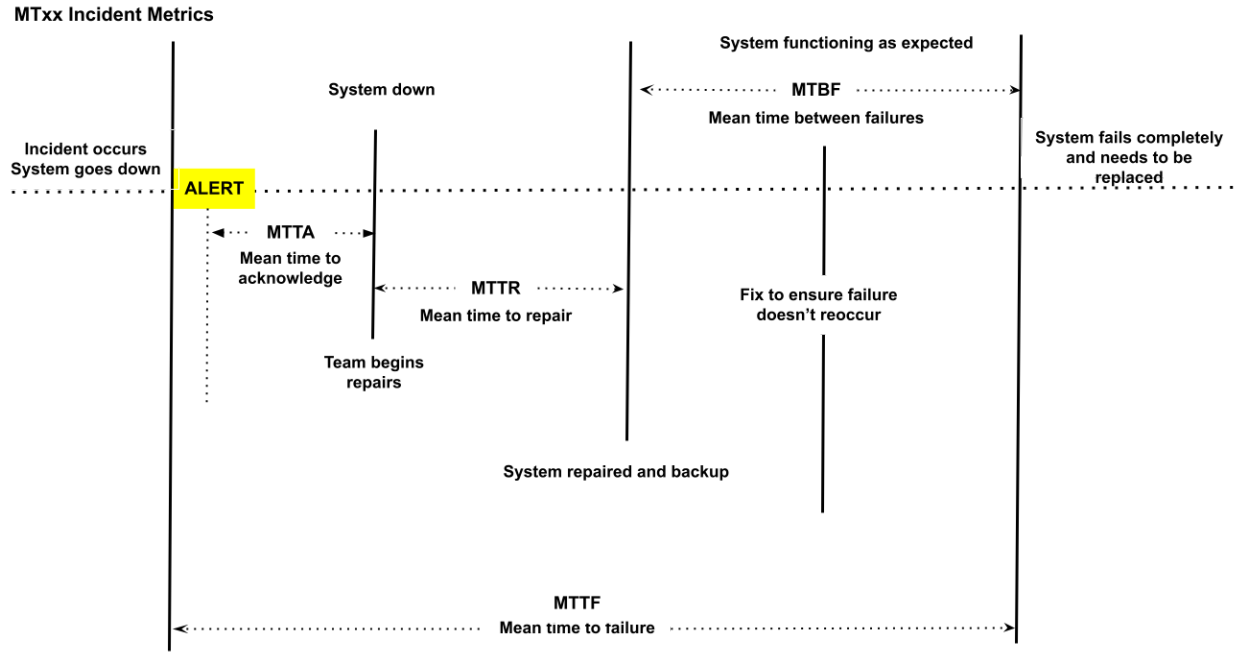
MTBF, MTTA, MTTF and MTTR

For today's businesses, technical incidents come with significant consequences. Companies can suffer major losses because of lost productivity, lost revenue, and maintenance costs when a system goes down.

According to a recent Uptime Institute survey, 62% of significant outages cost more than $100000 with 15% of these outages costing over a million dollars. Effectively tracking incident management metrics is more important than ever to the success of your business.

MTxx or Mean Time to XX metrics are used to measure the average time it takes for a team to detect, diagnose, remedy, and prevent incidents. The "X" can represent a stage or event in the incident management process.

MTBF, MTTA, MTTF, and MTTR are four commonly used metrics for incident management that help organizations identify and diagnose problems in their systems, create more efficient incident management systems, and reduce the number of incidents to better serve customers.



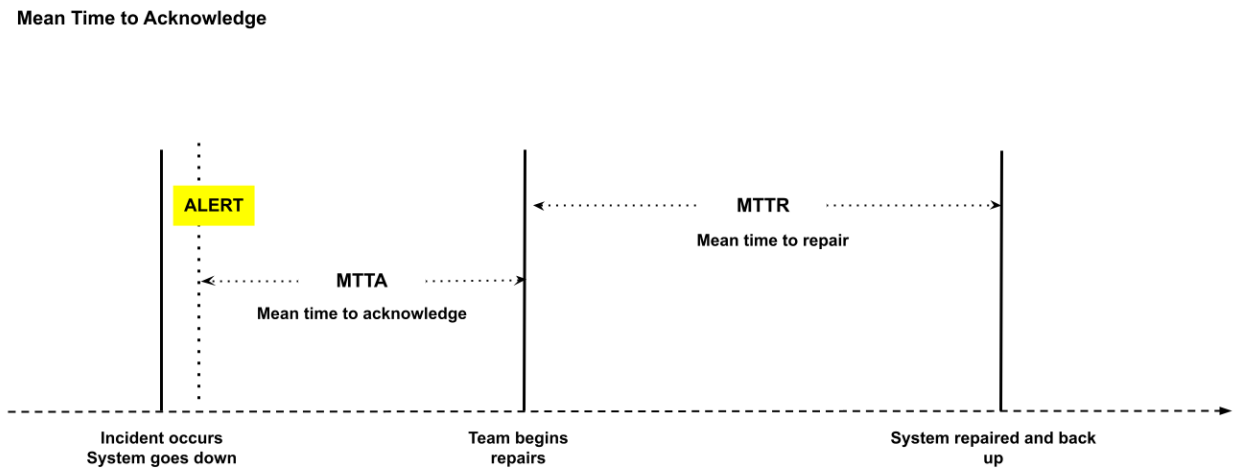
In this guide, we'll explain these metrics, their definitions, how to calculate them, and how you can use them to improve your incident management systems.

What is MTTA?

Mean time to acknowledge or MTTA is a key performance indicator in incident management. It measures the average time between when an incident alert is created to when the team acknowledges the issue.

In incident management, MTTA is used to measure a team's responsiveness to incidents over a specific time period, track the effectiveness of your alert systems, and track customer complaints. It can be measured by team, service, severity, and incident owner.

Tracking and reducing MTTA allows companies to optimize their processes while increasing customer satisfaction and boosting profits.



How to Calculate MTTA for Incidents?

MTTA is calculated by totaling the time between alert and acknowledgment for a specific time period and dividing that total by the total number of incidents within the same time period.

MTTA = sum of all time to acknowledge periods / total number of incidents

Example MTTA Calculation

A system goes down in 3 separate incidents over 60 days. The total time between the incident alert and acknowledgment for all three incidents is 45 minutes.

Sum of all time to acknowledge periods = 45 minutes
Total number of incidents = 3
MTTA over 60 days = 15 minutes

The Importance and Usefulness of MTTA

MTTA is important for organizations because it shows how responsive SRE and other support teams are to incidents as they develop. Slow response times can cause reduced employee productivity, lost revenue, and dissatisfied customers.

A low MTTA means you are acknowledging, prioritizing, and responding to the incidents that affect important business processes in a timely manner. This translates to less downtime, fewer business disruptions, and happier end-users.

A higher MTTA means your team is taking too long to acknowledge and respond to incidents. This could be due to alert fatigue when teams become overwhelmed by too many alerts, and either ignore them or fail to prioritize them as they get lost in the crowd.

In this digital age, customers expect a rapid response to their issues. Failing to respond quickly to incidents can result in almost immediate customer dissatisfaction. Monitoring MTTA gives you insight into how to improve team responsiveness and streamline incident management efforts over the long term.

Minimizing MTTA allows your SRE teams to optimize their processes, improve customer satisfaction and enhance profits and lets you know if your efforts to reduce time to acknowledgment are successful.

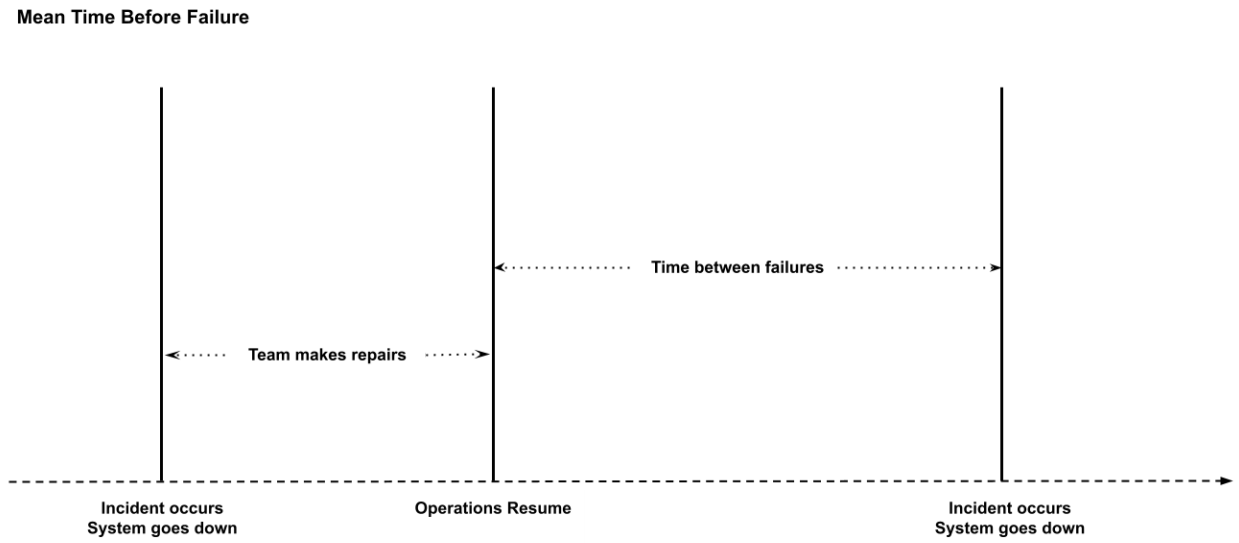
What is MTBF?

Mean Time Between Failures or MTBF is the average time between repairable failures for a technology asset such as a system, application, service, or hardware component. It is a critical metric for measuring the frequency of failures for repairable assets.

Besides measuring asset reliability, MTBF is also used with MTTR (mean time to repair), another failure metric, to calculate the availability of a technology asset.

Availability = MTBF/(MTBF+MTTR)
MTBF only focuses on unexpected failures and downtime and doesn't include scheduled outages and downtime that result from planned or preventative maintenance.

MTBF is not a fixed value and as an asset nears the end of its useful lifetime, it will decrease as the asset's failure rate increases.



How to calculate MTBF?

MTBF is calculated by dividing the total operational time of a set of similar assets by the number of incidents observed over a specific time period.

Mean Time Between Failures = total hours of operational time / total number of failures

Total operational time is the total time a technology asset has been operational without incident. It is determined by adding the lifespans of similar assets over the time you want to analyze (e.g. 4 months, 2 years, etc.).

The number of asset failures is the total number of failures for these assets over the same time period. Data is taken over a period for multiple failures to calculate an arithmetic average or mean.

Example MTBF Calculation

An operating system experiences 4 random crashes over the course of 30 days (720 hours). The total amount of downtime resulting from these incidents was 48 hours.

Total number of failures = 4
Total hours of operational time = 720 - 48 = 672

MTBF = 672 / 4 = 168 hours

Calculating MTBF from Failure Rate

MTBF is the inverse of the failure rate and can therefore be calculated from a known failure rate.
Failure rate = the number of incidents divided by total operational time
MTBF = 1/ Failure Rate

Example MTBF Calculation from Failure Rate
Failure rate = 20 failures divided by 1000 hours of uptime
Failure rate = 0.02
MTBF = 1/0.02
MTBF= 50

The Importance and Usefulness of MTBF

In SRE practices, MTTF typically measures the availability and reliability of IT environments, not the performance of the DevOps or SRE teams managing the environment.

MTBF is most useful for helping you predict and prevent unplanned outages. Measuring MTBF gives you important information about a failure and helps you mitigate its impact. MTBF analysis will help see how successful teams are at preventing and reducing incidents, in the long term so you can reduce downtime and increase productivity.

Using MTBF, you can optimize your maintenance schedule, evaluate maintenance processes, improve inventory management, and make better CapEx decisions. An initial MTBF gives a baseline for preventative maintenance. With an approximate timeline for when an asset will fail, you can better gauge when you need to schedule preventive maintenance.

MTBF also gives you better insight into what components you need to order and keep on hand for more efficient inventory management. An increasing MTBF also makes it easier to decide to replace an asset rather than repair it, for better use of human and financial resources.

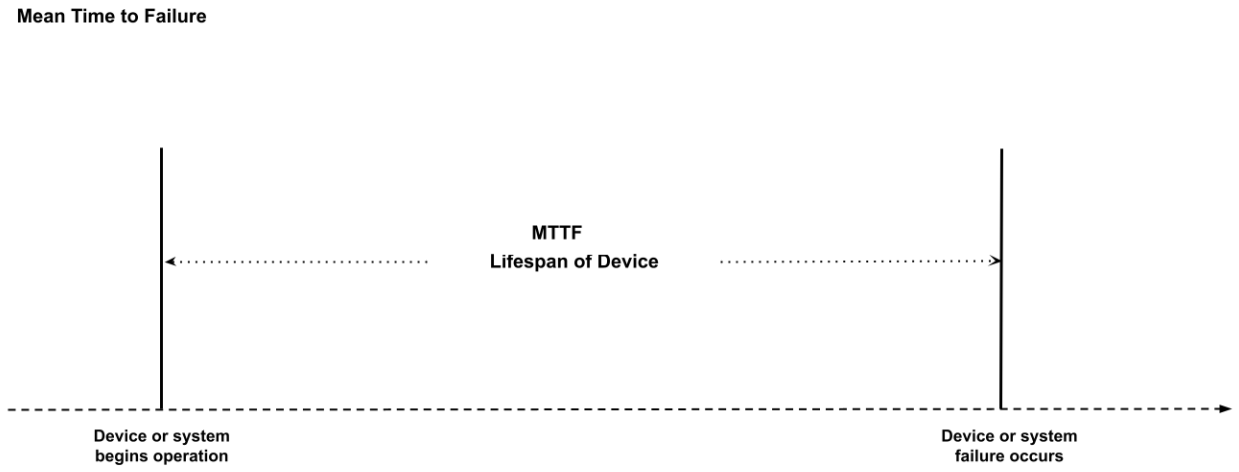
Companies aim to keep MTBF as high as possible. A low MTBF puts the reliability and availability of your system into question. You may need to conduct root cause analysis to gain more insight into incidents and implement preventative maintenance measures. Conversely, the more the time there is between incidents, the more reliable the system is. Fewer incidents mean less downtime and reduced costs.

What is MTTF?

MTTF or Mean Time to Failure is an incident management metric that measures the average operational time for a non-repairable technology asset before it fails completely. MTTF only records one failure per asset and is only used for assets that cannot or should not be repaired.

MTTF can help you understand how long an asset will last on average and determine the expected lifetime of an asset and schedule preventative maintenance. The more assets you observe, the more accurate your MTTF metric will be.

MTTF can also be used with service level agreements (SLAs) to inform customers about expected system lifetimes and when to schedule system maintenance.



How to Calculate MTTF

To calculate MTTF, you need to:

1. Determine the number of assets you want to access
2. Determine the total hours of operation for each asset
3. Calculate MTTF by dividing the total hours of operation time for the assets you are accessing by the total number of assets.

MTTF = total hours of operation across devices / total number of failed assets.

Example MTTF Calculation

Using MTTF to determine how long a particular brand of hard drive lasts on average before they fail.

Hard drive 1 lasts 500, 000 hours, Hard drive 2 lasts 400, 000 hours, Hard drive lasts 700, 000 hours, and Hard drive lasts 800, 000 hours for a total of 2,400,000 hours.

Total hours of operation = 2, 400, 000 hours
Total number of failed assets = 4
MTTF = 2,400,000 hours / 4 hard drives
MTTF = 600, 000 hours for this brand of hard drive

The Importance and Usefulness of MTTF

System or application failure can have a detrimental impact on service delivery, revenue, and customer satisfaction. MTTF can improve preventative maintenance processes. If a system and its components are always in good working order, the system is perceived as more reliable.

Like MTBF, there are several situations where MTTF can help you improve your maintenance strategy. MTTF can be valuable for non-repairable assets where preventative maintenance will prolong the life of the asset. If you know that a certain part or component has an average lifespan of 20, 000 hours, you can more accurately estimate when to order a replacement and have it arrive before the entire system breaks down.

MTTF can also help you reduce costs when deciding what parts and equipment to purchase. Not only does regularly scheduled maintenance reduce the number of parts you need to buy, but you can budget more efficiently if you know approximately when you need to buy components.

A good MTTF will be relative to the specific asset and your business objectives. Typically, the longer the MTTF, the better. When determining a good MTTF for your organization, consider the asset's expected lifetime, its operating environment, and how it compares to similar assets in similar environments and use cases.

The MTTF metric can also be used to evaluate suppliers. An increasingly shorter MTTF on products from the same supplier could be a red flag for a quality issue. Maybe you need to change suppliers or at least have a conversation with your current supplier about the quality of their product.

MTTF vs MTBF

So what's the difference between MTTF and MTBF? Well, MTTF is used for assets that cannot be repaired and MUST be replaced when they fail, i.e. failure occurs only once. MTBF is used for assets that can be repaired when they fail, i.e. failure can occur multiple times.

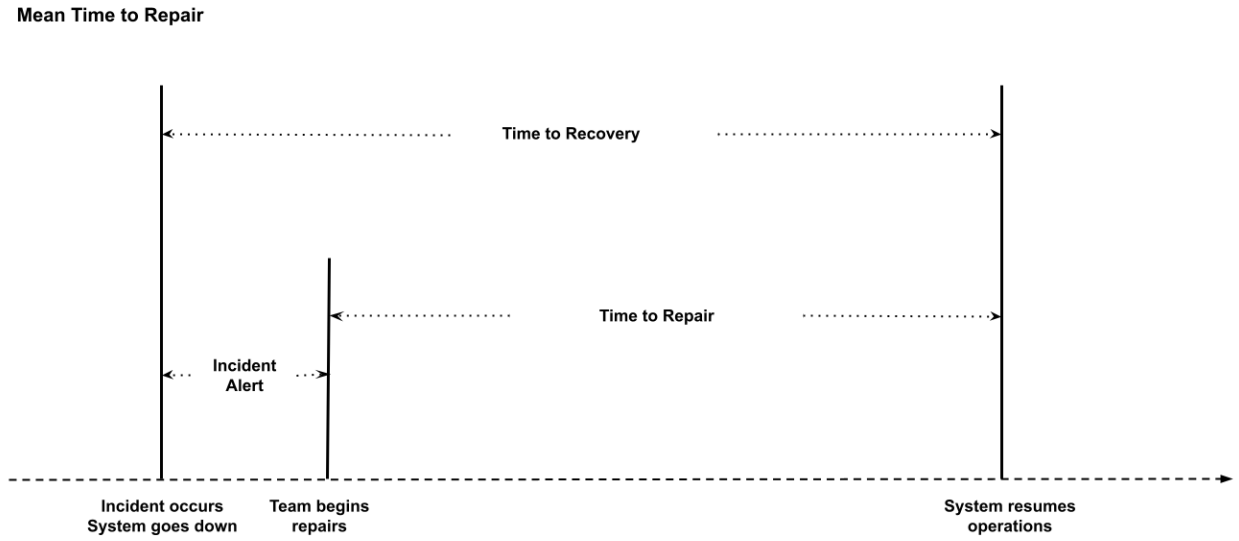
MTTF allows you to average the lifetime of similar assets and is a good measurement of the entire lifetime of an asset. MTBF is a measurement of how much time you have before an asset fails again and tells you how successful your team is at preventing and reducing future issues.

What is MTTR?

Mean Time to Repair or MTTR measures the average time between the start of an incident and when the system, application, or piece of infrastructure returns to production. It is a measurement of how quickly a team responds to and repairs unplanned outages.

MTTR begins when repairs start and considers the time needed to alert technicians, and analyze, diagnose, and repair the problem so that the asset is fully operational again. It, however, does not account for the time taken to order and receive parts.

The MTTR metric is not always equal to the same time period for the entire system outage as there might be a lag between when the issue occurs, when it is detected, and when the team begins repairs. This would be another MTTR metric, mean time to recovery, which measures from the time the incident is first discovered until the system returns to normal operations.



How to Calculate MTTR

To calculate MTTR, first select a period of measurement, e.g. weekly, monthly, quarterly, or yearly. Next, determine the total time your team spent on repairs during that period.

MTTR = time spent on repairs / total number of repairs for the selected period

Example MTTR Calculation

In the first quarter of the year, a team spends a total of 30 hours on repairs caused by 6 incidents.

Time spent on repairs = 30 hours
Total number of repairs = 6
MTTR for that quarter = 30 hours / 6 repairs
MTTR = 5 hours

The Importance and Usefulness of MTTR

MTTR is a significant indicator of how an incident will affect an organization and is most useful for tracking how quickly your organization can respond to and repair failures. Using MTTR, organizations identify and remove inefficiencies that lead to lost productivity and revenue.

An initial MTTR will help you understand how much you need to improve to develop a more successful MTTR for your business. It can be used by support and maintenance teams with the goal of increasing response times and the efficiency of repair processes. MTTR and your SLAs can also give you insight into how effectively you are providing the promised support services.

A good MTTR depends on several elements, including the type of asset, its age, and how critical it is to your business. You should aim to keep MTTR low. A low MTTR shows that a component or service can be repaired quickly, and its failure will have a reduced impact on the business. A higher MTTR suggests a greater risk that when an IT incident occurs, the organization will experience a significant disruption of service, leading to customer dissatisfaction, SLA violation, and loss of revenue.

Understanding MTTR can help you improve incident response processes, make repair or replace decisions for aging assets, predict lifecycle costs for new systems, and better understand how to schedule repairs.

MTTR vs MTBF

MTBF and MTTR are distinct steps in the same process. MTBF measures an asset's reliability and lets the team know how often the organization's systems and infrastructure breaks down. A higher MTBF indicates an asset will take longer to fail.

MTTR measures the efficiency of repairs and shows how fast the team can get things up and running again. An organization should aim to increase MTBF and reduce MTTR to minimize or avoid unplanned downtime.

MTBF vs MTTA vs MTTF vs MTTR

In this guide, you've learned how to use incident metrics, such as MTBF, MTTA, MTTF, and MTTR, to evaluate the effectiveness of your incident management systems and processes. MTBF, MTTA, MTTF, and MTTR are all important metrics for tracking and improving incident management and when used together, they give a more holistic view of how successful your team is at managing incidents and where they can improve.

Software tools such as [redacted]'s all-in-one incident response platform can give your team the metric data it needs to better understand incident management metrics.

With Lightstep, it's easy for DevOps and SREs to monitor and respond to changes in the IT environment to minimize the impact of system incidents. Reduce metrics such as MTTA and MTTR with integrated collaboration and counter alert fatigue with customized alert notifications and automated resolutions.

[redacted] also integrates with the most popular applications for monitoring and sending alerts and your other existing tools so you can automatically gather information across all your systems. Get started with [redacted] for free for faster incident response.