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Military Muzak: Cold War Spectra and the 21st Century Real-time Battlefield

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🡪 Abstract: The real-time battlefield is a military goal to achieve full spectrum dominance of a warzone using a plethora of real-time telecommunications technologies. These technologies have a long history of military and corporate collaborative development in terms of controlling aural and visual spectra. In the process the achievement of real-time communications provides supposed advantages for battlefield combatants by having time overcome space. The technological realization of this strategy has profound effects on individual and collective agency as well as geopolitical decisions. To chart some of this history and its effects on the present military and civilian spheres, this article uses the technologies that helped establish Muzak as a US cultural product with global reach. This unusual example of telecommunications technological prowess also has helped construct the real-time battlefield.

🡪 Keywords: Realtime Battlefield, Muzak, spectral analysis, telecommunications, geopolitics, Cold War

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A map of a satellite network

Description automatically generated with medium confidenceReal-time Battlefield. Electronic warfare in US military environments, source: japcc.org, 2018. <https://www.japcc.org/articles/electronic-warfare-the-forgotten-discipline/>

Real-time Battlefield: Media, Spectra and Telecommunications

“Just as connected aviation works to deliver the right data at the right time to enable real-time decision-making, military technologies are working to do the same within the connected battlespace. Through cutting-edge improvements, defense leaders working with RTX are now able to sense and make sense of data faster than ever before.” – James Daly, “Harnessing Connected Aviation and Battlespace Technologies for a More Sustainable, Safer Future” RTX advertisement article (22/07/2024)[[1]](#endnote-1)

The image above of the real-time battlefield above provides a view of the military telecommunications strata that operate from geosynchronous orbit satellites to low-atmosphere communication satellites, airborne and terrestrial – mobile and stationary – operations of manned and unmanned vehicles and platforms. It documents the flow of information in military conflict and intends to convey full-spectrum dominance of terrain (including ocean-based and underground polyscalar autonomous remote sensing systems). Now some years since its publication, and likely outdated when this image was published in 2018, this current battlefield exemplifies the importance of numerous teletechnologies to coordinate and operate the multiple personnel and materiel platforms and systems that constitute actual (and perhaps idealized) combat zones. This version of a battlefield builds on the Cold War military strategic goal known as C3I (command, control, communication and information), which has currently become C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance). An important dimension of these strategies is the implication and assumption that each element in the abbreviation is somehow synonymous with the others, or at least in a causal relation to the others: that is, if you have proper information and intelligence then command and control follow, and vice versa. Similarly, if command and control have computerized systems in place, the surveillance, intelligence and reconnaissance will result, and if they come into being, then command and control are realized. As the ad copy in the epigraph above states, the desire to have coordinated systems deliver “the right data at the right time to enable real-time decision making” is both a goal for military spatial control through time and information and for the civilian sector.

In these strategies and in the representation of the real-time battlefield’s drive for full-spectrum dominance, telecommunications technologies provide the essential media for delivery. This entails both the tele- and the spectrum to be invisibly operative in the service of the whole. The Greek prefix “tele-” means “at-a-distance” or “far off,” and the control of visual and audio spectra is how space yields to time. With real-time teletechnologies, “over there” becomes “right now” (as Paul Virilio pithily put it). An important strategic advantage sought by military research and development into the sensorium through technological enhancement and modification was the closure of the time-space gap of apperception, which in turn could rapidly become enactment, resulting in the capacity to act on targets with such rapidity and distance as to keep the military actor safe and the target immobilized. The “real-time” element of this battle scenario is part of many of our daily lives, the capacity to hear a live broadcast halfway around the world or speak to someone on a video platform and see/hear it virtually as it happens.

The central military influence in the invention and development of these systems and technologies is such that their provenance has taken some unusual shapes and appeared from interinstitutional activities seemingly quite far from military purview. One example is Muzak, the supplier of “elevator music” globally for corporate offices, homes, stores and even military bases. This benign, and much maligned, immersive aural environment provider is also the unlikely starting point of this article and directly connects to a wider range of research in telecommunications, surveillance technologies, algorithmic control of aural and visual spectra, etc. At the same time, these telecommunications systems embody institutions such as AT&T/Bell Labs, MIT, Harvard, to name a few, and funding agencies including the Department of Defense, the RAND corporation, the Rockefeller Foundation, the Macy Foundation and others that have helped shape our planet into a technologically constructed globe.[[2]](#endnote-2)

The military origins of Muzak and its multiple (and multiplexed) roles as a fecund source for the incredible array of telecommunications devices in the real-time battlefield of the present and future of military planning beggars belief, for the aural equivalent of vanilla blandness found in global elevators, offices and restaurants constitutes the antipode to the deafening onslaught of post-industrialized battle.[[3]](#endnote-3) George O. Squier, Muzak’s inventor, was described in a memorial as “a remarkable combination of American soldier, applied scientist, inventor and engineer, as well as an army administrator and outstanding Chief Signal Officer”.[[4]](#endnote-4) Squier’s fingerprints are all over the many technologies operating in the real-time battlefield of the present, not the least of which was the import of aerial vehicles and communications systems for them to speak to ground vehicles and ocean-based vessels. Rising to the rank of Major General in the US Army Signal Corps, Squier (pronounced “square”), most importantly for this article, invented telephone carrier multiplexing in 1910, which allowed for telephone wires to carry a wider range of frequencies than previously possible and support multiple conversations at the same time.[[5]](#endnote-5) The process he called “wired wireless” combined radio signal technologies with wired telephonic infrastructures, securing military transmissions from enemy interception. The engineering and physics bases for multiplexing became the forerunner of microwave frequency multiplexing after WWII and the current optical wavelength multiplexing systems found in powerline telephony used by power companies worldwide[[6]](#endnote-6) and later in fiber optic cables, WiFi, 5G, and other systems. The problems Squier grappled with to gain strategic communications advantages in battle were the same ones that led to information theory and occupied numerous figures central to C4ISTAR and cybernetics -- figures such as Homer Dudley, Dennis Gabor, Claude Shannon, and Norbert Wiener.

The “civilian” version of the real-time battlefield results from the “dual use” rationale for all military research and development as technologies for the military help constitute consumer culture and daily social life. For example, the large-scale remote sensing systems used in battle conditions to stream real-time information to combatants provides the same infrastructural technologies for multiple streaming services used by social media, industry and entertainment. Further, these systems also craft a larger geopolitical realm in which the military operates, with the result being that geopolitical and military realms become replicas of each other.[[7]](#endnote-7) Such complex teletechnological systems, often in isolation and without an awareness of their simultaneous operation and mutual influence, are reconstituting the political subject and its demarcated capacities within rapidly changing techno-geopolitics of automated tracking and governance. The resulting new regimes of teleactivity for real-time surveillance and data gathering do more than simply generate information. They create a markedly pervasive distribution of sensing, data gathering, and communication into the weave of the world while simultaneously reconfiguring human engagement with it.

A whole range of philosophical/political/technological trajectories that underpin Western intellectual history come into to play here in relation to the sovereign subject and its place in the material and immaterial world. Battlefield teletechnological operations in network-centric warfare occur through the combination of software platforms, sensing devices, machine-to-machine interfaces, autonomous monitoring and acting capacities, real-time teletechnologies, automated detection and responsive action components, and widely distributed sensory data (and used by a range of agents beyond the military). The attraction of such control over physics (through alterations of time and/or space relations) for the military reaches back to weaponry used at increasingly further distance. The mutually influential interaction of technological imaginaries with imaginaries influencing technological development and technological change firing imaginations, or what we can call “techno-noetics,” results in a mutually intertwined and interdependent system of influence between thought and technology that has translated to and become the basis for geopolitics and the reconstitution of planet as globe.

How to Make the Planet into a Globe

The global stands as a peculiarly specific construction redolent of Cold War values and agendas. If landscape is a militarized vision of nature, then the global is the militarized vision of the planetary in which nature exists as a teletechnologically contained resource. In contrast to the global stands planetarity, as articulated and theorized by Gayatri Spivak, Dipesh Chakrabarty and many others working with a critical and temporal distance from the historical Cold War. Joseph Masco invokes the term “techno-geographies” to describe the englobing of the planet.[[8]](#endnote-8) He argues that the constitution of the planet as an enclosed Earth-system results from Cold War goals, technologies and technics of thought, including the rapid escalation of visualizing technologies and telecommunications systems. And yet even at the moment of the full-throated technophilic construction of the globe as a goal in the 1950s and 60s, thinkers such as Buckminster Fuller argued for turning the exoplanetary ring of satellites toward reconstituting the globe as a planet replete with data scraping capacities for the shared commonweal in his non-competitive World Game.[[9]](#endnote-9) The globe is made for containment and control, though, whether as for military full-spectrum dominance or neoliberal economic perpetuation. Two of the three C’s in C3I, and the other elements in that formulation (communication and information) serve the other two.

But global systems leak; they ooze and morph into the chaotically organized, seemingly improvised systems of the planetary. Even though first-order cybernetic systems informed the control impulse of the emergent global order as globe, the ever-correcting elements that always settled into homeostasis somewhat blithely ignored the figure of the accident. Virilio’s lexicon of “accidentology”[[10]](#endnote-10) includes terms and their referents such as deep-effects, unintended consequences, faulty infrastructures, glitches, and other unforeseen phenomena that evade the control agenda. The drive for control and containment existed for multiple reasons and applications, not solely to realize a geopolitical ideology of materialist economics. As Derrida notes, atomic weapons also created “non-localizable nuclear war” (1984, 23), which in turn led to the kind of “local” outlined in the Truman Doctrine (in other words, the local as global). The local became the global, but it as an agonistic local formed by Manichean choices between competing superpowers, a local characterized by neighbor against neighbor and that also housed “the enemy within” (the old Fascist trope repurposed for Cold War liberal democratic agendas). It was not the local of unavoidable and necessary bio-chemical entanglement outlined in1930s systems theory, in which the biosphere shared by all planetary life exists within the largest-scale local for species existence (cp. Stiegler). The local of the planetary biosphere becomes reconstituted as global technsophere, which in turn becomes an infosphere. Thus, the rationale of and for control and containment operated in contradiction with its goals and realities on the ground and often literally in the ground. The “slow violence” of nuclear waste and fallout seeped into all bio-surfaces and circulated invisibly but in known, measurable ways discovered in the early 1950s.

In all the diverse infrastructural, technological and noetic elements that shape the realities and imaginaries of the real-time battlefield, the long-standing appeal of the micro- and an overriding atomistic logic is at play: the capacity to use small spatial units within a complex, dynamic (and temporal system) to affect and even control that larger system. Light and audio spectra, for example, provide such complex systems, and their harnessing occurs in multiple micro forms important for global ambitions. This article examines some of these and their logics to explore the real-time battlefield of which our neighborhoods and homes are only slightly domesticated epiphenomena, with the globe its largest iteration, and a certain stripe of geopolitics following from it.

The geopolitics of the globe-*as*-globe are bound up in the various forms of control and containment. Closed system rationales, thinking and goals mean the solution to control and containment problems can be found in the other portions of C3I namely communication and information. Both of these need to be one step ahead of the latest unintended consequence control or containment failure and yet always somehow perpetually lag behind. Such a situation is where Squier’s multiplexing perpetuates its influence and ongoing proliferation.

Mulitplexing and its Legacies

“He who rules the signals rules the nation.” – Bernhard Siegert “Mineral Sound and Missing Fundamental” (109)

Just as the role of spectra in the scientific understanding of light and sound dates back to the 17th century (and the spectrograph to the first years of the 19th century), the role of telecommunications for military success becomes readily apparent during the US Civil War and the French invasion of Russia (as part of Napolean’s innovations in logistics).[[11]](#endnote-11) Rapid communication across large physical spaces offers a signal history that reaches back to the ancients (examples include voice amplification and reception towers in the Mughal Empire, lamp and fire relay systems in Europe, and talking drums in Africa). The electrification of binary telegraphic code and its hard-wired infrastructure through terrestrial and undersea telegraph cables intensified the speed of communication and collapsed distance in the process.[[12]](#endnote-12) Nothing underscored the import of telecommunications for battlefield success as much as their limitations and failure. For example, the frequency capacity for aural transmission of voice far exceeded that needed for simple electrical connection or circuit breaking required by telegraphy, thus necessitating different cable systems or different engineering systems to maximize cable usage.

Siegert’s epigraph for this section can be rephrased “Whoever rules the signals rules the real-time battlefield”. To rule signals, and by extension a warzone or nation, a consistent challenge facing military and corporate telecommunications resides in the medium of transmission, a challenge that can basically be boiled down to one simple question: how can we get more signal on the wire or in the air or whichever medium is operative? After the Spanish-American War at the turn of the 20th century, Squier became fully convinced of the absolute strategic advantage that battlefield telecommunications provided a fighting unit and its command center. He was even more convinced that the US military, in this regard, was sorely lacking. The US occupation of the Philippines after that war found Squier laying underwater telegraph lines in the Southeast Asian archipelago, giving him ample opportunity to ponder the physics and engineering challenges of getting voice down such limited lines, a problem he never solved for telegraph cables but which nonetheless led to his development of the multiplex telephone wires. With the goal of making the systems more reliable, secure and robust, Squier’s multiplexing capabilities standardized the military’s aural geography and topography for communications and interception capabilities (that is, both offensive and defensive applications).

Ever the idealist and “the eternal public servant,” Squier believed the great collective electronics and technological future of a nation belonged to all its people, and thus he refused to patent his inventions as private property.[[13]](#endnote-13) However this did not prevent proprietal interests from using his work for their own gain. His fights with the public/private behemoth AT&T ended when the corporation argued that his public patents were only “suggestive” of the patents and designs developed by their engineers.[[14]](#endnote-14) Admittedly the idea of using different frequencies on the same line to carry multiple messages simultaneously had been around for a long time before Squier solved the problem and AT&T borrowed his engineering work. Court battles ensued with the private sector winning. Thus, Squier’s patents intended for the public good secured instead a cheaper means for the corporation to meet increasing telephone-usage demands with knock-off versions of Squier’s wires.[[15]](#endnote-15)

While firmly believing in the superiority of wired technologies over wireless, Squier ruminated on the long-imagined possibility of a programmed tele-aural world being accessible by wire to homes and businesses on tap like water and increasingly electricity and telephony – a vision also proffered in the speculative work of Edward Bellamy and the poet/essayist Paul Valéry.[[16]](#endnote-16) This extension of Squier’s military engineering into the domestic and business sphere led to a competition with Marconi’s own wireless delivery system of this shared aural spectral environment. Squier’s ambitions were once again directed toward the general commonweal: the affordable delivery of music and news to households and shops. Large corporations viewed these innovations differently, seeing in this technology a means for furthering Taylorism’s principles of maximizing time-motion-concentration studies. Standardized music could help standardized labor deliver standardized work results and progress in standardized schedules, and thus was born the earliest glimmer of large-scale pre-packaged music delivery systems and the establishment of Muzak.[[17]](#endnote-17) In an ironic twist, but not one of the humorous variety, the earliest landline delivery systems eventually used AT&T’s knock-off Squier telephone lines to provide homes and businesses with Squier’s music-on-tap innovation.

At the same corporation that Squier tussled with over multiplexing technological proprietary control, AT&T’s research arm, Bell Labs, faced its own regular patent issues. In exchange for its monopoly of telegraphic and telephonic delivery systems in the US, AT&T had to relinquish complete control of any patents they generated through their research labs and was forced by the government to share them with other companies.[[18]](#endnote-18) Nonetheless for much of the 20th century, the innovations derived from tackling wicked problems at Bell Labs created the US global role in telecommunications. At Bell Labs, Homer Dudley was tasked with the same consistent challenge that Squier faced about getting more signal down extant infrastructure. In this case, in the 1920s, he needed to ascertain how voice signals could travel down telegraph wires incapable of carrying the frequency range of human speech. His solution to this problem led to the first machinic voice/sound analysis-synthesis system, which is the building block of all telecommunications in the present.[[19]](#endnote-19) That assemblage, eventually known as the vocoder, broke the complex, analogue and dynamic system of human speech into the smallest signal units possible for intelligibility (sound analysis) and pushed them down the wire, where they were reassembled at the receiving end (sound synthesis).[[20]](#endnote-20) Dudley described the apparatus, its operating process, and the principle behind it to his children with a kitchen table analogy: “scrambling eggs and then basically re-chickening them”.[[21]](#endnote-21) Sound analysis-synthesis exists in thousands of sound technologies, e.g. electronic music instruments (hence synthesizers), hearing aids, computer speakers, sound compression software and smartphones.[[22]](#endnote-22) Dudley’s basic premise, though, anticipates Claude Shannon’s information theory breakthroughs by several decades because, like Shannon, Dudley separated information, or signal, from meaning.[[23]](#endnote-23) Dudley’s work undergirded the experimentation by Bell Labs with satellite communications as an updated version of Squier’s “wireless/wired” multiplexing system.[[24]](#endnote-24) Via Dudley and latterly Shannon, a host of experimental audio labs sprang up worldwide during the Cold War exploring information as a material aural entity, eventually leading to light as the medium for information delivery by fibre optic lines.[[25]](#endnote-25) All of these telecommunications breakthroughs formulate the infrastructural backbone of the real-time battlefield in its densely complicated operations and coordination: they are the stuff of C4ISTAR and, in their techno-noetic operations they convert the earth into an electronically cocooned globe.

VELA Uniform: Someone to Watch Over Me

All Watched Over by Machines of Loving Grace

I like to think (and

the sooner the better!)

of a cybernetic meadow

where mammals and computers

live together in mutually

programming harmony

like pure water

touching clear sky.

I like to think

(right now, please!)

of a cybernetic forest

filled with pines and electronics

where deer stroll peacefully

past computers

as if they were flowers

with spinning blossoms.

I like to think

(it has to be!)

of a cybernetic ecology

where we are free of our labors.

and joined back to nature,

returned to our mammal

brothers and sisters,

and all watched over

by machines of loving grace. – Richard Brautigan (1967)

Richard Bruatigan’s poem of liberation and potential utopia of the stripe that still underscores Silicon Valley’s technophilic cheerleading, but *sans* the poet’s irony, has its roots in the early moments of computational capacities harnessing biological systems theory and cybernetics, as espoused by Ludwig von Bertalanffy, Norbert Wiener and Buckminster Fuller. In its deft ambiguity combining scepticism with cautioned hope, the poem makes its way from these optimistic thinkers to the current state of the online tech giants via Stewart Brand’s libertarian paean to Fuller*: The Whole Earth Catalogue.* The cybernetic ecology upon which Brautigan places such measured aspiration has largely materialized in the less-than Edenic form of the “weapons ecosystem,”[[26]](#endnote-26) and the biosphere converted into a technosphere with distinctly contradictory results, as Bernard Stiegler analyzes in the collective Internation project.[[27]](#endnote-27) The pastoral meadow has been weaponized. And the telecommunications inventions of Squier and Dudley not only helped us weaponize the meadow but allowed us to remotely hear and see that weaponization unfold in real time as *and through* real-time teletechnologies: they allow us to sense them in their operations.

Watching over the real-time battlefield’s telecommunication connections between its spatially and functionally diverse parts is the geosynchronous and low-space atmosphere layers populated by missile warning sensors, SATCOM satellites, PNT (positioning, navigation and timing), signals devices and other satellites, commercial and governmental. OneStar and Weblink constellation satellites deployed during the late 2010s and 2020s have contributed significant complexity and density to the Thermospheric orbiting layers. Sputnik launched an era of interpreting near-space as a communication infrastructure through the use of spectrum control. The exoplanetary or exospherical ring renders the planet a globe that is simultaneously present in 2D and 3D perspectives. In the many manifestations of Cold War cartography, the 2D view lays out the entire surface of the earth like a flat map visible all at once while the 3D view renders the planet as an orb held in a teletechnological grip turning the planet at its visualizing leisure. The resultant erasure of the horizon in both 2D and 3D perspectives marks a post WWII moment that Martin Heidegger termed “Age of the World Picture.” The world picture is both figurative -- how the world pictures itself – and literal in that it can be pictured all at once.[[28]](#endnote-28) “Over-the-horizon” weapons prosthetically outfitted with optical capacities facilitated the loss of geophysical horizons and hastened the conversion of the planet into a fully visualizable globe.

Heidegger’s “age,” as is the case with almost all Cold War technologies and theories, was the product of a much longer *durée* of many research agendas for “the long Cold War.”[[29]](#endnote-29) His “world picture” in in fact the result a very long trajectory of “operational images.”[[30]](#endnote-30) In Jussi Parikka’s excellent study of the many versions of the operationality of scientific and technological images, the operational tasks of these images is to link the field with the laboratory through their work in institutions, such as universities, corporations and militaries. Thus the “world picture” is but a blip within the epochal unfolding of operational imaging, an epoch begun long before this short historical Cold War moment and expanded exponentially in the present through machinic imaging not legible by humans and intended for other machines. Within this bigger imaging context, Heidegger’s world picture emerges at that specific post-WWII moment as our collective, global *gestell* (enframing, or englobing, in this case) and remains pernicious in its persistence, amplified by the expanding domination of operational imaging practices. This enframing fuels the imaginations of geopolitics and delimits the possibilities of imagining geopolitics otherwise.

A substantive accelerant in this current state of remote control and offensive capacities for battlefield conditions came from Cold War research in the late 1960s in response to attempts to rein in nuclear proliferation. The Kennedy administration’s desire to ratify a nuclear test ban treaty eventually led to Project Vela, which aimed to remotely monitor nuclear tests taking place at any global strata: from the ocean to underground structures to the atmosphere and into low space.[[31]](#endnote-31) “Vela” in Spanish can mean a sentry or watchman, thus sharing an affinity with the etymology of “satellite” (in Latin, a close attendant or guard supposedly controlled by the protected), and its largely defensive posture seems a far cry from the current applications of the technologies developed to serve this peaceful global contract. Finding a viable means for using extant remote sensing capacities to accurately monitor Soviet nuclear testing above and below ground would allow the Kennedy administration to overcome military resistance to such a treaty and obtain Pentagon approval treaty.[[32]](#endnote-32)

The discovery of the algorithm known as the Fast Fourier Transform (FFT) in 1967 provided the key to break the impasse between civilian governance and military reluctance. Discovered by John Tukey, the FFT provided the technological breakthrough to give Project Vela the heft to start properly realizing its mission through the invention of the first FFT spectral analyzers in the same year. The protentional possibilities of Fourier series had been around for many decades and held a great deal of appeal to engineers before Tukey’s simplified equation allowed it to be fast enough for real-time application. In this specific instance, the Archimedian eureka moment allowed for geoacoustic remote sensing devices to rapidly determine if a perceived seismic occurrence was caused by an earthquake or an underground explosion, and to register that determination visually in the form of a spectrograph readout. With Tukey’s insight, multiple new areas of research, including geoacoustics and hydroacoustics explored oversight of the earth’s signal-bearing capacities. The FFT, dubbed “the algorithm the whole family can love” because of its eye-wateringly ubiquitous applications, helped fuel the explosion in remote sensing systems and sensor research conducted over the past sixty years or so, and it outfits the real-time battlefield in virtually every weapon and communication technology deployed there so that the battlefield can operate in real time – just as the FFT resides in all consumer telecommunications devices for the same real-time agenda.

Losing the Horizon in a Split Second: The Real-time Battlefield and/as the Global

“Norbert Wiener’s and Claude Shannon’s cybernetic ‘feedbacks’, which implement their ‘information theory’, will swiftly and progressively correct the decisions and thereby the historical course of world-around citizenry evolution. Very swiftly all humanity will learn to think about total Earth, total humanity, and total accumulated knowledge, total resources, etc. and will begin to make some powerful omnihumanity, omni-Universe- considerate decisions.” -- Buckminster Fuller *Critical Path* (1981: 342)

“Politics is, inherently, only an accessory after the fact of the design-science revolution.” --Buckminster Fuller “A Citizen of the Twenty-First Century Looks Back” (1969: 17)

The earth as globe, and the global as a guiding principle of late 20th/early 21st century geopolitical imaginaries, can be glimpsed in the operation, rationale and agency of the real-time battlefield. The weaponized telecommunications systems of this battlefield reveal antithetical impulses and ontological conditions for individual and collective agency as well as the formulation of the political subject as such.[[33]](#endnote-33) Through expenditures that would cause pharaohs to blush, we have crafted a global perspective of mastery and powerlessness, a *pharmakon* of control and computational disenfranchisement. On the one hand, the “tele-“ control of the battlefield reveals the subject’s control of space through time while simultaneously rendering the subject/combatant a mere plaything of polyscalar systems they can barely comprehend: puppet master and puppet at once. To paraphrase Benjamin Bratton, we do not even control what we control.[[34]](#endnote-34)

The loss of the earth’s horizon in the world picture, Heidegger argues, results from modernity’s coalescing of machine technology based on certain forms of mathematics that allows science to realize its visibility and its power in operation. The world picture aligns modern science with modern metaphysics while simultaneously creating and articulating human experience. Our contemporary global perspective (or the perspective of the earth as a globe) undoubtedly emerges from Renaissance applications of projective perspectival geometry in cartography, runs through centuries of scientific imaging, including satellite technologies and other telecommunications systems found in the real-time battlefield and the home front – the long epoch of operational imaging.[[35]](#endnote-35) The erasure of horizons is the ultimate triumph of time over space as the controlling element of physics in which geopolitics can operate. Thus, the loss of the horizon means the loss of a geopolitical operational sphere rendered fully temporal in an eternal now made possible by our teletechnogical exoplanetary ring. Buckminster Fuller, during the initial flowering of this global control, argued that the planet is and remained, despite the Cold War moment, the biggest system we can think through for design purposes.[[36]](#endnote-36) But the planet is an open system, and the construction of it as a globe reconstitutes it as a closed system through its teletechnological enframing. Within this technosphere, all the elements of the earth, especially human activity, connect to each other in preprogrammed ways.

In the real-time battlefield, the military mission merges with the state’s capacity for transmission: mission combines with transmission, and all parts providing data, signals, and information at all levels and at all times. The geopolitics of the global are made manifest in the real-time battlefield. If General MacArthur augurs the US role on the world stage at the earliest glimmers of the Cold War by stating “We defend everywhere,” it is because real-time telechnologies allow everywhere to be right now. And more importantly, in so doing, everywhere becomes anywhere, and at any time.

That temporal control realized through the kind of spectral intervention harnessed by the FFT is that of the split second, or more accurately, the second split into atom-sized units for spectral analysis and eventual control. This is not the split second of human perception but rather that of machinic capture for decidedly human means. The difference between the two is played out in a series of investigations by the research group Forensic Architecture that examine the state of exception for the human experience of the split second claimed by state actors, specifically the police, in incidents of violence directed toward civilians.[[37]](#endnote-37) The split-second decision provides a literal “get of jail free card” for state actors in crisis moments. Because machinic perception is capable of the kind of finely granular separation pursued by real-time teletechnologies, such as those that permeate the military and civilian spheres alike, it is possible to break down such incidents into varying timescales ranging from milliseconds to years, which is what Forensic Architecture has done.[[38]](#endnote-38)

Explaining the “investigative aesthetics” of this research, Fuller and Weizman acknowledge the massive “epistemological, temporal and geographic” distance necessary to travel from the specificity of one brief event to its larger historical contexts.[[39]](#endnote-39) Nevertheless, one could productively continue their assessments of the longer duration of historical legacies of the Realtime Battlefield through inventions such as Squier’s multiplex engineering, Dudley’s sound analysis-synthesis and Tukeky’s FTT for the reification of a global military full-spectrum dominance that is the stated goal of real-time battlefield.[[40]](#endnote-40) The brutality and inequity of the space-time conflations of the endless streams of split-second decisions that permeate this teletechnological war zone, has always already been the providence of state power exemplified from the Spanish-American War to the present: the extraterritorial expression of the imperial nation as world police officer.[[41]](#endnote-41) The second split by machinic perception is nought but the synecdoche of the human-experienced second, just as the real-time battlefield is a synecdoche of the geopolitical and all of its historical inheritances.

The military R and D into the manipulation of audio-visual spectra, frequencies and signals, as noted, includes examining the various ways microtemporalities pertain to military and political formulations of time, space and power. The strategic military advantage to further control time by splitting the second into the units of the split second of human apprehension extends the geopolitical state of exception into the battle zone. However, in the successful consolidation of the split-second (divided or singular) as a teletechnological goal for the military, the split-second disappears. It emerges instead as the permanent temporal condition of military engagement. As such it erases any other temporalities -- and thus human agency (other than that found in the operational software) -- for military decision-making. This situation, oxymoronically, converts the split-second into the infinite.

The results are even more consequential in geopolitical terms. The attempt to reduce chances of an error through strategic informational advantage actually increases the chances of mistakes resultant from increased speed. The operational and technological superiority coupled with ever-increasing, self-proclaimed accuracy rapidly narrows geopolitical options or takes them off the table altogether. Action yields to permanent reaction. In a perfect deconstructive manner – that is, a system that makes something possible can and often will make that same goal impossible – the closed loop of automated real-time teletechnologies that justify the real-time battlefield also prevents the full spectrum dominance they promise from being realized. The Platonic ideal of such a warzone is forced to return to the drawing board, but only to reinforce and refine the same systems for the same ends. And the geopolitical operatives that operate through it, and which are often but a larger version of the same technocratic ideal, can only revert to *post-facto* equivocation and adjustment.

Coda: Battlefield Muzak, or Put Away the Fife and Drums

“The ‘New Muzak’ – A System of Security for the 70’s” – Muzak ad

Along with inventing multiplexing, with its many subsequent manifestations, Squier grew interested in bringing music into homes and businesses in a private and bespoke manner separate from radio and through wire. The idea apparently first captured his active imagination during the 1893 Columbian Exposition in Chicago, where he encountered the novel experience of immersion in the electronic transmissions of orchestral music that bathed the activities there in an embrace of sound.[[42]](#endnote-42) As mentioned, he refused to patent any of his inventions and always pursued all of his technological and engineering experiments as turning nature through technoscience toward social well-being, with technology being the purview of all society and not individual or corporate interests. Understood through the lens of military standards and code of practice, he held many iconoclastic views by firmly resisting centralized authority, whether governmental, institutional or corporate. And yet, despite his idealistic positions, his inventions, especially Muzak, were turned to ends beneficial for the very entities he sought to resist. Cold War mood music played in corporate, governmental and military offices in the second half of the 20th century. Piped-in music for soldiers became the soundtrack of work and leisure, concentration and relaxation in various military sites and settings. Its origin, application, and dissemination show a marked self-contradictory distance between ideal and Realpolitik, one resident in the company’s name, which was Squire’s “jabberwocky jumble” fusing “music” and “Kodak”.[[43]](#endnote-43)

Muzak, as do telecommunications generally, exemplifies the increasingly permeable line between civilian and military spheres in the post-WWII world. Patrolling the North Sea, Polaris nuclear submarines streamed Muzak to reduce the stress of minute and tedious radar missile surveillance, a trick they adapted from the US army, which deployed the same aural easing of tensions and sharpening of attention for those posted on the remote Defense Early Warning line.[[44]](#endnote-44) At this Cold War surveillance installation site, soldiers huddled in their Bucky Fuller geodesic domes in the remote wilds of Canada watching for blips on their screens that might signal missiles or enemy planes while Muzak and its pre-programmed arrangements helped focus their attention for longer periods of time. New battlefield conditions required new means of avoiding battle work fatigue. Tested in the 1960s at US Army Human Engineering Laboratories in collaboration with the Muzak corporation, background music became part of the immersive experience cocooning soldiers in artificial environments designed to optimize performance. Much as the manufacturing sector from Fordism and Taylorism attempted to enhance production line performance, the military sought to hone the body and mind of soldiers, not only in direct battlefield conditions, but in the softer, non-material domain of Cold War surveillance and the tele-control of the globe. Just as labor was taken over by paperwork and eventually surveillance and computer screens, the military found its soldiers staring into screens at NORAD or listening intently to remote sensors along the Ho Chi Minh trail, attempting to read and interpret visual and aural blips and clangs, up to and including drone operators from the Gulf War to the present. Long hours of tedious labor requiring attention became the quotidian existence of office workers civilian and military alike. And a concerted effort to enhance lived sensation and meaningful stimulation also operated in both spheres.[[45]](#endnote-45)

By the 1970s, Muzak was a 400 million dollar a year enterprise servicing 43 of the top 50 industrial companies worldwide. Its focus, research and reach were very much in lockstep with those of the military while also deploying the exact same telecommunications inventions from Squier through to Bell Labs. The company’s focus on regulating the order of day (and night) included a project in collaboration with Bulova called Muzak-Controlled-Time, to synchronize the world’s clocks through Muzak’s musical supply system, sending a cycle-pulse from a satellite network through the corporation’s radio network tied to Greenwich Mean Time.[[46]](#endnote-46) The 1970s drive to further the interlinking telecommunications systems to control time down to the microsecond for economic and military gain played out in a variety of full-spectrum manners. One of the company’s1970s advertising slogans sums up the shared goals of all the interested parties: “Muzak Is a Total Communications System” – Muzak and the Department of Defense speaking the same language across the same media infrastructure. It is worth noting that adjectival application of the word “total” in such sloganeering differs markedly from the semi-utopian planetary invocations of Buckminster Fuller’s “total Earth” quoted earlier.

During this moment of telecommunications symbiosis, the US military strategy of real-time teletechnological control was slowly imploding in the quagmire that was the Vietnam War, though in this strategic collapse, the RAND visionaries could see a way forward by envisioning what was to become the real-time battlefield. These plans converted a large chunk of Southeast Asia into a live (and living) experiment, useful less for the immediate war efforts at the time and more for future wars: that is, the ones the military conducts in the present we currently occupy. Operation Igloo White, for example, was an early, slower version of the real-time battlefield vision, in which the faith in large-scale remote sensing systems to telecontrol space in real time emerged. Dropping thousands of sensors along the Ho Chi Minh trail, the military hoped to disrupt the logistics supply line between North Vietnam and its fighters in the south.[[47]](#endnote-47) The sensors could detect movement, sound, light and even olfactory clues of human presence and activities. Comforted by Muzak piped into a base in Isan in northeast Thailand, soldiers stared at screens and listened intently to interpret signals from noise miles away and initiate the information loop to scramble bombers permanently airborne and attack targets based on projections gleaned from this spectral information. The US military deemed Operation Igloo White a success despite its massive costs, minimal effects, and easy circumvention by the Viet Cong, such as sending water buffalos down the sensor-laden forest trails to be (expensively) blown up by EC-121BAT or QU-228 bombers. This allowed the Viet Cong to use the closed telecommunications system built for speed against itself, thus causing the US to waste ordnance, time and accuracy in the name of efficiency and strategic advantage at all levels. It would be some decades later in the Gulf War that the seeds of this operation and its “successes” were firmly on display in real-time television coverage, including video broadcast by ordnance on the path to their (and others’) fiery demise.

Muzak figures in another Vietnam War moment, one found in the split-second decision to abandon Saigon with the Viet Cong storming the city earlier and faster than expected. Lanza tells an anecdote about the US Embassy in Saigon in April 1974 being discovered in its rapidly exited state: “amid the chaos and desolation, the Embassy’s Muzak system remained undisturbed, playing on like a tree falling in an abandoned forest, heard by none but making a global impact just the same.”[[48]](#endnote-48) The real-time stream of aural environmental control to facilitate productivity and mission success continued to play its part, but the battlefield’s control center had been abandoned, leaving the haunted echo of disembodied sounds resonating through the administrative space void of personnel. The empty US government and military offices in Saigon, the closed system of Operation Igloo White, and indeed Muzak, provide uncanny *doppelgängers,* or metonymic proxies, for the real-time battlefield and the follow through of the deconstructive self-defeat of teletechnologies to achieve their very rationale for existing: control through full spectrum dominance.

Endnotes

1. RTX ad content *Politico* website <https://www.politico.com/sponsored/2024/07/harnessing-connected-aviation-and-battlespace-technologies/?utm_source=native&utm_medium=homepage> [↑](#endnote-ref-1)
2. The Macy Foundation funded the interdisciplinary gatherings known as the Macy Conferences begun prior to World War II, with continued correspondence between participants during the war, and after when it became the hotbed of Cybernetics and later Information Theory. The Macy Foundation’s funds originated in Nantucket, making huge amounts of money from that great early extractive energy industry: whaling, before later shifting to retail and the eponymous department stores. This was but one important nexus of interdisciplinary research and deep pockets operative in the post WWII moment and joined other major players such as ATT/Bell Labs, US Department of Defense, major research universities (such as Harvard, MIT, and Princeton), as well as the Rockefeller Foundation. This coalition embodies Vannevar Bush’s vision for the post-WWII R and D in order to keep the US in its newly acquired global power status. While not strictly a funding body, the RAND Corporation, as a Federally Funded Research and Development Center, redistributes portions of their funding from the government and the private sector to outside researchers and students to advance RAND projects. [↑](#endnote-ref-2)
3. Joseph Lanza, *Elevator Music: A Surreal History of Muzak, Easy-Listening, and Other Moodsong,* 2nd ed. (Ann Arbor: University of Michigan Press): 22-30 [↑](#endnote-ref-3)
4. Arthur E. Kennelly, “Bibliographic Memoir of George Owen Squier,” in *The National Academy of Sciences of The United States of America: Bibliographic Memoirs,* vol. XX- Fourth Memoir (Washington DC. 1938): 131 [↑](#endnote-ref-4)
5. Lanza 25 [↑](#endnote-ref-5)
6. Mischa Schwartz, “The Origins of Carrier Multiplexing: Major George Owen Squier and AT&T’, *IEEE Communications Magazine* (May 2008): 24 [↑](#endnote-ref-6)
7. Ryan Bishop “*Felo de Se:* The Munus of Remote Sensing,” *boundary2,* 45, no.4 (2018): 41-63 [↑](#endnote-ref-7)
8. Joseph Masco *The Future of Fallout, and Other Episodes in Radioactive World-Making* (Chicago: University of Chicago Press) 2021:17 [↑](#endnote-ref-8)
9. See John Beck and Ryan Bishop *Technocrats of the Imagination: Art, Technology and the Military-Industrial Avant-garde* (Durham NC and London: Duke University Press), 2020: 158-159 [↑](#endnote-ref-9)
10. Paul Virilio *The Original Accident,* trans. Julie Rose (Cambridge: Polity Press) 2007 [↑](#endnote-ref-10)
11. The long history of governance, politics and communications systems has been theoretically explored by many excellent scholars including, but by no means limited to Paul Virilio, Armand Mattleart, Friedrich Kittler, Caren Kaplan, Lisa Parks, Bernhard Siegert. [↑](#endnote-ref-11)
12. Increased speed provides the primary rationale of the real-time battlefield, as its name indicates, as well as for the general overcoming of spatial distance through temporal means. Virilio famously coined the term “dromoscopy” to place acceleration as the primary force in the development of Western culture and is developed through multiple angles in his entire career, including *Speed and Politics.* [↑](#endnote-ref-12)
13. Lanza,24 [↑](#endnote-ref-13)
14. Schwartz 1-3 [↑](#endnote-ref-14)
15. Schwartz 3-11, Lanza 25 [↑](#endnote-ref-15)
16. Lanza 27-28 [↑](#endnote-ref-16)
17. Lanza 26-30 [↑](#endnote-ref-17)
18. Jon Gertner, *The Idea Factory: Bell Labs and the Great Age of American Innovation,* (London: Penguin 2012): 30-32 [↑](#endnote-ref-18)
19. Dave Tompkins, *How to Wreck a Nice Beach: The Vocoder from World War I to Hip-Hop,* (NY: Melville House 2011): 68-72; Ryan Bishop, “Eyes, Ears, Mouths: A Sensorial Military Triptych (with satellite, electronic music and vocoder)”, in *War and Aesthetics: Art, Technology, and the Futures of Warfare*, edited by Jens Bjering, Anders Engberg-Pedersen, Solveig Gade, and Christine Strandmose Toft, (Cambridge, MA: MIT Press 2024): 151-170 [↑](#endnote-ref-19)
20. Vocoder technology as analogue mechanics yielded in the 1970s to a digital technological process known as “adaptive predictive coding” developed by Manfred Schroeder and Bishnu Atal at Bell Labs. The process uses predictive algorithms to anticipated speech based on large speech samples to express actual speech production while eliminating false predictions (an early avatar of linear predictive coding for machine learning and generative AI). This process also proved undesirable and not terribly convincing in terms of voice signal though the military deployed it as an advance over vocoder machincs. Voice compression goals gave way to concerns about secure voice communications in the 1980s as government research shifted priorities yet again, returning to concerns of early voice cryptography that the vocoder attempted to tackle. See Jonathan Sterne, *MP3: The Meaning of a Format,* (Durham and London: Duke University Press, 2012): 92-127) for an extended unpacking of this trajectory of speech synthesis research of the 1930s and the vocoder’s influence on the advent of digital audio. [↑](#endnote-ref-20)
21. Tompkins 42 [↑](#endnote-ref-21)
22. Mara Mills, “Media and Prosthesis: The Vocoder, the Artificial Larynx, and the History of Signal Processing,” *Qui Parle,* 21, no.1, (2012):107-149 [↑](#endnote-ref-22)
23. John R. Pierce *An Introduction to Information Theory: Symbols, Signals and Noise,* 2nd rev ed. 1980 (Garden City, NY: Dover):136. Pierce, it should be noted, was an influential researcher at Bell Labs for decades and was instrumental in the development of satellite communications, making him a key (if not the key) figure in the development of the Realtime Battlefield. [↑](#endnote-ref-23)
24. Gertner 212-227 [↑](#endnote-ref-24)
25. For an excellent study of Cold War sound electronics labs see Jennifer Iverson, *Electronic Inspiration: Technologies of the Cold War Avant-garde,* (NY: Oxford University Press 2019) [↑](#endnote-ref-25)
26. Paul Virilio, *A Landscape of Events*, trans. Julie Rose (Cambridge MA and London: MIT Press 2000): 27 [↑](#endnote-ref-26)
27. Bernard Stiegler and the Internation Collective (eds.) *Bifurcate: There is No Alternative,* trans. Daniel Ross (London: The Open Humanities Press 2021) [↑](#endnote-ref-27)
28. Martin Heidegger “The Age of the World Picture,” The Question Concerning Technology and Other Essays, trans. William Lovitt, (New York: Harper and Row 1977):115-54. [↑](#endnote-ref-28)
29. Ryan Bishop and John Beck (eds.), *Cold War Imaginaries: Systems, Theory, Aesthetics* (Edinburgh: Edinburgh University Press 2016) [↑](#endnote-ref-29)
30. Jussi Parikka, *Operational Images: From the Visual to the Invisual,* (Minneapolis and London: University of Minnesota Press 2023). Parikka’s excellent study of operational images provides a key inquiry that, among many other achievements, puts Heidegger’s essay within a vast and productive lineage of technological, scientific and political usages of imaging practices. [↑](#endnote-ref-30)
31. As part of the very large project known as Vela Uniform, which was meant to detect all forms of nuclear testing – underground, terrestrial, stratospheric – seismology suddenly became a strategic science in the eyes and ears of DoD. Begun under the Eisenhower administration in 1950, as noted above, and most but not all of the documents and research conducted by Vela Uniform were never classified to indicate US commitment to nuclear testing as a global geopolitical project. For a sustained overview of seismology and Vela Uniform, see Kai-Henrik Barth, “The Politics of Seismology: Nuclear Testing, Arms Control and the Transformation of a Discipline,” *Social Studies of Science,* 33, no.5 (2003): 743-78. This article is part of part of a special issue the journal entitled “Earth Sciences in the Cold War.” A portion of the Seismic Acoustics work that fell under Vela Project is represented in the proceedings of the Symposium on Detection of Underground Objects, Materials and Properties conducted by the US Army Engineer Research and Development Labs at Fort Belvoir, Virginia (1962). Some of the papers and reports given include work on soil, hydrology, underground explosions, infrared photography, digital recording of spectro-radiometric information, magnetic detection, geochemical auras, mine detection and aerial photographic interpretation of vegetation, among other topics. Thanks to Robert G. Pietrusko for this archival material. [↑](#endnote-ref-31)
32. Richard S. Preston, “The Nuclear Test Ban Treaty,” *Current History,* 46, no.274 (June 1964): 341-345 [↑](#endnote-ref-32)
33. See John Arquilla and David Ronfeldt’s edited collection on network-centric warfare *In Athena’s Camp: Preparing for Conflict in the Information Age,* published by the RAND Corporation, for a similar set of inquiries https://www.rand.org/pubs/monograph\_reports/MR880.html [↑](#endnote-ref-33)
34. Benjamin Bratton, “On Geoscapes and the Google Caliphate,” *Theory, Culture & Society,* 29, no. 7-8 (2010): 329-342 [↑](#endnote-ref-34)
35. See Parikka [↑](#endnote-ref-35)
36. R. Buckminster Fuller, *Operation Manual for Spaceship Earth,* (Zurich: Lars Muller Publishers 2008) [↑](#endnote-ref-36)
37. Matthew Fuller and Eyal Weizman, *Investigative Aesthetics: Conflicts and Commons in the Politics of Truth*, (London: Verso 2021):98-103 [↑](#endnote-ref-37)
38. Fuller and Weizman 101-103 [↑](#endnote-ref-38)
39. Fuller and Weizman 13-14 [↑](#endnote-ref-39)
40. The realization of this goal becomes the basis for Jean Baudrillard’s controversial analysis of the Gulf War as being but a simulation of a war. True it was a simulation with consequences, as he argues, but a simulation nonetheless, so asymmetrical was the US military’s full spectrum dominance. [↑](#endnote-ref-40)
41. The Spanish-American War explicitly saw the extension of settler colonization and its violence against indigenous populations beyond the nation-state’s disputed borders, much to the dismay of many public intellectuals, such as Mark Twain and William James. Twain unfurled his resistance in his satirical screed “To the Person Sitting in Darkness,” about US adventurism in the Philippines, where Squier laid telegraph cables. James conveyed his disgust in “The Philippine Question” with the visceral summation that “The country has once and for all regurgitated the Declaration of Independence and the Farewell Address, and it won’t swallow again immediately what it is so happy to have vomited up.” [↑](#endnote-ref-41)
42. (Lanza 24 [↑](#endnote-ref-42)
43. Lanza 30 [↑](#endnote-ref-43)
44. Lanza 149-150 [↑](#endnote-ref-44)
45. Such musical production and application has obvious links to ambient music, most directly associated with Brian Eno, who has a release entitled “Neroli: Music for Thinking”. [↑](#endnote-ref-45)
46. Lanza 153 [↑](#endnote-ref-46)
47. Pujita Guha, “Seeding the Forest,” *Cultural Politics,* 19, no. 3 (2019): 353-373; Paul Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America,* (Cambridge MA: MIT Press 1996); Ryan Bishop, “Smart Dust and Remote Sensing Systems: The Political Subject in Autonomous Systems,” in John Beck and Ryan Bishop, *Cold War Legacies: Systems, Theory, Aesthetics,* (Edinburgh: Edinburgh University Press 2010): 273-288 [↑](#endnote-ref-47)
48. Lanza 148-166 [↑](#endnote-ref-48)