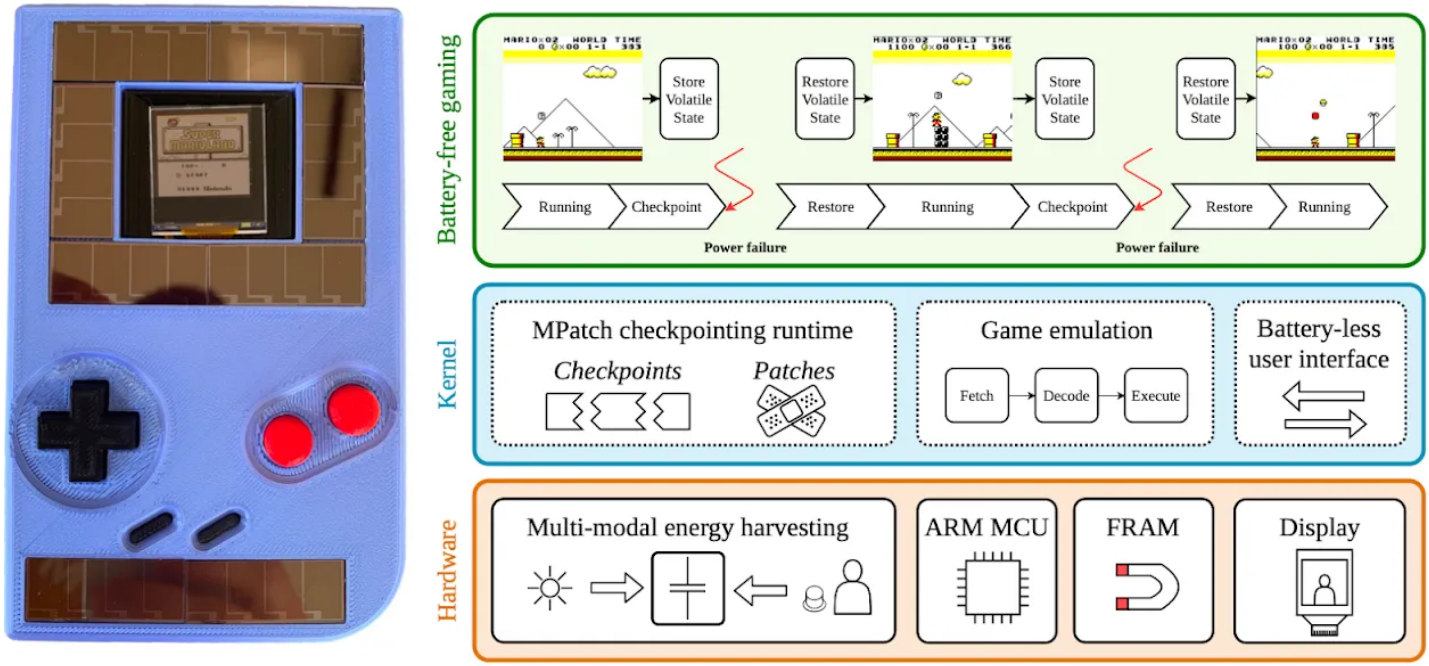
matter what, when the emergency happens, [the device] will still work," he says."



The Solar Game Boy

from: https://github.com/TUDSSL/ENGAGE/blob/master/doc-images/system-engage.png

https://www.techradar.com/features/the-quest-for-the-solar-powered-gaming-console

https://protean.systems/

The New Normal

In October 2022, as much as 40% of Ukraine's power grid was seriously damaged or out of service. Ukraine is considered a first-world country, yet it is not a thought that someone in a first world country wants to think or should have to think- that their energy security should all of a sudden become unpredictable. But that's exactly what happened. Whether it is due to climate change, a natural disaster, or man-made, planning for resilient networks and infrastructure is common sense. The semi-conductor industry makes its highest margins on the leading node, the chips that go into the latest iPhone and Galaxy, but the revenue from this profit doesn't always get reinvested into new and groundbreaking technologies, either because it does not benefit the market leader-it would cannibalize the sales of Intel i3 to sell a slower Celeron- which is why Intel discontinued the entry level line. AMD discontinued their Geode processor for similar reasons- the same processor found in the OLPC.

If I was in space, and just returned to earth in October after light years in the future, I kind of think this would be my reaction:

Charleton Heston And Greta Thunberg have a point though.

In 2011, the solar powered Claremont x86 was demo'd to the world. Samsung released a solar powered netbook, I kid you not, called the NC215S which took 2 hours of bright sun to charge the battery life one hour, and used a 6.5Watt Intel Atom N455.

Perhaps to compete with the OLPC, and, once its AMD Geode threat was over, and the ripple effects of the 2008 economic crisis began to subside, much like the 1973 oil crisis, the digital Malaise era ended and the big fabs went back to making non-solar laptops with no need to show any eco-consciousness in their products. While the slowest Atom processors weren't able to run

more modern OSes like Window 7 and YouTube very well, there was still a lot of potential for them for older operating systems. It took a couple more years to reach good enough computing. By the time i3 processors were released and quad core Athlons, however, PCs could run many more apps and quite quickly with the advent of solid state drives, eliminating Disk I/O as a system bottleneck.

In 2012 I already hoped to start building a solar powered laptop. But at the time, the lowest powered application processors used over 5watts (5000 mW) of power. As recently as 2020, research still mentions the Claremont, but it is unclear if Intel Labs has any research divisions dedicated to single core processors. The purpose of that demo was, apparently to demonstrate the capability of NTV, but now is used primarily for hyperscalers (HPC, which saves power). If a company like Intel back then realized that they could use that Claremont processor to build a Psion 3 with 256K, or a Nokia 6110-monochrome, not 24 bit color and extremely bright LED backlit display, they'd be able to build a modest, solar powered-phone with "instant-on" not just for the "third world", but maybe one that could be used in Ukraine today to send text messages on wifi, Teletype Morse SDR, LoReA, or LoRA over long distances without power:

"Although the WiFi-standard was developed for short-distance data communication, its reach can be extended to cover distances of more than 100 kilometres."

If the above link isn't working, try this one https://www.lowtechmagazine.com/2015/10/how-to-build-a-low-tech-internet.html (the "over long distances" link is a website powered by solar panels)

"The Spanish network is the largest WiFi-based long distance network in the world with more than 50,000 kilometres of links, although a small part is based on optic fibre links. Most of it is located in the Catalan Pyrenees, one of the least populated areas in Spain. The network was initiated in 2004 and now has close to 30,000 nodes, up from 17,000 in 2012. 822"

"However, the low-tech networks that distribute internet access to a large user base in developing countries can have much more limited bandwidth per user. For example, a university campus in Kerala (India) uses a 750 kbps internet connection that is shared across 3,000 faculty members and students operating from 400 machines, where during peak hours nearly every machine is being used.

Therefore, the worst-case average bandwidth available per machine is approximately 1.9 kbps, which is slow even in comparison to a dial-up connection (56 kbps). And this can be considered a really good connectivity compared to typical rural settings in poor countries. 26 To make matters worse, such networks often have to deal with an intermittent power supply."

The article goes on to explain lots of local solutions to that so it is not all pessimistic (If you were already thinking at 750Kbps that it was slow, you were maybe born after 2000, or haven't seen what you can do with 1.9kbps, or both)

Let's say that instead of using a GSM network (Ukraine has 2G in many places), because there could be an event that caused it to be down (manmade or natural disaster), an ad-hoc wifi network as the one above is implemented. Then, local routers subdivide the signal further and are able to transmit some of the network (maybe not bidirectionally everywhere but at least in a round-about manner). The solar phone isn't able to use SMS, but may be able to use bluetooth over internet and wifi, with solar powered relay beacons providing the network throughout a city. Even with a small data rate of 1.9kbps, you can have an XMPP protocol or IRC channel sending data in very small packets. The equivalent in text messages is 140 bytes:
"Text Message Bits and Bytes

SMS text messages use 7-bit characters and have a maximum length of 160 characters, making the maximum data size of each SMS 1120 bits, or 140 bytes."

If a router is used by 45 users (the maximum recommended, even if an off the shelf router can theoretically handle up to 250), and a 802.11g access point is only able to pick up a 85.5Kbps signal, those users would also have only a 1.9kbps signal. 1.9kbps is 237 bytes per second. That means that a 160 character text message could be sent every second (if you can type that fast), and if the headers and packet sizes are not large. MQTT uses a low-packet size. What kind of data could be sent? Your location, if you need help; request for food or water, and where one can go. Practically anything one would send in an emergency. Better something descriptive than a generic SOS signal, especially if many other signals are being sent co-localized and not much more sense can be made of that.

If you're on a kayak at sunset, in the middle of Lake Champlain, and you lose your paddle, a solar phone can recharge in the morning

And if you have more bandwidth, you can run SIP phones on an MCU with less than 256KB of RAM.

https://en.wikipedia.org/wiki/Bit_rate#Other_audio (minimum is 450 bits/sec, recommends 1.2kbit/s for Codec 2)

700 bit/s – lowest bitrate open-source speech codec Codec2, but barely recognizable yet, sounds much better at 1.2 kbit/s (actually 450bits/sec was mentioned)

800 bit/s – minimum necessary for recognizable speech, using the special-purpose FS-1015 speech codecs

2.15 kbit/s – minimum bitrate available through the open-source Speex codec

6 kbit/s – minimum bitrate available through the open-source Opus codec

8 kbit/s – telephone quality using speech codecs

32–500 kbit/s – lossy audio as used in Ogg Vorbis)

Low power LTE modems such as Quectel's BC660K -GL or Nordic nRF9160 may be able to use less power in idle and work with solar phones:

Max. 127Kbps downlink / 158.5Kbps uplink (could handle almost any of those codecs above)

https://www.mouser.com/datasheet/2/297/nRF9160_PS_v2_0-1954012.pdf

5.2.1.9 SPIM

Symbol	Description	Min.	Typ.	Max.	Units
I_{SPIM0}	SPIM transferring data @ 2 Mbps, Clock = HFINT		0.63		mA
I_{SPIM1}	SPIM transferring data @ 2 Mbps, Clock = HFXO		1.58		mA
I_{SPIM2}	SPIM transferring data @ 8 Mbps, Clock = HFINT		0.67		mA
I_{SPIM3}	SPIM transferring data @ 8 Mbps, Clock = HFXO		1.62		mA

5.2.1.10 SPIS

Symbol	Description	Min.	Typ.	Max.	Units
I_{SPIS_2M}	SPIS receiving data @ 2 Mbps, Clock=HFINT		0.63		mA
I_{SPIS_2MXO}	SPIS receiving data @ 2 Mbps, Clock=HFXO		1.58		mA
I_{SPIS_8M}	SPIS receiving data @ 8 Mbps, Clock=HFINT		0.67		mA
I_{SPIS_8MXO}	SPIS receiving data @ 8 Mbps, Clock=HFXO		1.62		mA

p.61 Can someone tell me what this means? If I read that right, it's using only 1.58mA to send and receive 2Mbps Or is that over the SPI (to MCU) (and not the cell tower)

Current consumption (23 dBm TX power, 3.7 V supply)	
PSM floor current	LTE-M: 2.7 uA NB-IoT: 2.7 uA
eDRX, 655 seconds	LTE-M: 6 uA NB-IoT: 9 uA

https://www.nordicsemi.com/-/media/Software-and-other-downloads/Product-Briefs/nRF9160-SiP-product-brief.pdf The above appears to use 9uA to to listen for new data incoming, but not transmit, which would be quite low!

https://www.quectel.com/product/lpwa-bc660k-gl-nb2 could also be used on conventional networks:
" Power Consumption (Typical) : 800 nA @ PSM 0.11 mA @ Idle (DRX = 2.56 s) 0.038 mA @ Idle (eDRX = 40.96 s, PTW = 10.24 s)"

"67 mA @ Connected Tx 0 dBm 330 mA @ Connected Tx 23 dBm "

Aha! they both use eDRX. I googled it. https://www.sierrawireless.com/iot-blog/edrx-lpwa/

"**What is eDRX?**

Developed by mobile network standardization body 3GPP and introduced in 3GPP Rel.13, eDRX enables application developers to set, and later change how long an edge device stays in low-power sleep mode before it wakes up to listen for any network indications for pending data.

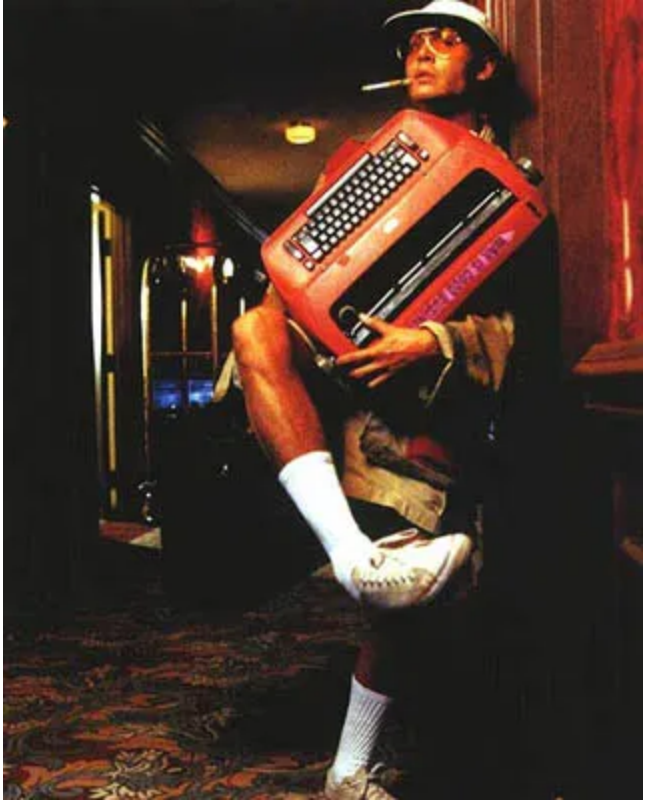
With eDRX, the device can listen for pending data indications without having to establish a full network connection. By just listening for a pending data indication, eDRX uses less power than if it made a full network connection, so this process helps preserve the device's power. The time needed for this listening process is also much shorter than the time it takes to make a full network connection.

The maximum sleep time for eDRX devices range from up to 43 minutes for devices using LTE-M LPWA networks, to up to three hours for devices using NB-IoT LPWA networks. The minimum sleep time can be as short as 320 milliseconds (ms) for LTE-M and 10.24 seconds for NB-IoT."

I'll take it! Add it to my tab, waiter. So you can send a text messsage, let your phone sleep with one eye lid partially open for 43-180 minutes. eDRX, a technology you can trust.

Thus, the benefits of resilient communication networks using a decentralized network of routers and solar powered mobile devices are obvious. The issue is more of a will to develop these technologies, or maybe even a disbelief that it is even possible.

50 years ago, being a travelling writer could involve hauling a 48 lb IBM Selectric 1, and dealing with hotel neighbors who can't stand the sound of Tennessee Williams typing next door.



There will always be a need for journalists writing stories- whether they are using voice-to-text speech recognition software or an 878 gram Fujitsu UH-X laptop, writing is indispensable. Likewise, solar powered phones that can easily scavenge for power will be essential in a world with unreliable energy security.

That, and of course, Lieutenant Dan:

What kind of batteries was he using? probably better than a solar phone, of course

The solar powered calculator, like the transistor radio, got its start as a product demo:

"Meanwhile, advances in manufacturing had made solar panels—first developed at Bell Labs in the mid-1950s—cheap and efficient enough to be used on devices other than satellites. Putting them on calculators showed off how inexpensively the panels could be made and how little energy was needed for the processors to function.

This kind of display of technological achievement was fairly standard in consumer products at the time.

"When Texas Instruments wanted to push the then-new transistor, they chose the radio as first blockbuster application," says Joerg Werner, who maintains the Datamath Calculator Museum online.

Werner points out that the earliest computer chips followed a similar path, going from rockets to pockets and wrists (perhaps you had a cool solar LCD watch to go with your sun-powered calculator).

The first solar calculators had their disadvantages: The Sun Man's solar panels were on the back and the Teal Photon, which came two years later, needed bright light to operate. But by the early '80s, Sharp and Texas Instruments had developed solar panels that could run under low or artificial light. This pushed solar and the attached low-cost calculators, firmly and finally, into the mainstream.

One Texas Instruments promotion in 1984 gave free solar calculators to businesses that bought TI computers. A few years later, Chicago Public Schools paid $1.1 million for 167,000 solar TI calculators to use in classrooms. A 1989 trend-watching column declared solar calculators "in" and astrology "out" (the same column declared Morris the Cat in and Kitty Dukakis out).

Newsweek referenced solar calculators in 1990 to explain what solar panels were, while a column in the *St. Petersburg Times* predicted,"You'll be seeing a lot more new solar products on the shelves in the coming year," including devices for scaring away backyard moles and charging car batteries.

The technology that made tiny, efficient calculators possible also brought us mobile phones, personal computers, Game Boys, Tamagotchis, and Furbys in just a few years—minus the solar cells. Some of these devices needed small, constant streams of power to maintain their

memories, and others just used a lot of juice, as anyone who tried to beat Link's Awakening on a long car trip surely knows.

And while solar calculators continue to outsell non-solar models for Texas Instruments, kids who stick with math class often move on to TI-89s and other graphing calculators. These are great for calculus and trigonometry, but they're too powerful to run on solar.

Instead, solar moved to less-visible places, like the lights and signs on highways. As they get more efficient, solar panels are increasingly showing up not just in large-scale arrays, but on house rooftops and parking lot canopies. If Tesla CEO Elon Musk's plans work out, we'll all have batteries to store solar power for our homes.

But that doesn't mean children of the '80s, '90s, and today are all rushing to make their houses as green as their calculators. Solar calculators may have convinced a generation that the sun could power gadgets, but it's not the same as convincing them that the power in tiny calculators could stream from an outlet.

The problem, says professor and futurist Cindy Frewen, is that people don't necessarily think of rooftop panels the same way they might think of consumer electronics. "People adopt their gadgets, but they accept their energy," she says. "They take it for granted: 'This is what I have in my house.

That might change as utilities and clean energy companies offer more consumer-friendly options for solar panels and batteries to go with them like Tesla's Powerwall, a battery designed by and for technophiles.

The next generation may not even expect to plug their gadgets into a grid. Texas Instruments, the maker of all those school calculators, is working on circuits that will draw power from their users' movement. It's not likely to power a house, but as tablets make their way to classrooms, it's a great excuse for a long recess."

Those types of power generators, among the many types that are being developed by companies like TI and e-peas. ZF makes a mechanical energy harvester-kind like regenerative braking but used in the solar Gameboy.

The Antecedent (A parallel thread)

"Hungarian physicist Leo Szilard realized that the neutron-driven fission of heavy atoms could be used to create a nuclear chain reaction which could yield vast amounts of energy for electric power generation or atomic bombs. He had first formulated and patented such an idea while he

lived in London in 1933 **after reading Ernest Rutherford's disparaging** remarks about generating power from his team's 1932 experiment using protons to split lithium." :

"However, a speech of Rutherford's about his artificially-induced transmutation in lithium, printed on 12 September 1933 London paper *The Times*, was reported by Szilárd to have been his inspiration for thinking of the possibility of a controlled energy-producing nuclear chain reaction. Szilard had this idea while walking in London, on the same day.

Rutherford's speech touched on the 1932 work of his students John Cockcroft and Ernest Walton in "splitting" lithium into alpha particles by bombardment with protons from a particle accelerator they had constructed. Rutherford realized that the energy released from the split lithium atoms was enormous, but he also realized that the energy needed for the accelerator, and its essential inefficiency in splitting atoms in this fashion, made the project an impossibility as a practical source of energy (accelerator-induced fission of **light elements remains too inefficient** to be used in this way, even today). Rutherford's speech in part, read:

> We might in these processes obtain very much more energy than the proton supplied, but on the average we could not expect to obtain energy in this way. It was a **very poor and inefficient way of producing energy**, and anyone who looked for a source of power in the transformation of the atoms was talking moonshine. But the subject was scientifically interesting because it gave insight into the atoms.[50]

The moral of the story: when a scientist says that some thing (e.g matter/energy) is insignificant, a competing scientist, driven by knowledge, curiosity, or both, is motivated enough to test that statement. Kuhn's *The Structure of Scientific Revolutions (1962)* is one such resource on this.

Einstein wrote to FDR in 1939 saying Uranium may be a "useful source of energy in the immediate future"

Seven years later, Einstein and Szilard write the DoE equivalent of "wait, wait, wait, "actually, actually, actually" maybe we shouldn't use this nuclear energy for weapons:

In 1946, The Emergency Committee of Atomic Scentists was founded by Albert Einstein and Leo Szilard. "Its aims were to warn the public of the dangers associated with the development of nuclear weapons, promote the peaceful use of nuclear energy, and ultimately work towards world peace, which was seen as the only way that nuclear weapons would not be used again."

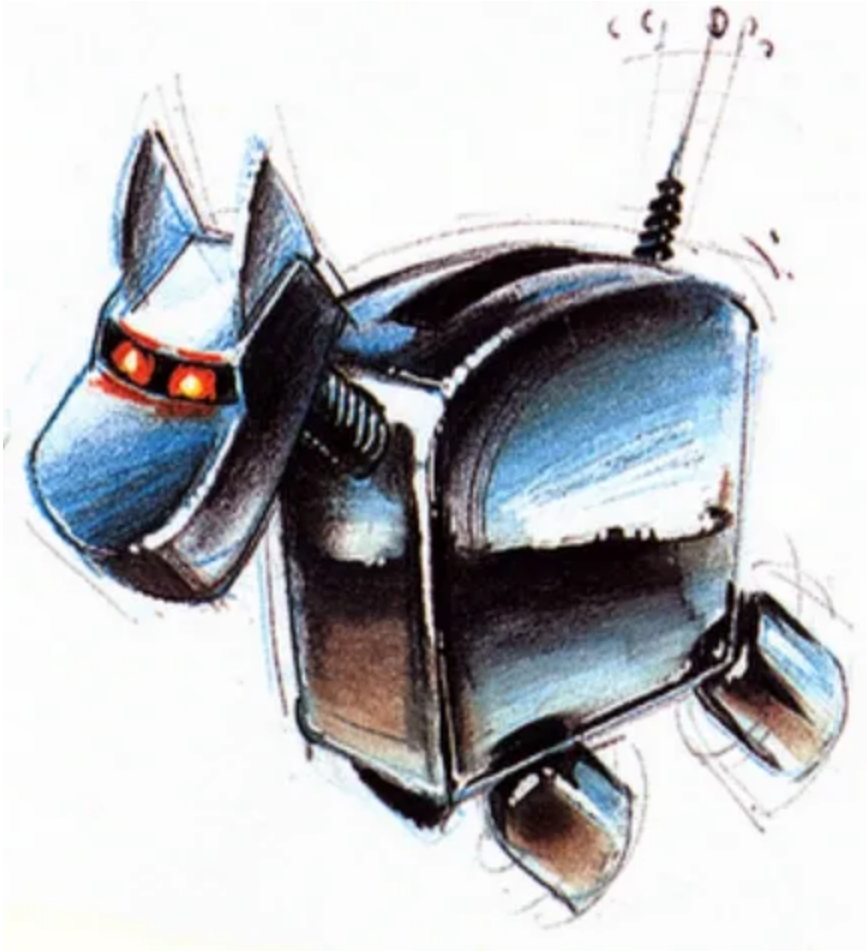
Lithium mining, while it may sound anticlimactic, is a slower, but

equally extractive process on low and middle income countries (LMIC), that does not produce any peace by depleting resources.

As Shakespeare wrote in Romeo & Juliet, “A burn by any other pace would smell just pungent.”

“Half the members had worked directly on the Manhattan Project and all had been indirectly involved or consulted on the production of the first atomic bomb.’

Like enriching Uranium, except enriching Photons, storing them on a capacitive plate, and Pluto wolfing down the stored electrons off the plate like the Pluto phone



Secret of Evermore, 1995

Sometimes I think, however badly solar technology could be ramped up, it could never result in the same kind of radioactive, uninhabitable land such as Chernobyl.

How Many Photons converted into electricity through a p-n junction does it take to produce a pixel on a screen? To flip a bit? To refresh a pixel? Probably less than you think.

Reductionist thinking isn’t all bad. But it’s not the only thing.

Sorcerer's Apprentice - Fantasia (1940)

Conclusion

Even if you disagree with the practicality of solar computers, there is one last reason I feel solar phones and PDAs should be developed. In 1977, The Voyager 1 spacecraft was launched to explore interstellar space. Included was a phonograph record, called the Voyager Golden Record containing “records contain sounds and images selected to portray the diversity of life and culture on Earth, and are intended for any intelligent extraterrestrial life form who may find them. The records are a time capsule.”

If you were Carl Sagan and wanted to know if extraterrestrial life existed, a Golden Record would be a logical idea to send into space. He once, said, "The spacecraft will be encountered and the record played only if there are advanced spacefaring civilizations in interstellar space. But the launching of this bottle into the cosmic ocean says something very hopeful about life on this planet."

If you’re not like Carl Sagan, you’re probably not very hopeful. The Golden Record may seem symbolic, but isn’t it practical? Even if there is no life found outside of Earth, the pursuit of science exists because some choose to believe that by testing a hypothesis, they no may no longer need to say, “I didn’t try so I’ll never know” What that means is, while there are some who want to believe just for the sake of believing, the scientist is neither a skeptic nor an optimist, but a

realist by testing nature. A agnostic person can be hopeful for an outcome, but a bias cannot exist. Theodore von Kármán once said, "Scientists study the world as it is; engineers create the world that has never been." When one is not studying, they are creating.

That sounds all nice and dandy, but there's more. The "planets" metaphor is sometimes used with people. There is certainly the reality that some cultures want to be remain uncontacted. And others, for other reasons. Cultural diffusion includes technology. The uptake of technology is not always a top-down phenomena. Yet there is often a tendency for technology to be rejected regardless of it source. The technological change that engineering is focused on is less on direct-to-consumer, who may be non-technical and unaware of the direct applications of new technology, often used in arcane specialties with little to no observable immediate benefit. Thus out of each class of engineers, is one everyman, who is not from a long line of priestly families, who learns the ways of high priests, first out of curiosity, and then for the vernacular. When you're teaching a foreigner, or selling a product, aren't you trading in Golden Records?

"If I could explain it to the average person, I wouldn't have been worth

the Nobel Prize. -Richard Feynman"

Fortunately, some educators are aware of this gap between the Two Cultures:

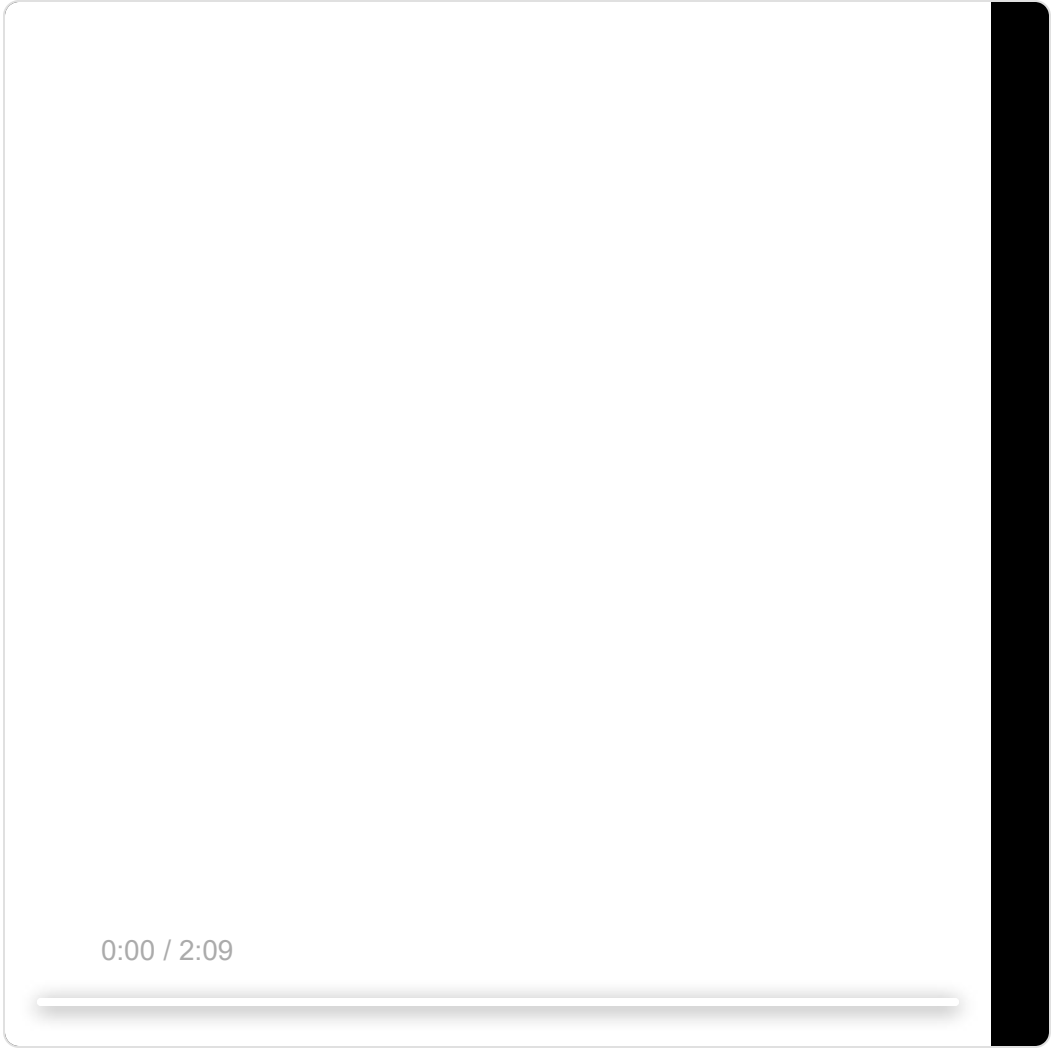
"Educators tend to describe engineering concepts in language and using examples that are unfamiliar to students starting out on their students. Research has shown that present[ing] engineering principles in a context that is familiar [to] students improves their understanding, helps recruitment and retention, and leads to higher ratings for professors."

Encore

David Bowie once described the Internet in 1999 as "an alien life form:"

Michael Warburton
@MichaelWarbur17

The always missed DAVID BOWIE predicting back in 1999 - with typical prescience - the impact of the Internet on all of us.



5:27 PM · Nov 5, 2022

5,936 Likes **1,462** Retweets

Bowie didn't invent the internet, yet his prediction that the internet would become much more integrated into the fabric of daily life was prescient. As Arthur Clarke once said, "Any sufficiently advanced technology is indistinguishable from magic." The internet isn't being compared directly to magic, but rather in that it was not immediately apparent in the early days of ARPAnet nor in 1999 to something so ubiquitous as as the IPv6 address system soon became needed.

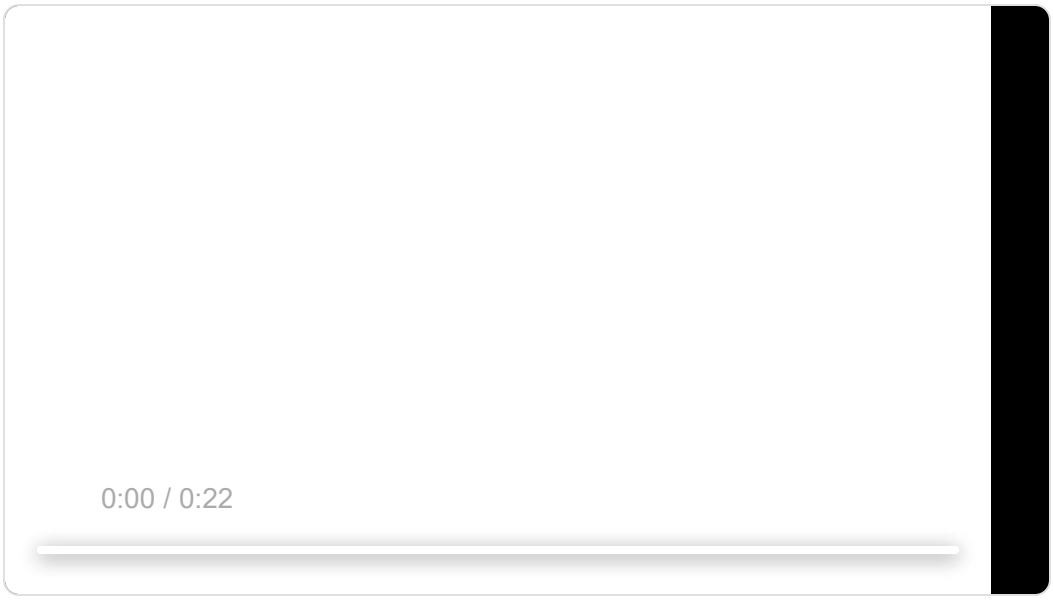
In other words, the internet is like an alien life form, *by other means*. It is sufficiently weird, that the weird became the *pros*.

So, Bowie deserves some credit, which is why I will name a new semiconductor law to him, which I call Bowie's Law. I previously wrote a guideline here. It states that for every solar powered mobile computer (MC), there is an equally eerie extra-terrestrial energy efficient-equivalent, which can be written MC=E^5 (one E was not counted because equivalent is hyphenated, and somewhat redundant)

This energy efficiency of a mobile computer requires that the TDP (thermal design power limit) not exceed the extra-terrestrial energy source (namely the sun) in ambient conditions- e.g low to average lumen levels) that is able to reach that device. In other words, for a typical phone or laptop that uses an earth-based energy source, the power consumption usually exceeds what a small solar panel beside it would be able to generate, often by a large margin. By contrast, as in the solar gameboy and in recent hardware prototypes,

@joeycastillo@mastodon.social
@josecastillo

@bradanlane Now it's battery free. Tiny solar cell is tiny!



3:49 PM · Nov 2, 2022

79 Likes **6** Retweets

The design of the MCU and Display is intentionally chosen with a TDP not to exceed the instantaneous amount of power that the small solar panel is able to generate. Other than a hard reset or a cold boot from extremely low light conditions (like a room with no windows), a energy autarkic device such as the one above could certainly be scaled up to that of a solar laptop.

But First: Eat your vegetables!

In the 2014 movie “The Interview” with Seth Rogan and James Franco, where the character Dave Skylark is pressing his producer, Aaron Rapaport to be able to interview the head of state of the DPRK. This is after the producer realizes he is a mediocre head of a tabloid news program: “After Skylark and his crew celebrate producer Aaron Rapaport's 1,000th episode, Rapaport is upset by a producer peer who criticizes the show as not being a real news program. He voices his concern to Skylark, urging change.”

Skylark says, “This is like eating vegetables. Once you eat those, *then you get to eat the steak.*” That “steak” today is the full fat modern operating systems like Android and iOS. And the salad is the Nokia 6110. The 1990s phone is the lean payload of the 2022 equivalent, if only because feature development has become inextricably linked to platforms now deliberately ignorant of energy-autarkic design. Another, albeit confusing analogy would be- the voice and text feature is the main course meal, and the games/idle browsing is the dessert. Thus anyone who seriously wanted to develop a solar powered phone or PDA should set more modest software goals for the short term, while emphasizing the benefits of solar hardware in future releases.

I am the Cargo Cult

One does not get to become Steve Jobs by developing an Iphone. One became Steve Jobs by visiting Xerox PARC in 1979, seeing Douglas Englebart’s Mother of All demos in the Alto, and realizing this is not just a Business 2 Business product, but an **intuitive** UI and product that average people, not mainframe users, could use.

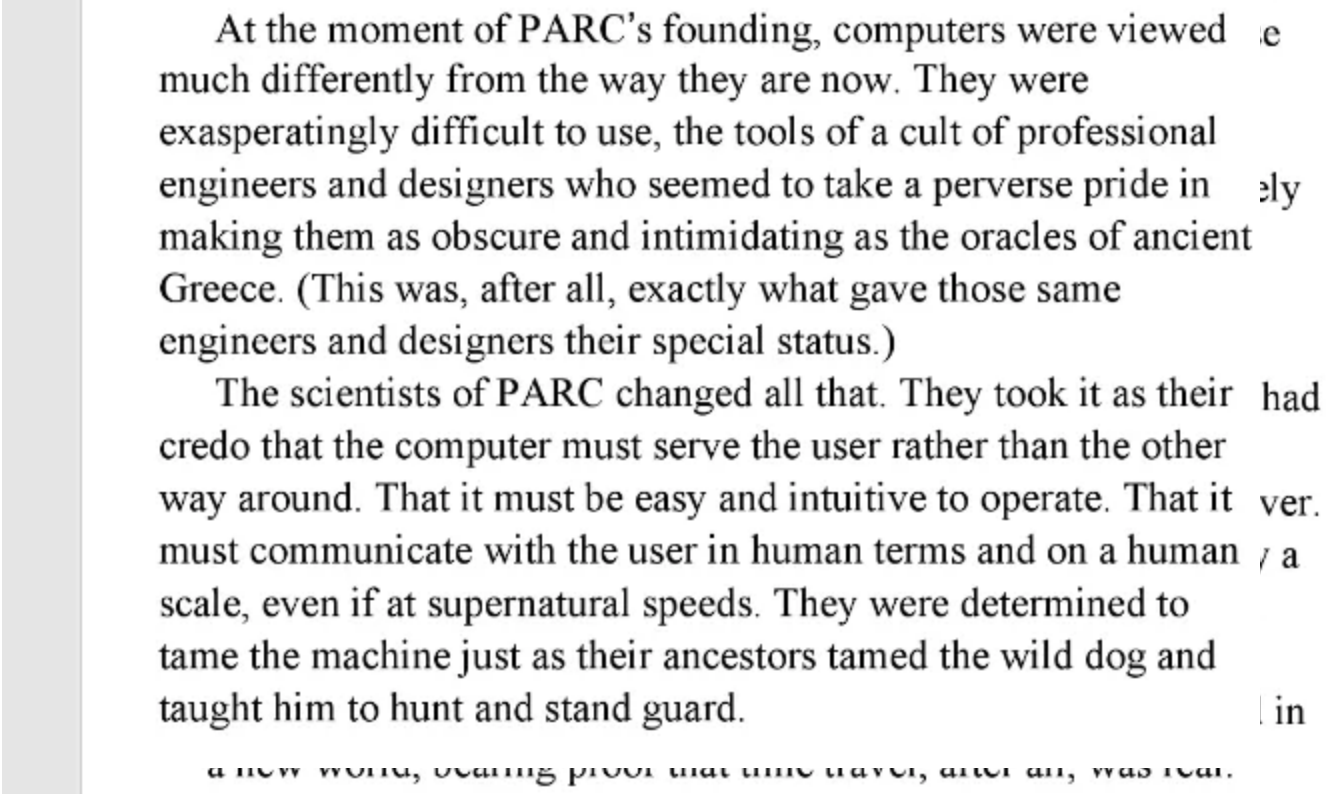
Thacker had spent much of the Alto design phase working out ways to make things smaller while retaining just enough memory and power to run complex software while simultaneously keeping the display active. In quest of efficiency he lifted tricks and shortcuts from every obscure corner of engineering science. Hardware added mass and slowed the system down, so wherever he could he replaced hard-wired circuits with miniature software programs called "microcode." This allowed him to wring bulk out of the design by jettisoning circuit boards like a balloonist dropping sandbags to gain a few more precious feet of lift. He knew his design was spare; he was just not sure it worked. Now the moment had come to find out.

The Alto's operating software had not yet been written, so its brains resided temporarily in a commercial minicomputer called a Nova, which was cabled to the Alto's back panel like a resuscitator to a comatose patient. A few members of the lab had crafted a sort of animated test pattern by converting several drawings of *Sesame Street*'s Cookie Monster into sequences of digital ones and zeros. Thacker flipped a switch or two and the bitstream flowed over the cables from the Nova into the Alto's own processor and memory.

There it was reordered into machine instructions that governed which of the display screen's half-million dots, or "pixels," were to be turned on and which were to be left dark. If it worked properly, this process would produce the series of test images in black outline against a glowing white background.

Everyone's eyes focused on the screen as it flickered to life. Suddenly the pattern appeared. As the group watched, transfixed, Cookie Monster stared back at them, shaggy and bug-eyed, brandishing its goofy grin, flashing upon the screen while holding the letter "C" in one hand and a cookie in the other.

That the image itself stood in absurd counterpoint to the sheer power of the technology did not matter. The message was not in the content, any more than the world-altering significance of the telephone could have been found one century earlier within the literal meaning of the words, "Mr. Watson, come here. I want you."



At the moment of PARC's founding, computers were viewed much differently from the way they are now. They were exasperatingly difficult to use, the tools of a cult of professional engineers and designers who seemed to take a perverse pride in making them as obscure and intimidating as the oracles of ancient Greece. (This was, after all, exactly what gave those same engineers and designers their special status.)

The scientists of PARC changed all that. They took it as their credo that the computer must serve the user rather than the other way around. That it must be easy and intuitive to operate. That it must communicate with the user in human terms and on a human scale, even if at supernatural speeds. They were determined to tame the machine just as their ancestors tamed the wild dog and taught him to hunt and stand guard.

from ***Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age (1999)***

Like a magician, he asked people to believe that they could interact with the TV-like monitors. An lo and behold, people could walk over water! jk. But they intuitively understood what the WIMP was. They didn't need a 700 page Unix technical manual to tell them how to develop/use software after unboxing. So I present to you a new general purpose technology. The nametag sized solar panel. It intuitively works! By holding it up or placing it on a flat surface, it passively collects sunlight and the PMIC does all the power management. Make room on your PCB & chassis, please. Because there are many solar panel deniers. There are unbelievers. Maybe if ARPA-E could develop a vertically integrated (yet open, modular and interoperable hardware) mobile phone, tablet, and laptop with a solar panel, you might have have believers, in the hinterlands, who will not view Silicon Valley so much a place of coastal elitism if only they could get a piece of the technology. However, cultural adoption of solutions, such as vaccines, are not always met with open triceps. For all the other believers, they are already queuing at landing strips, chanting for the next cargo drop. Make The White House Solar again. Oh, wait they already put them back on in 2002. Well, we put a man on the moon before, so we can also put a solar panel back on a laptop... ;)

"There is no end. There is no beginning. There is only the infinite passion of life." - Fellini

There are no natives. There are no millennials, Generation X, Baby Boomers. There is only the infinite diaspora of humanity.

Calais, France

Putting it all together (literally)

But in order for this to happen, I need to integrate a LOT of technologies- AEM10941 or TI BQ24074 with lithium ion capacitors (duty free!) that last more than 2.7 hrs (lithium just at the anodes) without a battery onto the phone, a small credit card sized panel, and an extremely low power display. Perhaps this idea of inverting the concept of devices that run on battery power to run on local generation is so radical, because no one ever thought of adding up the power consumption numbers of all the components, something only accountants do in other fields. I don't consider this idea that ***bold.*** The idea to redesign an entire computer and promote innovative technologies is exactly what the CHIPS act is trying to promote, but I think it's not explicitly supporting the small startups. It's supporting those who can continue to make more powerful chips that use the same energy- Dennard's scaling. The amount of display selection is dominated by emissive, relatively high power consumption backlit screens. Reflective displays like Azumo somewhat innovative and niche, but attempt to limit the backlight and instead add a front light.

“The AEMLIC charges the capacitor up to 3.78V and the output is enabled down to 2.49V. If your application draws 30mA from the 3.3V output, then it will run for: 250F*(3.78V-2.49V)*90%/0.03A= 10750s = 2.7 hrs” A display that runs at less than 9mA and an MCU that runs at 1mA could thus last over 8 hrs (not counting inputs or wireless).

Indoor Series

LL200-2.4-37

1000 lux:

- 0.462mW
- 0.220mA
- 2.1V

200 lux:

- 0.07W
- 0.044mA
- 1.6V

Classic Application

MPT2.4-21

100% Sun

- 32mW
- 14.2mA
- 2.4V

25% Sun

- 7.7mW
- 3.2mA
- 2.4V

from https://www.powerfilmsolar.com/products/development-kits/solar-development-kit-with-e-peas-pmic-cap-xx-supercapacitors

See also: https://www.powerfilmsolar.com/products/development-kits/solar-development-kit

So what else is available? No, not OLED. Something like 2.7" SHARP Memory in Pixel, or 4.4" Japan Display (maybe one day we can get 17" screens that run on 5mW, I hear ya). Other displays like discontinued Epson TFD displays use 3mW for 1.9"- potentially good enough for a phone. The advantage of these displays is that they are not so slow of a refresh as e-paper but also provide clear and non-glared reflective surfaces in sunlight, like the Pixel Qi display (defunct). This is a desire to offer consumers more display types, not just *faster* refresh rates. 60Hz, 120Hz 240Hz appear to imitate some vague notion of progress*, but there can be also lower refresh rates do not depend on highly interactive information. That is, more displays should be designed to display static information, and use less power to display that. One of those ways is to use bistable displays, as seen in epaper and other screens.

It's not minimalism, but counter-maximalism

Maximalism has been identified in the humanities such as literature by Joyce's *Finnegan's Wake*, Delillo's *White Noise*, David Foster Wallace's *Infinite Jest*, which were satirical uses of Maximalism, rather than blind acceptance of it. The design of technology is not viewed with the same critical rigor. Features are packed into an omnibus of an operating system, and hardware is designed around it. However, the operating systems of today are actually built on an hardware with an expectation of abundant transistors. A modern computer has more transistors on a single chip than the the number of humans on earth. The awareness and reaction of this trend, is what is called "software-defined hardware." In the past (1970s-90s) hardware was the limiting factor, thus hardware defined the amount of software. When RAM prices decreased (though not immediately after Taiwan's 1999 Jiji earthquake), hardware ceased to be the limiting factor. But now that less expensive hardware no longer limits software, one previous component which was given secondary or tertiary priority, power, can now be used to return to constrained hardware that can fit exactly one or a handful of apps, due to the power reduction of each generation of transistor node process.

The 1984 Macintosh was a simplification of the mainframe and a GUI

" Until now, Woz had dealt with electronics as a hardware exercise. You had a problem to be solved and you did so using some configuration of the hardware tools of electronics: the old linear devices like capacitors, oscillators, resistors; discrete devices of more recent vintage like diodes; and the new digital integrated circuits, including ROMs, RAMs and TTL logic. The obvious difficulty in this method--the only method the engineering world had known until recently--was that the more complex the problem, the more complicated the hardware setup needed to address it. In this world, the most gifted engineers were those who could puzzle out

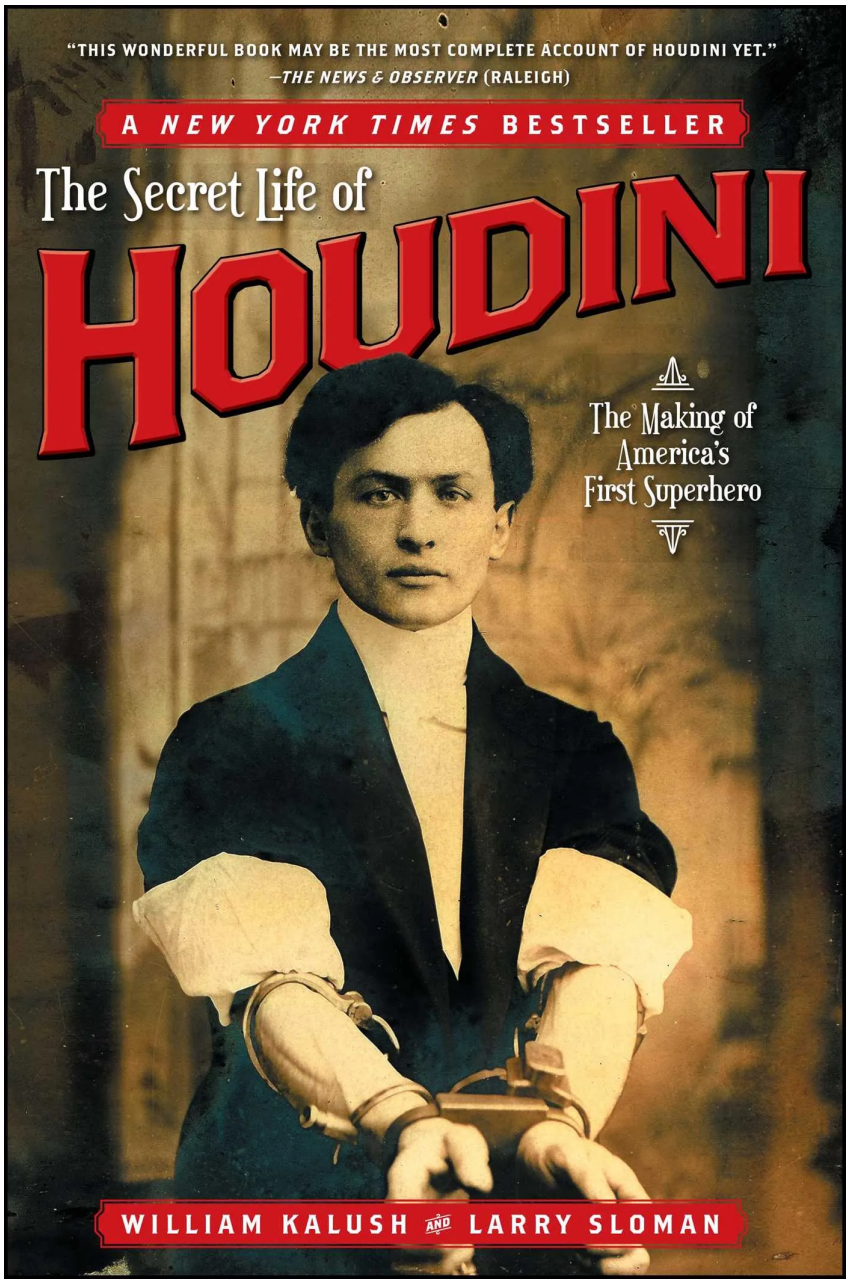
novel ways to reduce the number of components by, say, 10 percent. And it was in this particular type of simplification that Woz had shown almost supernatural talent."

from https://archive.nytimes.com/www.nytimes.com/books/first/m/malone-loop.html

More than a spectacle, less than a nebulae

In this way, it is software defined hardware, for the sake of allowing solar powered/autarkic devices, rather than the arbitrary or Houdini-like mysteriousness of creating challenges that make product ideas appear to be a spectacle, when they are rather, an efficient way of single-tasking user interfaces, for the sake of improving one's attention span.

Also sprach Houdini: Ein Buch für Alle und Keinen

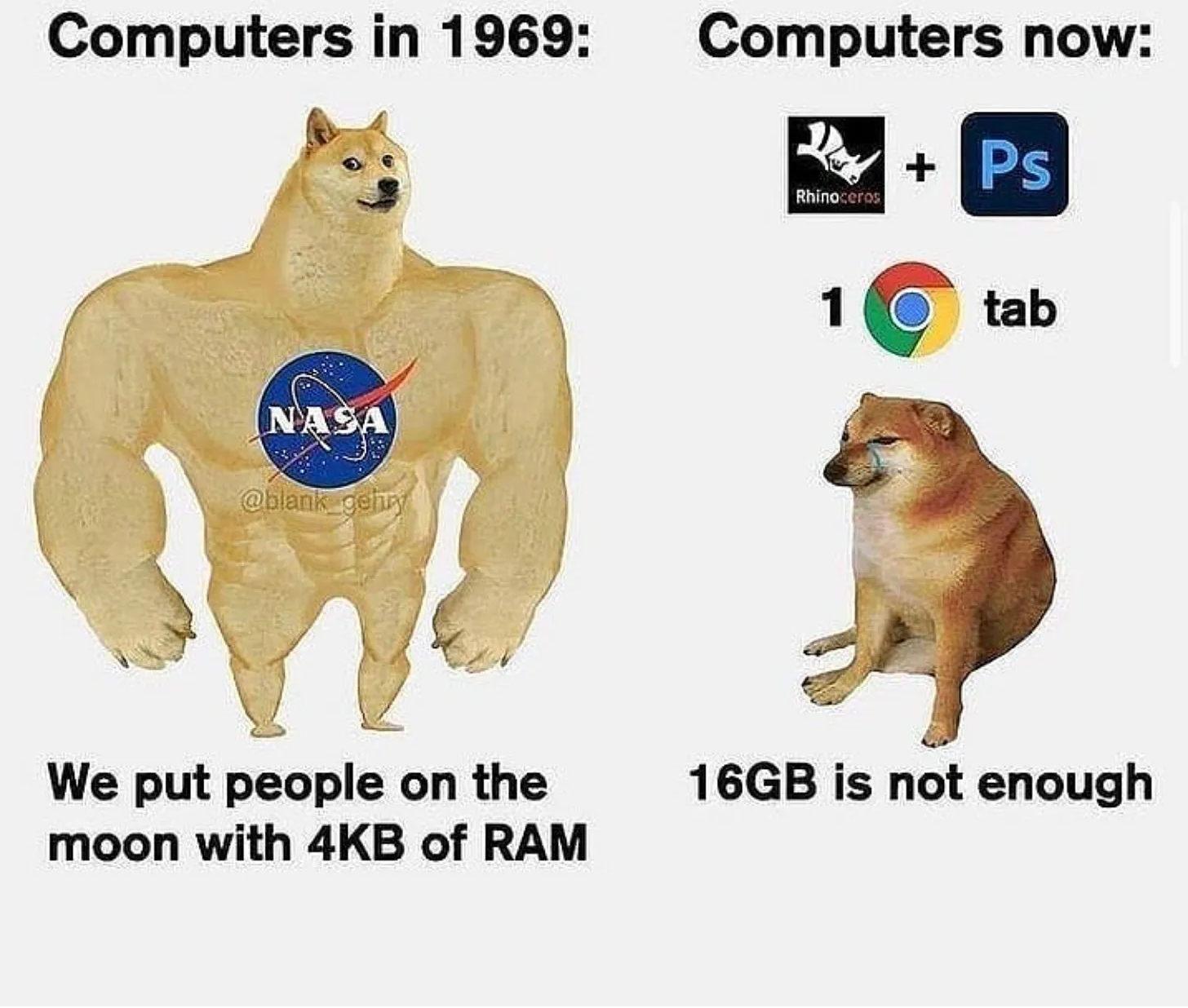


So, by instead designing every single part of the phone running even at 100% CPU utilization (with a maximum speed of perhaps 100MHz), it can use less power than the amount of power generated per second in ambient light. Isn't there a calculus term for that, like derivative or something? That's right- the differential at a point on a slope. The rate of power consumption SHALL NOT exceed the rate of power generation. *Ideally*. Some amount of fuzzy logic has to have some kind of utility here, right? But sometimes the generation will create a harvest when idling, and that can be used for longer durations. And sometimes the consumption will exceed available light. No matter how hard one tried to stress test the power consumption, the system shall be designed to never use more than what could be generated by a window sill from 8am-4pm. Obviously if one lives in a windowless cell, they wouldn't have the ability to charge it, unless you count the lightbulb in the ceiling…

Those average people today are not just iphone or android users. They are The Other, which the mainstream repeatedly, and belatedly tends to identify. Engineers, please stop ignoring this market. If you build it, they will come:

Don't worry about what applications should be designed for it. Just build the barebone kernel. People can figure what they want to put on it. No systemd. The mentality where someone thinks everyone needs at least 16GB (and still not enough!) of RAM is false.

https://www.metroweekly.com/2014/07/to-the-moon-and-back-on-4kb-of-memory/



Something simple and sweet. If one is of the mentality that one needs 512MB or 1GB, they will never get a solar powered device because 512MB uses way too much power - in 2022. Memory also uses more wafer area, and I recall is around 28nm- I estimate it will take another 10 years before 5nm memory is low power enough to run 512MB or 1GB on portable solar power- it's not that I think it shouldn't be pursued, but to wait a decade and not allow users to creatively explore simple apps on 2MB SRAM stymies innovation.

Edit (12/12/22): See:

https://www.thediff.co/archive/a-solution-in-search-of-a-problem/

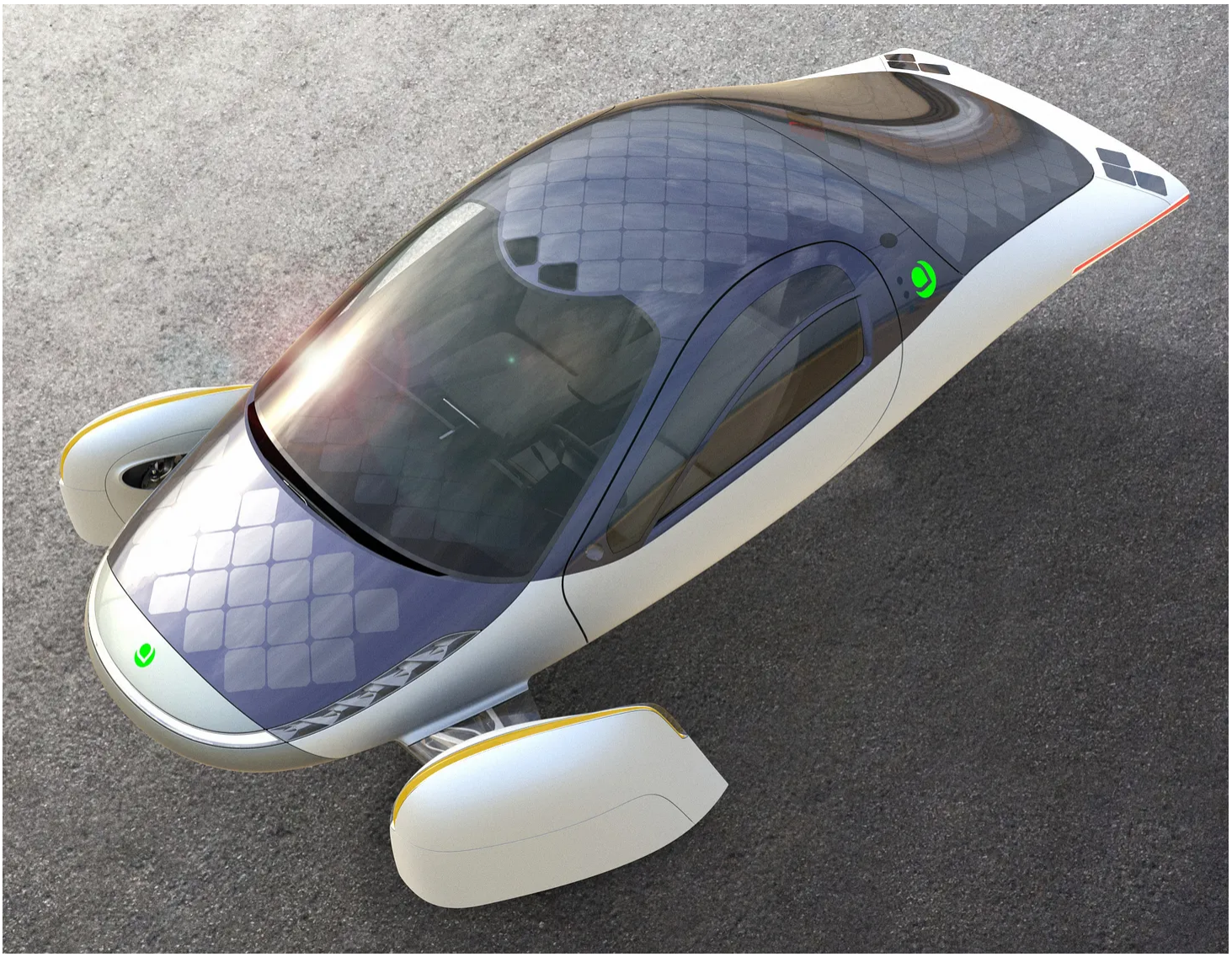
“The underlying characteristics of a new technology can determine potential, and in wide-ranging ways—there's a sense in which the ancestor to Twitter's, Instagram's, Snapchat's, and TikTok's voracious demand for constant attention from users who can access them from anywhere is all descended from the very trivial and definitely-a-toy Tamagotchi. Which, if nothing else, showed that people can be highly responsive to **low-bandwidth*** positive feedback from electronic devices, which they'll keep on their person at all times. But there's a feature of the outside world that also has a major impact: solutions-in-search-of-a-problem and toys-in-search-of-real-world-use are both less costly and more valuable in a world of lower real interest rates.”

“But this mostly means that the economy is asking technology to find some sort of money sink that can profitably absorb the vast amount of savings that a rich economy can produce. General-purpose technologies tend to be big capital sinks because they create demand for so much associated infrastructure.”

[**Note**: a solar powered mobile device and mesh network wouldn’t necessarily be a big capital sink, since it would be its own infrastructure- it would be self sustaining and not need SIM cards, special slip covers by a single supplier, brick and mortar shops for support, etc]

“One interesting trait of toys-turned-tools is that they seem more likely than average to become such general-purpose technologies. General-purpose technologies are fairly rare, and very important—many comprehensive lists of them will start with things like fire, writing, and the use of tools to improve other tools. A toy that finds another use case is more likely to be a general-purpose technology, in part because of the "Pirahã Are Off By One " phenomenon: most inventions are useless, some have an extremely specific use case, but if you discover that they have more than one use case, it's likely that this generalization will continue. And this is especially true from the standpoint of someone who hears about a new tool: it's going to be more viral if a) it spreads by being useful, and b) it spreads in as many different groups as possible, i.e. it has lots of use cases.”

The Little Solar Power Plant that Could



Look Ma! No sky high Threadripper electricity bill anymore, I can game Diablo IV in your backyard Aptera!

Maybe it's wishful thinking I'm thinking of myself when I read that article, and reasoning that a solar panel is general purpose. I'm glad Aptera built a partially/fully solar powered electric car (depending on how many miles a day you drive). Perhaps one day they will adopt iron-air batteries with 10x the density, since lithium mining is unsustainable. I was talking about Aptera as an unaffiliated, volunteer brand ambassador in 2010, promoting rooftop charging of electric cars to anyone who would listen, and people on a forum were telling me it was impossible. I think back to that Rutherford statement of too "inefficient." People wanted to sell me lead-acid batteries when I wanted something greener, and told me to go tell it on a rooftop, and so I did, and I met James Baldwin there. We chatted a bit. You know what? Don't you think it's ironic that we have a solar powered car now and not a solar powered laptop or phone? One that can charge several miles a day parked in a sunny parking lot from 8AM-4PM in a corporate parking lot. Discontinuous charging allows asynchronous use of power via a battery, rather than the mindset that solar should be instantaneously capable of powering a motor. This mentality stems out of

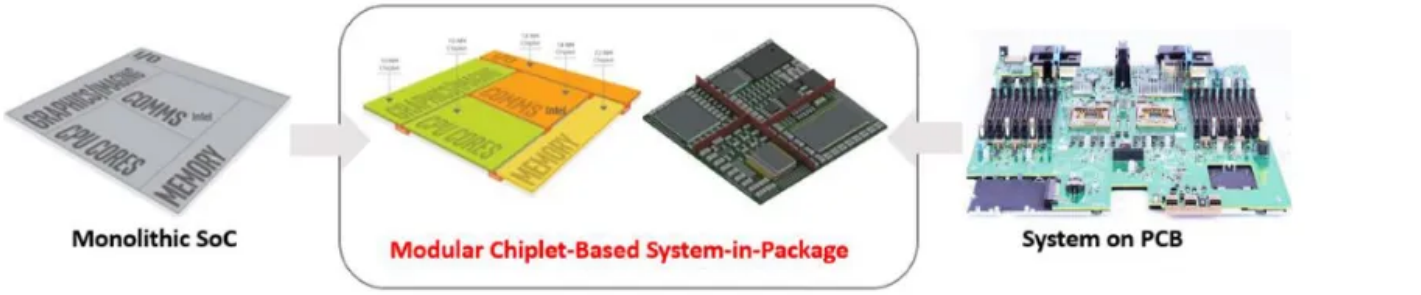
instant gratification, where patience should be a virtue. So I don't want to make the same mistake again, finding myself talking to people who say something is impossible, since one day, in 2033, perhaps, there may be startup saying *they first* thought of the the solar phone, and that they should be funded, when I'm one of the first to believe it's possible. It's not patents that I seek; it's the thought that counts. Though I don't really seek to be a tech-evangelist. Because I understand my tone isn't positive. If anything, my tech-evangelism will hopefully lead to another tech evangelist picking up the slack sooner rather than later. It would also be nice if they(you?) could give me a heads up before they(you?) go on stage with an iRack.

So my scrutiny towards the semiconductor innovation/stagnation is much higher than the ironically and debatably greener automotive startups, when there is a cognitive surplus for idle tweeting but not a utilization of passive mobile devices harvesting energy while someone is waiting at a bus stop. Sure there's Bell Labs and Intel Labs, but the Idea Factory is way past its heyday, although one would hope that Nokia is doing something revolutionary. I've wanted to apply, but I don't feel like I fit in anything. I feel like the open source "community" should tackle moon shot projects like this. They should be the ones building something bigger than any single company, and focus on a standard platform: https://semiengineering.com/is-ucie-really-universal/:

"**The journey**
Today, everyone creating a package that includes multiple dies is designing everything. They have full control over the PHY layer and the protocols they use for communications. It doesn't really matter if they fully conform to any of the standards. They only need compatibility between their own dies.

"The third-party target market is like **Plato's ideal world**," says Ilyadis. "That's the point where you have interoperability, plug and play, between devices. It requires having a packaging technology that is more accessible. It needs to be democratized so smaller companies have access. But it's a journey.""

That's the issue- a platform isn't really universal if you can't get to an agreement. If Raspberry Pi, OSI, and Free Software based Single Board Computers can agree on the dimensions of a board, including at least 4 of the same mounting holes (like miniITX, but smaller), and height, so it it can be used as a DUAL purpose laptop motherboard, then they can come back to talking about how virtuous they are with their universal chiplet.
I propose hiring U.S. ambassador and former labor union mediator Mason Skiles- this man's negotiating skills can bring any two parties together.



SoC disaggregation

- Enables SoCs larger than reticle & higher yield
- Uses optimized processes per functions
- Reduces R&D cost in advanced nodes
- Reduces time-to-market

SiP: System-in-Package

- Smaller footprint
- Higher performance
- Lower power
- Lower cost

from: https://semiengineering.com/is-ucie-really-universal/

Until then, it's virtue signaling and ensuring the devices can only be used by the top 10% of a socio-economic class by creating small batches with awkwardly exposed hardware that sits on a benchtop. What am I talking about 10%? from this article:

"As we have explained, in a market economy goods will be produced when only those who paid for them can consume their benefits. However, when benefits accrue to people other than the buyer of the good the producer will have less incentive to produce more goods. This forms the crux of the software dialectic. Free software favours inclusion rather than exclusion but for the market to provide goods it must be possible to exclude "free riders" from sharing in the benefits of a good."

If open hardware built a standard laptop, and then someone dumpster dives and finds a chassis with no case, you have someone who can put together a new laptop, because some thoughtless person decided the plastic was worthless and yet when that chassis is not standardized, that dumpster diver can't install a SBC motherboard in their laptop and carry it around like a cool person. They have to make do with a bunch of hardware that doesn't fit, all because FSF and Open Source can't work towards a common cause- the environment. The person might be taking a train and has to stuff a Raspberry pi in their bag because their chassis is an empty heap of plastic (e.g. Pi Top v2). if Rpi makes a Rpi5 and some other SBC makes one, I am curious if they are going to still duke it out while landfills in Agbogbloshie pile up with plastic cases.

So back to what I was saying. Early linux 2.4 perhaps. Sure, there are lots of people who can use a command line interface. I have used sudo apt get install __ hundreds of times, but that doesn't make me a programmer. My point is, developing a GUI-based OS, for solar powered CPUS, will allow more people to use linux on a mobile device. They can learn command line later, if they

choose. Not everyone gets into the world of programming by purchasing an expensive general purpose CPU, nor should they. This type of computer could be used in cafes without ample outlets for charging, on 8 hour bus rides in third world countries that don't yet have outlets like first world countries do. So you have a basic interactive typewriter that outputs information based on programming inputs. This is experiential based learning, and more productive than a text book-like e-reader. Thus if one had a quiz app, where a user is memorizing programming commands with rote exercises, or something like Thonny, they could learn programming without needing a high speed internet connection. This can be useful in areas where large exercises can be downloaded for offline use. And thus developers can be productive, even in the absence of a more RAM intensive IDE. Thonny uses 39MB, too much for a microcontroller, but perhaps not too much for a 64MB RAM SBC in a serial task-based OS (one that doesn't allow tabbed windows or apps, but the ability to save one's work if toggling between apps on microSD storage), which I believe would help with assisting users with attention span as well.

Revisiting OLPC

The cancelled, would-be solar XO-3

Just for a minute, let's suggest that phones are not computers. First, are phones a computer? I would say yes and no. A phone doesn't always need to be a computer, and it's best that they are a phone first.

In Ben Morris's "The Symbian OS Architecture Sourcebook," (2007) Chapter 1 "Why Phones are Different," a brief history of mobile phones and technological convergence, along with some key points why phones are different- it is their complexity:

"Mobile phones are different from other devices for many reasons and

most of those reasons make them more complex too.

• Mobile phones are multi-function devices.

•Mobile phone functionality is expanding at an exponential rate.

•Phone-related technologies are evolving at an exponential rate.

•Mobile phones are enmeshed in a complex and still evolving business model.

•Mobile phones are highly personal consumer devices (even when

someone else pays for them)

In a word, the mobile phone difference is 'complexity' and the trend

towards complexity appears to be growing at an exponential pace."

"Device convergence is not a hypothesis, it is the reality. As discussed

above, mobile phones have cannibalized the PDA market, appear to have

eroded the digital camera market, and threaten other markets including

the personal music-player market."

User Expectations

Users expect and demand rock-solid stability and performance from their phones; desktop computer performance standards are not acceptable.

At the same time, users are fickle, tending either to be infinitely happy or infinitely unhappy.[17] When they are infinitely unhappy, they return the phone. However, it is not always easy to understand precisely what triggers happiness or unhappiness (the trigger often seems removed from ordinary measures of good, bad and defective behavior). Desktop PC users seem more likely to be either *infinitesimally* happy (the machine has not crashed) or unhappy (it crashed but they did not lose much data).

The conclusion is that phones really are different from other systems and they are complex.

"The conclusion is that phones really are different from other systems and they are complex."

A simple way of thinking what a smartphone is can easily be described by this Simpsons cartoon: