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Statistical physics and peer-to-peer: What next?

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Peer-to-peer systems



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- Peers contribute with resources voluntarily
Computational power, bandwidth, storage space
 - Nodes are autonomous
Peers arrive and depart dynamically
 - Approximately same functionality
Heterogeneity in resources may lead to deviations
 - No centralized control
Self-organizing
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- P2P vs. Overlay
 - P2P vs. Distributed systems

Peer-to-peer applications



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- Content distribution (download and streaming)
Time to download, frequency of interruptions
E.g., BitTorrent, PPLive, Joost
- Lookup
Lookup speed
E.g., Chord, Kademlia
- Search
Hit probability, overhead
E.g., Gnutella
- High performance computing
Overhead, speedup
E.g., BOINC (SETI)
- Gaming (MMOG)
Speed and accuracy of spreading information
E.g., Colyseus
- Communication
E.g., Skype

Issues in Peer-to-peer

- Security
- Heterogeneity
- Stochastic behavior
 - As compared to average behavior
- Adaptive P2P systems
 - Underlay awareness
 - ISP friendliness
 - Effect on the distributed algorithms
 - Clustering, starvation
- Graph topology vs. data distribution
 - Focus on user perceived application performance



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Self-*



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- Self-properties
 - Self-organization
 - Self-configuration
 - Self-healing
 - Self-synchronization
 - Self-adaptation
 - Self-management
- Emergence of properties
 - Inspired by Biology
 - Engineering minded
- Possibilities vs. Limitations
 - Impossibility of certain features?