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Anatomy of a 5G Network That Can't Fail

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5G holds a great deal of promise, but as with any new undertaking, there are many risks and unknowns. What was acceptable on 3G networks became unacceptable by 4G standards, and the same will be true of 5G. It is, after all, human nature to want and expect more. But when the consequences of failing to deliver as promised are more than a temporary nuisance, precautionary measures are no longer optional — they become the new imperative.

THE DEFINITION OF FAILURE

Traditional communication services can help provide some context. Most of us rely heavily on our cell phones to communicate with others and to stay in touch with pop culture. Phone calls, text messages, social media, and streaming video services keep us connected to the outside world. This connectivity is especially important during times of physical isolation, such as the COVID-19 pandemic. But even with our deep reliance on these services, we've become tolerant of the failures that

Fig.1 Traditional Communications Services

commonly occur — a dropped call, an undeliverable text message, or emails not synching to our device. We can usually manage these failures with simple strategies like moving out of a dead zone, resending a message, or rebooting our device. In some cases, we are able to ignore them completely without any disruption or meaningful impact to us.

The issues that are causing these failures usually originate from within the network, such as authentication or attach issues, or as a result of interoperability or incompatibility between the network, the services and applications that run on it, or end user devices.
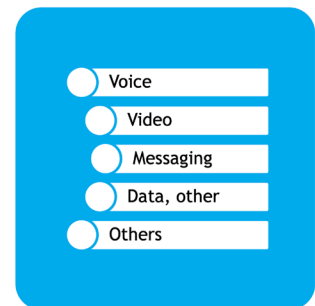
WHY IS FAILURE ACCEPTABLE?

So the question is why have we, as consumers, come to accept this? There are at least two perspectives worth considering. From the end users' vantage point, is zero failure really their expectation? Are they willing to pay the price for zero failure? Do the benefits justify that price increase? Probably not. Mobile services are a commodity and consumers have become extremely sensitive to price. The benefits of zero failure would not deliver enough value to warrant a cost increase.

Fig.2 Why Have We Come to Accept Failure?

Not surprisingly, service and network providers have a similar perspective. The financial investment required to achieve zero failure would not only be significant, but would fail to deliver a high enough ROI to justify the business case. It would have little impact on churn and would not offer enough incentive to lure consumers away from the competition.

Furthermore, ownership of the issue may not be clear. There are a number of vendors and technologies interoperating and reliant on each other to deliver the service. It's not always easy to determine what triggered the issue, its root cause, or where it occurred. Partners may not even have access to the right data to perform a proper triage or to derive actionable conclusions.

Fig.3 Who Really Owns the Problem?

In summary, when it comes to traditional communication services, consumers have come to accept a certain level of failure. While there would be some benefits for both parties, the business case for making the necessary investments to attain zero failure cannot be rationalized.

5G — THE FUTURE ENGINE OF OUR DAILY LIVES

5G holds a lot of promise for consumers and providers alike. For traditional services, consumers will appreciate improvements in reliability and performance while operators anticipate reduced delivery costs and improved average revenue per user (ARPU). Those improvements will no doubt be valuable, but the true value and promise of 5G stems from the new services and use cases that 5G enables. Those new use cases will transform every industry and aspect of the economy, and are the motivation for building 5G in the first place.
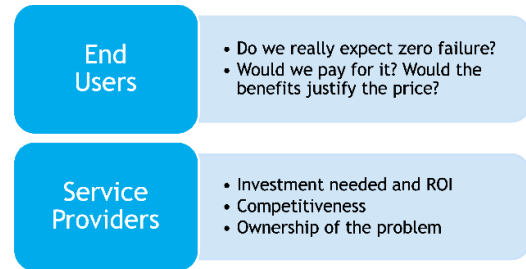
...when it comes to traditional communication services, consumers have come to accept a certain level of failure.

The promise of 5G is such that we will all come to depend on it, expect accurate outcomes, and, ultimately, trust it. In most cases, we won't even be aware that 5G is the engine enabling us to do what we do each day. But we will come to understand the gravity of consequences should failure occur.

WHY FAILURE IS NOT AN OPTION

While 5G will continue to support the traditional communication services, it has been designed to enable a range of new services — many of them critical in nature. Features like ultra-reliable low-latency communications (URLLC), massive machine type communication (mMTC), mobile broadband (MBB) are

Fig.4 Consequences of Failure

enabled to support a diverse set of services that run on the same network in parallel. The most critical services require flawless performance from both the 5G network and its ecosystem. Any failure, large or small, could put human safety or business health at great risk. Think about the impact that the following examples could have on trust.

- Factory downtime would impact revenue and could result in layoffs or have a downstream impact on the supply chain.
- A self-driving car that does not detect traffic congestion could result in an accident or loss of life.
- Loss of connectivity during surgery would be catastrophic.

It's hard to envision these services as part of our daily lives right now, but the takeaway is clear — failure is not an option in any of those scenarios. A public apology would never be enough, nor would we quickly forget what happened.

The scenarios above may cause you to wonder:

- How does one build a network that can't fail?
- How does one build trust (or lose it)?
- With whom should trust be built?
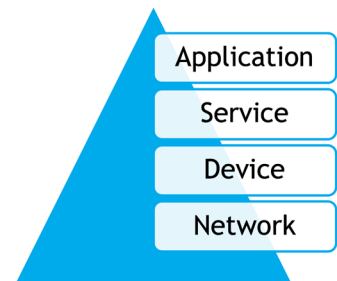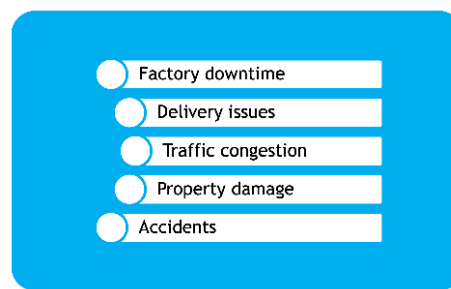
The ecosystem surrounding the network can produce interoperability issues between the network, services, applications, and end devices.

TRUST — IT'S A CURRENCY

Let's explore the concept of trust. You may not have thought about trust in this way, but trust is a currency exchanged between people, companies, or both. Loss of trust in any of these relationships could have an economic or legal consequence, or result in their dissolution. The higher the stakes, the greater the consequences. Depending on the circumstances, loss of trust can occur over time or in an instant, and may not be repairable by way of an apology, credit for future services, or additional promises, which may be perceived as "disingenuous."

TRUSTING 5G

Let's consider the 5G ecosystem — it has a high degree of complexity with multiple vendors and technologies. The expectation is that all of them interoperate seamlessly and without failure(s) — a tall order considering how many points of intersection there are. End users or consumers are often unaware of this complexity and may not fully understand the dependency and risk that they accept when they choose to use the service. What's more, they have little control over the outcome and cannot mitigate issues the way they can for traditional services. With so many moving parts, failure, at some level, is inevitable. A single glitch can break the chain.

The 5G network is not immune either. In fact, there are more points of potential failure within the network than the ecosystem as a whole. It is, most certainly, a new breed of network comprised of a broad, diverse set of vendors and technologies all combining to deliver unprecedented levels of access, efficiency, robustness, and reliability. But it's how 5G networks are constructed that truly demonstrates the challenge with building trust.

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Just think about the number of technologies and vendors involved in the end-to-end service chain of new, 5G-enabled services. 5G decomposes the core network, access network, and its supporting systems into functions that move

5G Network

Failure points within the network

5G Ecosystem

Interworking between network, services, applications, devices

Fig.5 What Can Go Wrong?

freely around and are no longer constrained by the stringent rules of prior-generation networks. Orchestration capabilities must interact with the infrastructure resources and the network functions that run on top of the infrastructure. The ecosystem surrounding the network can produce interoperability issues between the network, services, applications, and end devices. And, finally, automation is tasked with correcting human error, optimizing performance, and recovering from or preventing failure when risk factors are spotted. Even with these capabilities, things can, and will, go wrong. With so many points of potential failure, pinpointing what went wrong, and where and why errors occurred will be significantly more difficult. Similarly, establishing trust between end users, ecosystem vendors, and the network will be more challenging than ever before.
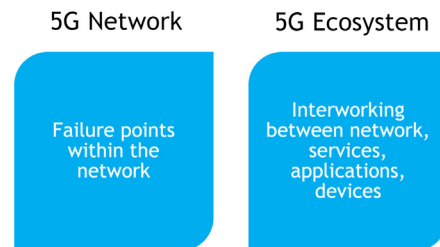
HOW TO BUILD TRUST

Although seemingly impossible, trust must be established between a host of players. Network and service providers as well as application and device vendors all play critical roles in delivering exemplary quality of service to the end users. Not only must they trust each other, but end users must come to trust them as a collective entity. Failure by one is no better than failure by all, since the outcome remains the same from the perspective of the end user.

Providers of 5G networks, services, applications, and devices must adopt a new mindset if they want to build trust with their ecosystem partners and end users. Visibility has been the industry standard for network and service assurance for many years. It has played an important role in helping network and service providers improve customer experience and the performance of their networks, services, and applications. But, as discussed, the network and the ecosystem are evolving and the stakes are higher. In the context of the 5G network and the 5G ecosystem, visibility can only tell network and service providers and other players what potentially happened. But it is not capable of identifying and contextualizing what exactly was the issue, where the issue truly originated, and why it happened — important aspects of any failure that enable operators and other parties involved to derive actionable conclusions that, when implemented, address the true root cause of the real problems. And it is these actionable conclusions that enable trust to be built, expanded, and reinforced

Networks are no longer one dimensional; there are both horizontal and vertical dimensions.

ARE TODAY'S SOLUTIONS UP FOR THE CHALLENGE?

As mentioned, visibility has been the industry standard for network and service assurance solutions but it fails to provide the contextualization required for operators and other parties to derive actionable conclusions. Monitoring and assurance solutions play an important role in building trust — but are they up to the challenge in this new 5G ecosystem?

- Cover larger scope
- Uncover interdependencies
- Decipher the issue
- Bring clarity

Fig.6 How Solutions Have to Evolve

First, monitoring and assurance solutions will have to cover a larger scope. Networks are no longer one dimensional; there are both horizontal and vertical dimensions. The horizontal dimension includes all of the components, and their interworkings, that make an end-to-end service transaction possible. The vertical dimension includes the interworkings between layers including infrastructure, network, orchestration, service, and application. One-dimensional monitoring solutions are not equipped to see all dimensions and will leave blind spots where issues can unknowingly propagate.

Another important area that needs to be addressed to ensure zero failure and build trust is the ability to uncover interdependencies. In an environment that generates hundreds of interactions between things and layers in order to execute a transaction, the interdependencies will be many — some of which won't be known. Uncovering these interdependencies will be key to identifying the true root cause.

A third challenge for today's service assurance solutions is contextualization, or the ability to help define why the issue occurred in the first place and where it originated. This is the single most critical element for enabling automation, a strategic objective for many operators. Monitoring and assurance solutions will have to bring clarity to what is a very complex picture.

In summary, we have explored three key ideas throughout this paper:

- Why some failure has been acceptable until now.

- Why the 5G network can't fail.

- The implications of failure and how monitoring and assurance solutions need to evolve in order to build trust.

Network and service providers and other ecosystem players are building a complex web of vendors and technologies in order to deliver on the promise of 5G. 5G will enable new use cases that require monitoring and assurance solutions to go beyond visibility in order to enable 5G players to ensure zero failure and build trust with their ecosystem and end users.

Visit www.empirix.com to learn more about KLERITY, a solution framework for 5G and IoT monitoring, assurance, and analytics that is cloud-native, open, and flexible by design, with the lowest TCO.

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