Probably Right, Probably on Time: An Analysis of **CAN** in the presence of **Host** and **Network** Faults

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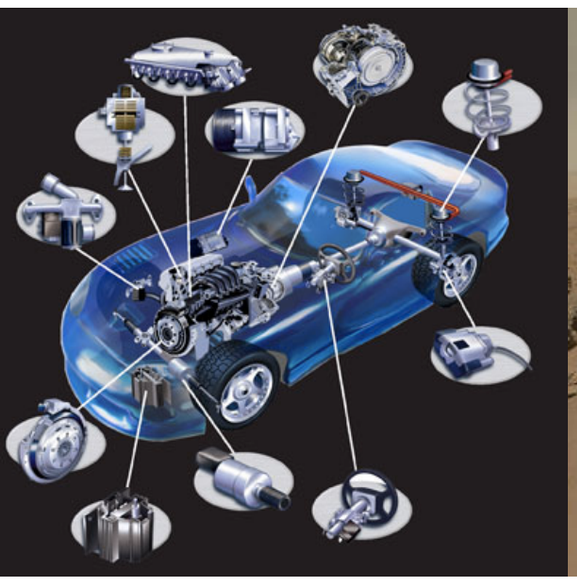
Safety critical real-time systems are susceptible to **electromagnetic interference (EMI)**



Ex: power lines

environmental radiation

high-power machinery

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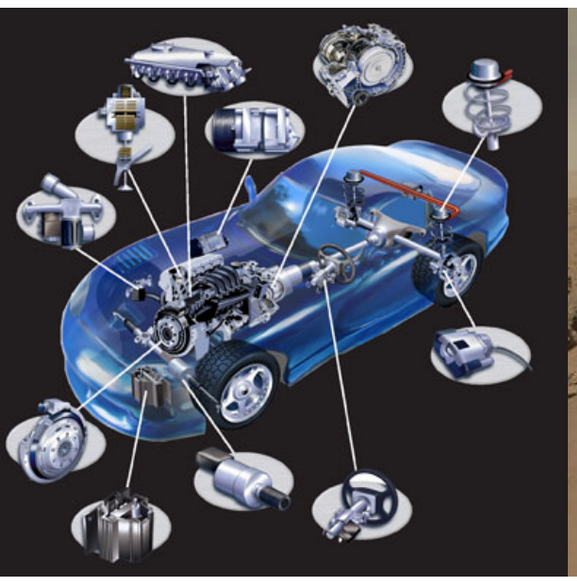

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EMI can have adverse effects

- **Transmission faults**: corrupted messages in networked systems
- **Host faults**: hangs, crashes, incorrect outputs

Mechanisms to **tolerate** EMI-induced faults

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Transmission faults

Retransmit erroneous messages
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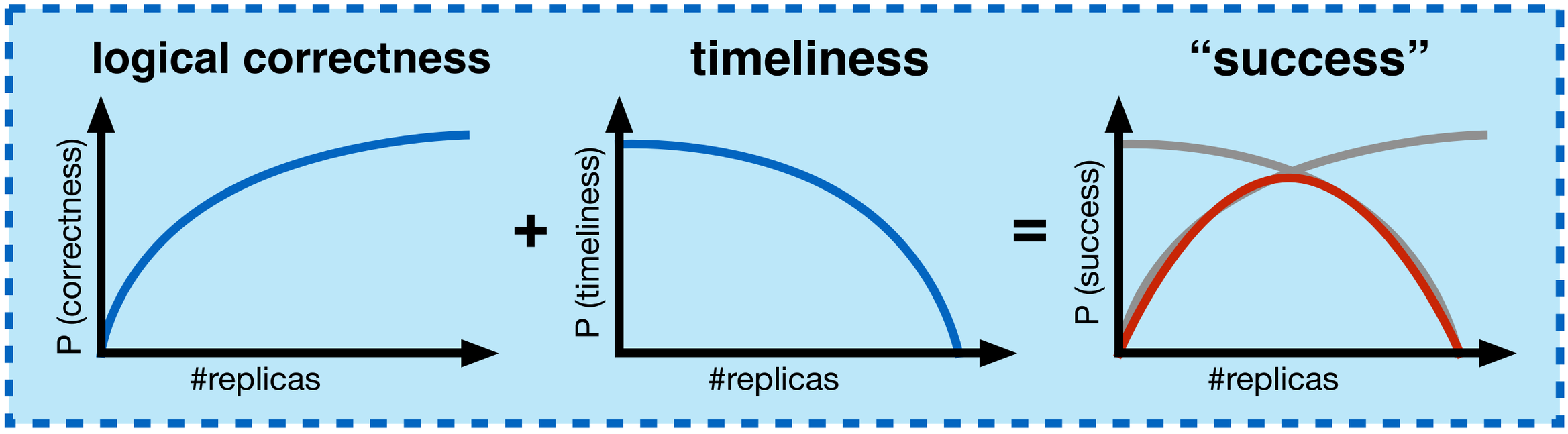
➔ *The **more slack**, **the better**!*

Host faults → **Active replication** replicate task on independent hosts

➔ ***More replicas = less slack!***

Correctness *vs.* timeliness tradeoff



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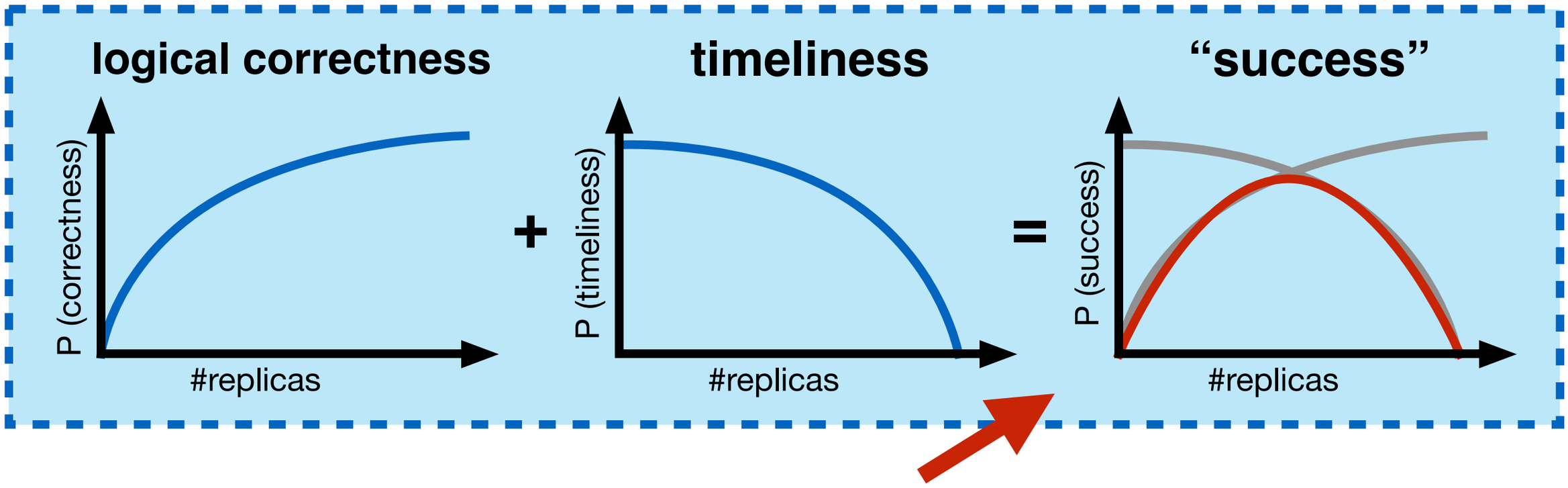

Problem: What is the probability of a

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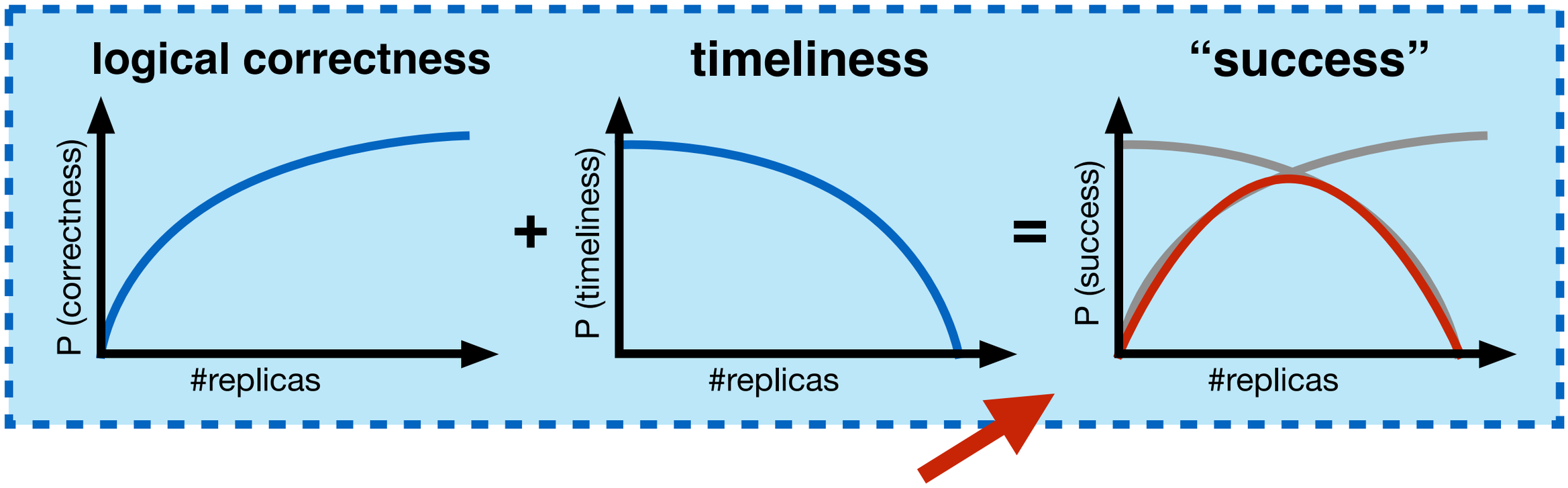

Problem: What is the probability of a

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The message recipient infers the **correct** value of the message

The message recipient infers a value **on time**

Probabilistic analysis to **quantify** the notion of a “successful” message transmission

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Considered systems:

- **CAN-based system**
- Four different scenarios
  - ➡ **periodic / sporadic** message arrivals
  - ➡ hosts with **synchronized / asynchronous** clocks

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Probabilistic fault model

- **Poisson distribution** for retransmissions
- **Fixed, host-specific probabilities** for host faults
  - ➡ for omission and commission errors, respectively

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