

Foundations of Distributed Systems

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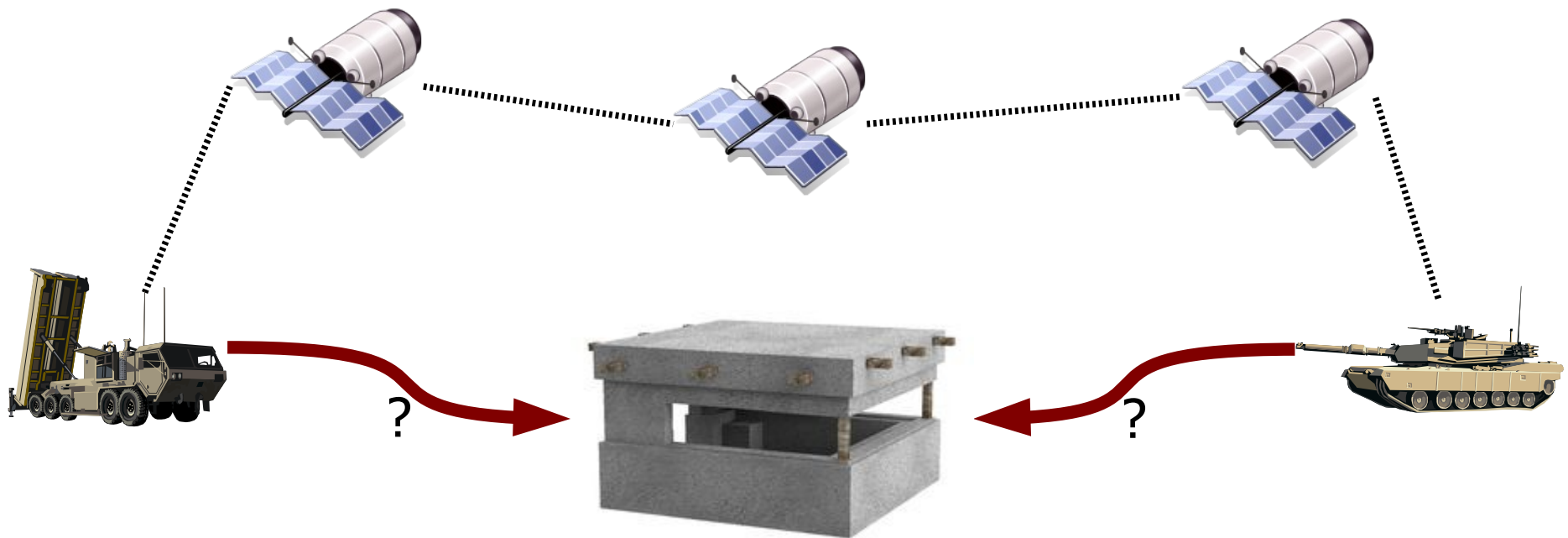
2019/2020

Goals

- What is possible (and impossible) in distributed systems?
 - Recognize common problems
 - Apply known solutions
- Programming large servers:
 - Multi-threaded vs Event-driven

Example: Coordinated attack

- Problem: Agree on a simultaneous attack
 - Both attack: Win!
 - One attacks: Dead.
 - No one attacks: Safe...

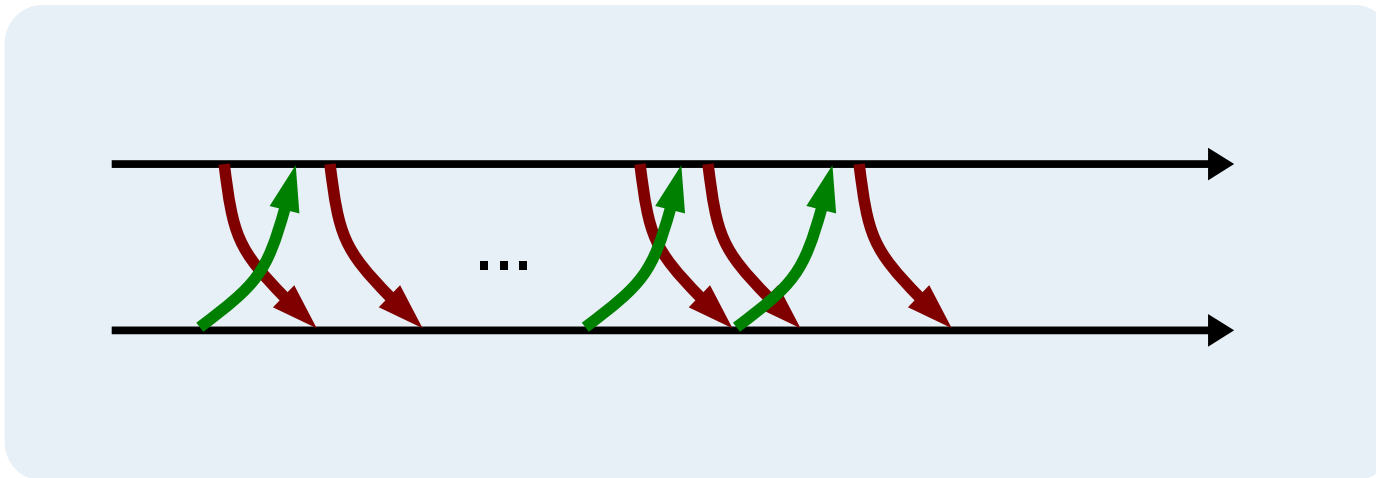


Example: Coordinated attack

- Consider just messages sent and messages received
- Alternatives:
 - Messages received = messages sent
 - Messages received \subseteq messages sent
 - Any messages received
- Does it work?

Example: Coordinated attack

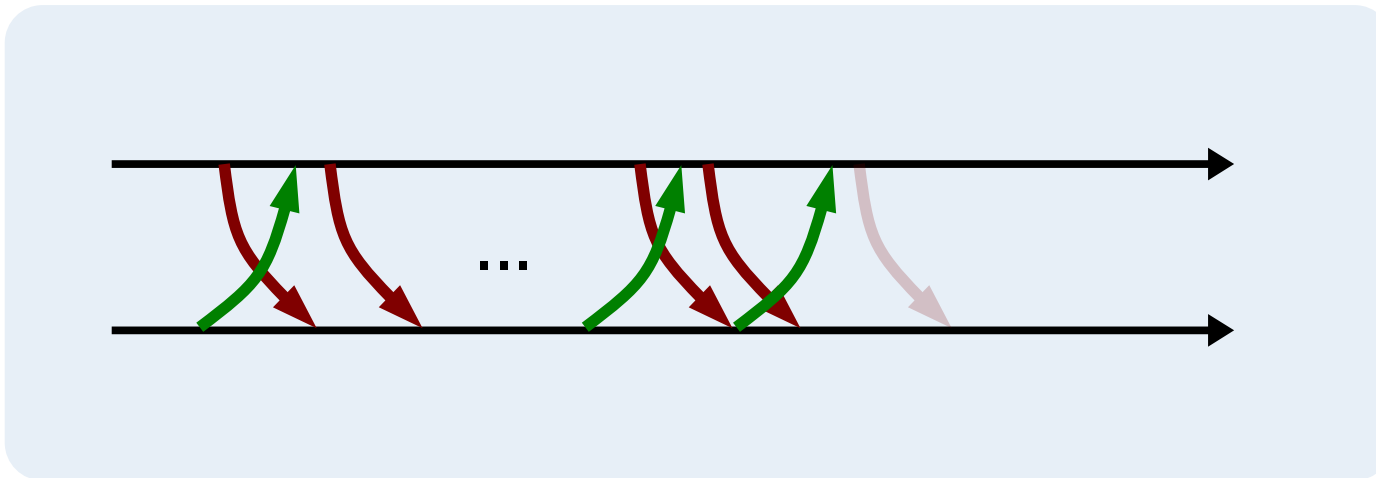
- Interesting case: Received a subset of messages sent
- Consider an hypothetical solution:



- Does the last message matter?

Example: Coordinated attack

- It doesn't matter, because:
 - It can be lost...
 - Therefore, both have already decided



- And now, does the next message matter?

Example: Coordinated attack

- We discover that no distributed program can solve the problem
- Consequences:
 - How to draw money from an ATM?
 - How to fly an airplane with redundant controllers?
- What can we actually solve in a distributed system?

Roadmap

- Event driven programming
- Asynchronous system model
- Causality and logical time
- Distributed transactions

Prerequisites

- Java
- Concurrent programming:
 - Threads / monitors
- Sockets

Information

- Grading:
 - 60% written exam
 - 40% project
 - Both 8/20 minimum
- Contacts:
 - Blackboard
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 - CG7-2.16 / 253 604 449

Main references

- (1) S. Mullender (ed.). **Distributed Systems**. 2nd Edition. Addison-Wesley, 1993. (Chaps. 2 and 4)
- (2) A. Tanenbaum, M. van Steen. **Distributed Systems: Principles and Paradigms**. 3rd Edition, 2017. (Chaps. 6.2, 6.3, 6.4, 8.5)
 - <https://www.distributed-systems.net/index.php/books/distributed-systems-3rd-edition-2017/>
- (3) G. Alonso, F. Casati, H. Kuno, and V. Machiraju. **Web Services: Concepts, Architectures and Applications**. Springer, 2004. (Part I)

Additional references

(1) J. Gray and A. Reuter. **Transaction processing: Concepts and techniques**. Morgan-Kaufmann, 1993. (Parts III-V)

• **Java Platform Standard Edition 9 Documentation**,
<http://docs.oracle.com/javase/9/docs/>

(1) Research papers