

# ➔ Peer-to-Peer

Introduction to a New Set of Opportunities

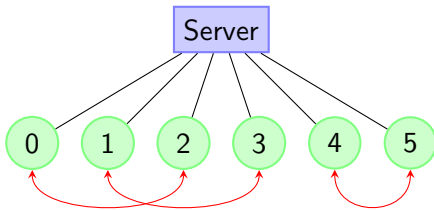
Gwendal Simon

Department of Computer Science  
TELECOM Bretagne  
Jan. 2008

## ➔ Birth

### Context : Napster Shutdown

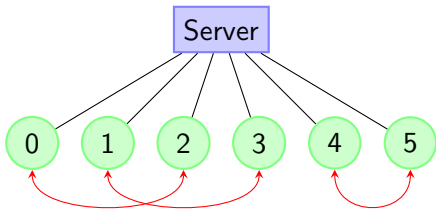
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- early majority is just joining
- legal perspectives are dark



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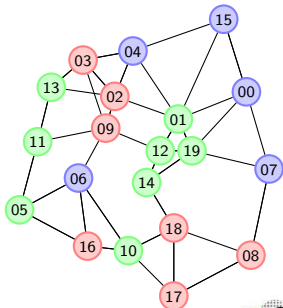
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### Gnutella : Serverless Napster

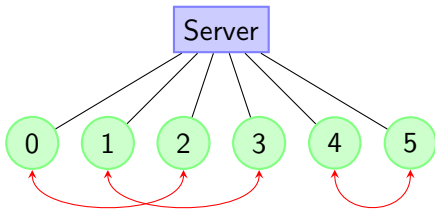
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- just a piece of software
- viral *bazaar* diffusion



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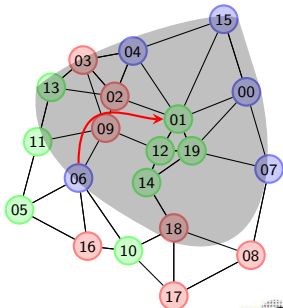
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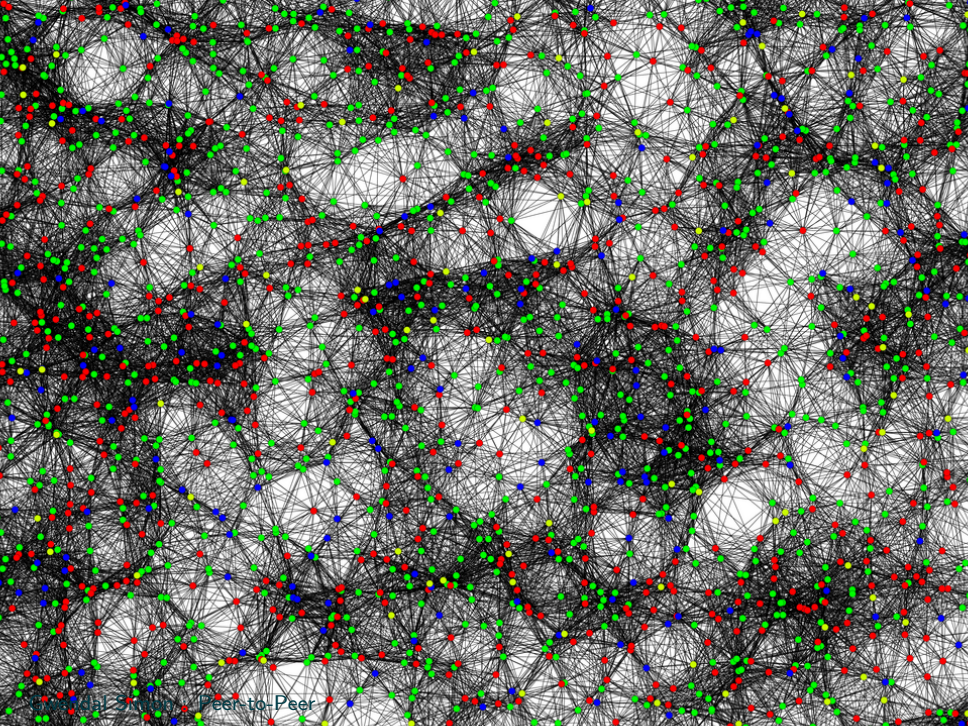
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## ➔ Peer-to-Peer is not only File Sharing

...but also large-scale *legal* applications :

- where peers just have to be introduced : *phone, storage...*
- where server become bottleneck : *broadcasting...*
- where nobody should be responsible : *virtual world, forums...*

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**Attractive Issues** : no governance, nor understanding

- academic : *what exactly is scalable ?*
- developers : *is the Bazaar consistent ?*
- users : *what is the value when I contribute ?*

## Part I

Is there any Opportunity in the Bazaar ?

## ➔ Motivations

| network            | empirical law | value per user | global value |
|--------------------|---------------|----------------|--------------|
| broadcast (TV)     | Sarnoff       | 1              | $n$          |
| one-to-one (phone) | Metcalfe      | $n$            | $n^2$        |
| peer-to-peer       | Reed          | $2^n$          | $2^n$        |

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Stirring up a community is the actual challenge :

- aggregate a vast population
- incite them to contribute

⇒ **joining** an existing community may be far easier  
*(1047 projects referenced in Sourceforge)*

## ➔ Yahoo's Gnutella Developer Forum

"a forum for active Gnutella developers without distractions"

- developers from a company hosting an "official" client
- independent open-source developers
- just some curious guys. . .

Emerging usage : **normalization forum**

- protocol update, feature proposal, idea exchanges
- Collateral usage : *innovation center*
  - feedback from users : chunk swarming
  - external opportunities : URN by Bitzi
  - technical development : bootstrap, NAT traversal

## ➔ Innovator's Dilemma

Cooperative or competitive behavior ?

- actors are **competitors** : have to differentiate
- the value is in Gnutella usefulness : have to **cooperate**

Conciliate **gain for the user** and **progressive adoption**

- no innovation should require full agreement
- for most innovations, gain grows with the number of adopters
- individual innovations (e.g. ergonomics) allow differentiating

## ➔ Business Opportunity

A *complex* ecosystem :

- **leery of market economy** :
  - bazaar culture implies free software
  - contributors are reluctant to pay
- **but attractive** :
  - several millions of active users
  - a technophile population of *online influencers*

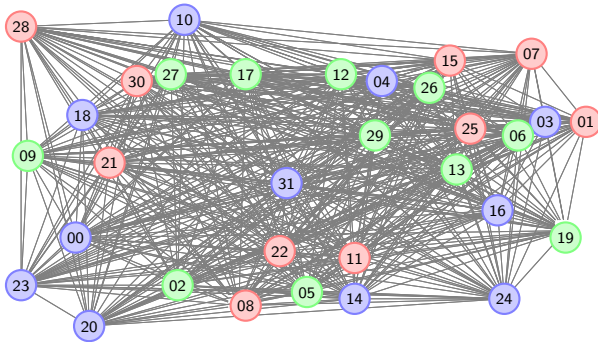
Requires a **hook** mixing technical expertise and social understanding

- **out of the peer-to-peer system**
- **but in the peer-to-peer activities**

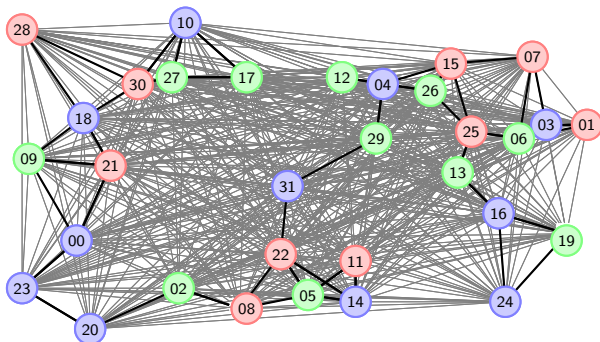
## Part II

# When Academic Studies Become Reality

## ➔ Peer-to-Peer Fundamentals

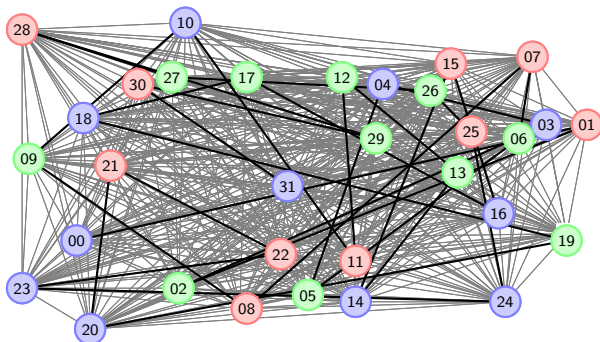


## ➔ Peer-to-Peer Fundamentals



- each peer chooses *some* direct neighbors among all peers
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## ➔ Few Mature Works

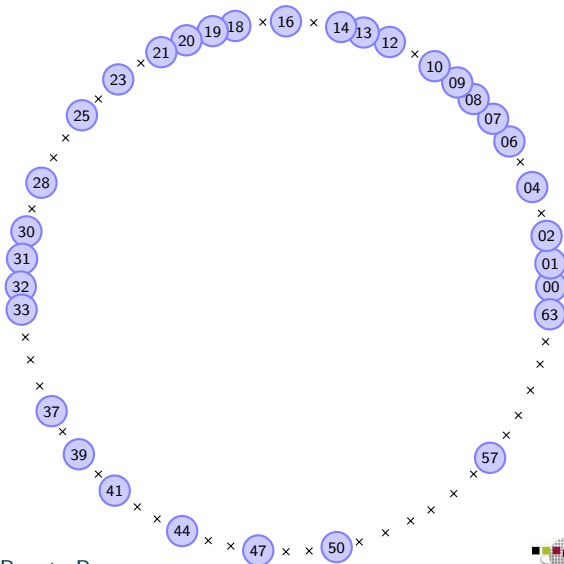
Scientists have focused on few services :

- diffusion of large files (bit-torrent)
- distributed hash tables (DHT) :
  - store a pair (*key*, *resource*) in the system
  - give the *key*, retrieve the related *resource*
  - if a resource has been stored, it *must* be accessible

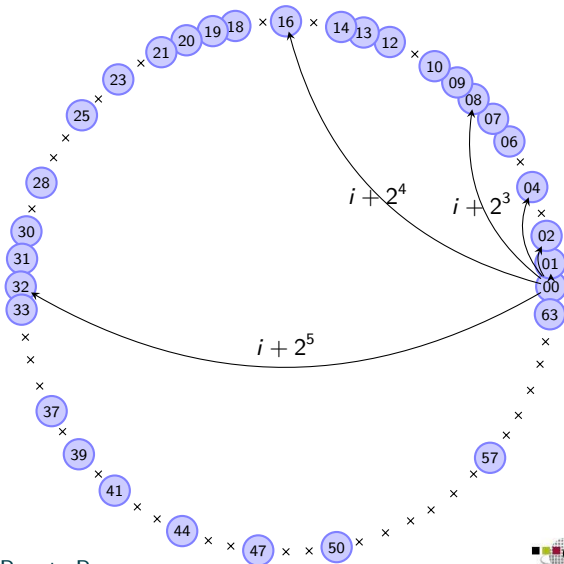
Attractive implementations for controlled network :

- *server farm* : managing a vast amount of resources
- *content delivery network (CDN)* : pushing contents
- *network of boxes* : the new eldorado

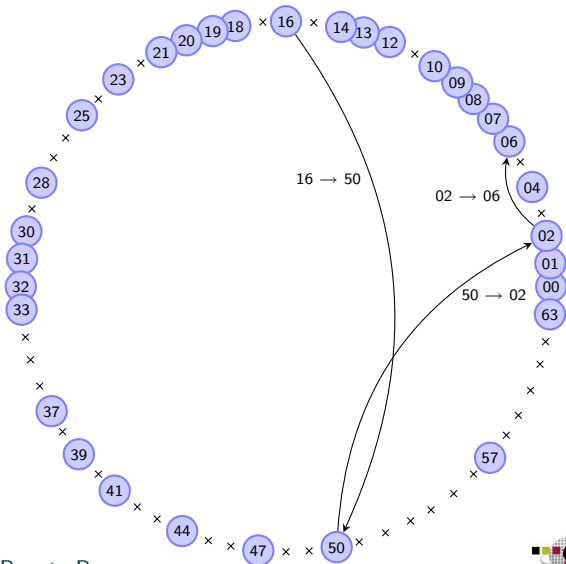
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## ➔ Business opportunities

Any cost reduction on existing services ?

- *one overlay per need* : initial development may be costly
- *decreasing server cost* : gain for large-scale systems

But new services are possible :

- *lightweight and immediately worldwide*
- *relying on networking skills*

## Part III

# Conclusive Thoughts

## ➔ I&R activities on peer-to-peer

Few projects claim studying peer-to-peer :

- *Solipsis* : a *bazaar* peer-to-peer virtual world
- *P2P-images* : a *industrial* peer-to-peer streaming system

However many academic skills on peer-to-peer in Bretagne :

- *computer sciences* : world-class teams at IRISA and Telecom Bretagne
- *social and human sciences* : M@souin gathers high-level institutes

## ➔ A Shift

Along with **Web2.0 trend** :

- capturing money requires complex models
- empower a community → beta web-based eye-candy
- both technical and social *wow effect*

Also a **deep scientific trend** :

- toward “*one billion computers per human*”
- balancing power between edges and core network

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Few possible projects :

- *self-administered network* : distributed package management
- *mixed reality* : distributed “1.5 life”
- *tangible gifts* : distributed Wikipedia