Where now for P2P?

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My Background

- Research Fellow at Lancaster University
- Managing Director of Isis Forensics

- Working in the areas of:
  - Software Engineering
  - Peer-to-Peer
  - Services
  - HCI

- Predominantly worked on large EU funded projects
  - Strong industrial slant

Background in P2P

- Worked within the field for over 5 years
- 2001 – 2004: P2P ARCHITECT
  - Supporting the development of dependable P2P systems
- 2006 – 2008: PEPERS
  - Supporting the development of secure mobile P2P systems
- Worked with companies who want to utilise P2P technology

- Monitoring of P2P systems and user behaviour
  - First study to quantify the scale of illegal pornographic distribution
  - Working to help track distributors of child abuse media

- Isis Forensics
  - P2P based monitoring solutions

Question:
Is P2P dying?
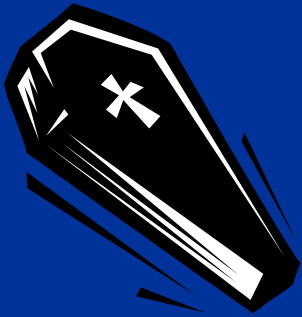
Overview

- The grand vision
- Where are we now?
- Neglected issues
- Themes for the Future

The grand vision

- 2000
  - Napster has been recently launched
  - "One of the four technologies that will shape the Internet's future" - *Fortune*
  - Predictions of a revolution:
    - in business models
    - in the way internet based software systems are developed
  - The vision of a decentralised world
    - Connecting users without the use of central authorities

Where are we now?

- P2P is rarely used in a business and industrial setting
- No longer seen as a hot technology
  - Superseded by GRID and Web Services, etc
- Limited number of application types
  - Dominated by file sharing applications
  - Increasing move to web based applications
    - Web 2.0, etc

- Has it all gone wrong??

Neglected Issues

Issues: Security and Legitimacy

- **Security**
  - P2P introduces new security concerns and can make existing networks vulnerable
  - P2P security research is still fairly young (especially for decentralised systems)
  - From an industry perspective: it is not clear what the general security concerns are, and how they can be dealt with
    - ➡️ **Safer to avoid**

- **Legitimacy**
  - P2P technology has been 'tainted' by its use in illegal file sharing and piracy
  - Perceived lack of legitimacy which hinders its uptake
  - Alternative real world uses of the technology is one possible way of addressing this

Issue: The Needs of Business

- Divergence between:

P2P Research and Development
and
What Business wants from the technology

- Businesses like their Servers
    - Investment in hardware
    - Investment in work practices/organisation structure
    - Maintain control over data and resources
    - Ultimately, servers succeed in doing the job asked of them

- Want P2P to support existing approaches rather than replace
    - For example, to support more flexible communication between remote workers

Case Study: Journalism

- Worked with two publishing companies who want to adopt P2P technology

- Wanted to allow their journalists, photographers, editors to work together
  - Communicate
  - Share
  - Be geographically dispersed
  - Not necessarily be supported by a centralised mechanism

  P2P

- But… have a central store for documents
  - Completed articles, etc

  Client-Server

Case Study: Theatre Booking

- Booking company geographically dispersed around Italy
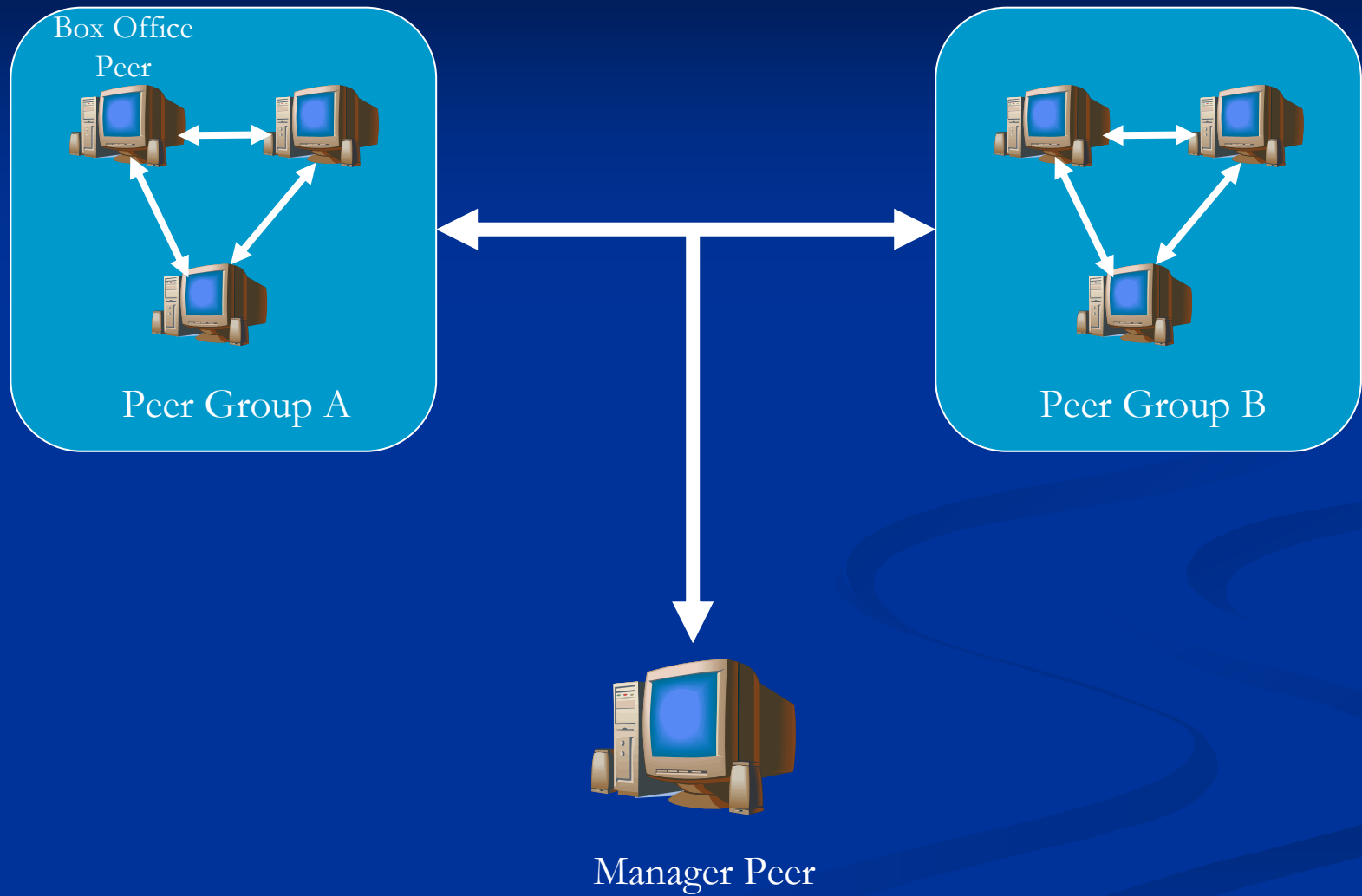
- Wanted their Box Offices to:
  - Communicate
  - Exchange 'available' tickets with one another
  - Perform distributed backups
  - Ideally not be supported by a centralised mechanism

  P2P

- But… have a central store for auditing purposes
  - How many tickers each Box Office sold, etc
  - Monitor backup operations

  Client-Server

Box Office
Peer

Peer Group A

Peer Group B

Manager Peer

Meeting the Needs of Business

- P2P developments should be able to work alongside or integrate into existing systems

- New business models that consider P2P working should be developed

- Greater support to help businesses understand the benefits of P2P and the technical considerations

- Methods need to be developed to support the integration of P2P technology into legacy systems

Issue: The Lack of Applications

- File sharing still the dominant use of P2P

- Can P2P compete with the recent rise of web based applications?
  - YouTube, RSS file feeds, even Bittorrent is partially web based

- Study of P2P research publications
  - Less than 15% of recent research publications related to P2P applications
  - "all the (core P2P) research done will receive neither feedback nor validation unless there's an active set of clients for the technology"

Relationship between Technology and Applications
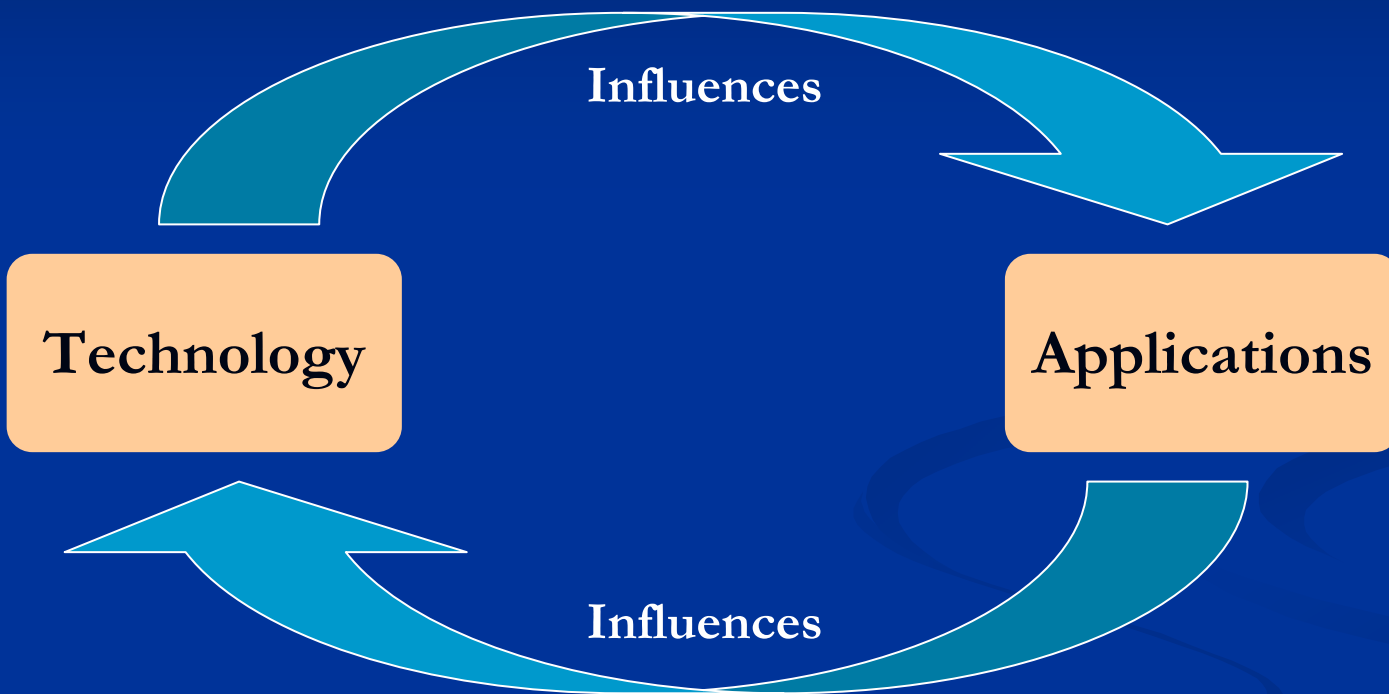
- Underlying technology can influence the types of application
- Likewise the types of application can influence the underlying technology

Lack of development support

- Development methods
- Design/modelling notations
- Standards
- Reference Architectures
- Analysis of topologies, technologies, etc
- Development case studies
- Technical support for businesses

Example Development Issues: Secure Mobile P2P Systems

- Security needs to be central to the design
  - Must be considered at all stages of development
  - Security requirements can impact on the choice of P2P technology/topology, and vice versa

- Mobile technology requirements and constraints
  - Impact on security and P2P technologies

- Network and Communication requirements and constraints
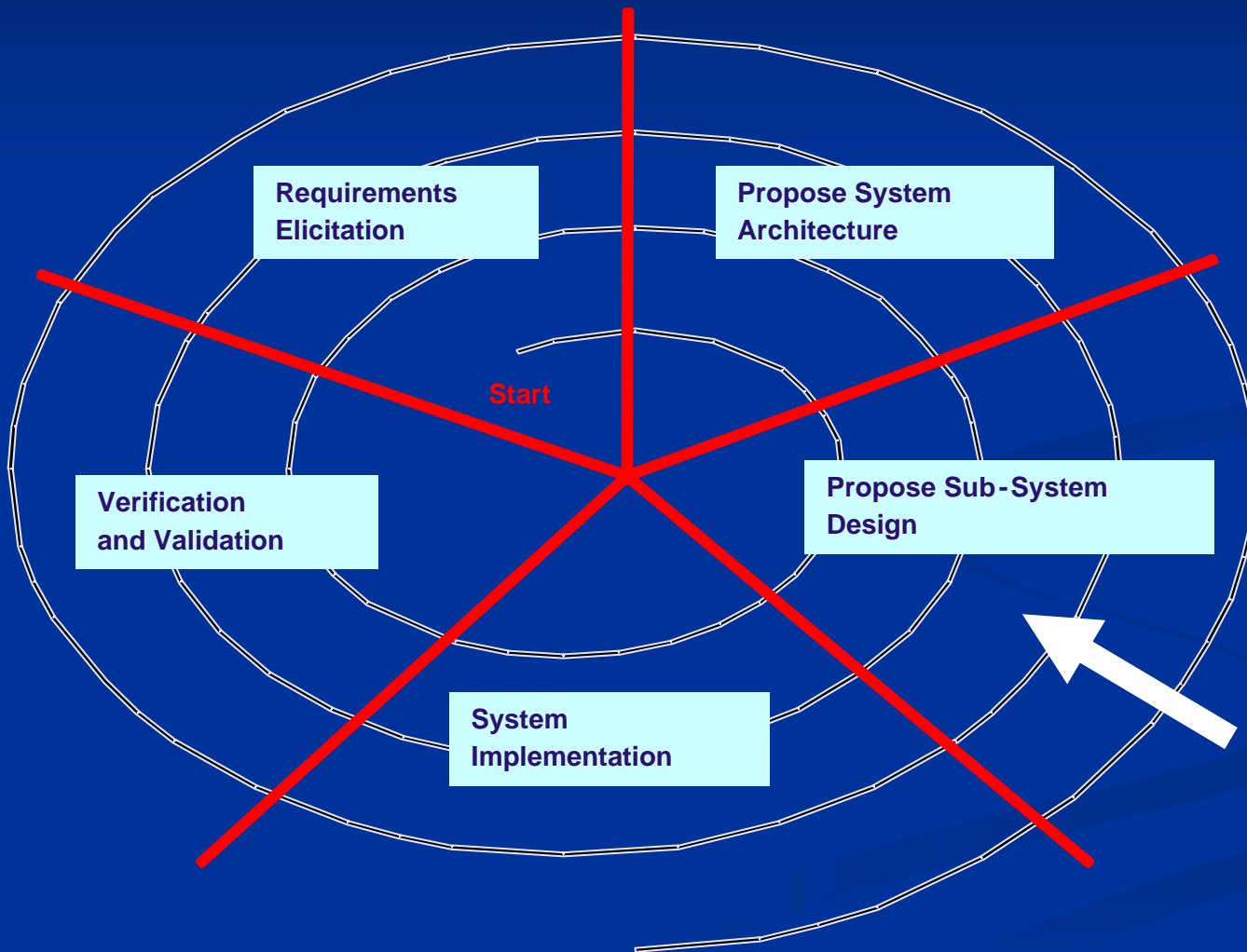 - Network coverage, cost, bandwidth, etc

Example Development Issues: Secure Mobile P2P Systems

- P2P technology requirements and constraints
  - Impact on requirements, design and implementation
  - Studies: impact topologies can have on system dependability and security

- Architectural driven design
  - Architectures play a core role in P2P system development
  - Require design methodologies that support this

Existing work

- Modelling overlays
  - OverlayML, P2

- Abstractions
  - Open Overlays, iOverlays
  - P2P Application Framework

- P2P ARCHITECT
  - Development methodology, reference architectures, notations and general guidance

- PEPERS
  - Aims to provide similar support for secure mobile development

Support provided within PEPERS

Requirements
Elicitation

Propose System
Architecture

Start

Verification
and Validation

Propose Sub-System
Design

System
Implementation

Each stage tailored
to consider P2P,
Security and Mobile
aspects

Example Stage:
Propose System Architecture

- Select P2P topology
- Derive system functional capabilities
- Select secure P2P application reference architectures
- Establish architectural model
- Describe sub-systems
- Initial PEPERS runtime platform consideration
  - Provides functionality to support secure, mobile P2P systems
- Where possible, allocate requirements to sub-systems
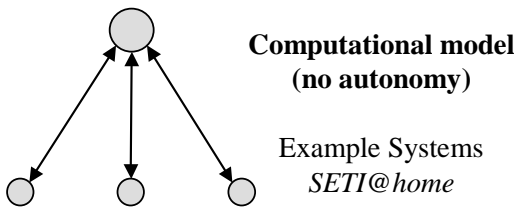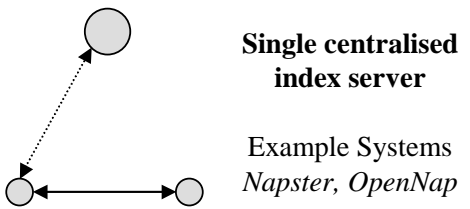- Evaluate architecture

Question:
Is P2P dying?

Perhaps… there are still issues to be overcome
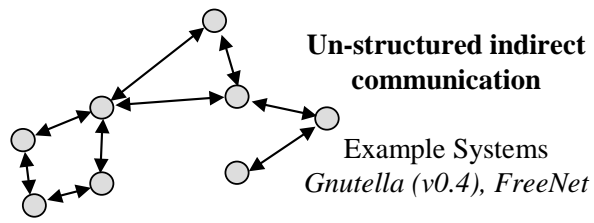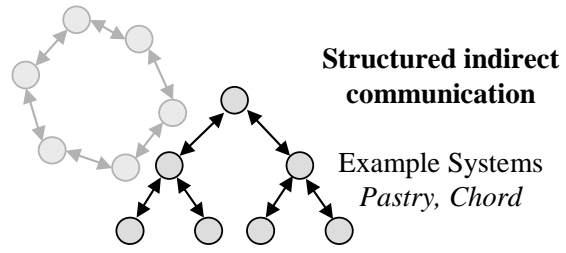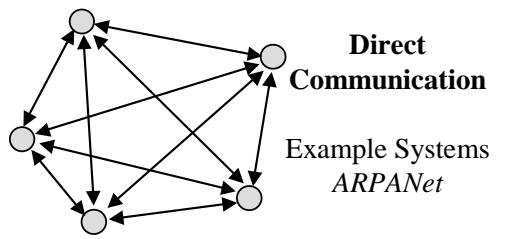
Themes for the Future

Theme: Topologies

- P2P Topologies represent an abstraction of the underlying network

- Consider just the peer nodes and the connections between them

- Topology evolution
  - As a result of new technologies
  - As a result of external factors
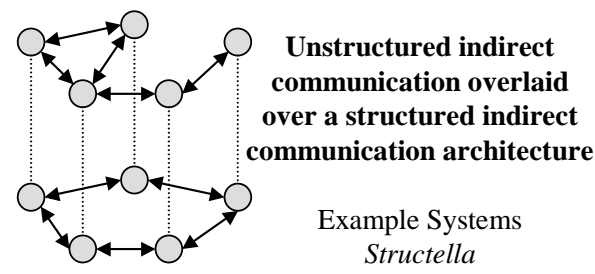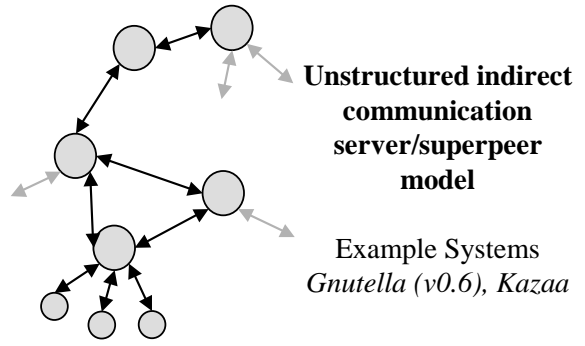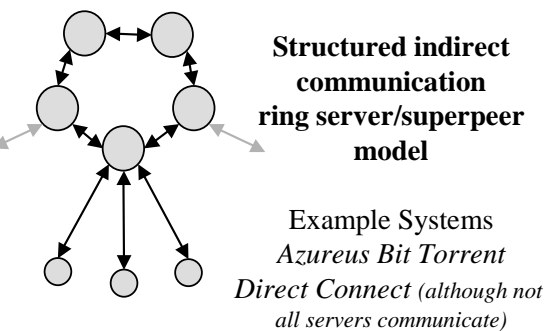   - Application requirements
    - Legal pressures
    - Etc…

Semi-Centralised

Single centralised index server

Example Systems
Napster, OpenNap

Computational model (no autonomy)

Example Systems
SETI@home

Decentralised

Direct Communication

Example Systems
ARPANet

Structured indirect communication

Example Systems
Pastry, Chord

Un-structured indirect communication

Example Systems
Gnutella (v0.4), FreeNet

Hybrids (examples)

Structured indirect communication ring server/superpeer model

Example Systems
Azureus Bit Torrent
Direct Connect (although not all servers communicate)

Unstructured indirect communication server/superpeer model

Example Systems
Gnutella (v0.6), Kazaa

Unstructured indirect communication overlaid over a structured indirect communication architecture

Example Systems
Structella

Next Generation Topologies

- Hybrid topologies are increasingly becoming the norm
  - Maximise the advantages, minimise the disadvantages
  - Composite topologies

- P2P topologies will need to work alongside client-server topologies
  - Layering of topologies
  - Gateways between topologies

- Will need to support systems in which peer roles and functionality can fluctuate depending on circumstance
  - Dynamic and mobile systems
  - Adaptive topologies

Case Study: Security guards

- HQ organizes and controls the guard patrols
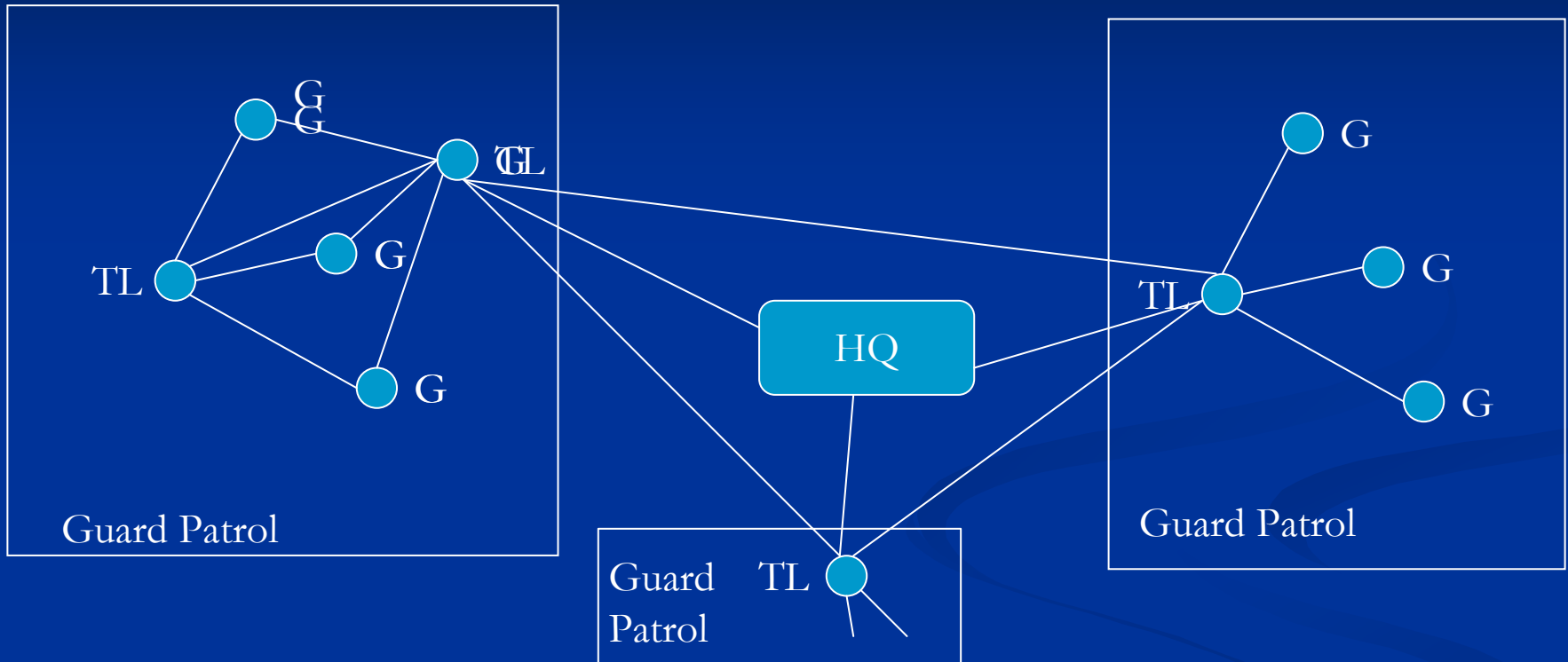
Theme: Mobile P2P Services

- Already been moves to combine P2P with Service-orientated technologies

- Next step will be to move this into a mobile environment

- Users being able to offer services to others from their mobile devices

- A mobile service environment that is dynamic and heterogeneous

Mobile P2P Services - Scenarios

John has a Word document on his PDA that he needs to convert to PDF. He carries out a discovery activity and finds that someone in the vicinity is offering such a service. John sends his document, pays for the service, and receives the PDF'ed document back

Peter is an affiliate for a music company. He receives commission when he sells MP3 files for them. Peter publishes his music selling service to devices in his vicinity.

Mobile P2P Services - Challenges

- Building lightweight services
  - Reflecting the limited resources on mobile devices
  - Technological constraints

- Mobile service infrastructure
  - Discovery mechanisms that support greater heterogeneity
    - Devices
    - Services
  - Delivery
    - QoS
    - Security

- Business and Cost models
  - New models for business
  - Mechanisms for describing cost and making payments

Theme: P2P and Society

- P2P 'empowers' the user, at the cost of the collective
- Creates new types of communities/markets
- Anonymity
  - Can be both positive and negative
- Rapidly evolving
  - Hard to control

- Implications
  - Changes in laws
  - Changes in business practices
  - Policing
  - Social phenomena
    - Free riding, etc

Free Riding

- User takes from the network, but does not contribute
  - E.g. Downloads files, but does not share

- Detrimental to the P2P system as a whole

- Free Riding studies of Gnutella
  - 2000: Found that 70% of users free ride
  - 2005: Found this had increased to 85%

Sub-communities

- Studies have shown that sub-communities can form within P2P systems

- 2005: Study of illegal pornography distribution on Gnutella
  - Accounted for 1.6% of searches, and 2.4% of responses
    - Equates to several hundred searches a minute
  - Distributed by a small sub-set of the community
    - 57% were solely devoted to this activity
    - Only communicate with each other

P2P and Society
Open Issues

- Vast scope for interdisciplinary research
  - Economists, psychologists and sociologists
  - Digital communities of millions

- Society needs to adapt to this new reality
  - New laws
  - New policing mechanisms
    - Copyright infringement vs paedophiles?
    - One enforcement attitude to all?
    - Hostile user community
    - Resources required to achieve this
    - Community regulating?

Summary

Summary

- P2P has not yet 'met' its original vision
  - Strong bias towards developing low-level technologies
  - Stagnation?

- Key areas have been neglected
  - Considering the needs of business
  - Support for P2P application development

- P2P is not yet dead!
  - Potential new avenues