



Distributed Systems

LIKE IT OR NOT



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CIRCONUS



Beginning of Software Mass Production.

- ▶ Ship
- ▶ Install
- ▶ Run Disconnected.

Things got connected.

- ▶ We built connected software like disconnected software.
 - ▶ Either thick with updates (new versions) available online.
 - ▶ Or it was thin with all logic on **the server** side.

Distributed Applications (examples)



The Web MVC

MC on the server

V In the browser



PoS Applications

Inventory on main server

Inventory, sales on client



HPC

Coordinated progress:

Central jobs, distributed work.



Distributed Backends Changed Everything

► Ratio of

Affected users to
Node failures



The Mysteries of Distributed Failure

Some things are
best described
through poetry

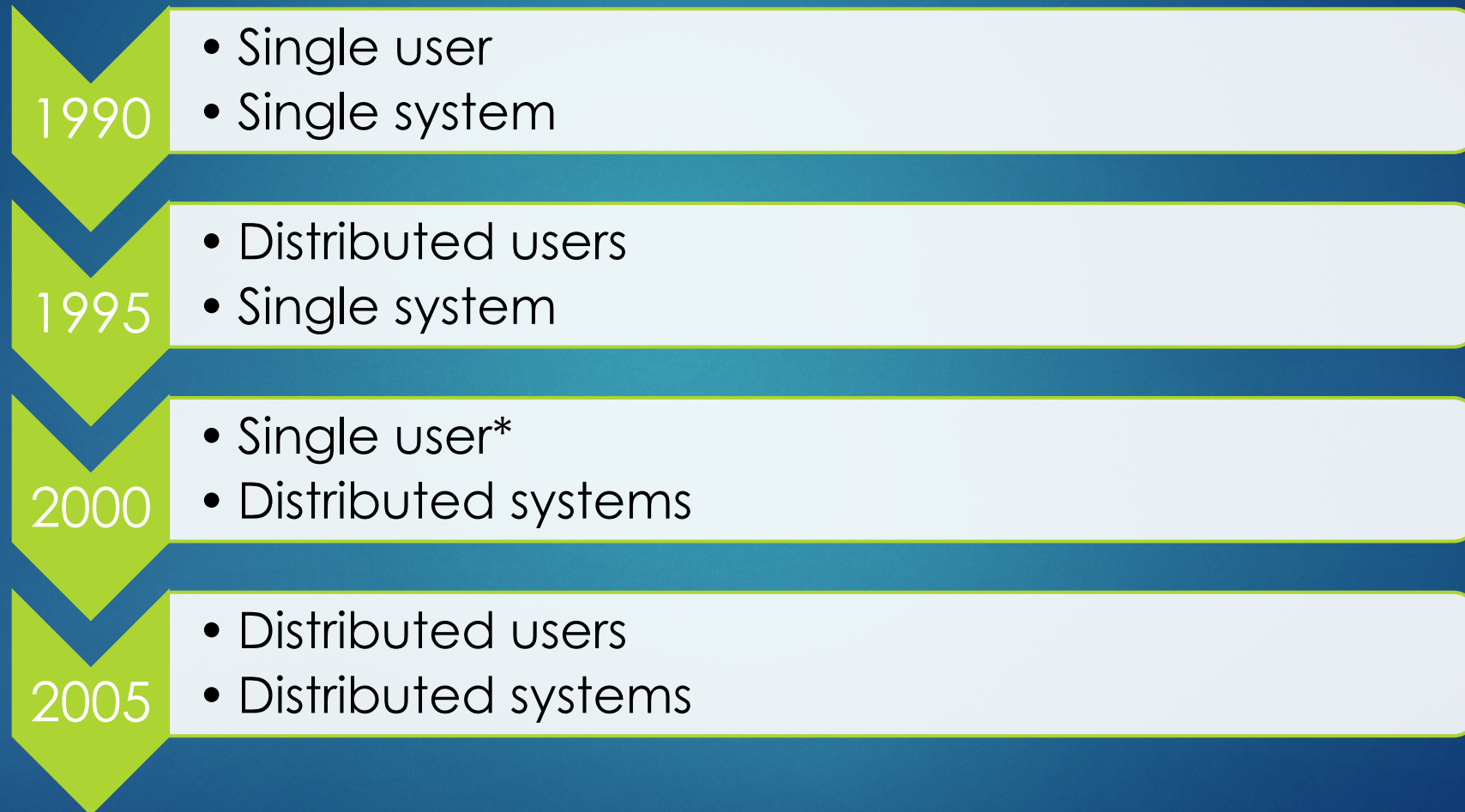
It's not DNS

There's no way it's DNS

It was DNS

- SSBroski

Progression of Understanding



* Lack of tech and understanding to understand both distributed users and systems.

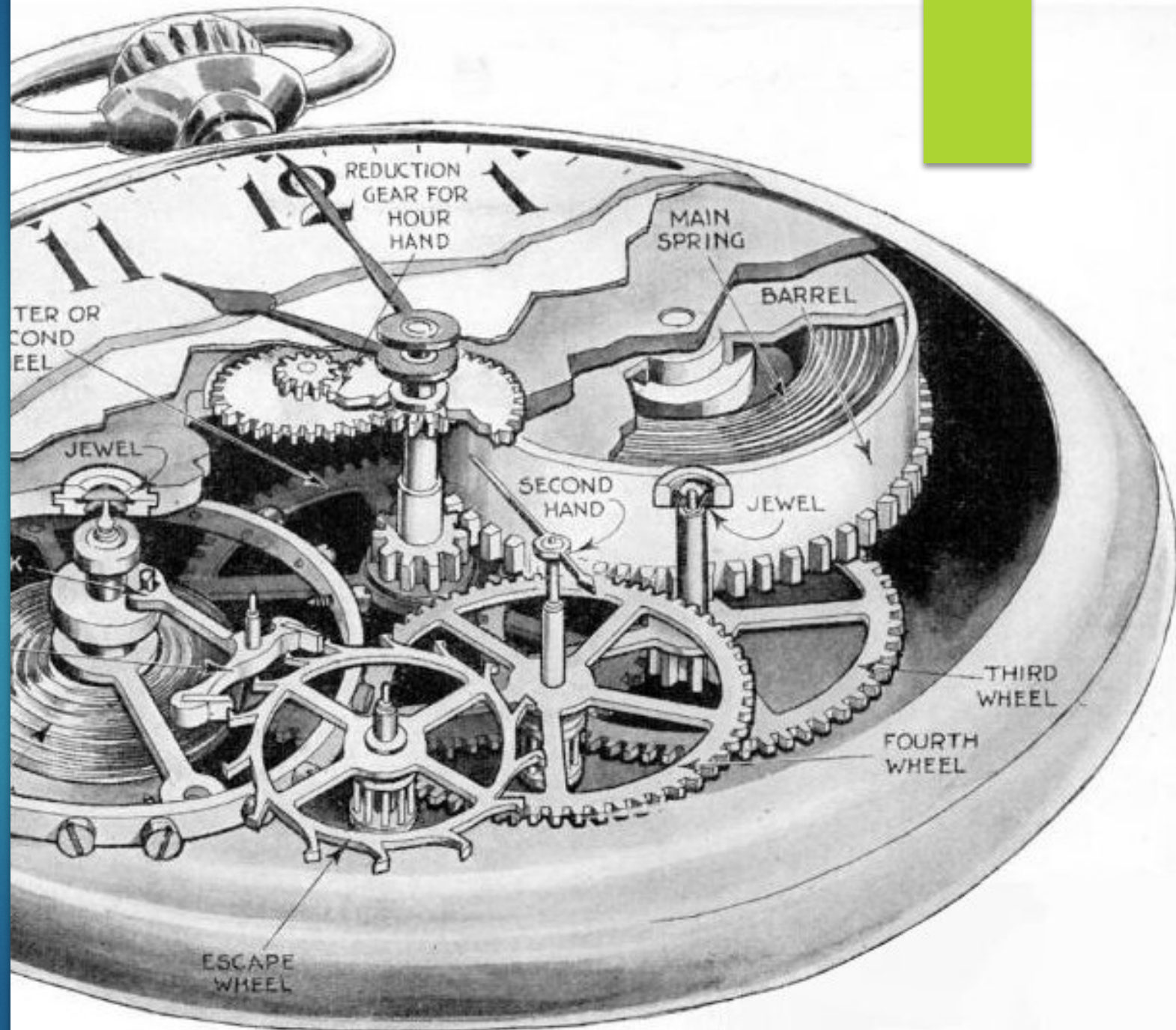


Distributed Systems Are Unavoidable

- ▶ Almost every system you build today will be distributed.
- ▶ Most single systems have multiple processors of different architectures with different clock speeds (think GPU); the distributed nature is mostly hidden.

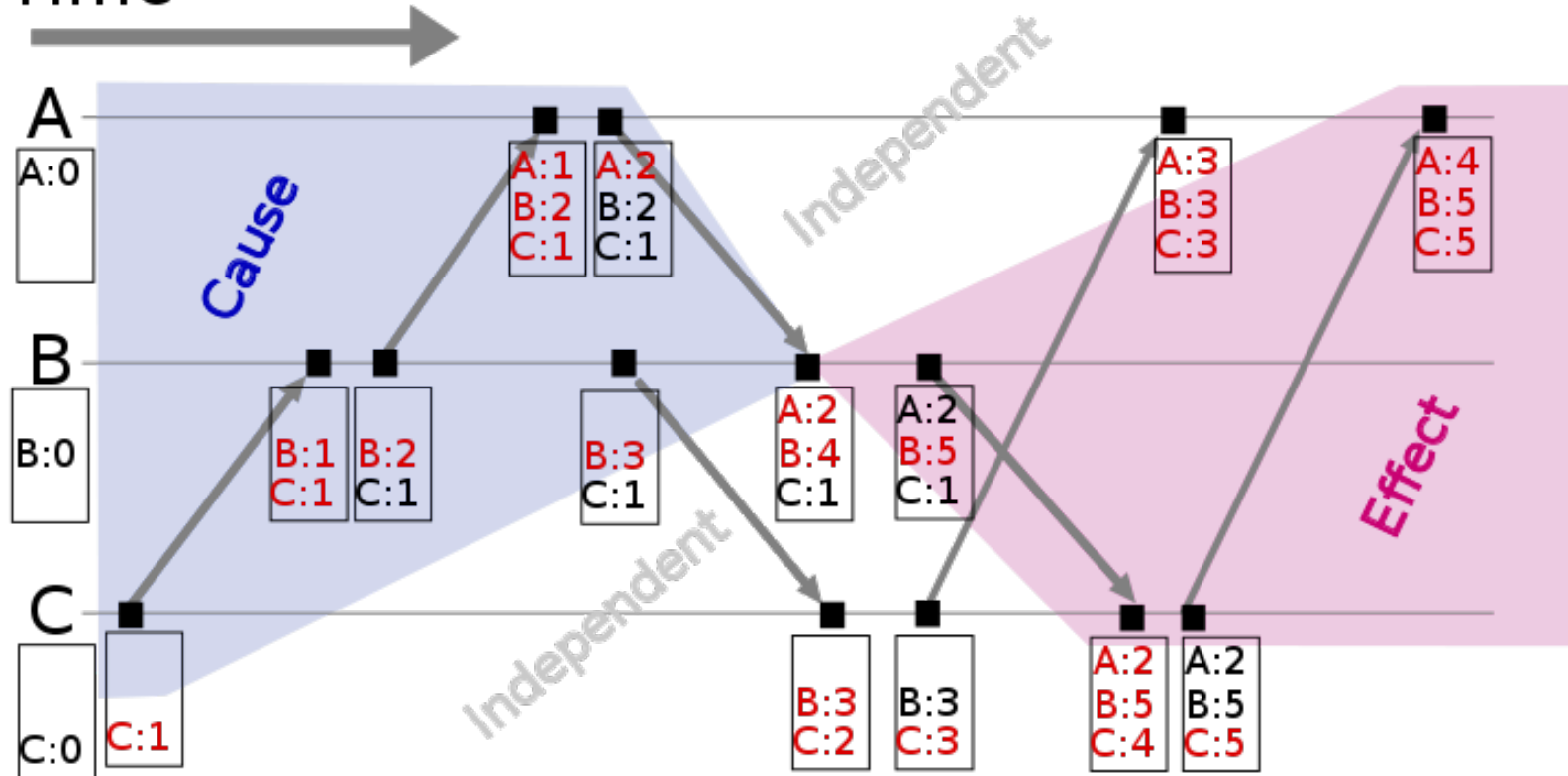
#1 Clocks & Time

- ▶ With 1 clock, you know the time.
- ▶ With 2+ clocks, you never know the time.
- ▶ You must think distributed.

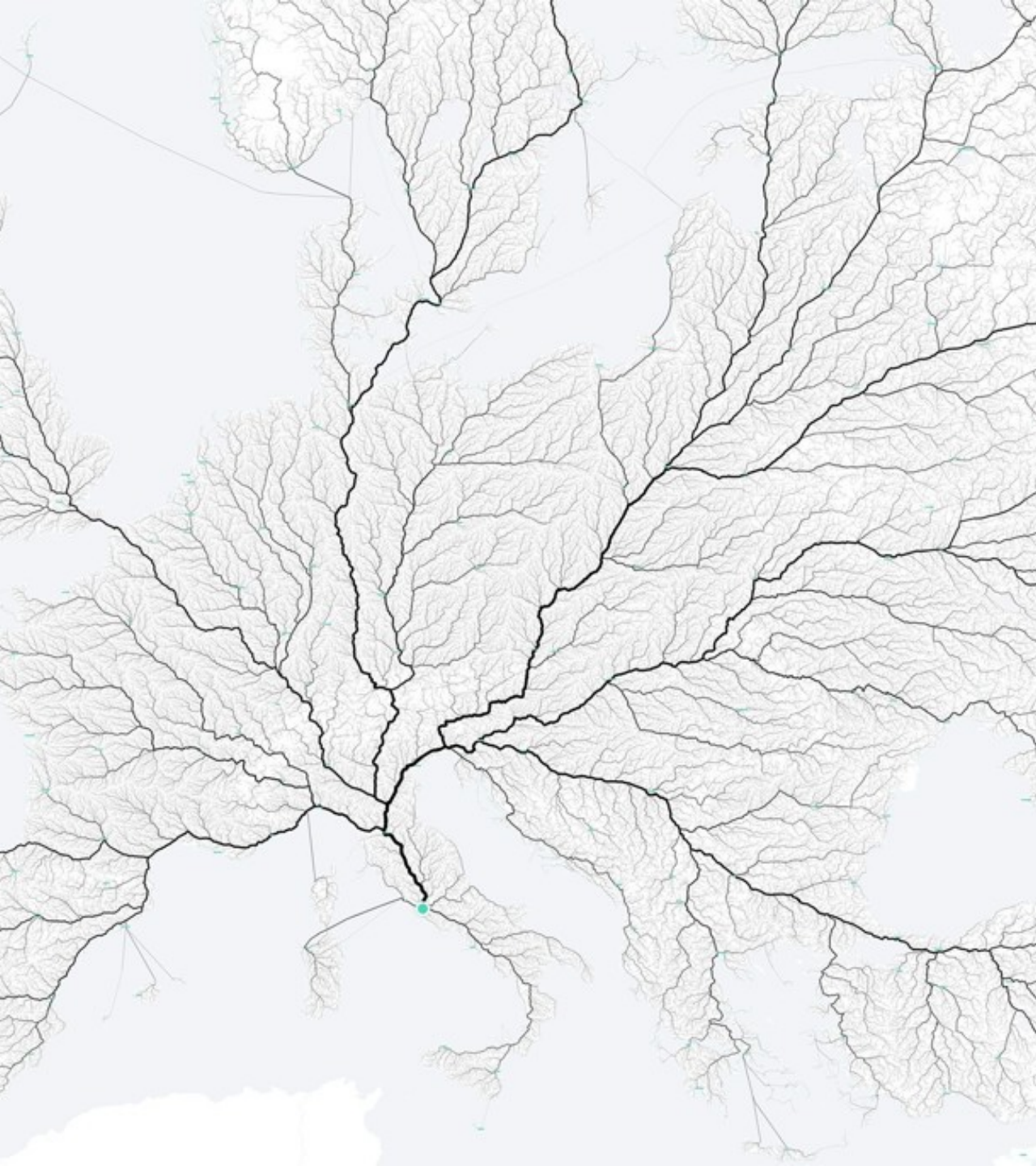


Leslie Lamport, Turing Award Winner:
<http://l42.org/HgE>
Colin Fidge:
<http://l42.org/IgE>

Time



Thinking about causality



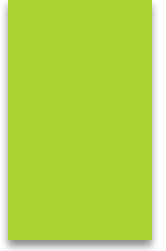
#2 Causal thinking, but with all possible initial states.

- ▶ That debugging step of understanding prior state still exists:
 - ▶ more possible states,
 - ▶ harder to constrain, and
 - ▶ no clocks (#1)

#3

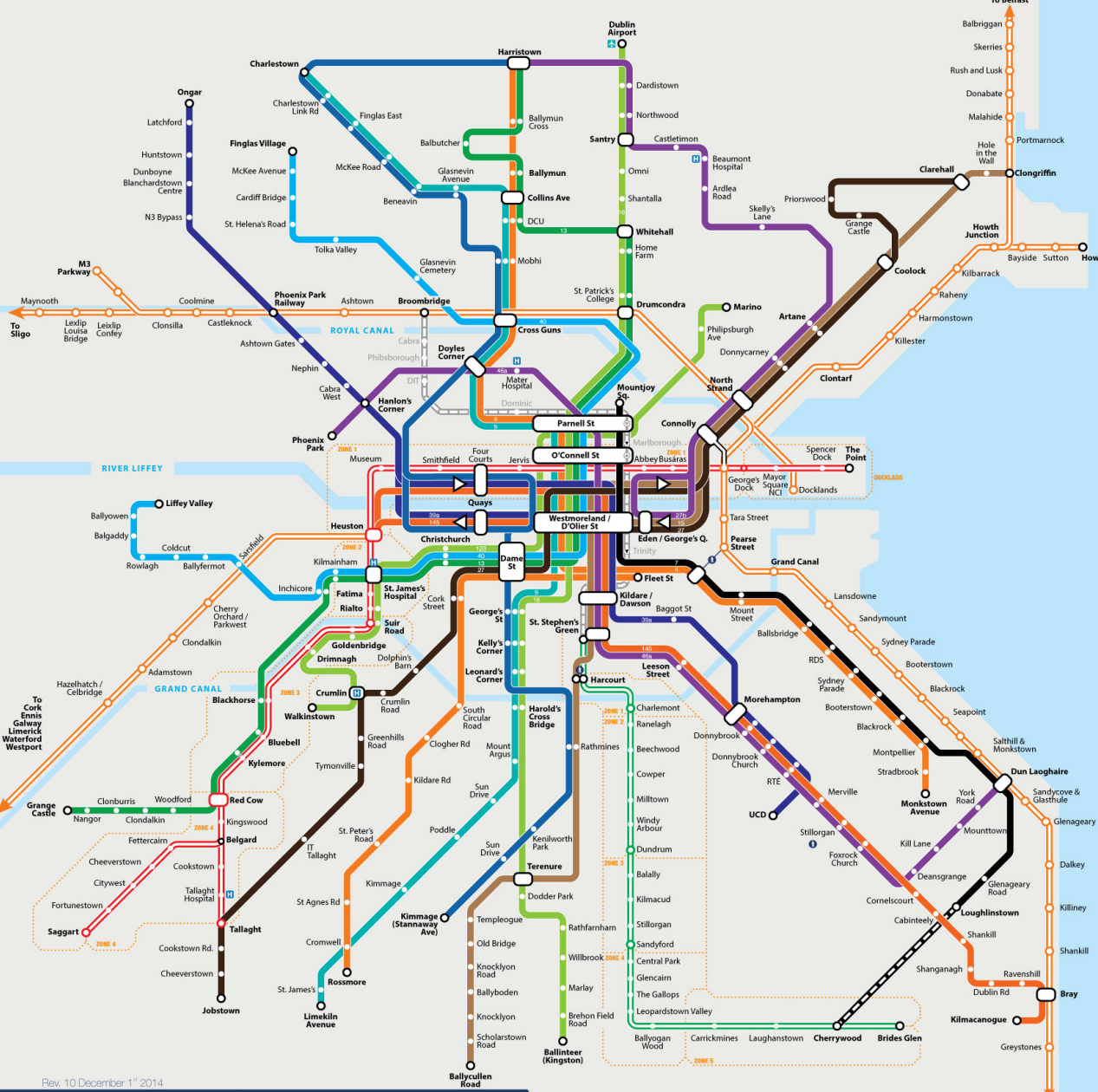
One person's failure,
is another's Byzantine
tragedy.

▶ Arguably reasonable isolated
behavior can have
pathologically bad system
behavior.



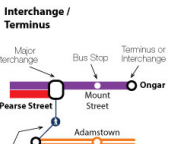
Pathological Timing Failures

- ▶ The most common failure conditions are timeout related (in my experience)
- ▶ Mismanged and awkwardly aligned timeouts can cause pathological and unstable situations.



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Map Key



Fare Information

In Dublin there are no multi modal cash fares and as such there are a number of fare systems in operation. There are a number of prepaid tickets which can be used on both Dublin and Luas services.

Leap Card

Leap card is an electronic purse which allows you to get discounted fares when travelling on Dublin Bus, Luas or Irish Rail (Short Hop Zone only).

Dublin Bus Present Card to Driver

1-3	€1.50
4-7	€2.05
8-13	€2.05

Dublin Bus Cash Fares

1-3	€1.95
4-7	€2.55
8-13	€2.80
13	€3.30
Expresso	€3.60

Discount Card to Driver at side of
Identified stops and interchanges on map

Dublin Bus

4	Harristown to Monkstown Avenue	Every 15 mins at peak
16 B	Airport to Ballyteale (Kingston)	Every 8 mins at peak
46A	Phoenix Park to Dun Laoghaire	Every 8 mins at peak

Luas

Red Line	The Point to Saggart / Tallaght	Every 5 mins at peak
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All routes shown this map operate on at least 15 minute frequency between 07h00 - 19h00 Monday - Friday. Frequencies can vary after 19h00, Saturday and Sunday.

Guide to Services

#4

Understand Consensus

Paxos

- Lamport
<http://l42.org/IQE>

Raft

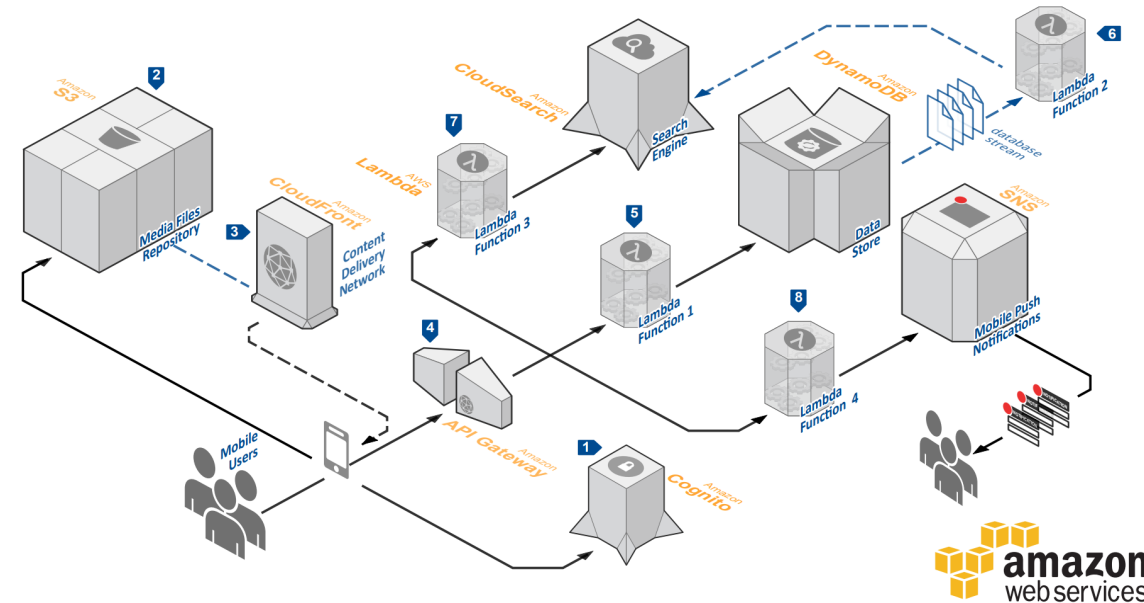
- Ongaro & Ousterhout
<http://l42.org/IAE>

VS

- Birman
<http://l42.org/HwE>

Microservices SOA Cloud

The democratization of useful services has shifted the burden of understanding distributed systems from “distributed systems engineers” to every developer everywhere.



Is it all worth it?

▶ Modular development

▶ Language domains

▶ Security domains

▶ Availability domains

▶ Resiliency domains





Many Distributed Situations Make Little Initial Sense

Pathology

- ▶ **Pathology:**
concerned with diagnosis of issues via post-event analysis
(coopted from medicine)
- ▶ **Pathological:**
involving, caused by, or the nature of a physical or mental disease
or
obsessive or compulsive



Thank You!