Dependability within Peer-to-Peer Systems

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Background to this work

- EU funded P2P ARCHITECT Project
- “seeks to develop methods and tools to support software-developing organisations in building dependable P2P software applications”
- October 2001 – June 2004
- Lancaster’s role
  - Identify dependability issues within P2P applications
  - Develop a methodology for dependable P2P application development (with tool support)
  - Develop reference architectures for P2P applications

Peer-to-Peer Systems

- P2P becoming increasingly popular
- “Class of applications that takes advantage of the resources that are available at the edge of the Internet”
- Increasing interest from industry to utilise such technology -> dependability becomes important
- P2P possesses specific properties that can influence system dependability
- Choice of logical network architecture can also influence dependability

Dependability Properties of P2P Systems

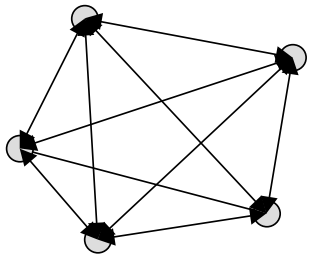
- Internal Properties
  - Network evolution
  - Legacy versions
  - Fault tolerance
  - Connection bandwidth
  - Intermittent peer connectivity
  - Peer discovery
  - Peer addressing
  - Load balancing

Dependability Properties of P2P Systems

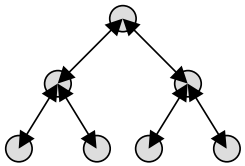
- External Properties
  - Scalability
  - Survivability
  - Maintainability
  - Manageability
  - Repairability
  - Trust
- Hybrid Properties
  - Responsibility, accountability and reputation
  - Data integrity
  - Adaptability

Logical Network Architectures

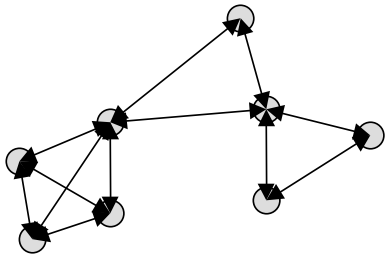
Decentralised



(a) Direct Communication

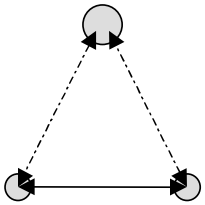


(b) Structured indirect communication

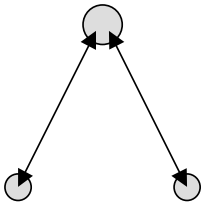


(c) Un- structured indirect communication

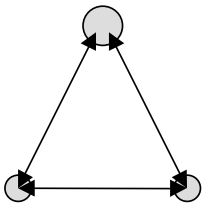
Semi-centralised



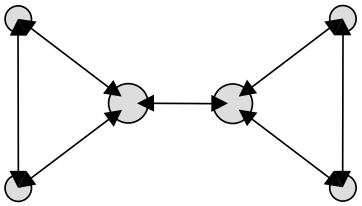
(d) Single centralised index server



(e) Computational model (no autonomy)



(f) Computational model (with autonomy)

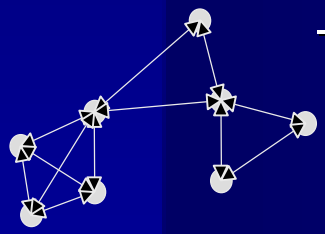


(g) Multiple server node model

LNA's and dependability

- The type of LNA used can influence the dependability properties of a P2P system

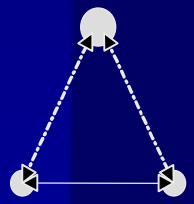
- Unstructured Indirect Communication architecture
  - No single point of failure
    - Help tackle system *survivability* and *fault tolerance*
  - Difficult to control/monitor the system
    - Can hinder system *management* and *maintainability*
  - Freeform network structure
    - System can easily *adapt* and *evolve*
    - Can hinder system *scalability* and *responsiveness*



Un- structured indirect communication

LNA's and dependability

- Single Centralised Index Server architecture
  - Better suited for controlling and monitoring a system
    - Help where *safety*, *maintainability* or *manageability* are important
    - Server peer can help support *trust* and *accountability* techniques
    - Server peer can aid in system *responsiveness* particularly with *peer discovery*
  - Single point of failure
    - Can hinder a systems *fault tolerance* and *survivability*



Single centralised index server

Summary

- Additional properties should be considered when developing a dependable P2P system
- The choice of Logical Network Architecture can also have an impact on these properties
- The LNA should be chosen based on the dependability requirements of the system
- Such consideration should be made early within the development process
- Future work – assess specific implementations to help quantify the initial analysis

- http://polo.lancs.ac.uk/p2p – Lancaster's P2P site
- http://www.atc.gr/p2p_architect – Project website