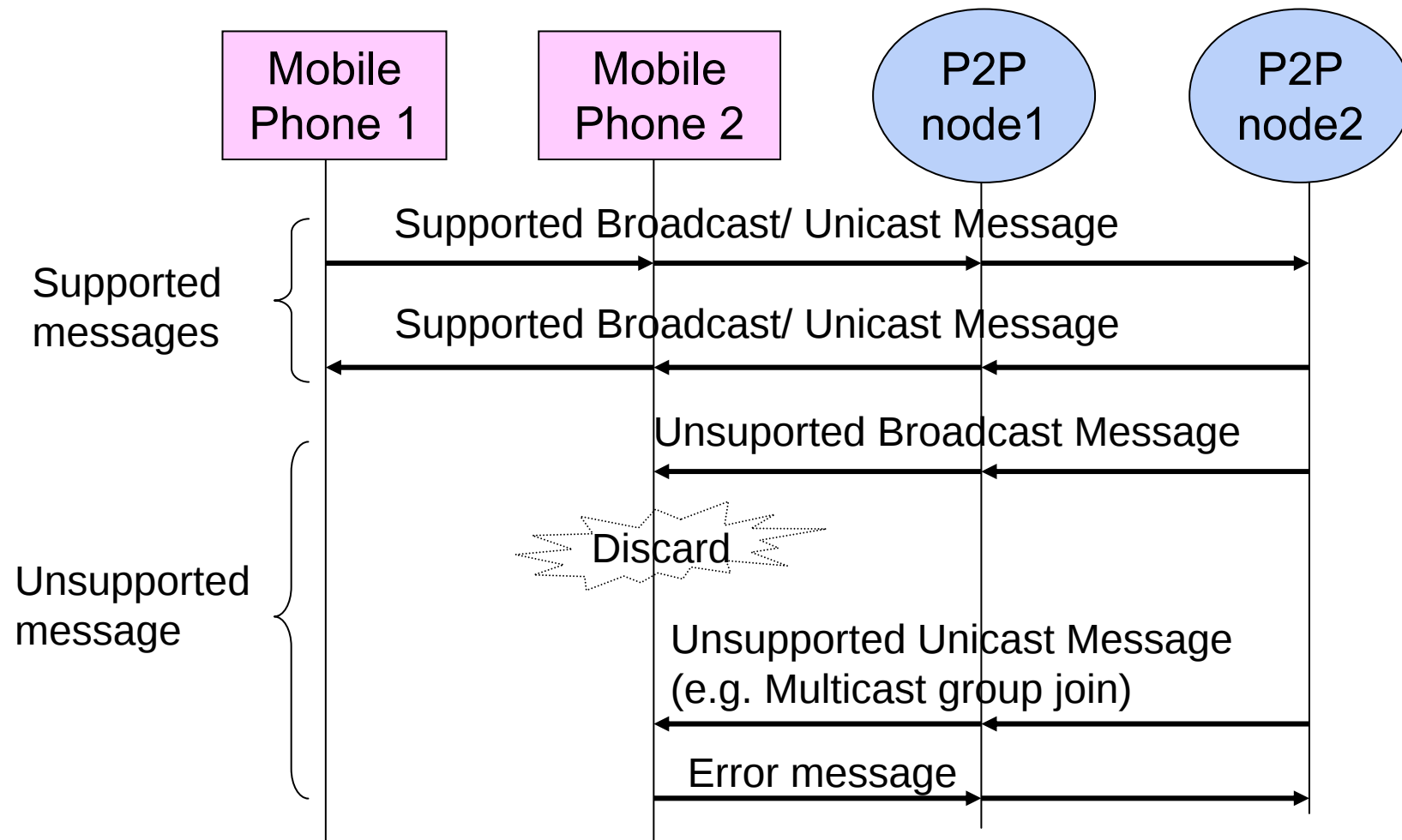
Nest step

- Improve the performance
- Realize security functions
- Other applications for mobile phones
 - Home network application, sensor network application etc.



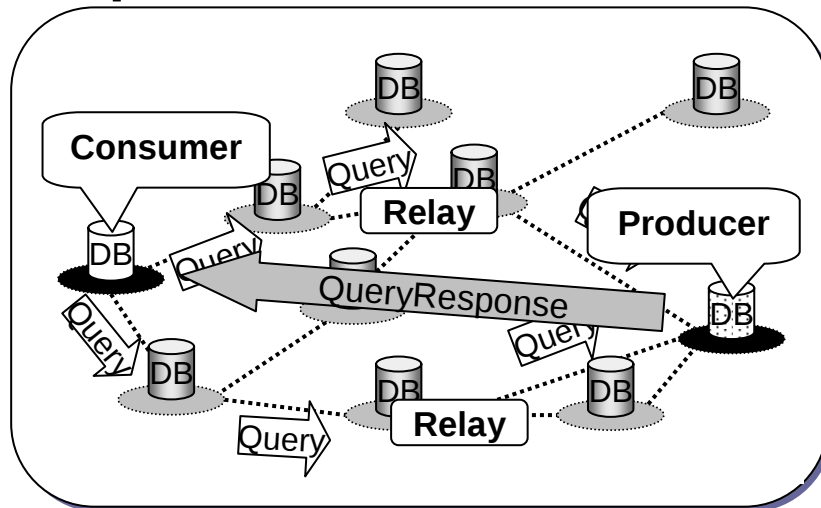
Thank you very much for your attention

●●● Message transfer between PCs and mobile phones

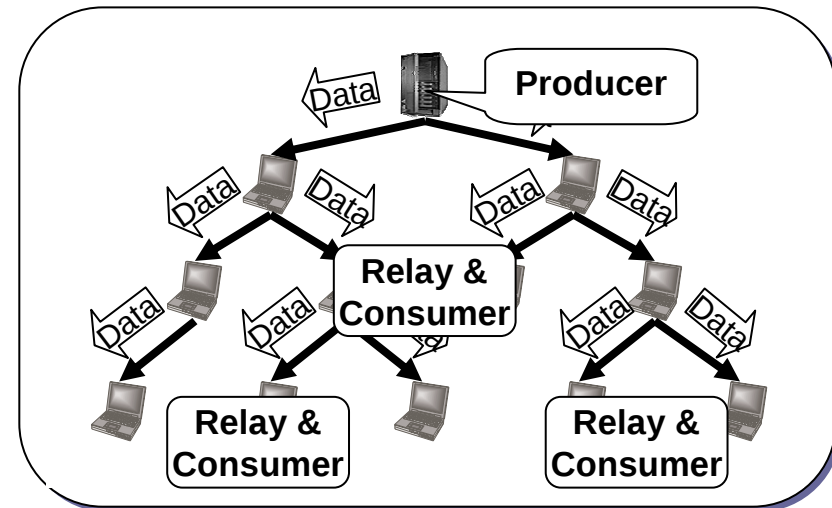


P2P Communication model

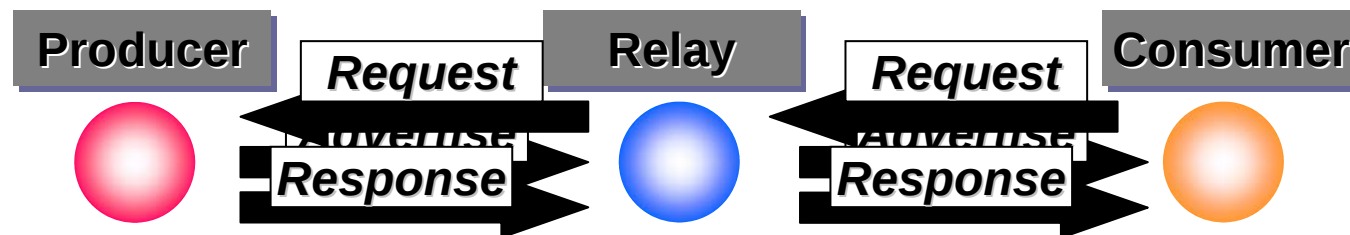
Architecture



Distributed Search Application



Application Layer Multicast

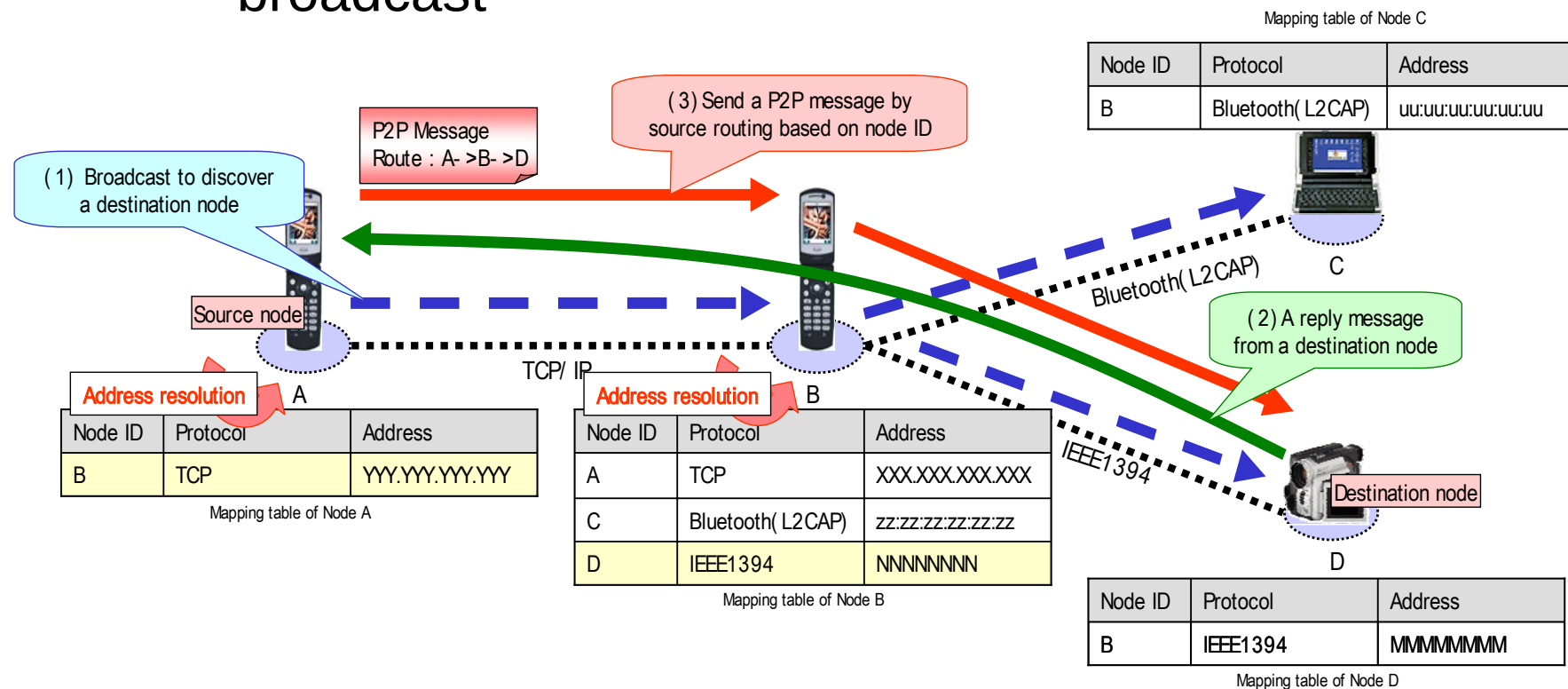


Reactive Communication model

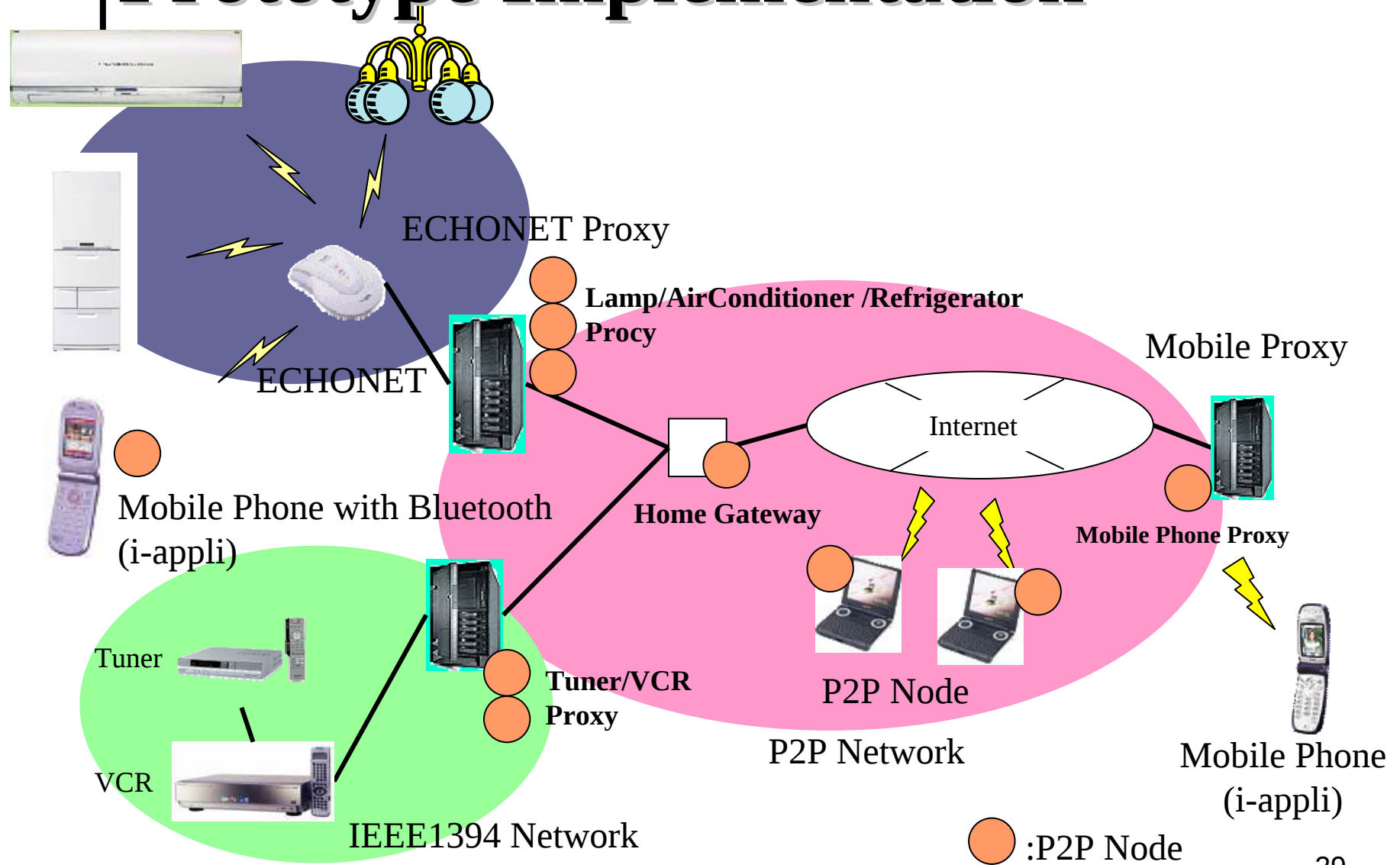
●●● Routing

Architecture

- Node ID based source routing
 - Discover route to destination using P2P broadcast



●●● Prototype Implementation



●●● Example of P2P applications

- **Message Exchange**
(Instant message, chat)
- **Content Exchange**
(content search using metadata)
- **Game**
- **Home Appliance control**
- **Streaming**

