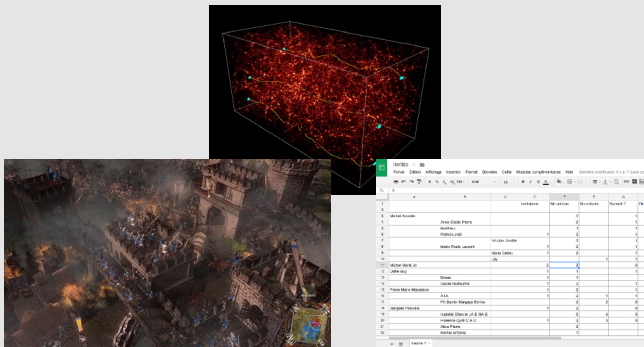# Brief Announcement:
Update Consistency in Partitionable Systems

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Shared Objects in Distributed Systems

- ▶ Strong **C**onsistency
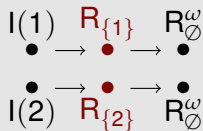- ▶ **A**vailability
- ▶ **P**artition tolerance

Impossible [Gilbert, Lynch, 2002]

Eventual Consistency

Eventual consistency

H is EC if either:

- U_H infinite
- remove $Q' \subset Q_H$ finite: all the queries are done in the same state

Specification

- To what state ?

$\varnothing$	I(1)	{1}
$\varnothing$	I(1) $\longrightarrow$ D(1)	$\varnothing$
$\varnothing$	D(1) I(1)	{1}
$\varnothing$	D(1) $\longrightarrow$ D(1) I(1) $\longrightarrow$ I(2)	{1, 2}

Limits

- Simple?
- A set?
- Implementation independant?

$$I(1) \overset{R_{\{1\}}}{\underset{\bullet}{\bullet \longrightarrow \bullet}} \overset{R_\varnothing^\omega}{\longrightarrow \bullet}$$

$$\bullet \longrightarrow \bullet \longrightarrow \bullet$$
$$I(2) \quad R_{\{2\}} \quad R_\varnothing^\omega$$

Update Consistency
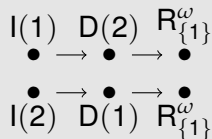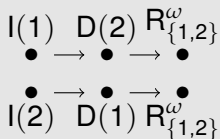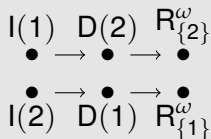
Eventual consistency

H is EC if either:

- U_H infinite
- remove $Q' \subset Q_H$ finite: all the queries are done in the same state

Update consistency

H is UC if either:

- U_H infinite
- remove $Q' \subset Q_H$ finite: *H* is sequentially consistent

$$
\begin{array}{ccc}
I(1) & D(2) & R^{\omega}_{\{2\}} \\
\bullet & \rightarrow \bullet \rightarrow & \bullet
\end{array}
\qquad
\begin{array}{ccc}
I(1) & D(2) & R^{\omega}_{\{1,2\}} \\
\bullet & \rightarrow \bullet \rightarrow & \bullet
\end{array}
\qquad
\begin{array}{ccc}
I(1) & D(2) & R^{\omega}_{\{1\}} \\
\bullet & \rightarrow \bullet \rightarrow & \bullet
\end{array}
$$

$$
\begin{array}{ccc}
\bullet & \rightarrow \bullet \rightarrow & \bullet \\
I(2) & D(1) & R^{\omega}_{\{1\}}
\end{array}
\qquad
\begin{array}{ccc}
\bullet & \rightarrow \bullet \rightarrow & \bullet \\
I(2) & D(1) & R^{\omega}_{\{1,2\}}
\end{array}
\qquad
\begin{array}{ccc}
\bullet & \rightarrow \bullet \rightarrow & \bullet \\
I(2) & D(1) & R^{\omega}_{\{1\}}
\end{array}
$$

Properties of Update Consistency

Based on a sequential specification

- ▶ Defined by classes
- ▶ Allows formal methods

Can be implemented

- ▶ For all UQ-ADTs!

Stronger than eventual consistency

- ▶ Can replace EC objects in a program
- ▶ Also works if distributed specification (e.g. the OR-set)