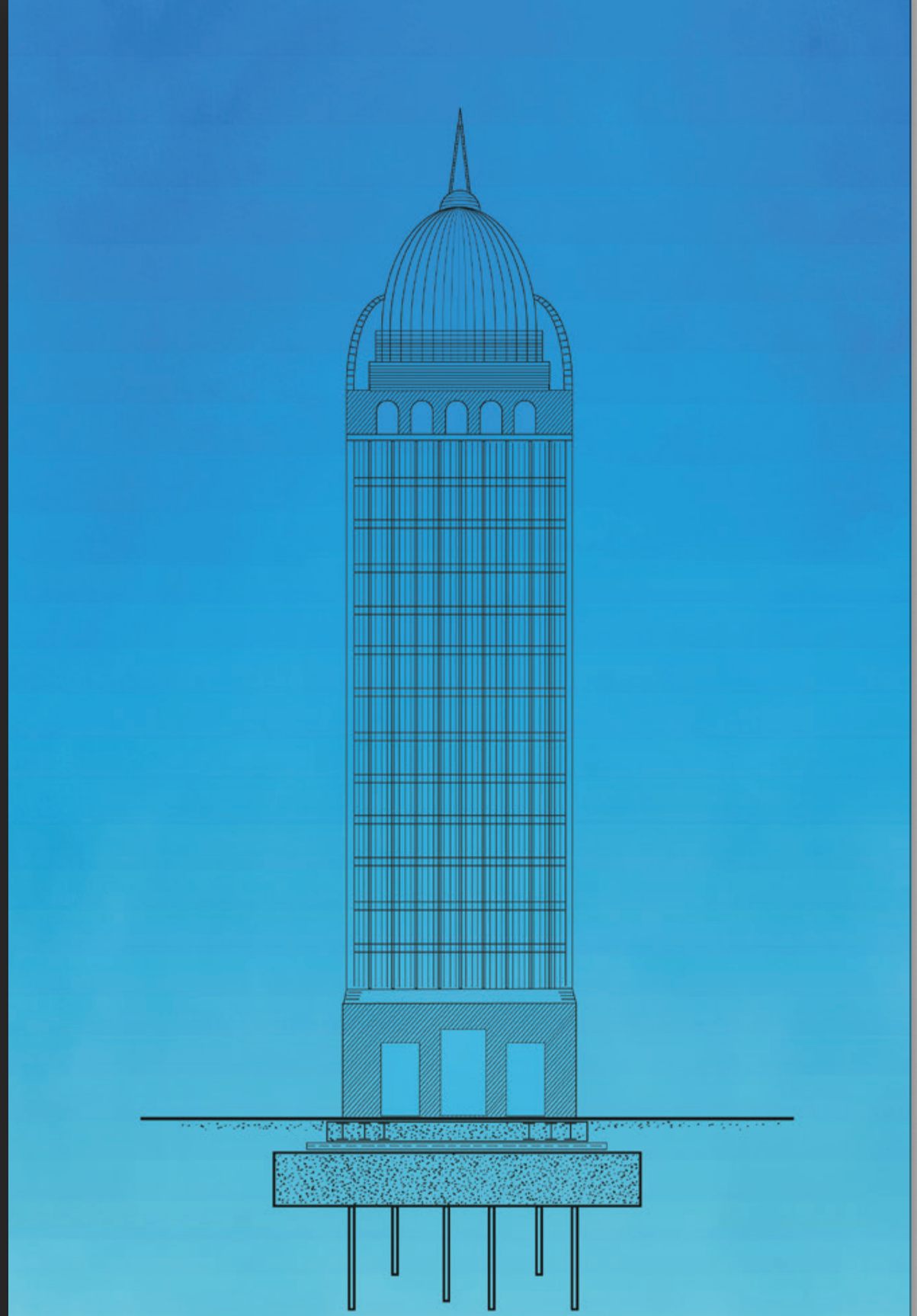


THE POWER OF THE MILLISECOND

On the morning of October 11, 1871, embers smoldered, looters picked over burnt-out storefronts, and newly homeless residents wandered the streets, clad in velvet robes and jewels, having saved only their most expensive belongings as they fled the flames.
When a cow's tail caught the edge of a lantern nights before, it took only a millisecond for a spark to ignite the dry farm grass and set the blaze on its destructive path. In the ashes of the Great Chicago Fire, a city contemplated how to rebuild. And two architects saw a huge opportunity.

At the time of the fire, it was widely understood that skyscrapers were only possible in cities such as New York, where bedrock lies just below the surface. Nineteenth-century architects designed tall buildings that relied on this bedrock to support immense height and weight.

But after the fire, architects flocked to Chicago, eager to realize their visions on the suddenly empty swath of downtown real estate. Among them were Daniel Burnham and John Root. Though they were both just draftsman when they met in 1872, they shared an aspiration to create "big buildings for big business."

One key challenge blocked their way: Chicago's soft clay soil.

They searched for a workaround—an innovation that would allow them to make the designs in their heads a possibility on the ground.
They pioneered a solution beneath their Rookery project, an eleven-story building in the heart of Chicago's burgeoning Financial District. Using a grid of iron rails and beams encased in concrete, Burnham and Root invented a new "floating" foundation capable of supporting an enormous building's weight.

And, to top it off, the building included an elevator and electric lighting. The duo's innovations below the earth's surface—in the building's foundation—gave the Rookery the scale that allowed the architects to incorporate the newest aboveground inventions.

In the quarter century that followed, Chicago accelerated. Skyscrapers were erected, industry prospered, populations migrated. By 1893, the city had surpassed pre-fire expectations, even constructing an expanse of gleaming buildings to host the World's Fair (and its 27.5 million tourists). The city was reborn, and with it the entire practice of architecture.

A century later, seven people gathered in a San Diego home to challenge another industry stalled by tradition. These colleagues and friends schemed in the den, eventually reaching a shared vision: to leverage wireless technology to transform the quality and speed of communication. When they landed their first contract and set up shop in nearby La Jolla, their "quality communications" company—Qualcomm—was born.

At the time, the telecommunications industry was just beginning to integrate digital technologies but had a limited conception of what was possible. They were limited by technological constraints as insurmountable as the need for bedrock had once seemed to nineteenth-century architects. But, much like Burnham and Root, these seven individuals saw beyond presumed givens, imagining a new kind of foundation for the future of digital communication.

The newly formed Qualcomm had a vision of completely redefining the telecom industry: their inventions would serve as bedrock upon which to build tools that would accelerate information, accelerate interactions, and accelerate connectivity.
For decades to come, this foundation would pave the way for information innovation to grow. Ultimately, these inventions would enable a future in which information can be shared by humans and their devices in a mere millisecond, 400 times faster than the blink of an eye.

Qualcomm plays a unique role as a "below the line" inventor for the industry, meaning that the company develops foundational technologies that form the bedrock for mobile communication. It is upon this strong foundation that vertical innovation—from products to businesses to entire new industries—can be built. Each icon represents an example of vertical innovation enabled by Qualcomm technology from early pivots in 2G to the 5G future.

I. ACCELERATION OF INFORMATION

Much like Chicago architecture, the conversation began with scale.

By their tenth birthday, Qualcomm had already spent years inventing core technologies to improve efficiency and speed in the cellular age. Mobile opened to the masses with 2G, which changed the communications landscape by allowing anyone to have a cell phone. At that point it was becoming clearer (to the far-sighted anyway), that mobile technology was destined for more than talk and text, and the company's engineers began to envision a device that could do far more than just make calls. But the ability to scale was bound by a natural resource: spectrum capacity.

In 1995, the company's code division multiple access (CDMA) technology was adopted by the major telecom industry players as one standard for 2G wireless communication. The invention made more efficient use of limited spectrum resources, increasing network capacity tenfold and putting a mobile phone in everyone's hands.
But beyond improving 2G voice offerings, this new conception of scale introduced a question that would redefine possibility for years to come: What happens if we put the internet on our phones?

Building from a foundation of CDMA standards, 3G effectively cut the dial-up leash tethering the internet to people's desktops. With this monumental shift, information became unbounded by location.
The notion that internet access would require hours of dutifully sitting at a desktop computer quickly became an anachronism.

Mobile internet freed businesses and consumers from a major constraint to information access.
Even at speeds of a megabit per second—painfully slow by today's standards—the accelerated rate of information availability was palpable, and the unhindered transportation of data to people, where and when

Mobile access to internet, email, and document sharing, makes it possible for workers to conduct business remotely.

3G introduces mobile broadband. For the first time, mobile broadband becomes accessible across entire cities.

they needed it, was fast becoming the norm.

In the near-term, it became possible to email, browse the internet, and even get turn-by-turn directions using a new "smart phone." But Qualcomm was focused on the long-term: By connecting the phone to the internet, their engineers had built the foundation for accelerating information. The smartphone shifted from gadget to necessity. But only by slashing response times to a fraction of a second would the full potential of the smartphone soon be realized.

II. ACCELERATION OF INTERACTION

It didn't take long for the vision of a mobile-first world to come into focus. In 2010, the number of mobile broadband connections surpassed the number of wired connections for the first time. By 2012, TIME Magazine observed that "a typical smartphone has more computing power than Apollo 11 when it landed a man on the moon." As the computing capabilities of smartphones steadily increased, the goal was not simply to increase the speed at which a website could load on a smartphone; it was to completely reimagine the way we interact with the internet.

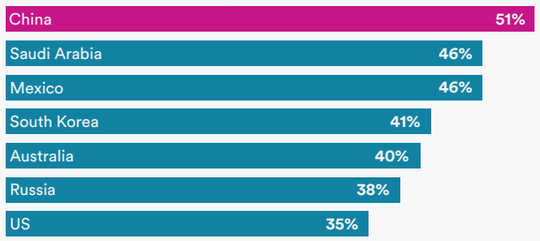
Qualcomm's inventions achieved just that, improving network capacity, data speeds, battery life, camera and video capabilities, and location services. By building a strong technical foundation, the company paved the way for an economy of innovators creating new online experiences far beyond the '90s vision of email, websites, and directions.

A single social media network now connects 1.8 billion active users. Music-streaming platforms provide instant access to over 30 million songs. In 2017 alone, smartphone users will stream a billion YouTube videos a day, make over $100 billion in mobile purchases, and take trillions of photos.

The phone has evolved beyond a device to become nearly an extension of ourselves. When we're running late, we use our phones to find a ride-sharing vehicle three minutes away. Our phones keep us up to speed on the latest news, scores, albums, and episodes. We use them for face-to-face chats with loved ones and to connect with strangers across the globe, simultaneously bringing us closer and extending our reach. And they make the most of our minutes, allowing us to be more productive and to easily multitask. Our relationships with our phones have led us to redefine the potential contained in a fraction of a second.

MOBILITY APPS ARE GAINING GROUND

Share of population using apps, 2016



Source: Dalia Research

Ride sharing and other mobility apps that draw on mobile data and GPS facilitate convenient transportation across the globe.

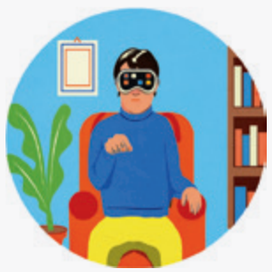
III. ACCELERATION OF CONNECTIVITY

At a high level, the shift from 3G to 4G might be seen as simply speeding up mobile internet connections. But the shift from 4G to 5G will go beyond speed. Today, gigabit LTE is becoming the new standard for connectivity. With speeds over 500 times faster than early 3G connections, smartphones are coming to be seen as just one part of a much larger ecosystem of wireless devices, from fitness trackers to electricity meters to connected cars. As Qualcomm builds technology to offer fiber-like speeds over 5G networks, they are, again, fundamentally reimagining the way we conceive of the internet. Rather than a tool for sending and receiving information at greater and greater speeds, the internet will soon be ubiquitous—just another layer to the way we understand the world.

We're nearing the age where the

Smartphone apps transform the mobile experience, granting access to everything from games, to online shopping, to social media.

Tracking apps and wearables provide users increased control and agency over their own health.



By involving the user in immersive experiences, virtual and augmented reality will transform entertainment, job training, and education.

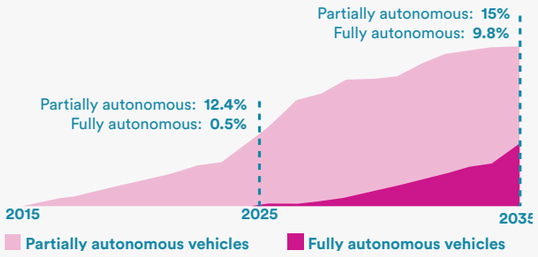
Constant connectivity and low latency will ensure reliable access to data, enabling safer, more autonomous transportation.

phrase “Sorry, my internet cut out” will be a relic of an earlier time. Connectivity will be a given regardless of where we are or what we want to do or see. With each user’s data consumption projected to grow from 1.9 GB per month in 2016 to 11 GB per month by 2022, it’s evident that we will continue to consume more and more of our media and entertainment on the go. With a 5G network expected to be more than 10 times faster and 100 times more efficient than today’s LTE networks, streaming media will be constantly available in high definition, and at economies of scale that will democratize data.

Beyond efficiency, Qualcomm’s improvements in real-time performance will cut latency—the time between action and response—and give rise to a host of new immersive digital experiences that could alter our entertainment paradigm: moving from passive consumption to active participation in the stories we care about.

AR/VR applications could even provide realistic emergency training for first responders or allow doctors to view patient information and vital signs during surgery.

BY 2035, AUTONOMOUS VEHICLE SALES WILL ACCOUNT FOR 25% OF THE MARKET



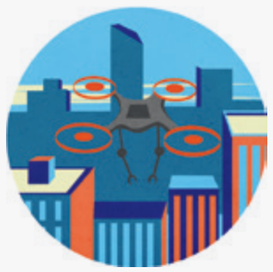
Equipped with technology to guarantee safety and security, the autonomous vehicle market will grow rapidly.

Not only will people in emergencies be able to rely on that flow of critical data, but connected devices will be able to communicate directly with one another. Cars will soon be in constant, direct communication not only with all other vehicles on the road, but with traffic signals and pedestrians’ devices. This 360-degree awareness will go far beyond human line of sight, helping people drive more safely and bringing the autonomous vehicle a step closer to widespread implementation.

AR telemedicine and autonomous vehicles will rely on low latency for real-time response, but they are only the tip of the hyper-connected iceberg. The 5G framework is expected to scale data rates and power to provide extremely lean, low-cost connectivity for a growing ecosystem of connected devices. Instant access to information gathered by billions of intelligent connected sensors will unlock new efficiencies in the way we do everything from treating disease to growing food.

Imagine a power grid that never goes down because each node can repair itself or communicate with others to balance power loads. Imagine farmers being able to grow bumper crops year after year, no matter the weather, because low-power sensors in their fields give real-time data about soil health. New digital tools paired with more efficient use of resources will unlock earning potential for companies across sectors, boosting global output by as much as $12 trillion by 2035.

With increased efficiency, speed, and connectivity, 5G will be the tipping point from which we can scale the connected digital ecosystem to solve urgent problems. Latency has nearly been reduced to one millisecond, and with the entire tech industry poised to build 5G further, the power of that millisecond is seemingly limitless.



Secure, unwavering connections will pave the way for widescale commercial drone deployment.

The internet of things will grow to connect entire cities, monitoring everything from traffic, to energy consumption, to air quality.

Over a hundred years ago, Burnham and Root laid the foundation for a city of skyscrapers, but never could have imagined the networks that would eventually connect today's Rookery with the world around it.

Twenty years ago, employees in that same building looked forward to sending email on their phones but could never have predicted ridesharing or AR telemedicine.

Today, we can envision a world of autonomous vehicles, VR, and smart sensors, where a single millisecond stands between us and a world of possibility. It's impossible to predict what new heights will be reached from this 5G foundation. But if history is any indication, by tomorrow's major breakthrough Qualcomm will already be at work on the next paradigm shift in the way we connect, the way we work, and the way we live.