CMPT 473
Software Testing, Reliability and Security

Chaos Engineering

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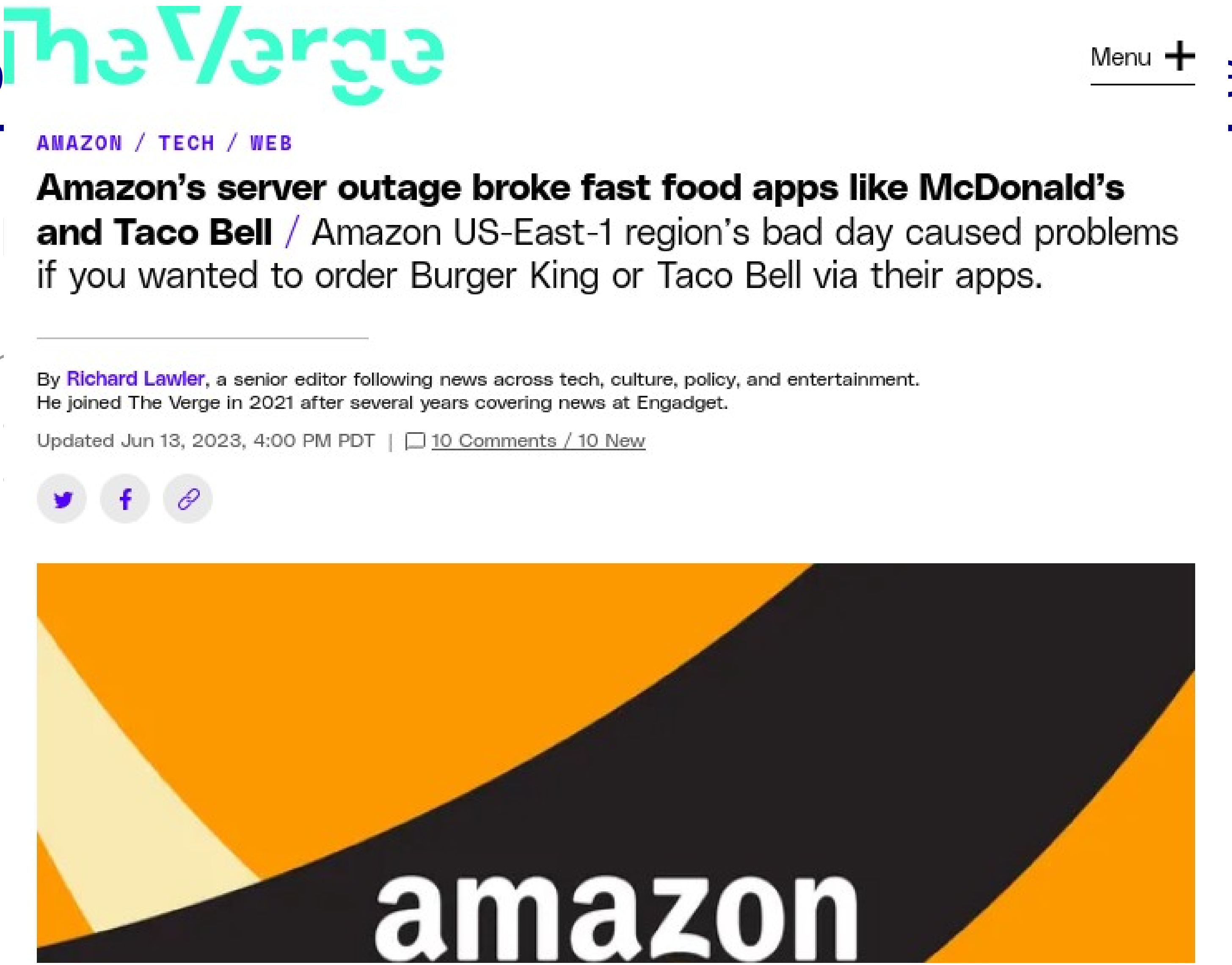

Menu +

AMAZON / TECH / WEB

Amazon's server outage broke fast food apps like McDonald's and Taco Bell / Amazon US-East-1 region's bad day caused problems if you wanted to order Burger King or Taco Bell via their apps.

By Richard Lawler, a senior editor following news across tech, culture, policy, and entertainment. He joined The Verge in 2021 after several years covering news at Engadget.

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- Every one of these challenges makes application writing harder
- And yet the trends (good or bad) are pushing in this direction
  - SOA & Microservices
  - IoT
  - Control systems
  - *coin & smart contracts
  - …

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  - Failure is always an option
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  - ***Actual behavior?***
  - ***Performance?***
- Spec. verification still faces challenges on more empirical issues

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  where tests focus on pathologies of system reliability
- Instead of looking for improvements, you look for degradation
- Chaos engineering is about finding the latent chaos in the system

The 8 fallacies of distributed computing

- Common mistakes from Lyon, Deutsch, & Gosling
  1) The network is reliable
  2) Latency is zero
  3) Bandwidth is infinite
  4) The network is secure
  5) Topology doesn't change
  6) There is one administrator
  7) Transport cost is zero
  8) The network is homogeneous

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  8) The network is homogeneous
- Originally, experiments targeted these,
  but others are inspired by fault injection, race conditions, …

Coping with failure

- How failure is handled varies depending on a system
  - Logging & continue?
  - Rerouting?
  - Approximation and quality of service degradation?
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fallback strategies are common

- What impact might fallback strategies have on business performance?

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  the more confidence you have in the robustness of your system
- NOTE:
  Just as in sequential hypothesis testing, you might want an "early out"
  - Managing the risks is critical even to getting management buy in

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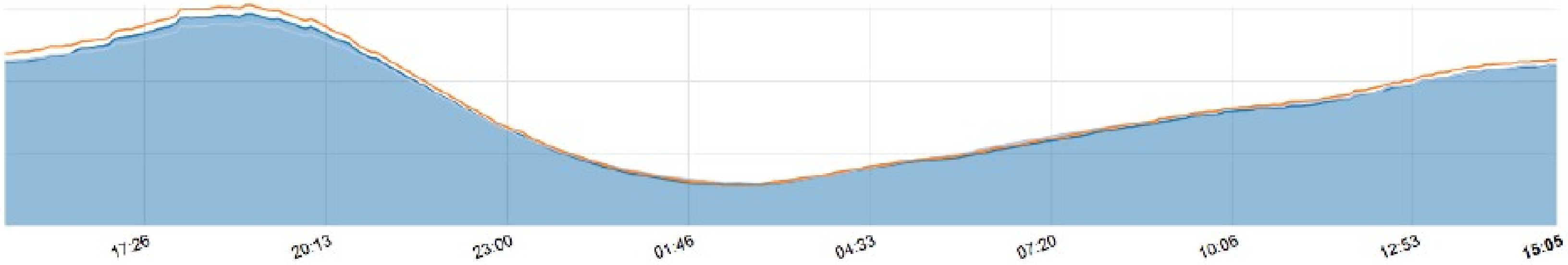

[Netflix SPS, 2016]

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    (clicks/sec, successful purchases, video views, ...)
- Recognize that the baseline captures a distribution with trends
- Coarser grained metrics focus on business value and avoid getting distracted by details
  - Netflix: CPU load vs SPS? SPS captures availability & business demands

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  - 92% of distributed system failures come from poor error handling
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  - 92% of distributed system failures come from poor error handling
  - One form of failure leads to another, causing failure cascades
- Examples:
  - Inject random latency on requests
  - Terminate VM instances
  - Force request failures
  - Make entire Amazon regions unavailable
  - Corrupt headers & communication
  - Double send requests, permute orders, etc.

Managing risk

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- Choose your population based on service tolerances
- Design early exit strategies and circuit breakers into the process
- Start in test environments & work toward production

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Refining the objective of chaos

- Be careful that the goal is not to add instability to a system
- You are engineering the chaos already in the system, and you want a methodical process to expose it
- The process should be one of discovery, uncovering unknowns, and making a system more resilient
- The goal is to uncover the latent chaos early in a controlled setting
  - By identifying unlikely problems early, you can prevent uncontrolled risk

Popular Tools

- Several tools are available
  - Chaos Monkey (Netflix)
  - Gremlin
  - Chaos Mesh (Kubernetes)
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- They focus on different strategies & potential injection abilities
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- Several are open source
- We can explore examples through:
  - (1) Problems, (2) Likely outcomes, and (3) Experiments to test them

Examples: unreliable networks [Gremlin]

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- An experiment can simply make a service unreachable

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  - Fire alarm triggers
- An experiment can simply consume CPU cycles

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- This can be implemented by
  - Making the datastore unavailable
  - Increasing latency to the datastore
  - Actually consuming bandwidth to the store

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- It can discover problems at a small scale before they become larger
- By managing the existing chaos in your apps, you can produce more reliable apps in general