kompost*klang*küche*: Telematic WORLDing with Glitch

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Abstract

This paper explores concepts and practices of telematic performances, particularly through the lens of the project \textit{kompost\text{*}klang\text{*}küche*}. It emphasizes spatial discontinuity within networked artistic collaborations, as opposed to immersive continuity.

Telematic performance formats utilize network technologies to facilitate low latency artistic endeavors across geographical divides, creating a complex interplay between local, remote, and intermediary spaces. In this context, we interpret spatial configurations from a phenomenological point of view as \textit{telematic SPACE} in which technical components are in place in three spaces (local, remote and intermediary space) while practiced, embodied and inhabited in an \textit{anthropological space}, where the overlay and dynamics of physical and virtual elements shape the experience of their inhabitants.

Our analysis delves into the place—the geometric configuration—of the specific telematic SPACE \textit{kompost\text{*}klang\text{*}küche*}, examining the challenges of establishing telematic connections and their solutions. The consequences on signal routing and mixing lead to the embrace of aesthetics of failure.

Through the emergence of \textit{Glitch} in the intermediary space the Internet transforms from medium to instrument and ultimately becomes the message.

Our examination extends to noise artifacts and signal corruption found within the extensive history of networked systems used for musical interaction. This investigation reveals that glitch phenomena are fundamentally integrated into configurations of networked and telematic performance formats.

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Using theoretical approaches from the field of new materialism we contend that, within this conceptual framework of *Glitch*, technologies emerge as active participants that disrupt traditional notions of spatial continuity and transparency in telematic performance settings.

Thus in the telematic glitch SPACE of *kompost*klang*küche*, telematic practices operate *with* the network, rather than *over* or *in* the network. From the perspective of new materialism, telematic SPACE shifts its focus from spatial configuration to a performative state, leading us to the proposition of the concept of *telematic WORLDing*. In these telematic WORLDings inhabitation is not limited to human users (performers, audience), but includes non-human agencies. Telematic WORLDing is a performing and becoming in a human-non-human entanglement.

**Introduction**

Telematic performance formats involve the use of networked technologies to enable live artistic collaboration and performance across geographical distances. The spatial configuration in telematic performances is most often diagrammatically mapped as shown in Figure 1. The distant locations A and B are bi-directionally linked so that from either perspective one space is local and the other remote. The transmission of audio, video and other data is facilitated by C which can be interpreted as an intermediary space.

On a phenomenological level, however, the situation presents itself radically differently: all three elements (the local, physical space; the remote, represented space; and the mediating transmission space) are present and play out their effects at each of the two physical locations as shown in Figure 2.

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Figure 1: Telematic performance setup from a technical and organizational perspective. The telematic spaces are regarded from an abstract perspective where the physical and technical infrastructure is centerstage.

Figure 2: Telematic SPACE. The telematic SPACE is interpreted from a phenomenological point of view and is shaped by the activities and perceptions of its users (performers, audience).

Concepts from spatial theory can shed light on the distinction we make between space and place. Place describes a geometric configuration of positions, where something is in one place and not another. Space describes an anthropological space, where space is practiced and embodied, in short: “inhabited.”

In a telematic performance, the aspect of virtualization must also be considered. Virilio argues that in this kind of communication, in low-latency time and through interactive techniques, “the event does not take

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‘place’ or more exactly, it takes place twice,”\(^8\) or it takes place in a third space, understood as the fusion of the physical (first) and the remote (second) space.\(^9\) Space and place are nevertheless interdependent.

The overlay of real and virtual spaces, taken from a phenomenological, experiential perspective, can only be articulated artistically if its technical components can be intentionally manipulated and overviewed; in other words, if they are in place. This concerns the shaping of the physical spaces (be they local or remote—A or B) with their media use as well as the configuration of an intermediary space (C) which bridges the different locations. All spaces (local, remote, intermediary) have an influence on each other; changes in one affects the others. The combination of this overlay and the dynamics of different spaces is what shape the experience of its users (performers, audience) at the respective locations in a telematic SPACE, and precisely what distinguishes the telematic performance format from other performative genres. To express this idea specificity, the term telematic SPACE (in capital letters) is used hereafter.

In reviewing the literature and history of telematics, and in the practice of our telematic research unit at Zurich University of the Arts (ZHdK), we observe two fundamentally different approaches to engaging the interconnection of distant locations from a spatial perspective: spatial continuity and spatial discontinuity.

In the former approach, spatial continuity, the involved spaces are synthesized into a homogeneous spatial configuration which leads to an immersive experience not influenced by the contradictions of the physical characteristics at play in the different spaces.

The goal of this approach is to construct a spatial continuity and to produce a shared virtual space.\(^10\) Central to achieving this immersive unity and seamless integration of remote spaces, preserving “fidelity in relation to their equivalent real-world sensory modalities,”\(^11\) are the underlying material conditions.\(^12\) Foremost among these conditions is the requirement for high-bandwidth and low-latency internet connections.\(^12\) This requirement not only emphasizes the technical demands of such performances but also points to an inherent exclusivity, as the infrastructural capabilities to meet these needs are predominantly situated within well-resourced institutions and metropolitan centers.

In the latter approach, spatial discontinuity, the different spaces in telematic performances are grafted on each other, actively making the rupture lines perceivable, disclosing spatial discontinuity, as shown in Figure 3.\(^13\) In this approach the intermediary space (C) can be understood not only as a technical

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service but as one with its own materiality and spatial characteristics, enmeshed with and integral to the entire behavior of the performance practice or artwork.\textsuperscript{14}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image.png}
\caption{Discontinuity approach}
\end{figure}

In this paper we position the telematic performance project \textit{kompost*klang*küche*} within the framework of the second approach, emphasizing spatial discontinuity. The project deliberately operates in physical locations marked by unreliable network conditions, proposing alternatives to performance practices within well-connected and -resourced realms of academic institutions.

\section*{Background}

The \textit{kompost*klang*küche*} project builds on a transdisciplinary research encounter of four human actors from the fields of sound art, culinary art, and the art of composting. It was funded by Pro Helvetia in the Innovation and Society sector as a Contribution to Research for Art Projects.

Driven by a collective ambition to share their ways of becoming-with in processes of composting, sharing food, deep listening, and speculative fabulation, the collaborators conceived a spatial-temporal artwork: \textit{kompost*klang*küche*}. The telematic performance premiered at Musikfestival Bern 2023 from September 7-10, 2023.

\section*{kompost*klang*küche* Project Overview}

Spanning multiple localities, the \textit{compos(t)ition} narrates human and more-than-human interrelations, the real and imaginary. Hybrid human-machine creatures resonate, creating sound. They produce human and more-than-human food. They grow within a virtual, networked ecosystem surrounding the \textit{com-post-human geo-gastro-culture}. They move with organic bodies, reproduce, digitally duplicate, and weave their relational agency into a dynamic assemblage.

Five human performers and musicians are interconnected telematically through live sound and video across distributed stages, interacting with organic and pseudo-organic beings in a distributed micro-macroscopic theater conveyed through multiple media. In several simultaneous scenes, they speculatively narrate how transdisciplinary and translocal knowledge can be generated and transmitted in the Anthropocene era of high-technological mediation and ecological catastrophe.

kompost*klang*küche* performs, sounds, lives, and eats at various locations simultaneously. kompost*klang*küche* contributes to world-making. kompost*klang*küche* becomes with the subterranean, the worms, the microorganisms, bacteria, fungi, and single-celled organisms, and with materials and processes from the humus-human kitchen (a series of culinary practices and creations by Margaretha Jüngling, which draw inspiration from the practices of composting and from the visual, olfactory, and textural characteristics of soil ecosystems, highlighting the integral connections and mutual dependencies between human and non-human entities within the human-soil nutrient cycle).

Visitors are invited to listen, eat, smell, imagine, and discover in this networked performance across past, present, future, fragmented experiential spaces.

Description of the Performance Setup

The performance utilizes narrative methodologies to articulate experiences within an interconnected, more-than-human world. It is structured around the practices of five human protagonists, performing on three distinct stages situated in two disparate locations, henceforth referred to as Location A and Location B. Positioned within a fifteen-minute walk from one another and interconnected via the internet, these sites challenge traditional performance spaces' norms through their unique characteristics and contrasting atmospheres. In what follows, we provide a brief overview of the locations, stages, and actors involved in the project.

Location A: The Grand Palais

The Grand Palais is a self-organized and non-commercial artist-run space, a place for contemporary art in the former waiting house of the blue Worrbähnli at Bern's Helvetiaplatz. It is an open three-room wooden cabin that stands out like a sore thumb amidst its brick and mortar institutional neighbors, the Alpine Museum, the Historical Museum, the Yehudi Menuhin Forum, and Kunsthalle Bern.

Within Location A, two stages hosted distinct aspects of the project. Stage α, Foleymatic Lab, featured a percussionist’s sound and visual media laboratory, with a collection of objects serving as sound producing entities. The protagonist in Location A, Stage α, is Tele-Being: Blua, played by the percussionist and performer Julien Mégroz. As a speculative human-machine entity, Blua plugs into the digital world from a future present to retrieve lost knowledge from a past present and thereby alter space-time.

Stage γ hosts the NEXUS, a geodesic dome equipped with nine tension straps, each individually connected to custom-built weight sensors, forming a climbable network, pointing to the complexity and interconnectivity of relationships within the real-digital ecosystem. In the geodesic dome's aerial network, the human protagonists Switch, played by Chimère Électrique (aka Robert Torche and HannaH Walter)
operate as future telephonists who connect and weave together digital-real space-times and telematic worlds.

**Location B: Stiftsgarten**

In the center of Bern, located between the Münster platform and Fricktreppe on the south-facing slope of the UNESCO World Heritage Site, lies the Stiftsgarten, the former nursery of the Stift building, now supported by the nonprofit organization Stiftsgarten Ltd. At the garden’s highest point stands a wooden pavilion, its architecture reminiscent of a greenhouse with a glass roof. A processing kitchen forms the central element in the new building. Banks of windows in front of the frame structure offer views into the garden and the neighborhood. The garden, with its diversity of old cultivated plant varieties, its own compost heap, and the non-human microorganisms that feed from it hosts *Stage β, kompost*klang*küche*, a laboratory of compost and soil analyses and a kitchen. The human protagonists in Location B are *Tele-Being: Orange*, played by Anja Fonseka, expert in regenerative agriculture and compost, and *Tele-Being: Néon*, played by Margaretha Jüngling, expert in human cuisine and human food.

Collectively, the human protagonists and microorganisms (such as bacteria, fungi, protozoa, and nematodes) create a utopian, proliferating, blossoming, decaying, decomposing, transitioning, and sounding laboratory of transformation and creation in real soil-root and digital telecommunication networks.

**Technical Infrastructure**

The orchestration of live audio-visual content dissemination across the two physical spaces (Locations A and B) is facilitated through a network of multiple inputs and outputs in each location. In *kompost*klang*küche* digitally mediated sounds and video projections of the respective distant and local stages overlap, thus engendering a common virtual environment across locations and stages.

Both performers and audience members experience the audio from Locations A and B via wireless headphones. Visual content is materialized through the deployment of projections onto specialized projection textiles within the physical environments. The visual experience of the audience is intentionally curated through a video mix that amalgamates the input from nodes situated in both physical spaces. Olfactory and gustatory experiences are shared with the audiences at both locations and speculatively intertwined over geographical distances.

It is beyond the scope of this article to introduce the speculative practices of *kompost*klang*küche* and critically reflect upon the methodologies employed through transdisciplinary practice-based collaboration in telematic SPACE. Rather, in the following analysis, we aim to scrutinize the use of media within the physical environments of the *kompost*klang*küche* project, with a particular emphasis on the place of the intermediary space, which serves as a conduit between disparate locations. Our focus will extend to delineating the constraints and affordances of the specific telematic SPACE and its technical and aesthetic strategies of data transmission, making space for a speculative non-human figure: *Glitch*. 
Network and Internet Connection: Challenges and Solutions

The network and internet connection for the kompost*klang*küche* project faced challenges due to the lack of telecommunication technologies in the Grand Palais (Location A) and Stiftsgarten (Location B). The connection was facilitated using Ethernet cables from neighboring institutions: a restaurant near the Grand Palais and a public library overlooking Münsterplattform’s garden. While the restaurant, and thus the Grand Palais, had fiber optic connectivity, the library's connection was limited to a 5G mobile standard facilitated through a Huawei Router Model H122-373. Upon evaluating the network at its most critical point, the library’s connection, a download speed of 425.20 Mbps and an upload speed of 93.87 Mbps were detected. This was accompanied by a latency of 9 ms and jitter of 3 ms. However, the bandwidth limitation to 100 Mbps upload made streaming high-quality video and audio channels challenging, necessitating innovative solutions in signal treatment and routing architecture.

Signal Routing: Audio, Video, and Sensory Integration

As a result of the bandwidth limitation, it was impractical to transmit all audio and video inputs individually through the internet via the Telemersive Toolkit15 and across locations.16

Instead, inputs were pre-mixed locally to consolidate multiple streams into a single stereo audio signal and a single video stream for each location. This preliminary mixing step, executed at the source sites, drastically reduced the volume of video and audio data transmitted via the internet, thereby optimizing bandwidth usage (for additional details, refer to the video-audio signal routing diagram in Figure 5).

Operator-assisted Telematic Connections

In kompost*klang*küche* the aforementioned audio and video data mixing process across locations was facilitated using a specialized mixing console designed specifically for this purpose. Inspired by historical telephone operators, the authors developed NEXUS (see Figure 4), a large-scale, sensor-augmented interface (situated in Stage γ) enabling mixing telematic connections across multiple stages (in the case of kompost*klang*küche*, Stage α, Stage β, and Stage γ).

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16 The Telemersive Toolkit, which includes the Telemersive Gateway, developed utilizing the MaxMSP platform, a visual programming language for music and multimedia, functions as a peer-to-peer application designed for enabling communication among multiple peers across distinct networks. This system was developed in our research unit at ZHdK by Martin Fröhlich and employs a central server, referred to as the 'telemersive-router,' which facilitates the creation of virtual spaces. Within these spaces, peers are capable of sharing their resources, thereby facilitating collaborative and interactive experiences.
Figure 4: A still from the live transmission via a mobile phone camera equipped with a fisheye lens in Space γ, capturing a wide-angle view of the sensor-augmented interface NEXUS and the two Switch performers.

The Tangible User Interface (TUI) of NEXUS, a geodesic dome, is equipped with nine sensing lines. Each line comprises weight sensing units connected to a makeshift slack line. This construction enables the Switch performers’ climbing interactions with the sensing lines to alter signal values of the local and remote world inputs send through the network (as detailed in figure 5), thus re-envisioning the embodiment of sound mixing engineers’ labor of moving faders with their fingertips on the surface of a mixing console.
To facilitate nuanced control over both local and remote mixes, sensor data was transmitted to an MQTT broker running on the central ZHdK server. This setup enabled the retrieval of sensor data from any location via a `mqtt-object` within Max/MSP, allowing the mixing agents to dynamically influence the virtual audio and video mix remotely using their physical movements and weight (see Figure 6).

**Figure 5**: *kompost*klang*küche* audio and video routing diagram (Stage α, Stage β, and Stage γ)
Figure 6: kompost*klang*küche* audio, video and sensor data flow within the network

Legend
- Audio & Video Data
- Sensor Data
Thus, by establishing three telemersive rooms in the Gateway (Room A, Room B, and Room Γ) alongside the stages, the transmission of six data streams (one audio stream and one video stream from each of the three locations) is efficiently manageable (see Figure 5). This operational model was strategically selected for its efficiency. The sensor data, being significantly less demanding in terms of bandwidth compared to audio and video streams, can be transmitted remotely without compromising the network's performance.

Video Transmission

Despite managing signal routing and reducing data flows through the internet, slow or unreliable internet connections in the locations of kompost*klang*küche* led to dropped frames, freezes, stutters, and stalls—collectively known as glitches.

frrrrrrrrrrreeezes, st-st-st-st-st-utters and stalls: Navigating Disruptions

As highlighted by Sadiad Fouladi et al. (2018), a contributing factor to these disruptions is the independent development and subsequent integration of codecs and transport protocols, which can lead to synchronization issues. The codec's role is to compress the video, making it more manageable for transmission, while the transport protocol oversees the delivery of data packets, estimating the network's streaming capacity to avoid overload. A critical aspect of uninterrupted video streaming is the seamless interaction between the transport protocol and codec. This synergy is vital for accurately determining the volume of data that can be streamed, taking into account variables such as the strength of the internet connection. Misalignment between these two components can lead to synchronization issues, manifesting as glitches or stalls in the video stream. The integration of UltraGrid with the Telemersive Gateway exemplifies these challenges. The setup relies on standardized, separately developed transport protocols like RTP and compression codecs such as H.264.

Given the constraints of low bandwidth and the limitations of existing tools, achieving a continuous telematic spatial configuration, as discussed in section 1 (a.), was not feasible. Moving beyond the idealistic perception of the network as a medium for seamless connectivity, our approach aligns with Tiziana Terranova's perspective on informational dynamics. We consciously engage with the inherent behavior of information transmission, navigating “the relation between noise and signal, including fluctuations and microvariations, entropic emergences and negentropic emergences, positive feedback and chaotic processes,” thereby embracing the complexity and unpredictability of networked systems.

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18 RTP (Real-Time Transport Protocol): The network protocol, is designed for real-time audio and video delivery over IP networks. It’s utilized in streaming media for applications such as video conferencing, telephony, and broadcasting. RTP’s primary focus is on the packetization, delivery, and timing of streaming data, rather than media compression or quality. H.264 is a widely adopted video compression standard. It’s prevalent in recording, compressing, and distributing video content. Known for efficiently compressing video files, H.264 reduces the data required for transmitting and storing high-quality video.
communication. This theoretical framework informed our practical experimentation with the system's capabilities, prompting us to explore how technological constraints could be leveraged creatively.

Hence, we delved into the advanced VideoCapture settings of UltraGrid and the Telemersive Gateway, seeking a combination of settings that would transform the glitch into an artistic and aesthetic element while maintaining bidirectional communication.

In the subsequent list of settings, we further explore and explain our choices:

**libavcodec** We opted for H.264, known for its high compression efficiency and quality at lower bitrates, making it ideal for streaming services. It supports resolutions up to 4K, providing high-definition video quality. Its efficient compression is crucial for reducing file sizes and bandwidth usage in internet streaming.

**Bitrate** We chose a bitrate of 20 Mbps, higher than the default 10 Mbps, to enhance quality while allowing the system to handle larger files, thereby increasing the presence of glitches throughout the performance.

**FPS** We set the frames per second to “0,” which signals the system to automatically select the frame rate. This means that the system will decide the fps based on various factors like the source material, encoding settings, or system capabilities. This lets the encoder determine the optimal frame rate for the video, which can be particularly useful when the ideal frame rate is not known or varies within the video content, an essential characteristic of bidirectional telematic communication.

**Video Mixing**

Due to the bandwidth limitations, we adopted a bifurcated routing method, distinguishing between the direct local distribution of streams and the internet-based transmission of remote streams (see Figure 5).

A mixture of video qualities was obtained: Local streams were high-quality, sent directly to outputs, while remote streams, routed via the Internet and the Telemersive Gateway, exhibited **glitch quality**. This approach created a visually diverse hybrid intermediary space (C). The use of fade transitions between video channels effectively blended remote and local scenes, adding a dissolved effect to the video streams.

By analyzing stills from two representations at the Musikfestival Bern 2023 we identify five distinct spatial configurations (see figure 7):

(A) Single Local Streams: Clear images with high resolution.

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21 Offers a range of codecs for encoding and decoding video (and audio formats).
22 Measures the data processed over time in a video or audio stream, expressed in bits per second (bps). It's key to determining the media file's quality and size.
23 FPS indicates the number of individual frames displayed in one second of video. Higher FPS usually results in smoother video motion.
(B) Single Remote Streams: Notable pixelation, typical of compression and transmission errors.

(AA) Overlapped Local: Multiple layers of high-quality local streams.

(BB) Overlapped Remote: Compounded distortion from layered low-quality signals.

(AB) Overlapped Local-Remote: Clarity juxtaposed with distortion.

Figure 7: 5 possible combinations of spatial configurations in the intermediary space (C) as observed in the telematic SPACE of Location A

The analysis shows that video mixing contrasts clarity and detail in local streams against remote streams’ pixelation and color distortions. Combinations result in gradients of collage-like appearances with a variety of textures and patterns (from smooth to heavily pixelated or blocky) stitched together. The intentional use of glitches alongside high-quality streams, enhanced by fade transitions, results in images
of the physical spaces, where glitches introduce uncontrollable movement and transformation, abstractness, hues, and tones.

Our observations resonate with Rosa Menkman, who states that “the glitch has no solid form or state through time; it is often perceived as an unexpected and abnormal modus operandi, a break from (one of) the many flows (of expectations) within a technological system.”

Discussion

Glitch

As a genre emerging in the digital age, glitch music thrives on the Internet's rapid exchange of ideas, propelling it beyond academic confines. Its roots lie in the inherent failures of digital technology—glitches, bugs, and system crashes—transforming these imperfections into a unique sonic palette. This movement, termed “post-digital” by Kim Cascone, reflects the increasing digital penetration of everyday life and a shift from the medium as the message to the tools themselves becoming the message.

Artists in this genre, often self-taught, exploit the Internet as a tool for learning, creating, and distributing their work, completing “a cultural feedback loop in the circuit of the Internet.” Thus, when the linear notion of transmitting information via the Internet is interrupted, this medium for cultural exchange becomes the instrument and ultimately the message.

Telematics and the Aesthetics of Failure

In the following overview, we aim to contextualize glitch and its inherent aesthetics of failure, as observed in the telematic project kompost*klang*küche*, within the broader history of networked systems used for multimedial explorations in diverse fields, including music, dance, theatre, and teleconferencing, from 1950 to 2015.

Imaginary Landscape No. 4 (1951)

John Cage's use of the commercial transistor radio as a musical instrument in Imaginary Landscape No. 4 (1951) is considered as one of the first instances of an electronic “interconnected musical network,” where the outcome relies on the interdependent actions of all participants.

26 Ibid., 17.
The piece was designed to explore the potential for cross-influence between remote radio broadcast
agents and local pairs of performers, among which the control of frequency and adjustment of volume
was distributed. The unpredictable nature of real-time radio broadcasts introduced a significant element
of chance, making each performance of the piece uniquely determined by external, uncontrollable factors.
Thus, the piece exemplifies how the use of analog broadcasting systems can serve as an infrastructure for
musical interdependency and indeterminacy.

Building on the insights provided by Weinberg and Barbosa concerning the unpredictability of sounds
emanating from transistor radios, our discussion further explores the piece's intrinsic aesthetic of noise.
Tuning radios to different stations introduces radio noise (commonly referred to as radio static). In
Imaginary Landscape No. 4, the performatrice of switching frequencies and inadvertently picking up
electrical noise from other stations or devices manifests as a form of sonic glitch. These audio artifacts,
which would typically be considered undesirable in traditional musical contexts, play an essential role in
the performance, contributing to its sonic texture.

Although Cage's piece predates the formal recognition and naming of glitch music as a distinct
aesthetic, his engagement with these unpredictable elements signifies an ideological congruence with
 glitch art's celebration of randomness and the subversion of anticipated technological functionalities.

The League of Automatic Music Composers

During the 1970s and 1980s, The League of Automatic Music Composers, comprising John Bischoff,
Jim Horton, and Rich Gold (later succeeded by Tim Perkis), played a pivotal role in evolving the application
of algorithmic principles from acoustic (like the change operations by John Cage,28 the stochastic
processes of Iannis Xenakis,29 or the minimalist patterns by Steve Reich30) to live electronic music. Their
work, deeply embedded within the burgeoning electronic technology culture of the San Francisco Bay
Area and the experimental traditions of instrument building (e.g. Harry Partch, John Cage, and David
Tudor), was characterized by a rigorous do-it-yourself ethos towards the development of both hardware
and software for their compositions.

Using early personal computers, specifically the 1976 Commodore KIM-1, the League of Automatic
Music Composers pioneered the use of interconnected computing devices to act as large, interactive
musical instruments. Their approach to networked music performances was conceptualized by the
ensemble itself as a hybrid entity composed of both "human" composer-performers and "artificial"
computer agents. Chris Brown and John Bischoff, members of the Hub (for their relationship to the League
see the following section and footnote 33), allude to this when they argue that “the League is an
organization that seeks to invent new members by means of its projects.”31

2007), 1–7; Alvaro Barbosa, “Displaced Soundscapes: Computer-Supported Cooperative Work for Music Applications” (PhD
diss., Universitat Pompeu Fabra, Departamento de Tecnologia, 2006).
University Press, 2004), 19–32.
31 Chris Brown and John Bischoff, “Indigenous to the Net,” accessed February 22, 2024,
These new members explicitly include agents from the electronic realms, embracing their agency and emerging phenomena that human performers would perceive as glitches. The paradigm is also reflective of the contemporary conceptualizations of electronic systems as musical actors by David Tudor and Gordon Mumma.\textsuperscript{32}

The Hub

Originating in the mid-1980s as a direct offshoot of the League, the Hub was formed by a collective of composers, a transition that marked a shift from the use of standalone microcomputers to a more interconnected approach, employing a centralized microcomputer—or “hub”—and MIDI (Musical Instrument Digital Interface) technology to facilitate the exchange of musical data and control signals among the members of the ensemble.\textsuperscript{33}

The work of the Hub also presaged contemporary practices of networked music performance over the Internet. They experimented with early forms of remote collaboration and audience participation, exploring the artistic potential of connecting distant performers through digital networks. In the remote networking project Points of Presence, a live performance produced by the Institute for Studies in the Arts at Arizona State University (ASU), the Hub sought to interconnect members across Mills College, California Institute for the Arts, and ASU through the Internet. Unfortunately, the experiment encountered significant technical difficulties, ultimately leading to a system collapse within 10 minutes: “The technology had defeated the music. And after the concert, one by one, the hub members turned in their resignations from the band.”\textsuperscript{34}

From the performers’ viewpoint, their endeavor failed both technically and artistically, struggling to navigate the intricate dynamics between human and nonhuman actors, leading to a disillusionment of the Hub’s members, as indicated by their sequential resignations from the collective. Yet, paradoxically, this failure illuminates the impactful role of nonhuman actors in shaping technologically mediated musical compositions, arguably achieving a form of successful failure. In Chris Brown and John Bischoff’s reflection, “computer music instruments are best when they take on a life of their own, surprising their creator/performers with a liveliness and character that could not be predicted.”\textsuperscript{35}

Thus, this incident not only underscores the glitch as a moment where both the author and the technology recede into the background, but also reaffirms the potential of computer music instruments to defy expectations, manifesting unpredictably lively qualities. In other words, as Rosa Menkman’s Glitch Studies Manifesto states: “The glitch does not only invoke the death of the author, but also the death of the apparatus, medium or tool.”\textsuperscript{36}

The experiments in algorithmic music and computer networking undertaken by the League and the Hub, as previously discussed, reveal a connection between networked music and glitch aesthetics. This


\textsuperscript{33} The Hub, The Hub: Pioneers of Network Music, ed. Ludger Brümmer (Heidelberg: Kehrer, 2021). It included, besides the original League members, John Bischoff and Tim Perkis, who were later joined by Chris Brown, Scot Gresham-Lancaster, Phil Stone, and Mark Trayle.

\textsuperscript{34} Brown and Bischoff, “Indigenous to the Net.”

\textsuperscript{35} Ibid.

\textsuperscript{36} Menkman, “Glitch Studies Manifesto,” 343.
relationship is characterized by a focus on procedural dynamics and the acceptance of failure as essential elements of their artistic expression.

M@ggie’s Love Bytes (1995)

M@ggie’s Love Bytes is a networked dance theatre performance created by the collective Motherboard, co-directed by Amanda Steggell and Per Platou. The piece was premiered at the 1995 Norwegian Void Festival, featuring three female dancers “dressed in bras and pants and equipped with a plunger” (each representing M@ggie). The audience was present locally in the theater space and over the Internet via videoconferencing in places including London, San Francisco, Cologne, and Yokohama. During the performance, remote viewers may submit sound, text and image files which are played or projected on the screen behind the dancers. Thus the participants, some regularly active as collaborators (musicians and dancers who are involved in rehearsals), others for the first time during performance, become remote ‘lovers,’ providing gifts (love bytes) to stimulate the three M@ggies.

The performance is directed live by Platou and Steggell from three home computers, with the desktops of two computers projected onto a large wall, making the performance’s running process constantly visible. Utilizing CU-SeeMe and Ivisit for video and text transmission, dancers navigate both physical and virtual spaces, incorporating remote participants’ images and texts into the performance. These projections not only guide the dancers’ movements but also expand the audience and serve as dynamic scenography. File Transfer Protocol (FTP), Real Audio, Email, Internet Relay Chat (IRC) and speech-manager transforming text into speech enhance the multimodal interaction between performers and the digitally connected audience. Thus, the telematic performance is characterized by its use of several interwoven physical and virtual telecommunication platforms for interaction, dehierarchizing channels of communication, creating a spatial discontinuity.

In a statement on their website, Steggell and Platou articulate: “The performance is carefully planned to take on the unpredictability of cyberspace; improvisation is of essence! Computers inevitably crash, connections break. The restrictions and malfunctions of the technology are used creatively. For example, the time lagged, freezing and pixilating moving images in CU-SeeMe are juxtaposed with the fluidity of similar movements in brickspace. Time stands still, time moves on, time and place are out of sync.” Contrary to the common perception of technological limitations and errors as detrimental, Steve Dixon

38 Motherboard, Steggell, and Platou.
39 An inexpensive Internet based desktop videoconferencing system, introduced to the public in 1993 as part of an NSF funded education project called the Global Schoolhouse, which allows users to communicate each other using audio and video technology.
40 IRC is a text-based chat system for instant messaging created in 1988.
42 Brickspace refers to the physical, real space, as opposed to the virtual, cyberspace.
43 Motherboard, Steggell, and Platou, “M@ggie’s Love Bytes.”
highlights collective Motherboards’ innovative approach of integrating these imperfections into their artistic process.  

**Siku Aappoq (Melting Ice) (2015)**

The telematic performance *Siku Aappoq (Melting Ice)* by Yggdrasil Dance was a part of *Fluid States North* in 2015. The event connected three distinct geographical locations: the Nuuk Art Museum in Greenland, the Nordic House in the Faroe Islands, and the University of Copenhagen’s Amager Campus in Denmark, utilizing telematic technology and creating a shared space of artistic exploration. *Siku Aappoq (Melting Ice)* took place at the Art Museum in Nuuk, directly engaging a live audience while simultaneously being transmitted via Skype to audiences in Tórshavn and Copenhagen.

This choice reflected a deliberate move towards a low-key, non-elitist technological approach, making use of everyday materials for projection surfaces and creating a DIY aesthetic that contrasted sharply with the more polished, high-tech environments expected at professional teleconferences. The technical setup was designed to create a circular loop of telematic presence, positioning people at each location as both observer and observed, thereby fostering a form of engagement that oscillated between voyeurism and exhibitionism.

The performance encountered significant technological misperformances which were particularly pronounced due to the low bandwidth in Nuuk, resulting in a weak connection between Copenhagen and Nuuk. These glitches—freezes, pixelation, and sound disruptions—introduced moments of uncertainty and disconnection, challenging the audiences’ expectations of seamless technological communication, opening up space for alternative modes of engagement and understanding. Yet rather than merely presenting obstacles, these glitches became integral to the performance’s overall impact. They underscored the fragility and unpredictability of telematic connections, turning moments of technological failure into opportunities for creative engagement and reinterpretation, highlighting the impermanence and vulnerability of both digital communication and the the ecology of the cryosphere it sought to represent. The technical misperformances and glitches thus became an integral part of the performance’s narrative of global ice loss and the aesthetic experience of data loss.

In their article on “New Modes of Conferencing Across Distances,” Borggreen and Johannesen conclude with a generalized advice for future PSI(tele-)conference formats to use a low-key, non-elitist approach: “This will serve as a critique of an “upgrade” technology loop... The uneven access to Internet connections at various geographical sites, as well as a variety of technical issues, will create an awkwardness in terms of how to interact and behave, and will lead to an awareness of the gap between the familiar and the unfamiliar. Such renewed attention to technological and social expectations will foster alternative ways of being involved with, and make meaning from, the telematic encounter.”

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45 Choreographed by Birgitte Bauer-Nilsen and performed by Yggdrasil Dance, featured dancers Thomas Johansen and Alexander Montgomery-Andersen.
47 Performance Studies international (PSI) (for more details see: https://www.psi-web.org)
48 Borggreen and Johannesen, “Misperforming Telematics.”
Telematic WORLDing

The previously discussed works collectively underscore a fascination with the unpredictable and often flawed nature of digital and networked technologies in the history of networked music systems. By embracing glitches, delays, and failures as integral to their artistic practice, these artists and collectives foreground the highly complex assemblage of interconnected musical networks.

In “Putting a Glitch in the Field,” Nick Prior elucidates how glitch music exemplifies an inter-meshing of human and technological agents. By harnessing insights from both Pierre Bourdieu’s sociological theories and Actor-Network Theory, he demonstrates that glitch music is not merely an aesthetic or technological phenomenon but a complex socio-technical network. We contend that within this conceptual framework of glitch, devices and tools transcend their roles as passive conduits, emerging as active participants that disrupt traditional notions of spatial continuity and transparency in telematic performance settings. Thus, the techno-informational heterogeneity and the rupture lines inherent in the glitch-aesthetics underlines “network’s heterogeneous (at times maybe anarchic) character,” thus positioning its telematic SPACE within the framework of spatial discontinuity. On this line, the project kompost*klang*küche* aims to articulate the dynamics involved in these discontinuous processes.

Franziska Schroeder and Pedro Rebelo argue that such understandings and practices of the network as a communication “framework that favors glances, fragments, desires and fantasies” correspond with a transformation from the operation over the network to the notion of being/performing in the network. Contrary to their anthropocentric perspective, which emphasizes the human body as a disruptor of seamless connectivity—thereby challenging the notion of an all-encompassing continuously connected space—our examination of the glitch highlights the network's active role in shaping telematic SPACE. Consequently, the network “becoming noise,” becoming glitch, signifies not playing over or “in’ the network, but ‘through’ and ‘with’ the network.

Karen Barad articulates becoming in the context of neo-materialism as a dynamic interplay between social and material phenomena, suggesting a continuous process of transformation and emergence through their intra-action: “There is only intra-acting from within and as part of the world in its becoming.” This concept becomes relevant in unstable, discontinuous telematic SPACEs, where the distinction between real and virtual blurs, and glitches constantly mutate and matter.

This perspective shifts the focus from spatial configurations to the performative state of being alive to the numerous possibilities of becoming in telematic SPACEs, leading us to the proposition of the concept of telematic WORLDing. The notion of worlding, informed by non-representational theory and

51 Ibid., 5.
elucidated by Kathleen Stewart,\textsuperscript{54} refers to how affective forces and non-human agencies achieve expressivity, becoming legible and impactful in shaping individual and collective experiences. “The addition of a suffix –ing, denoting the verbal noun phrase,” shifts the telematic world “from a being to a doing; to a gerundive and generative process.”\textsuperscript{55} For Donna Haraway, worlding embodies the essence of SF (science fiction, speculative fabulation, storytelling, and fact telling), described as “a risky game of worlding and storying; it is staying with the trouble.”\textsuperscript{56}

Conclusion

With kompost\textsuperscript{*}klang\textsuperscript{*}küche\textsuperscript{*}’s explorations into the dynamics of spatial discontinuity we stay with the risky game and trouble of glitch. By doing so we challenge traditional narratives of the unlimited, the infinite, and the global network, and in turn illustrate how technological disruptions can be integral to the creation and understanding of networked artistic spaces as inherently complex intra-actions between physical and virtual space-times. By embracing the aesthetics of failure, Collective Mycelium’s project kompost\textsuperscript{*}klang\textsuperscript{*}küche\textsuperscript{*} underscores the importance of acknowledging technical limitations and glitches as opportunities for creativity and expression, rather than obstacles to be overcome. Accordingly, the kompost\textsuperscript{*}klang\textsuperscript{*}küche\textsuperscript{*} project exemplifies the transformative potential of telematic SPACE, challenging the conventional artistic and technological paradigms that prioritize spatial continuity. By proposing a shift in the conceptualization of telematic SPACE from realms of immersive unity to worlds of dynamic interaction and discontinuity, this perspective invites a critical reevaluation of the role of non-human actors within the fabric of telematic spaces.

Drawing upon the frameworks of new materialist theories, the project challenges boundaries between performers (users) and the technological apparatus, advocating for a more inclusive understanding of agency that recognizes the contributions of non-human actors within the telematic performance ecosystem. Through the analysis of historical and contemporary examples of networked music systems (spanning from Cage’s \textit{Imaginary Landscapes} to translocal conferences), we have positioned kompost\textsuperscript{*}klang\textsuperscript{*}küche\textsuperscript{*} within a historical continuum of networked artistic practices attentive to entanglements of becoming with the network and the technology. Consequently, our artistic and reflective practice uncover the network’s transformative potential, where the network serves not only as a conduit for communication in networked music systems, but where it becomes the message in itself.

In alignment with Karen Barad, Kathleen Stewart, and Donna Haraway, the term \textit{telematic WORLDing} emerges as a conceptual framework. This term encapsulates a process of becoming-with, weaving together a complex web of human and non-human patterns of relatedness. This framework invites a reconceptualization of telematic spaces as sites of rich, interdependent co-creation, underscoring the transformative potential of engaging with digital networks as vibrant, agential entities.

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Directed by Chimère Électrique aka HannaH «Vyborg» Walter and Robert Torche

Performed and realized by:

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- Julien Mégroz, sound and performance
- Margaretha Jüngling, kitchen and performance
- HannaH “Vyborg” Walter, performance
- Robert Torche, technique and performance
- Erwin Fonseca, camera and multimedia
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- Cedric Spindler, programming
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57 https://worldingmycelium.space
58 https://networkperformance.space/
59 The research project group consists of Patrick Müller, Benjamin Burger, Martin Fröhlich, Joel De Giovanni, Roman Haefeli, Eric Larrieux, Johannes Schütt, Hannah “Vyborg” Walter and Matthias Ziegler
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