

October 2019
VOL. XXXV, NO. 10

Daniel Burrus'

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TECHNOTRENDS[®] NEWSLETTER

*The biggest ideas that are
changing everything*

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5G Entrepreneurs Creating Billion-Dollar Businesses

By Daniel Burrus, CEO of Burrus Research

Within the next five years, new multibillion-dollar businesses will appear that didn't exist before thanks to the amazing new capabilities the next generation of 5G wireless technology will offer.

Many Industries including healthcare, manufacturing, retail, automotive, and entertainment will either be agile, trying to react as fast as they can to an ever-increasing number of 5G innovators disrupting their industry, or they will be anticipatory innovators and use the predictability of 5G capabilities to become the disruptor in their industry by creating the product and service disruptions that need to happen in order to increase efficiency while transforming products, services, and customer experiences.

I've been accurately predicting the future of wireless technology going all the way back to 1G, thanks to the highly predictable exponential curve that technology has been following. Every time we went from one generation of wireless to the next, new game-changing businesses emerged. The first generation (1G) of wireless came with the introduction of cell phones that allowed for voice calls and nothing more. They were big and expensive and offered a communication solution for big business and high-level executives.

The second generation (2G) gave us much better call quality for wireless phones and offered a new capability for text messaging via SMS and much wider adoption in

industries in which communication urgency was important.

Advances in processing power and the spread of fiber-optic and cell tower infrastructure enabled the next generation (3G) that evolved rapidly enough to enable media-rich experiences such as mobile internet browsing with speeds up to 4 Mbps and even early video calling.

“ **Why didn't Apple introduce the first iPhone a year earlier?** ”

What did the jump to 4G bring us? It turned our phones and other wireless devices into useful multimedia networked computers with media-rich streaming applications like Snapchat, Instagram, Facebook, Netflix, and much more.

Why didn't Apple introduce one of the most game-changing products in recent history, the first iPhone, a year earlier? The Three Digital Accelerators that would drive exponential change I first identified in 1983 (processing power, bandwidth, and digital storage) had not evolved quite far enough to give the user a good experience. Because they all have advanced and will continue to advance on a predictable curve, Apple knew exactly when it could launch the first iPhone, and wireless bandwidth played a key role.

The next generation of wireless technology

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TECHNOLOGY NEWS HIGHLIGHTS

Indoor Solar Cells

Scientists in China and Sweden have developed a commercially viable organic solar cell designed to generate power using indoor lighting.

Although the technology is only applicable for low power applications, it is ideal for powering the Internet of Things when used in temperature sensors, security sensors and other low power electronic devices.

By carefully determining the composition of the active layer materials, efficiencies as high as 26 percent at ambient lighting levels of 1000 lux (typical of that found in a supermarket) have been achieved.

At levels of 200 lux (normal living room illumination), that translates to an operating voltage of 1.8 volts at 45 microamps. And when used in conjunction with small supercapacitors,

devices could remain powered even in the dark.

The new Organic PhotoVoltaic (OPV) cells are inexpensive and sustainable to manufacture since they don't rely on scarce or toxic materials.

They can be produced in thin, flexible sheets that are easily integrated into a variety of product designs. In addition, recent testing has indicated that polymer-based OPVs rival silicon in terms of efficiency, with a life expectancy of 20 years.

Future applications will include using them in buildings to supplement traditional solar power as well as large-scale energy production.

For information: Epishine AB, Westmansgatan 47A (II), 58216 Linköping, Sweden; email: info@epishine.com; Web site: <https://epishine.com/>

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Medical Delivery Drones



Quantum Sound Waves

United Parcel Service (UPS) recently received certification from the Federal Aviation Administration (FAA) to deliver health care supplies – including blood and tissue samples – on medical campuses across the U.S.

The decision was passed down following a one-year trial period at Wake University Medical Campus in Raleigh, North Carolina, during which approximately 1,000 single-operator flights were conducted. The new drone airline, dubbed UPS Flight Forward, will be limited to operating on medical campuses for at least two years. The company hopes to expand to homes, particularly in rural areas, in the future.

While at least six other companies have submitted requests to the FAA for commercial drone operations, Wing (the drone-delivery unit of Google's Alphabet) is the only other company currently authorized to fly the unmanned delivery vehicles in the U.S. Its certification differs from that awarded to UPS in that Wing is authorized to operate only one pilot and one drone at a time. The UPS certification allows the company to operate multiple pilots and drones simultaneously.

Outside the United States, other companies are using drones to deliver medical supplies, including Zipline, which distributes blood in Rwanda, and Swoop Aero which delivers vaccines and other supplies in the Pacific region.

For information: Federal Aviation Administration; Web site: https://www.faa.gov/news/press_releases/news_story.cfm?newsId=24277

Phonons are to sound what photons are to light – basically quantum packets of the vibrational energy that make up sound waves. Scientists have hypothesized that phonons could be useful in quantum computer processing systems but, until recently, they haven't been able to detect them without destroying them.

Now a team of researchers has tuned the energy of a quantum circuit (or superconducting qubit) so that phonons can be detected and measured.

Phonons of various wavelengths were passed between sound-reflecting “mirrors.” By measuring the time it takes for them to travel back and forth, phonons of multiple wavelengths could be precisely controlled. Because sound travels much slower than light, the mirrors needed to be separated by only a hair's width; doing something similar with light would require a separation of 12 meters (approximately 40 feet).

The lifespan of the phonons was a mere 600 nanoseconds, so although this is considered to be a breakthrough in phonon research, much work remains before the applications for quantum computing will be fully understood.

For information: University of Colorado Boulder, JILA, 440 UCB, Boulder, CO 80309; phone: 303-492-7789; fax: 303-492-5235; Web site: <https://jila.colorado.edu/>



Bacteria-Killing Air Filter

The spread of biological contaminants in hospitals is a growing concern. The Centers for Disease Control and Prevention (CDC) estimates that the chances of acquiring a potentially antibiotic-resistant infection during a hospital stay are approximately 1 in 30. But a new air filter has been developed that not only traps bacteria, viruses, fungi and other pathogens; it also destroys them and any by-products that they might produce.

A new material has been developed called laser-induced grapheme (LID) – a flexible, porous material that can conduct electricity. When applied to a filter for a commercial vacuum filtration system, it's very effective at trapping contaminants carried by droplets, aerosols and particulates in the air. Periodically, the filter is heated to 350 degrees Celsius (662 degrees Fahrenheit) to obliterate any living organisms as well as their toxic derivatives. The heating method used (Joule heating) requires very little power and only takes seconds to heat up and cool down.

The filters were tested by passing air contaminated with pathogens through them for 90 hours at a rate of 10 liters per minute. Subsequent testing revealed that all living components and their by-products had been destroyed. The filters were then incubated to confirm that there was no bacterial growth. A single filter may be adequate to replace the two-filter system currently mandated by federal standards in hospital ventilation systems and will require changing less frequently.

For information: James Tour, Rice University, Tour Research Group, Department of Chemistry, P.O. Box 1892, MS 60, Houston, TX 77251; phone: 713-348-4082; fax: 713-348-5155; email: tour@rice.edu; Web site: <https://chemistry.rice.edu/>



Feeling Sound

A new device has been developed that translates sounds into tactile vibrations, enabling the wearer to feel sounds. The Fitbit-style wristband – dubbed Buzz – was designed for hearing impaired individuals, but it could be used by anyone to extend their sensory range.

That's because the technology works not only with sound; it can also translate images and other data streams into sensations that are interpreted by the brain, including information that humans cannot detect, such as infrared and ultraviolet light.

The inspiration for Buzz came from studying synesthesia – a condition in which people smell colors in addition to seeing them. The developer saw this simply as an alternative way of perceiving the world, and building on 50 years of brain research in the field of sensory substitution (beginning with the neuroscientist Paul Bach-y-Rita), set out to build devices that exploit the brain's ability to relearn how to decode the signals it receives.

Experiments on deaf subjects showed that after approximately eight hours of training, they were able to distinguish the feel of 50 different words. In another test, participants

were asked to distinguish between a dog barking, a car passing or a door slamming. Eighty percent of them could correctly identify the sounds without any training at all.

Compared to cochlear implants, which cost thousands of dollars and involve invasive surgery, Buzz could provide a much-needed option for the deaf to enhance their ability to sense sound.

It is expected to become available by the end of this year at a cost of about \$600. A vest version is also in the works, which will incorporate four times as many motors to induce vibrations across the chest and back.

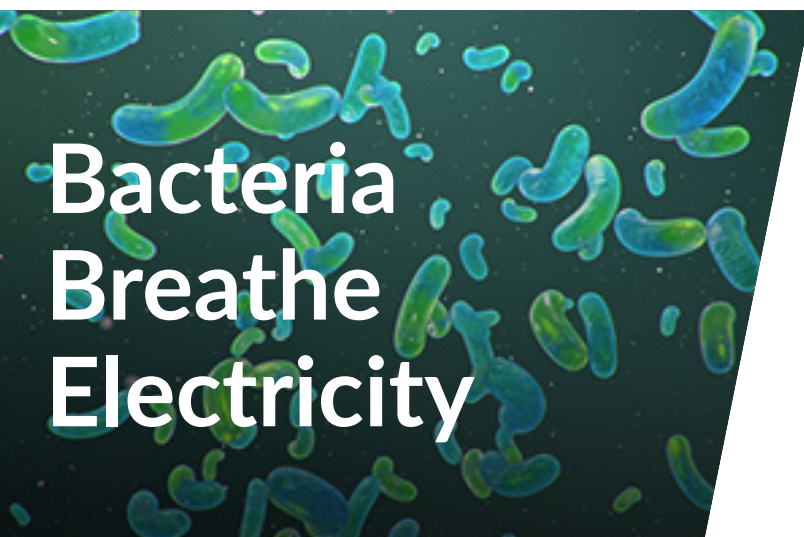
For information: David Eagleman, Neosensory, 4 West 4th Avenue, #301, San Mateo, CA 94402; Web site: <https://neosensory.com/?v=7516fd43adaa>

Polarized electrodes were submerged into the hot springs at four different locations. After 32 days, the microbial communities were analyzed to determine the impact of polarization levels. The researchers found that the electrodes generating the highest cathodic and anodic currents had the most substantial effect.

Bacteria such as these could play an important role in combatting environmental pollution while producing electricity for low power applications. As they “eat” toxic pollutants and convert them into less harmful materials, they pass their electrons on to metals and other solid surfaces, generating an electric current.

This method of enriching them will provide researchers with access to a broader range of electrochemically active microorganisms for further study.

For information: Haluk Beyenal, Washington State University, School of Chemical Engineering and Bioengineering; Web site: <https://voiland.wsu.edu/> or <https://news.wsu.edu/2019/03/05/capturing-bacteria-eat-breathe-electricity/>



Bacteria Breathe Electricity

A team of scientists exploring the depths of Yellowstone recently discovered a way to capture bacteria that “breathe” electricity.

The organisms are found in pristine alkaline hot springs that range in temperature from about 110 to 200 degrees Fahrenheit (approximately 45 to 90 degrees Celsius). But since such conditions are difficult to replicate in a lab, the researchers decided to enrich their population in their natural environment using an inexpensive electronic device known as a potentiostat.



Surveyor Drone

An aerial surveying robot known as CivDrone is poised to disrupt the construction market by replacing survey crews with an automated platform. Its developer envisions a digital construction organization that combines high-definition surveying and geolocation with

digital collaboration and advanced analytics to improve productivity, accuracy and reliability. CivDrone uses a heavy-lifting drone platform with landing gear that has been adapted for its survey-staking mechanism.

Onboard software ensures accurate positioning of marking locations to within one inch. The stakes themselves contain readable tags that link to cloud-based blueprints. And while a traditional survey crew can mark about 100 points a day, the autonomous drone-based system is capable of marking 500 locations in the same period of time, with a single operator.

As federal, state and municipal governments continue to push for upgrading our aging infrastructure, smart construction systems could not only improve results and shorten project timelines but also create millions of new opportunities for workers to upgrade their skills for the future.

For information: Tom Yeshurun, CivDrone Ltd. The Tech Garden, 235 Harrison Street, MD #47, Syracuse, NY 13202; phone: 646-705-6431; Web site: <https://www.civdrone.com/>

thermochemical energy from renewable sources for hours, days or even months before it is released again as heat at temperatures as high as 900 degrees Fahrenheit (450 degrees Celsius).

At the heart of the technology is a non-toxic, nano-coated salt called SaltX that retains its crystal form even when exposed to water. It can be charged and discharged thousands of times without sacrificing performance, and unlike ordinary salt, it will not cause corrosion.

In its uncharged state, the salt is mixed with water. To charge the thermal battery, the mixture is heated to over 900 degrees Fahrenheit (about 500 degrees Celsius), at which point the water evaporates.

The salt is charged as long as it remains dry. To discharge the energy, steam or water is simply added back into the salt, and a chemical reaction releases the stored energy as heat, which can be supplied directly to homes.

Since renewable energy sources are often dependent on weather conditions, the SaltX battery system is going to be used to store energy for release when needed. The pilot system is currently serving about 100 households. If successful, the Berlin power plant plans to scale up the technology to supply heat to thousands more.

For information: SaltX; phone: +46-(0)8-794-0370; email: hello@saltxtechnology.com; Web site: <http://saltxtechnology.com/> Vattenfall AB; phone: +46-(0)8-739-5000; fax: +46-(0)8-17-8506; Web site: <https://group.vattenfall.com/>



Salt Battery

A power plant in Germany recently began testing a new technology for replacing fossil fuels as an energy source.

The system uses salt and water to store

5G Entrepreneurs Creating Billion-Dollar Businesses

continued from page 1

(5G) is already being deployed in major cities in the U.S. and other countries with Qualcomm, Ericsson, and Broadcom as well as network providers such as AT&T and Verizon, to name only a few, all putting in maximum effort. Sprint has recently boasted 5G speeds of 150 megabits. Mobile device manufacturers such as Samsung, Apple, and many more are either starting to launch or are close to launching their first 5G enabled devices.

If you've seen a commercial from a network provider or smartphone manufacturer anywhere lately, be it YouTube or on TV, you've likely heard several companies boast of offering or debuting 5G networks. At this point, as consumers, we've all become quite jaded to these terms, so you've likely filed it away, assuming you won't notice the transition. And according to a recent CNET wireless speed test, 56% of Chicago's West Englewood residents still lack an internet connection. While that may be true, there are many consumer and business implementations of 5G to be excited about, including the ability to connect us all if we include an elevated vision and strategy for everyone. It takes political will and an understanding of the main differences between what 5G has to offer and that of its predecessors.

To begin, once deployed and fully operational, you will seldom need any kind of wire or cable to deliver communications or even entertainment service to your mobile device, to any of your fixed devices such as your Smart TV or Smart Appliances, or even

to your automobile. 5G would essentially be the solution to delivering complete digital connectivity from the tip of the carrier network, and hopefully help the user in the veritable death of the pesky need to plug in a thousand cables behind your Smart TV and then zip-tie them somewhere inconspicuous to prevent an eyesore along the wall. High frequency 5G requires line of sight, thus the higher number of small 5G hubs. Fixed wireless antennas will allow for 5G cellular coverage within buildings and homes, without using cables or lines.

As it stands today, 5G would function as a set of simultaneous revolutions, all of which must function without any trouble whatsoever, in order to provide the speed and connectivity it boasts. The hiccups that could prove to be roadblocks for 5G will be overcome, but some actually go beyond technological functionality and spill into business and social conflicts.

Consider this: at the end of the 19th century, the telegraph industry was what society had for telecommunications. What if industry leaders had come together and found a way to jump straight from that to fax machines? Structurally, that sounds utterly difficult, right? That's about the level of infrastructure shifting that would occur in the transition from 4G to 5G technology.

Here are three examples of how 5G would affect some infrastructures we've become accustomed to:

Unified Carriers. It is likely a correct assumption that your broadband internet provider also provides TV to your household, assuming you haven't cut the cord with cable. 5G wireless would essentially place companies like AT&T, Verizon, and the combined T-Mobile and Sprint in competition against Comcast and Charter

Communications for services.

Remade Landscapes. 5G allows for smaller transmitters that consume lower power. Sounds beneficial, right? Fewer cell towers would be a good thing for the aesthetics of our world; however, smaller 5G transmitters would cover much smaller service areas than those typical 4G towers. Therefore, a carrier would need more of them, about four hundred times more than we currently have. However, their small stature allows us to camouflage them better with the landscape, much like street lights or parking meters blend in urban areas.

Restructured Global Technology Economy. Upon implementing 5G, areas such as Scandinavia where Nokia and Ericsson reside would become the primary hub for telecommunications. Likewise, because China has China Mobile and Huawei, which are jointly responsible for the architecture of 5G, it becomes quite powerful as well. That may strike fear into the hearts of many Americans who are rightfully concerned about data theft, as other issues arise such as some of those countries leading us in the development of new technology or leaving us in the dust in the way of manufacturing technological devices. These concerns can be resolved but it will take time.

Yet, beyond those three scenarios, the cost is of most concern in many cases. Prices for service would most likely start out pretty high compared to where we are now, mostly covering the costs to implement the technology. However, the cost benefit would be tremendous and, for the anticipatory minds out there, incredibly beneficial for businesses and their customers alike.

In several articles of mine, I've called on businesses and individuals to pay attention to the Hard Trends shaping the future both

inside and outside of their industries, and the digital disruptors that may affect them directly or indirectly. Implementation of 5G and the technology that goes along with it would certainly jump-start those disruptions, and the fact that the early stages of 5G networks are already in development should spark the interest of those anticipating accurately.

The following are perfect examples of technology-driven changes I've discussed in previous articles, and their correlation to 5G technology:

Vehicle-to-Vehicle Communications and Driverless Automobiles. 5G will enable Vehicle-to-Vehicle (V2V) communication using the low latency of 5G wireless networking, allowing each vehicle to know exactly what all the other vehicles are doing around it and automatically avoid accidents. In addition, autonomous safety features in driver-operated vehicles that are on the road with semi, and in some cases fully autonomous vehicles would greatly increase safety by speeding up response times of computer devices in automobiles.

Virtual Reality (VR) and Augmented Reality (AR). Beginning with VR, ultra-fast connectivity and synchronicity are important for the user experience. I've mentioned in past writings that video communication within corporations will be meshing with VR; for example, a remote employee could take a virtual tour of a manufacturing plant with individuals who are physically there, to help solve problems. Fast connectivity for VR users is a must. In the AR world, the amount of data that must be processed every second of every day on wearable AR technology is colossal; therefore, the very infrastructure of AR glasses and other AR technology is contingent on high-speed connectivity.

Cloud Computing. 5G wireless has the potential for distributing cloud computing services, creating near real-time experiences that are much more engaging to users than Amazon, Google, or Microsoft are today. With that, telecommunication companies become competitors with these cloud providers, especially for businesses with critical workloads. Another way to highlight the opportunity is edge computing, which is the act of pushing computing power and data analytics to the edge where they are being used. By bringing data intelligence and AI closer to the customer and using 5G to eliminate latencies caused by distance, many new opportunities will be discovered and exploited.

Internet of Things (IoT). Everything from kitchen appliances to climate control systems, to home surveillance and, most importantly, health monitors – not to mention smart streets, parking meters, cars, and much more – can all be made easier to produce, easier to control, and more connected than ever before. Another example is that 5G transmitters will become IoT hubs, acting as real-time service hubs for all the households in their specific coverage areas. In manufacturing, machine-to-machine (M2M) communications enable scenarios in which robots can coordinate with one another for construction, assembly, and other tasks in a more effective manner with 5G wireless connectivity.

Healthcare. The availability of low-latency connectivity in extremely remote locations such as western Nevada or southern Arizona would revolutionize critical care treatment for individuals nationwide. An individual would not need to relocate to a more urban area just to receive medical care. Recent trials of this concept in Mississippi are proving that connectivity at 5G levels enables caregivers in rural and remote areas to receive real-time instruction and support

from remote medical professionals.

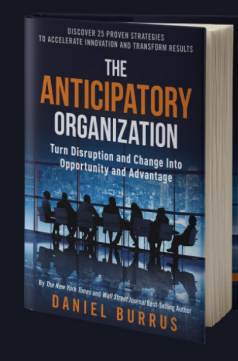
Many telecommunication providers are being anticipatory in their thinking, and pre-solving problems with 5G before they occur by way of moving customers into a 5G business track now, even before most true 5G services exist.

This is to make the transition feasible in homes and businesses, and again, to pre-solve problems they find prior to 5G becoming widely accepted, thus keeping them ahead of the curve. And by laying these foundations, businesses and consumers alike can be more easily upgraded to 5G once it's available.

Given all this information, it is the perfect time for you and your organization to anticipate what's to come, and more importantly, what is to be affected by 5G in your industry.

What will change with this level and speed of connectivity? What will be made easier? What roles will ultimately need to be transitioned due to technological disruption?

By paying attention to the Hard Trends shaping the future, use the Hard Trend of 5G capabilities to stay ahead of the curve and to avoid falling behind.



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