

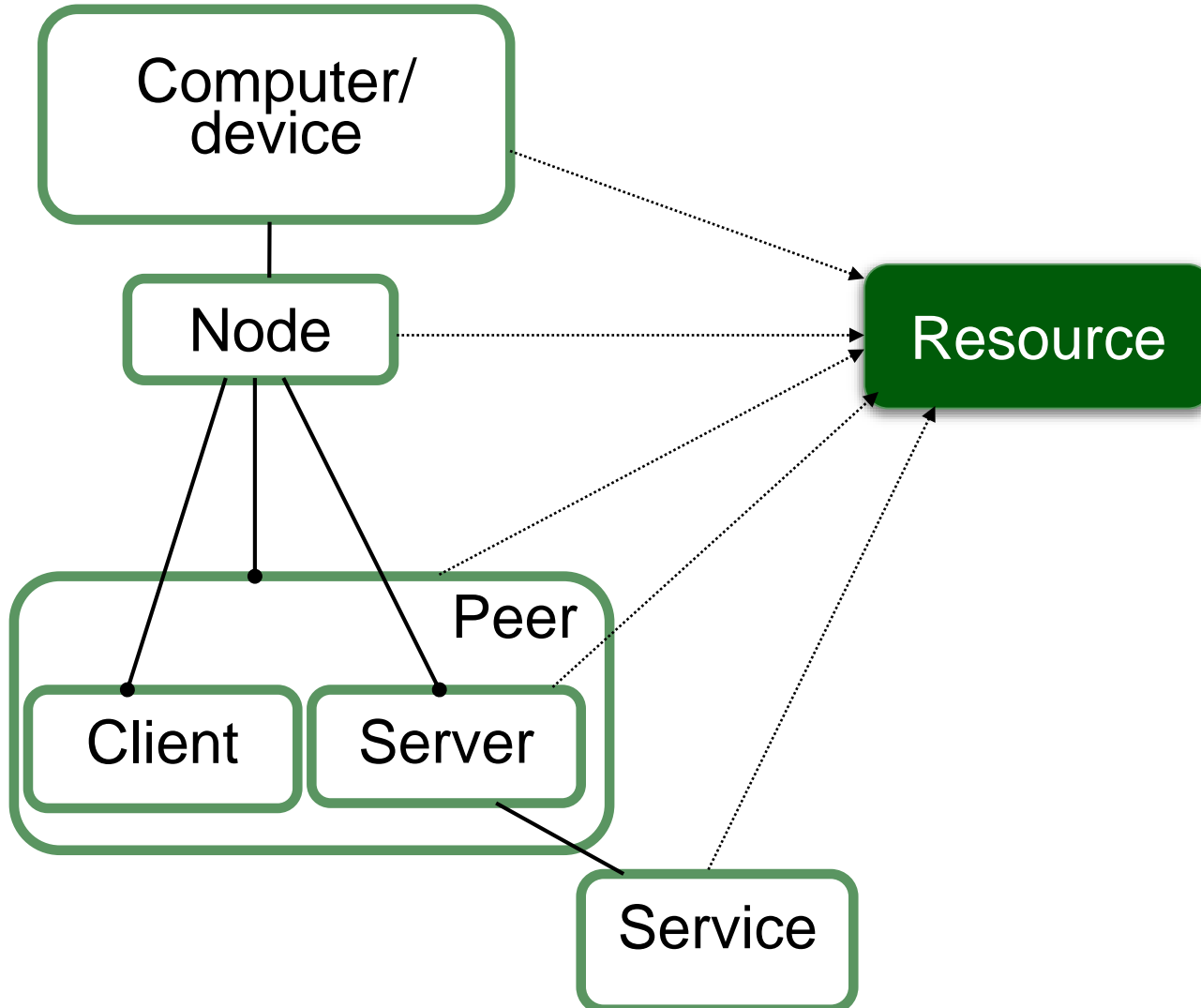
# DISTRIBUTED COMPUTING SYSTEMS

Taxonomy Of DCS

# TERMINOLOGY OF DISTRIBUTED COMPUTING SYSTEMS

- ⊙ **Resource:** any hardware or software entity being represented or shared on a distributed network. For example, a resource could be any of the following: a computer; a file storage system; a file; a communication channel; a service.
- ⊙ **Node:** a generic term used to represent any device on a distributed network. A node that performs one (or more) capabilities is often exposed as a service.
- ⊙ **Client:** is a consumer of information, e.g., a Web browser.
- ⊙ **Server:** is a provider of information, e.g., a Web server or a peer offering a file-sharing service.
- ⊙ **Service:** a network-enabled entity that provides some capability; e.g., a simple Web server could just provide a remote HTTP file-retrieval service. A single device can expose several capabilities as individual services.
- ⊙ **Peer:** a peer is a device that acts as both a consumer and provider of information

# BASIC TERMS OF DCS

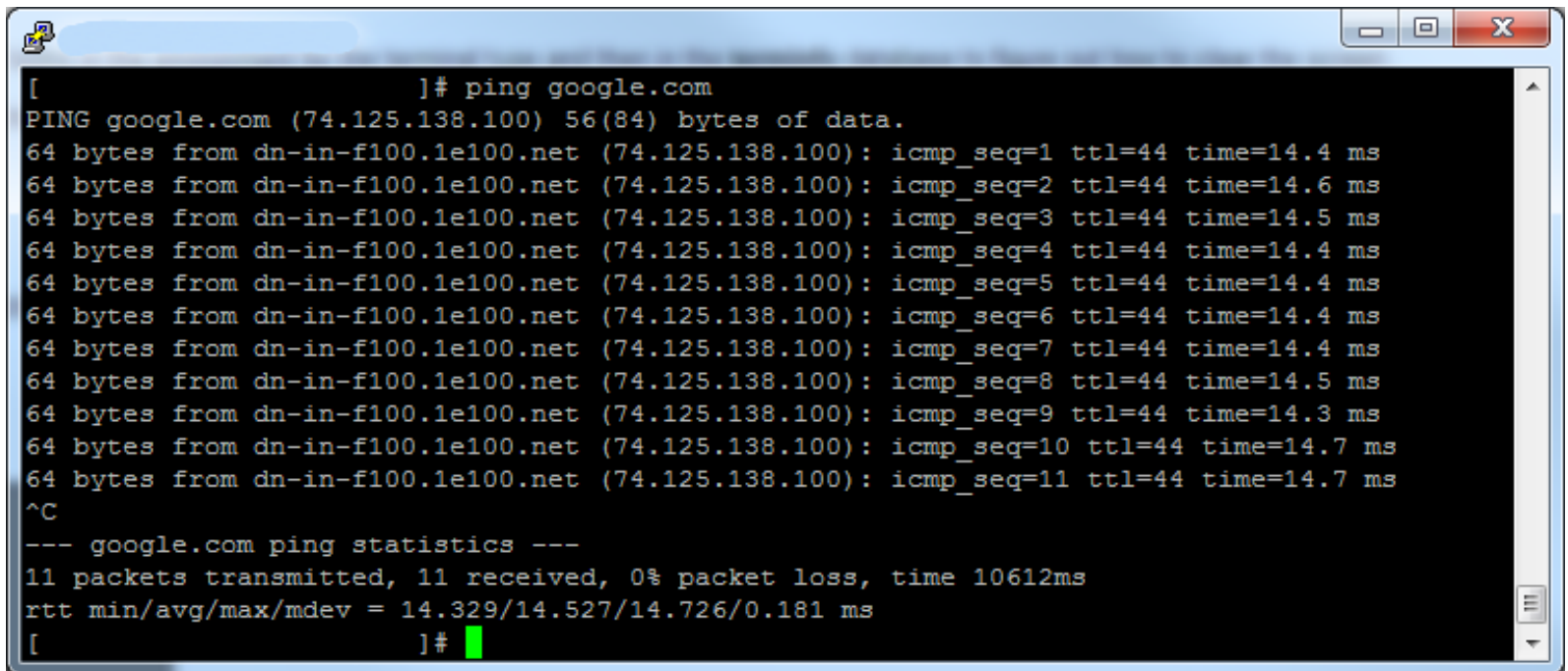


# Distributed Systems Issues

- Distributed systems are inherently different from non-distributed systems.
  - Latency - network speed
  - Memory access - not shared
  - Partial Failure
    - remote failure does not mean local failure
    - no global coordination (like an OS)
  - Guaranteed Concurrency
    - combined with latency, events are not received in the same order as they are generated
  - Indeterminacy
    - Your system is not in control of the whole system
    - With partial failure, a system may just disappear with no indication of status.
    - was it the remote machine or a network link?

# CHECK A LATENCY

- 🕒 Start -> run -> ping [URI or IP-address]

A terminal window with a black background and white text. The window title bar shows standard window controls (minimize, maximize, close). The text inside the terminal shows the execution of the 'ping google.com' command. It displays 11 successful ping responses with their respective times and TTL values. At the end, it shows a summary of the ping statistics, including the number of packets transmitted and received, and the round-trip time (RTT) statistics.

```
[          ]# ping google.com
PING google.com (74.125.138.100) 56(84) bytes of data.
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=1 ttl=44 time=14.4 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=2 ttl=44 time=14.6 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=3 ttl=44 time=14.5 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=4 ttl=44 time=14.4 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=5 ttl=44 time=14.4 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=6 ttl=44 time=14.4 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=7 ttl=44 time=14.4 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=8 ttl=44 time=14.5 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=9 ttl=44 time=14.3 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=10 ttl=44 time=14.7 ms
64 bytes from dn-in-f100.1e100.net (74.125.138.100): icmp_seq=11 ttl=44 time=14.7 ms
^C
--- google.com ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 10612ms
rtt min/avg/max/mdev = 14.329/14.527/14.726/0.181 ms
[          ]#
```

- 🕒 time – what time it took to a network package to reach the destination

# CHECK A PATH OF A PACKAGE

- ◎ Start -> run -> tracer [URI or IP-address]

```
[ ]# traceroute baidu.com
traceroute to baidu.com (123.125.114.144), 30 hops max, 60 byte packets
 1          0.492 ms  0.481 ms  0.460 ms
 2 ip-10-1-40-1.eu-west-1.compute.internal (10.1.40.1)  0.429 ms  0.446 ms  0.518 ms
 3 ip-10-1-40-254.eu-west-1.compute.internal (10.1.40.254)  0.470 ms  0.577 ms ip-10-1-48-254.eu-west-1.compute.internal (1
 4 ec2-79-125-0-132.eu-west-1.compute.amazonaws.com (79.125.0.132)  0.852 ms ec2-79-125-0-136.eu-west-1.compute.amazonaws.c
.125.0.202)  0.786 ms
 5 178.236.0.212 (178.236.0.212)  1.131 ms  1.124 ms  1.054 ms
 6 178.236.0.212 (178.236.0.212)  1.084 ms 178.236.0.211 (178.236.0.211)  0.988 ms 178.236.0.212 (178.236.0.212)  0.990 ms
 7 178.236.0.209 (178.236.0.209)  1.239 ms 178.236.0.207 (178.236.0.207)  1.022 ms dln-b2-link.telial.net (80.239.167.141)
 8 dln-b2-link.telial.net (80.239.167.149)  1.345 ms ldn-bb2-link.telial.net (213.155.136.8)  15.291 ms ldn-bb1-link.telial.net
 9 ldn-bb1-link.telial.net (213.155.134.90)  14.834 ms nyk-bb1-link.telial.net (80.91.249.249)  87.174 ms ldn-bb1-link.telial.
10 las-bb1-link.telial.net (213.155.135.153)  157.980 ms las-bb1-link.telial.net (80.91.246.71)  148.828 ms nyk-bb2-link.teli
11 las-bb1-link.telial.net (213.155.135.153)  157.969 ms chinaunicom-ic-151188-las-bb1.telial.net (213.248.94.126)  350.133 m
12 219.158.27.33 (219.158.27.33)  369.419 ms 365.822 ms chinaunicom-ic-151188-las-bb1.telial.net (213.248.94.126)  335.748
13 219.158.97.221 (219.158.97.221)  371.284 ms 369.835 ms 365.519 ms
14 219.158.3.153 (219.158.3.153)  338.857 ms 338.867 ms 219.158.97.221 (219.158.97.221)  355.492 ms
15 123.126.0.70 (123.126.0.70)  368.497 ms 219.158.3.153 (219.158.3.153)  322.898 ms 339.147 ms
16 123.126.0.70 (123.126.0.70)  372.408 ms 123.126.6.194 (123.126.6.194)  400.715 ms 123.126.0.70 (123.126.0.70)  354.956 m
17 123.126.6.194 (123.126.6.194)  405.847 ms 406.056 ms 389.642 ms
18 * 123.125.248.46 (123.125.248.46)  346.159 ms *
```

# TAXONOMY OF DCS

# CHARACTERISTICS OF DCS

We can highlight the following classification characteristics of DCS:

- ① Resource discovery methods
- ① Resources accessibility
- ① Methods of interaction



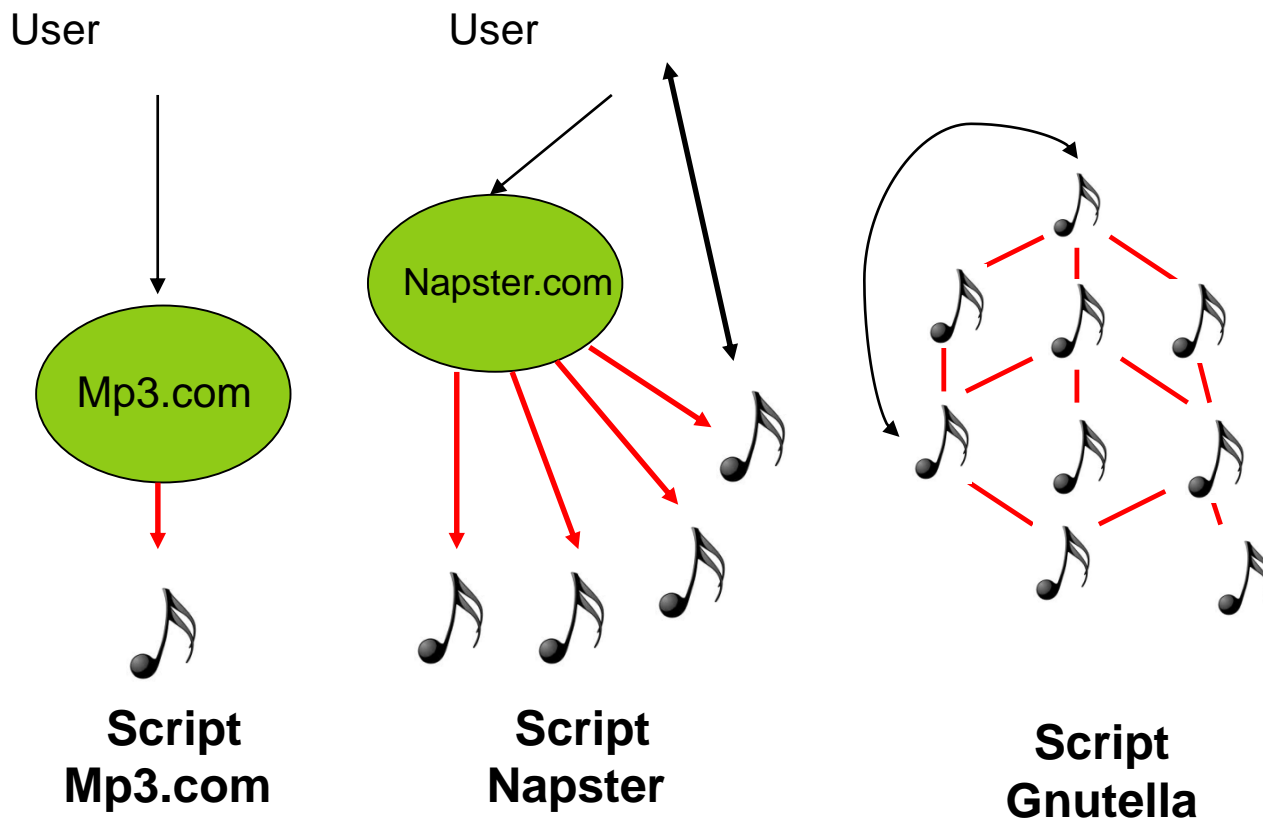
# RESOURCE DISCOVERY METHODS

How does the resource search and discovery implemented in DCS?

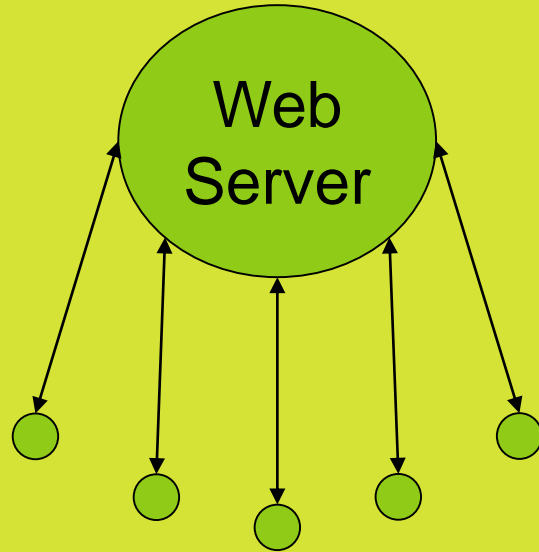
- ⊙ **Centralized:** there is a site (or multiple sites), which are responsible for resource search and discovery (UDDI, DNS)
- ⊙ **Decentralized:** resource search and discovery is conducted without the use of selected central hubs (Gnutella)

# RESOURCES ACCESSIBILITY

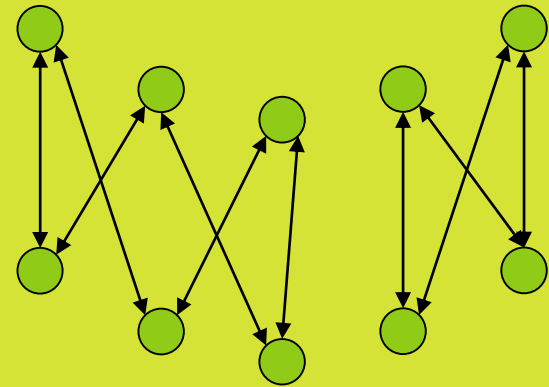
Is there a set of resources that provide similar opportunities?



# METHODS OF INTERACTION



Centralized






Decentralized

Peer-to-peer (P2P) networks

# EXAMPLES OF DCS

# ONE WEB SERVER

	Discovery	Accessibility	Interaction
Centralized			
Decentralized			

- 🎯 **Discovery:** centralized, DNS
- 🎯 **Accessibility :** available or not
- 🎯 **Interaction:** a single server

# THE WORLD WIDE WEB

	Discovery	Accessibility	Interaction
Centralized			●
		●	
Decentralized	●		

- ◎ **Discovery:** the links to various search engines, etc.
- ◎ **Accessibility:** depending on resource – there is some amount of replicated and cached resources
- ◎ **Interaction:** inside the centralized servers

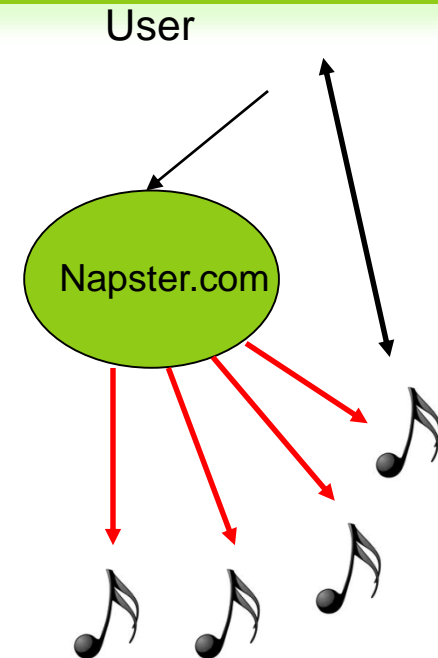
# THE SETI@HOME PROJECT

	Discovery	Accessibility	Interaction
Centralized	●	●	●
Decentralized			

- ◎ **Discovery:** Central search site
- ◎ **Availability:** Hubs
- ◎ **Interaction:** receiving and transmitting of data only from the central server

# THE NAPSTER

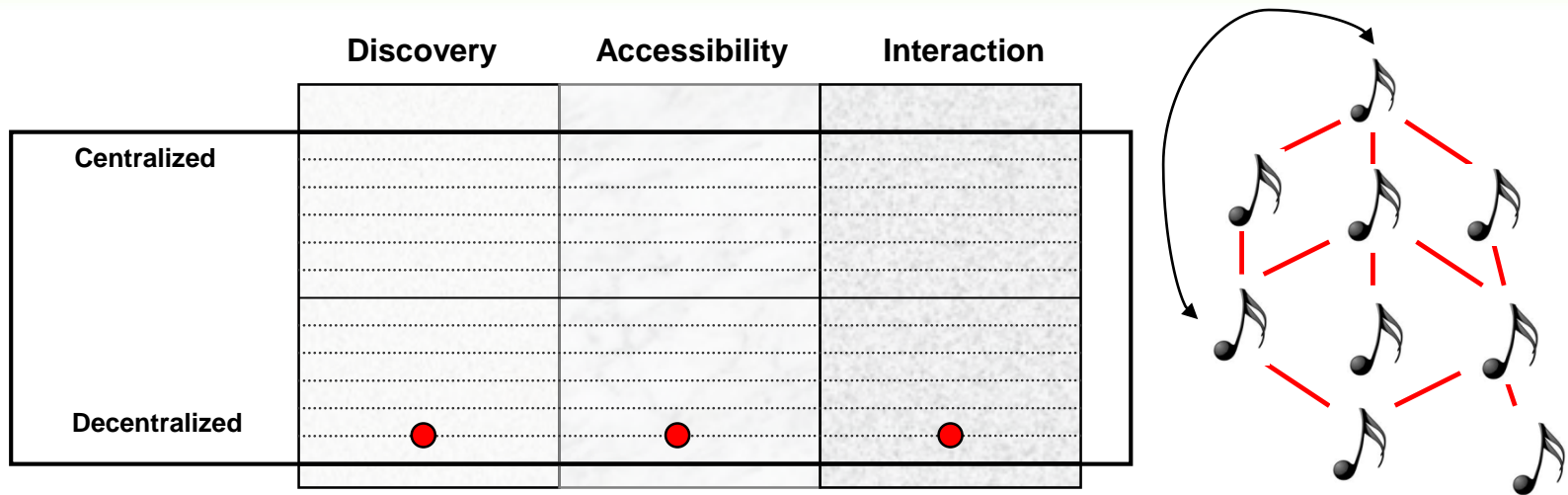
	Discovery	Accessibility	Interaction
Centralized	●		
Decentralized		●	●



- ◎ **Discovery:** Central search engine
- ◎ **Accessibility:** links to numerous identical resources
- ◎ **Interaction:** decentralized, between the resource owners



# THE GNUTELLA



- ⊙ **Discovery:** through the messaging system (ping/pong mechanism)
- ⊙ **Accessibility:** many alternative paths to a single resource
- ⊙ **Interaction:** decentralized, between the resource owners