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  - Superseded by GRID and Web Services, etc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

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

- P2P

- 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

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

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**P2P**

**Client-Server**
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
- Propose Sub-System Design
- System Implementation
- Verification and Validation

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

- Ongoing focus on controlling different patrols against one another

HQ monitors and controls the different patrols

Changing Team Leader within a guard patrol

Different patrols communicating with one another
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
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