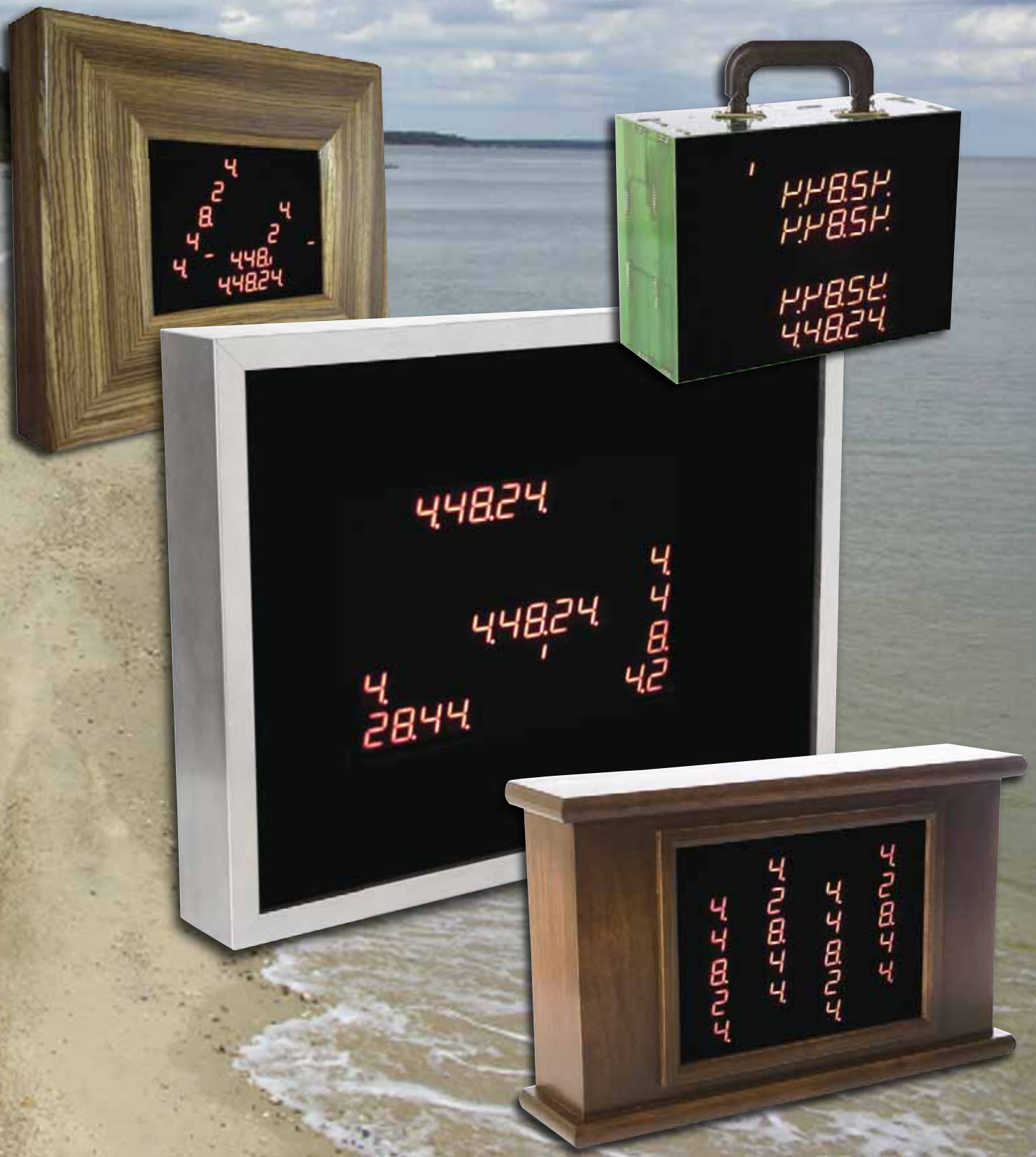


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The Next Generation of Clocks

by Robert Roan (CA)

Paradigms don't stop changing—the sundial, the hourglass, the pendulum, the quartz, the digital—the evolution of the clock is far from over. In this article I share some of my thoughts on the future of clocks, based on my studies, observations, and work building clocks with computers inside.

Specialization

The Industrial Revolution revolutionized industry because of major progress in power, accuracy, repeatability, consistency, rate of production, and rotational reliability. These changes profoundly affected our relationship with time and clocks, stripping away much of their numinous character and turning them into scheduling and synchronizing servants of industry.

We are aware of how machines leverage our strength, but they also leverage our accuracy. Only a machine could arrange millions of switches on a computer chip less than an inch square. No matter how well a person can do something once, they cannot repeat it with a precision of more than about 1 percent. Machines can do the same thing over and over with a lot more precision.

Machines repeat at a constant rate and output. Water clocks, candles, and hourglasses dwindle, expire, and require resetting; all these events throw the accuracy off. Mass production made clocks more affordable and therefore let them go new places.

Reliable rotation was a backbone of the Industrial Revolution. A rotational coordinate system is well suited to time's circular nature, which cycles through seconds, minutes, hours, days, and so on. Rotation is natural addition. Gears let you carry.

These factors led to a clock that can be set to a time and then accurately measure elapsed time and display a current time—not a time that is current because it has been synchronized to an external standard, like the sun, but a time that's current because the durations have all been added together.

We replaced the sun with calculations and got a space time coordinate system that could be mathematically and mechanically navigated and manipulated. There has always been a “workable” space time (meet at the mountains when the moon is full), and the Industrial Revolution dramatically increased the accuracy of the grid.

Scheduling has both a spatial and a temporal component. The accuracy of the scheduling is related to the accuracy of both and determines the span over which reliable scheduling can occur.

Reliable rotation increased the temporal accuracy through a more widespread and consistent time system, which meant that things like trains, with their temporal span, could be brought into scheduling. This was

great because trains were much more accurately than wagons.

Scheduling is coordination on a human scale. Let's all be at a certain place, give or take a few feet, at a certain time, give or take five minutes. When we can increase that precision by a factor of thousands, we have synchronization. Let's have the gears of these two machine parts both be at the same place, give or take a millimeter, at the same time, give or take a millisecond. Increase that by thousands and we are sending data packets over the Internet and reassembling them at the end of their journey.

Synchronizing is the dominant impulse of our world.

We have been in an era of unbundling—an age of specialization and customization. One size no longer fits all. Integrated circuits and software have unbundled clocks. There are cooking clocks on ovens, alarm clocks in radios, date-stamping clocks in computers, reminder clocks in PDAs, duration clocks on cell phones, and media players and bargain clocks in the drugstore. The collectible clock has what is left, but we are not sure what that is.

Trends

In the last 50 years, space has spread out in a process we call globalization and to which we have devoted a lot of social and cultural attention. Meanwhile, time has contracted into the clock pulse in a process that has been pretty much ignored except on a technological level.

Our relationship with time is ripe for change. Digital technology is transforming industry after industry, and our relationship with time is in desperate need of reevaluation. The latest force in digital technology is “computers inside,” also known as embedded systems. They are paradigm changers and have transformed the rotary into the cell phone, the mono LP on a clunky record player into an I-pod, and the Brownie into a five-megapixel camera. They run our communications infrastructure and factory floors.

There is a deep structural connection between clocks and digital technology through the clock pulse, which makes this a particularly appropriate technology for the next generation of clocks.

We've lost touch with the timelessness of time. The short-sighted thinking that caused the environmental and other crises is not visually short sighted but temporally short sighted. We have lost touch with the eternities. Our deteriorated relationship with time is the reason we feel frazzled, disoriented, and hectic.

Our body needs repetition on a regular basis. So we have circadian rhythms—internal clocks that cycle everything from hormone levels to hunger pains to sleepiness. Circadian rhythms might make me tired

every 23 hours and 53 minutes and you every 24 hours and 6 minutes. Left on our own, each day, our wake-up and bed times would move 13 minutes farther away from each other.

That dilemma is prevented by the sun, which signals the start, middle, and end of each day. Our circadian rhythms all synchronize like a computer reset, and it's that adjustment that lets us agree on time.

If there was no synchronization, we would be in a billion different time zones, without a common time. We would each have our individual time ... less, less a common time. I believe it's synchronization that transforms timelessness into time.

Timelessness and imagination are linked. The rhythms in dreams are unsynchronized and that's why, when we try to synchronize them in retelling or remembering, there's nothing to grab onto. Timelessness may be what scientists call imaginary time, which occurs inside black holes. However, before we get inside a black hole, we must deal with the infinity at its door, known as the Schwarzschild radius, where the time dilation predicted by Einstein's equations becomes infinite, forming an impenetrable boundary.

If something falls into a black hole, no external observer will ever see it happen. Over an eternity, it will get closer and closer and closer, but never quite get there, like the tortoise and the hare. If time is a verb that moves processes to completion, and you never see the object complete its trip into the black hole, then there was no movement at the boundary and no time as an action verb. The Schwarzschild radius is timeless, and the imagination is held by timelessness. The gravity of the pendulum clock may be more timeless than the electricity of the modern computer and battery clocks.

In the cosmos, gravity creates black holes and their timeless interiors. On the earth, the gravities of the moon, earth, and oceans create the unsynchronized timeless motion of ocean waves while the focused precision of electricity creates the synchronized time-based motion of our digital devices. When psychological gravity makes our eyes heavy, we fall asleep and dream. Light from the electromagnetic spectrum jolts us back to attention.

In string theory, the graviton is a closed string with the endlessness of no start or finish. The photon, a characteristic of electromagnetic theory, is an open string with the finiteness of a beginning and an end.

In Einstein's theories the uniqueness of light determines the nature of space and time. Light determining time brings us back to the circadian rhythms.

Electricity is replacing gravity as the dominant force in our lives. We even communicate electronically instead of walking (carrying our body through the forces of gravity).

Modern clocks are as much a cultural reflection as a functional necessity. We give them a glance, because our attention is always on the move in this frenetic world. Clocks update themselves every second because we

need to know the latest. Yesterday's news is ancient history. A lot can happen in a few minutes—or so the medical mentality supposes.

Clocks are precise, unequivocal, and familiar. They speak to themselves in milli- and microseconds and all agree. They march confidently and resolutely into the future, one successive number after another, reflecting our can-do attitude that the longest journey is made one step at a time. We deny the world's messiness, contradictions, and unpredictability. The clock face is Esperanto, the universal language, seven segment or rotating hands. They are an anchor of certainty.

Clocks do not need us. They set themselves to the universal clock signal or the GPS, and they do it without our help. We are too busy to be involved with an 8-day or, heaven forbid, 30-hour movement, so we have clocks that drift a second every millennium.

Because we live in an age when synchronizing is occurring on a vaster scale than ever before, timelessness is being transformed into time at a faster rate than ever before. We are synchronizing differently. We no longer share the same experience of time (e.g., the clock tower) on the psychological plane. Now, we share the image of time, instantiated in many ways on our cell phones and watches. Instead of synching to a communal time, we each synchronize in our own way and to our own device. We do not have the common eating, sleeping, and working schedules we did when the sun was synchronizing.

A Candidate for Change

The clock changed dramatically with the Industrial Revolution and then with the age of specialization. Now there's a new revolution, so it's time for another change. The next generation of clocks cannot be more of the same; clocks need to question the mob mentality of ubiquitous precision in all things digital and unwind our synchronized assumptions about progress so we can move forward in a more soulful and chaotic way. Clocks must learn to inhabit the digital realm without trying to do what they used to do. Instead, they need to reach back to their history as deep anchors and wow factors.

Some of the directions and influences on the next generation of clocks are in luxury watches, the effect that computers have had on phones, music players, and cameras and the rise of mythological thinking. The watch is a throwback to the past, an actual object, unlike the software that shows the time on a cell phone or a computer. For all the glory we give to ideas and the mind, we are still tangible, physical beings and have a somatic bond with material objects.

The luxury watch is a public statement in a secret language that speaks of economic status, hipness, and style to others of the same socioeconomic class. It is part of your outfit, like your shirt and suit. Those who cannot afford luxury do not understand the language or syntax and all watches look the same, but for aficionados, the watch is functional art, a conversation piece that can

start a number of dialogs. You can discuss the impulse to mastery and excellence in the way the watch uses precision and miniaturization, two major threads of industrialization. Its multiple displays are opportunities to interpret, explain, and compare. The exotic materials of its components are another source of conversation about the beauty of design at the cutting edge of technology.

The clock is more communal than the watch. A watch is on your body, so it is a more personal statement. The clock is in a more communal space, so the access does not go through one person. More people can look at it simultaneously and share the same experience. We can look at the clock longer and let it seep into a deeper experience because someone does not have to reveal their wrist. The clock is not portable, so it does not speak to as broad an audience. It speaks to people who come to your home or into your office. It is not an introduction, but an elaboration to people who already have an impression of you. A well-dressed person wears a watch, but the idea that an elegant home has a communal clock has disappeared from our mythology because clocks have stopped saying interesting things in a culturally relevant way.

Music, Phones, Cameras, Globalization

Music, phones, and cameras have been profoundly affected by the computers inside. They reinforce our obsession with the immediate. We no longer have to wait until we get home to listen to music or talk on the phone. We do not need to wait an hour for our pictures to be developed. And, because they are digital, we can start snapping immediately without spending any time composing our pictures because we can take as many as we want and discard most of them.

Music and phones have continued our alienation from the communal by giving us new private spaces. We have our own phone so we do not need a family phone. We have our own music player so we do not need a family stereo. They not only perform their traditional tasks but also organize music and phonebooks into my play lists, my contacts, and my favorites.

Computers bring "the time" to all these devices. In addition, we know how long the song has been playing and how long it will last, how long we have been on the phone, and exactly when the picture was taken. The phone is also an alarm clock. We make them ours, and not the groups, through personal customization. Ringtones are customized. Screens are customized. The camera has multiple modes that we can configure for our own purposes and save as my camera.

Music players and cell phones also speak to our need for entertainment. We cannot walk down the street without a musical distraction, and we play games on our cell phones.

Clocks face a kind of paradigm globalization, with the cheap imports coming from the world of digital electronics. Time displays have become commodities.

Although the digital revolution has destroyed clocks' traditional role and caused their identity crisis, it is also a great opportunity. The way to compete is to move up the value chain to a place where simple time displays cannot compete and synchronization is not a primary function. Clocks that bring back a sense of community and get people more connected with timelessness will tap into a deep need in society and find a strategic niche.

Old clocks naturally created a sense of home and community. They were the only kind of clocks so they got it all. They did not need awareness because the unbundling had not started. The family clock was a hearth and home. To reclaim that energy, clocks will need to deepen some cultural impulses, challenge others, and recast the story of time from the slave of commerce to the mystery of existence.

Paradigm changes take us back to the past as well as into the future. They take us back because we have to relearn what something means. They take us into the future on the currents of history. It's this tension of the opposites that creates something new.

Time's New Face

With those opposites in mind, I'm trying to build clocks that let people learn to tell time all over again. I combine network and systems thinking, ideas about communal customization, and theories from Carl Jung to create clock displays that challenge and play with our assumptions about the way time looks.

Play is crucial, because the age of sternness is gone. Clocks do not need to resemble Disneyland, but they will tickle that same funny bone in a different spot. They will be multilayered, more engaging, fun, amusing, and intriguing. Or they will be ignored.

My clocks, which I call Chronoclasts™, are systems on the network, like everything else in the world of Web 2.0. Network thinking does not care about location, nature, or number, and changes the clock face from a single design element into a major subsystem. They have a central computer controlling clock hands and LED digits, each of which I view as a peripheral, so there can be a variable number of design elements in flexible configurations of hands, digits, and other forms taking all sorts of shape beyond circles and 1" by 6" rectangles.

One clock might have three separate LED displays and another might have one, but it is five times the size. Peripheral thinking has a well-thought-out way of dealing with this. A system open to peripherals soon gets many. Why should there be just hands or LEDs? Why should they have to be in preconceived places? Why should there be only one second, minute, and hour hand?

Clock displays are becoming customized and the trend will accelerate. Multiple time zones are shown on some clocks. Future clocks will let you customize the background (the actual look of the clock case), what is

displayed (New York Time, London Time, Dubai Time), where it is displayed (the location of the hands and/or the digits), and the format in which it is displayed.

I use a model based on the way word processors let us format paragraphs and characters, but Chronoclasts™ format time. Instead of single or double spacing, it is right side up or upside down or sometimes one or sometimes the other. I use about ten parameters, including options about normal/mirrored, moving/stationary, horizontal/vertical, to specify whether I always want one or want to see both. Each configuration lasts for a period of time I determine before the computer randomly chooses another configuration that fits within the parameters I specified.

Clocks like this will build community because they occupy a space between the universal and the individual. Because the parameter sets are user defined, the set of time formats will vary from one clock to another. Each community will be different, and sharing a unique characteristic forms a bond. The number of formats in any particular clock requires learning, and people will talk to each other about them. The time is an easy icebreaker, and a puzzle is a Petri dish for conversation.

Although each community is different, they will all be linked together by the universal nature of time, just as geographical communities are all distinct but share a common thread of humanity.

Mythologies are the stories of the collective unconscious. The story is the first horologe. Its progression depended on indicating times during its beginning, middle, and end. The medial age thinks in story lines. There is so much information in the world that we cannot organize it as data, so we generalize it into stories. The image is front and center in our awareness. Magazine ads are pictures with very few facts. Television commercials seek to bond us to the characters and imagine the products in their stories. Politicians appeal to us with their stories instead of their positions and attack their opponents by painting them as images in stories of deceit and dishonor.

Stories occur at psychological and physical borders because they are about movement from one place to another. Making decisions about the parameters is telling a story about possibilities. Embedded computers write the sentences about “glanceability,” flow, rate, synchronization, precision, accuracy, and other subjects we take for granted.

Computers let us move clocks from the familiar terrain of assumptions to the border between clocks and not clocks by asking questions about the nature of clocks. They will open the tangible fact of time to see the stories of the sun god that the original sundials told.

Time and Eternity

My goal is to implement some of Carl Jung’s ideas and reestablish the link with Psyche’s images of time. I’m approaching time not as a solid entity, but a solution of possibilities similar to the way that DJs combine samples of music into a new composition that gets strength and impact from transitions. Carl Jung thought of

alchemy as the metaphorical language of psyche, and I hope to use the alchemical process of solution to loosen and dissolve the preconceptions of time to reveal its golden radiance in much the same way that sampling has loosened and dissolved ideas about music.

Our relationship with time is becoming narrower and narrower. The Industrial Revolution started this process, and digital technology has brought us close to a point of no return. Time and eternity were once connected like the animal and the godhead. We could see the animal (time) and it called down eternity. We experienced this as rituals, occurring at certain times and giving us a glimpse of the eternal gods. The clock pulse is far sharper than a razor and has sliced and diced timelessness out of our lives. Rituals have changed. We may have rituals like a morning cup of coffee or a TV show, but we do not use them to see timelessness. We use them to see consumer gods and the brand’s eternity (which will hopefully last as long as the payment plan).

Timelessness is an old growth forest that we are harvesting too fast. We need to reintroduce the mystery that is time. The same digital paradigm that has built the frenetic world in which we live can also slow it down. The embedded systems clock will be as different from the precise clock as the mechanical clock was different from the water clock.

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About the Author

Bob Roan attended The Johns Hopkins University where he studied creative writing and learned about time as the beginnings, middles, and ends of stories. After graduating with a B.E.S., he stayed to pursue a PhD. in theoretical physics and became fascinated with time while trying to understand Einstein’s general theory of relativity. He designed his first clock as a teaching assistant in a physics lab course. He moved to Alaska without receiving his doctorate and became a computer entrepreneur. After a few years, he received an MBA from the Harvard Business School where he became interested in the way commerce has appropriated time. Recently, he received an MA degree in Mythological Studies from the Pacifica Graduate Institute where he was introduced to the archetypes of time.

Bob has been involved with computer software for over 40 years and has been interested in robotics and artificial intelligence since 1985. He’s been exploring the clock paradigm for the last five years.

He counts Jung, Freud, Springsteen, Neufeldt, Edinger, Giegerich, Elvis, Jagger, Cohen, Campbell, Einstein, Gilkyson, Cline, Newton, Weinberg, and Feynman among his inspirations and is happiest when his work is being guided by Jung’s ideas, self-thinking thoughts, boundaries, chaos, and the tension of opposites.

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