

Coordinating Distributed Systems

Theory and practice

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Introduction

Outline

- **The consensus problem**

- ▶ A few examples of distributed consensus
- ▶ Eventually consistent Vs Strongly consistent, CAP theorem
- ▶ Fault tolerance: possible faults in distributed systems

- **Consensus protocols**

- ▶ Raft from A to Z
- ▶ Paxos overview
- ▶ Other protocols

- **Implementations - Zookeeper**

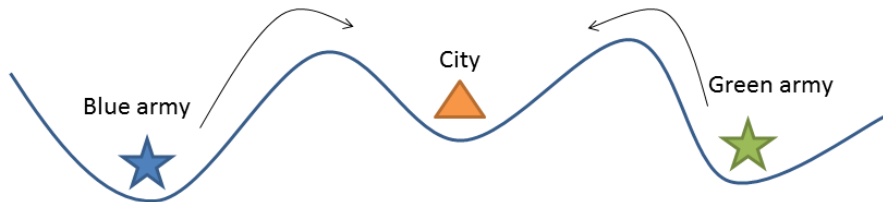
- ▶ History
- ▶ Architecture
- ▶ Data model
- ▶ Higher-level primitives

The consensus problem

Wedding consensus

- The priest follows a well known protocol to reach a consensus:
 - 1 Priest: Alice, will you marry Bob ?
 - 2 Alice: yes
 - 3 Priest: Bob, will you marry Alice ?
 - 4 Bob: yes
 - 5 Priest: You are now husband and wife
- In distributed systems this becomes:
 - 1 Coordinator: Alice, can you commit key X with value 5 ?
 - 2 Alice: yes, I can
 - 3 Coordinator: Bob, can you commit key X with value 5 ?
 - 4 Bob: yes, I can
 - 5 Coordinator: Ok, both of you record that X has now a value of 5
- What if Bob flees from the church?

The two generals



- Two generals want to attack a city
- They can only use unreliable messengers to communicate
- They need to attack at the same time to succeed

An infinite number of messages is needed for each general to be sure the other agrees on the time of the attack.

Consensus protocols

Zookeeper

The two generals

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