grokking-the-system-design-interview

<https://www.educative.io/courses/grokking-the-system-design-interview>

A screenshot of a black and white website

AI-generated content may be incorrect.

Reliability

A screenshot of a computer

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Let’s break down **MTBF** and **MTTR** with examples so it’s clearer in a system design context.

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**Interpretation:**  
On average, your service runs **238 hours (~10 days)** before failing.

**2. Mean Time To Repair (MTTR)**

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AI-generated content may be incorrect.**Interpretation:**  
On average, it takes **2 hours** to fix an outage.

**In System Design**

* **High MTBF** → Failures are rare (good reliability).
* **Low MTTR** → Recovery is quick (good maintainability).
* **Ideal Goal** → Maximize MTBF, minimize MTTR.

**Availability — how MTBF and MTTR combine**

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AI-generated content may be incorrect.**

**Availability** is the fraction of time a service is up.

**Common “nines” and what downtime they correspond to (per year)**

* **99%** → 87.6 hours/year (~3.65 days)
* **99.9%** → 8.76 hours/year (~8 hours, 45 minutes)
* **99.99%** → 0.876 hours/year (~52.6 minutes)
* **99.999%** → 0.0876 hours/year (~5.26 minutes)

(These numbers help translate SLA language like “three nines” into real downtime.)

**If you have a target availability — what MTBF do you need?**

Rearrange the formula:

MTBF=Availability×MTTR1−Availability\text{MTBF} = \frac{\text{Availability} \times \text{MTTR}}{1 - \text{Availability}}MTBF=1−AvailabilityAvailability×MTTR​

Example: target **99.9%** availability with MTTR = **2 hours**:

MTBF≈0.999×20.001≈1998 hours (≈83 days)\text{MTBF} \approx \frac{0.999 \times 2}{0.001} \approx 1998\ \text{hours} \ (\approx 83\ \text{days})MTBF≈0.0010.999×2​≈1998 hours (≈83 days)

If instead you reduce MTTR to **0.5 hours**, required MTBF for 99.9% drops to ~**499.5 hours**.

**Practical takeaway**

* To **increase availability** you can:
  + Increase **MTBF** (fewer failures): better hardware, redundancy, conservative changes, load-shedding.
  + Decrease **MTTR** (faster recovery): automation, runbooks, warm spares, faster rollback strategies, better observability.
* Often the most cost-effective route is **reducing MTTR** (automation and runbooks) before massively over-engineering MTBF.

Want me to calculate availability for any other MTBF/MTTR pair or compute the MTBF needed for a specific SLA and MTTR you expect?