Peer-to-Peer Information Sharing in a Mobile Ad Hoc Environment

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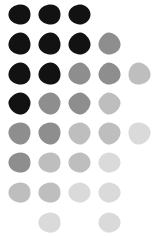


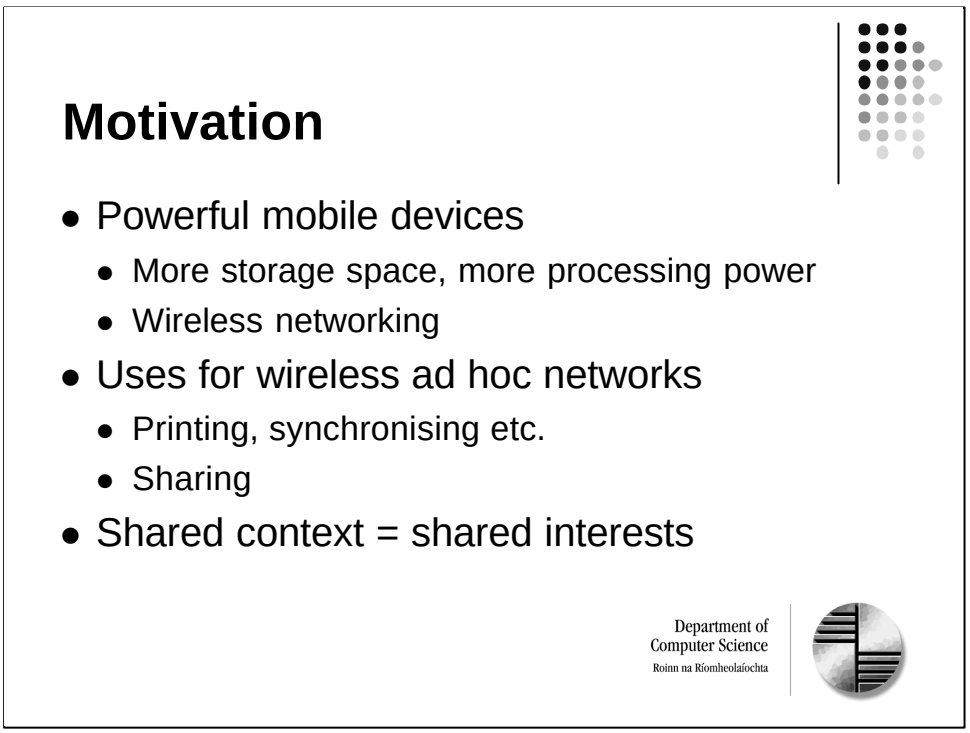
%give summary of the whole work:

%contents

We've developed a peer-to-peer system for mobile devices, including the protocol used by peers to set up the network and communicate with each, and also the application that gives users access to the network and allows them retrieve relevant information and data.

Current work in the area of mobile P2P has focused on the protocol aspect of mobile p2p systems, since given the characteristics of mobile networks, there are a number of interesting challenges that need to be addressed, including node mobility and routing.

Our work also looks at the application, because we believe that a mobile environment requires a different type of application to the user-driven type used on the Internet, where the user is presented with a typical search engine interface. Using this model won't be very effective for the user. For a start the mobile networks are a lot smaller, so there is less peers to query. By looking at these differences between Internet-based peer-to-peer networks and mobile networks we can determine the properties of mobile peer-to-peer networks, and from this we can then design an application that would be suited to this type of environment.



Most people carry some form of mobile device with them: ranging from laptops to mobile devices.

Laptops and PDAs are getting more powerful, with more processing power, more storage space and the ability to join lans wirelessly using one of the 802.11 standards, more commonly known as WiFi, and also to set up ad hoc networks using either WiFi or Bluetooth.

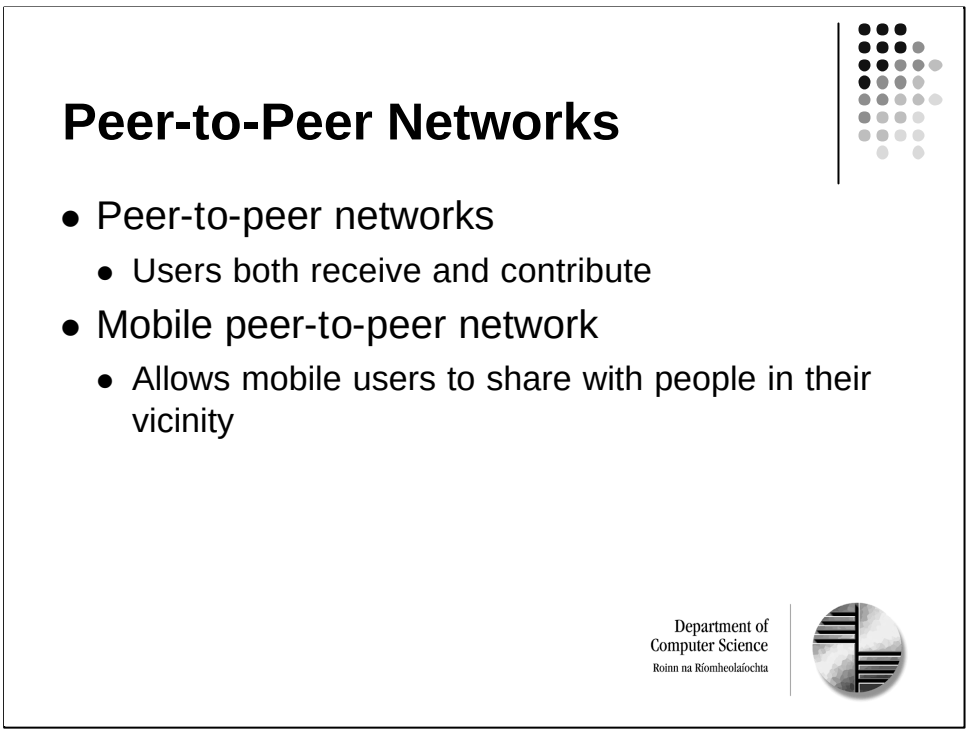
Bluetooth was created to be suitable for all sorts of electronic devices and is being added not just to laptops and PDAs, but also to mobile phones and in the future we can expect to see mp3 players with Bluetooth.

Newer models of mobile phone allow users to install applications.

So we are all increasingly able to set up and take part in mobile ad hoc networks.

These networks are being used for functions like connecting to printers and synchronized data between mobile devices and desktops. These are device to device connections.

We are interested in the possibility of creating person to person connections, where people interact through their devices, passing relevant information and data to each other



So, people have the necessary hardware to interact with other people, and being able to share with others in the local vicinity would be beneficial because people often share interests with those around them. So, we need an application that will allow users to interact and share through their devices.

Recently, peer-to-peer networks have become extremely popular as a way to share with other Internet users. Each user installs and runs an application that lets them define objects to share and distribute queries to other users on the network. If we create a peer-to-peer application for mobile devices, users can use this application to take advantage of their mobile networking ability to share with those around them.

Mobile P2P Systems

- Peers
- Underlying network
- Application
- Protocol

- Design protocol and application for mobile environments

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A mobile peer-to-peer system consists of:

peers

an underlying transport medium

a protocol

And an application a. purpose

b. user interface

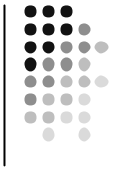
A mobile p2p system consists of peer devices, such as PDAs and laptops, a networking standard, such as Bluetooth or 802.11 in ad hoc mode, an application which allows users to define the objects they want to share and to query other peers on the network and finally a protocol which defines how peer devices work together to set up the network and communicate with each other.

Most work on mobile peer-to-peer networks lately has focused on the protocol aspect only. However, we also consider it important to look at the application design. The interface is what gives users access to the network and so its design has an important part to play in ensuring users get the most out of the network. Currently available P2P sharing applications are designed to be used on the Internet, which has very different characteristics to a mobile ad hoc network.

Note: need to say that we look at the design of the application and develop a protocol.

In designing the app we compare the properties of static and mobile/mobile p2p ->

Internet P2P Networks



- Many potential peers
- Powerful nodes
- User interaction
- Consistent connectedness
- Wide coverage for queries
- Large selection of files
  - ? User-driven usage model

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Note: p2p sharing apps are user-driven to suit the properties of the internet. These slides list the properties of static, mobile, and mobile p2p resulting in us choosing to implement the application with a software agent.

user driven usage model - what are the characteristics of the Internet that allow this to work?

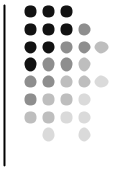
1. Many potential peers
2. Powerful Nodes
3. User Interaction
4. Consistent connectedness
5. wide coverage for queries
6. large selection of files

user driven model

Internet-based peer-to-peer networks use the same usage model as search engines, where the user enters a string query and is returned a set of results, which ranges in size from about 5 to maybe 100 or more results.

As we can see, the properties of p2p networks on the Internet make this a feasible option. But mobile networks have very different properties where this model isn't quite so feasible.

Mobile Networks



- Short range (10m – 100m)
- Generally less powerful peers than Internet-based peers
  - Storage space, processing power, networking ability, form factor, battery power.
- Short-lived
- Dynamic topology

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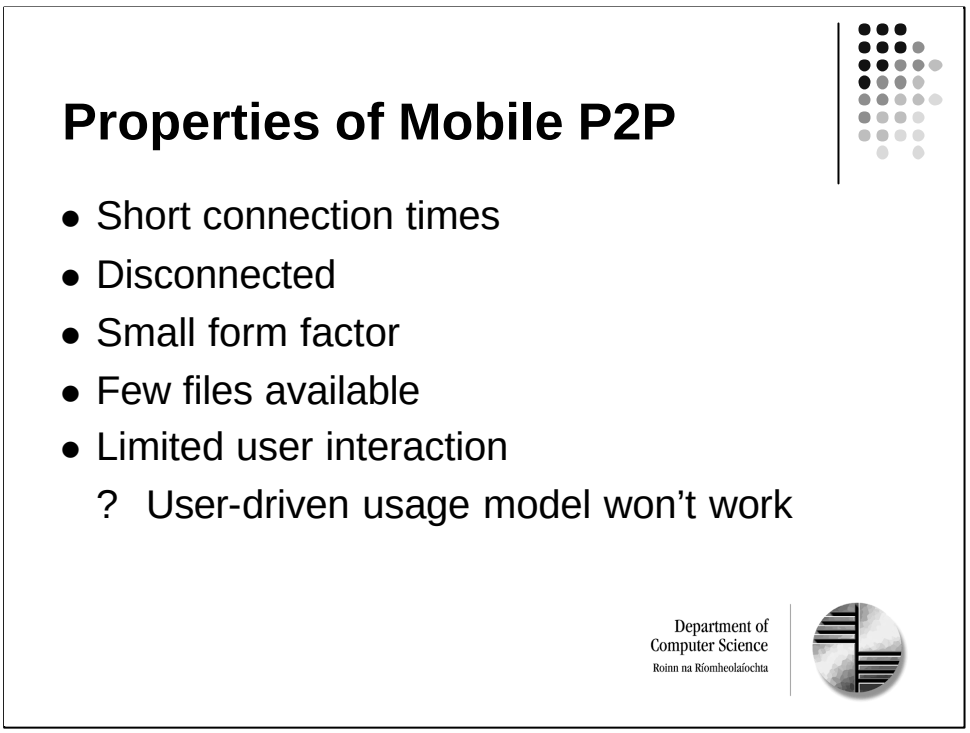
what are the characteristics of a mobile environment?

1. short range
2. nodes limited in power (i.e ...)

Short-lived – Connections between peers on the Internet are generally broken because the application has been shut down on one of the peers. In a mobile environment, connections can be broken for a number of other reasons, such as one peer runs out of battery power or moves out of range. Networks on a whole can also be short-lived, as the network will only exist while all devices stay in range.

Dynamic topology: not only will nodes enter and leave the network, routes will change as peers change their positions relative to each other.



what are the characteristics of a p2p app in a mobile environment?

Problems:

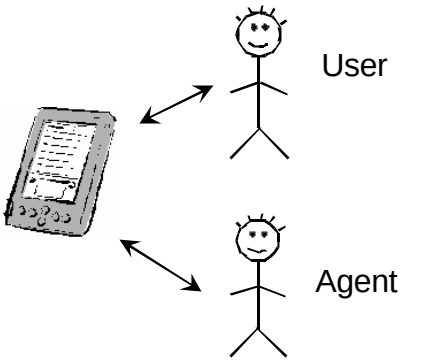
1. Short connections times – 2 more reasons for disconnection – range and battery failure
2. Disconnected
3. Small form factor
4. Few files available
5. Decreased level of user interaction / usage model

(smaller networks – do I describe reasons for few files out loud?)

User-driven model won't work.

Interface Agent

- Benefits
  - Maximizes interactions
  - Maximizes number of available files
  - Connections can be shorter
  - Small form factor
- Tasks
  - Interact with remote peers
  - Build up a profile of the user



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In an application containing an interface agent, both the user and agent have control over the application.

The user interacts with the application as normal, carrying out tasks, and the agent also carries out these same tasks on the user's behalf where appropriate.

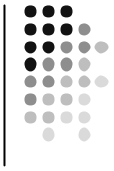
To carry out these tasks for the user, the agent needs to know how the user would like the tasks to be done.

It learns this by observing how the user interacts with the application and by communicating with the user.

Because a device can only expect to be part of a mobile p2p network some of the time, and when it is, the networks will be quite small, overall it won't expect to have the opportunity to interact with the same number of peers as it would on the Internet. So it is crucial that each opportunity is taken up either by the user or the agent. The user may not always be on hand to carry out this interaction, but the agent will. So by using an agent we can maximize the number of interactions, ensuring the user gets the most out of using a p2p application on their device.

We also maximize the number of files available, since the number available is the accumulation of all files encountered, rather than the number of files

Interacting with Remote Peers



- Three possible methods:
  - Send successive queries
  - Retrieve details of remote shared items
  - Send a profile of the user to the remote device
- Recommendation request and response packets
  - Agent sends RecRequest with profile, threshold and max item size.
  - Peer sends RecResponse, listing items and similarity values

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3 methods for automated interacting: (why did I choose this method?)

a. send successive queries

b. retrieve list of available files + file metadata and compare with profile to make recommendations

(disadvantages: could be many files with lots of meta-data, either this meta data will be computed remotely and sent, which will further bloat the amount of data to be sent, or files will need processing to retrieve meta-data)

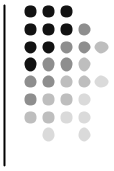
c. send profile of user to remote peer and receive recommendations

search agent requires services of a recommender

describe search agent, building up profile

describe recommender

Creating a User Profile



- User profile consists of keywords denoting interest
- Keywords gathered implicitly
  - File metadata
  - File contents
  - User queries
  - File usage
- Keywords gathered explicitly
  - Inputted by user

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Recommender

- Content-based recommender
  - Keywords in the user profile are compared to filenames and file metadata.
  - Matches above the specified threshold are returned.

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Comparing the profile with available files

Mobile P2P Protocol

- Adapt Gnutella
  - Widely used
  - Large development community
  - Open and extensible
  - Lightweight

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Gnutella is widely used – networks of size ? This allows us to create gateway nodes that will give small mobile networks access to the larger Internet-based network.

Gnutella was first developed in and since then a large development community has grown. Using Gnutella means that we benefit from future developments.

Gnutella Protocol Functions

- Peer discovery
  - Internet-based Gnutella uses central solution, and Ping and Pong packets
  - Bluetooth uses Service Discovery Protocol
- Connection Establishment
  - Request connection and accept connection
- Search
  - Query – includes keywords
  - QueryHit – lists matching items

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requirements of p2p protocols and how we satisfy each

1. peer discovery
2. connection establishment
3. search
4. routing
5. file transfer

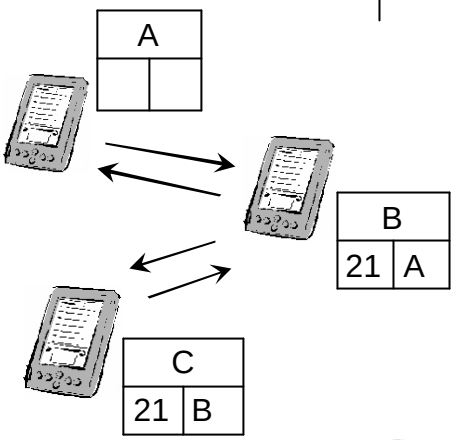
Describe what Gnutella does and how we've adapted it for Bluetooth.

P2P protocols must perform five core functions.

As I mentioned, the Gnutella protocol is extensible. Extensions are made using the Open Vendor Framework, and so to remain compatible, we used this framework in our design. All packets have the same header. The header allows the packet to be routed through the network and lets each node know what type the packet is...

Gnutella Protocol Functions

- Routing
  - Queries and RecRequests are flooded
  - Routing tables route responses back
- File Transfer
  - FileRequest
  - FileResponse



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Search agent protocol packets:

RecRequest

RecResponse

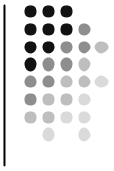
Routing

- Queries and RecRequests are flooded
- Routing tables route responses back

File Transfer

- FileRequest
- FileResponse

Protocol Comparison



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Conclusions and Future Work

- Conclusions

- Future Work
  - Scatternet Formation
  - Other recommendation techniques

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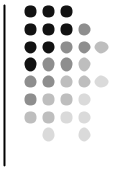
Conclusions:

Future Work:

Scatternet Formation



Thank You

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