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ABSTRACT In recent years, various forces within and outside the music industry – record producers, hardware and software suppliers, and Internet service providers – have created techniques and tools that allow recording studios in remote locations to be networked in ever more complex and intimate ways. The effort behind the creation of the 'network studio' is, in part, the result of an overall progression in the historical development of the tools, architectures and practices of the contemporary recording studio. Studios do not exist in a musical or cultural vacuum, however: traditionally, music scenes, session musicians, and local aesthetics and practices have played an important role in the development of specific approaches to recording and have had an influence on the resulting sounds. But the rise of the network studio raises fundamental questions about such relationships and about the role of space and place in sound recording and, in this regard, can be considered as an expression of larger tendencies described within various theories of globalization. This paper addresses how the emergence of the network studio, with its emphasis on standardized technologies and practices and its reliance on the virtual space of network communications, may have an impact upon and/or work alongside conventional recording studio practices.

Keywords acoustic space, digital networks, globalization, mixing consoles, music scenes, place, recording studios, reverberation

The Network Studio:

Historical and Technological Paths to a New Ideal in Music Making

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> Rocket Network is the industry standard global production network for audio production and session management. The company has established this standard through development and resale partnerships with leading audio companies that account for more than 90% of the professional audio production market. Rocket Network allows multiple users to simultaneously access and make changes to a file at the sub-file level, from anywhere in the world.[1]

Between 1995 and 2003, the Rocket Network generated considerable excitement within the recording studio industry by offering a server-based technology that allowed multiple users to access and update digital audio files via the Internet. Using a standard software recording application (such as Digidesign's 'Pro Tools' or Steinberg's 'Cubase VST'), users could

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record individual audio files and add them to existing tracks (in the manner of recording an overdub), or edit and mix entire multi-track sessions, in a near real-time collaborative fashion. The promotional discourse of the Rocket Network ranged from the mundane – the promise of reduced production costs – to the hyperbolic: 'the Company is changing the paradigm for audio collaboration and production by eliminating the geographic, time and cost barriers inherent in brick and mortar studio work'.[2]

What is interesting in these statements is not simply the way in which they create yet another universalizing myth of networked communications (a similar mythologizing has been a feature of the introduction of new communications technologies ever since the telegraph), but rather, the way they promulgate the network model itself as an idealized form of sound-recording practice. The basic question that motivates the investigation found in this paper, however, is not the validity of such a model, or even the history of the rise (and eventual fall) of the Rocket Network (although I will return briefly to the story of the Rocket company at the end of this paper). What most interests me is the question of how we got from the idea of the 'brick and mortar' recording studio – a very specific kind of place, made up of carefully engineered acoustic spaces, in which a variety of actors (artists, session musicians, producers and engineers), working with sophisticated technologies, come together to create a sound recording – to this notion of a placeless, virtual studio in which just about anyone with a computer, anywhere in the world, can participate in the recording of music.

The 'easy' answer to this question would be that the relatively recent rise of computer technology, multi-track recording software and high-speed Internet connectivity has created the necessary preconditions for technologies such as the Rocket Network to exist. In purely technical terms, this may be true. However, while digital technology may be considered as a *necessary* technical precondition to the existence of the network ideal, it is not a *sufficient* answer to the more general question of how we got there.

The effort behind the creation of what I will call, for lack of a better term, 'the network studio', can be understood as the result of an overall progression in the historical development of the tools, architectures and practices of the contemporary recording studio. The aim of this paper is, in part, to trace a number of neglected aspects of this historical development. In addition, the rise of the network studio raises fundamental questions about the role of space and place in audio recording. In order to address some of these questions, I will draw on a number of theoretical observations made by Manuel Castells (2000), Arjun Appadurai (1996), Marc Augé (1995) and Antoine Hennion (1989). In different ways, each of these authors points toward a new form of spatial logic that is the result of large-scale changes in economy, information technology and social organization. As I will argue, the rise of the network studio can be considered as an expression of this new spatial logic.

Globalization, Information, Space and Place

In recent years, scholars from a wide range of disciplines and fields of study – from economics to geography, from information and technology studies to anthropology – have attempted to analyse and understand the forces at play in the present historical moment, now generally referred to as 'globalization'. The literature on globalization is vast and often contradictory, not simply in the sense that academics disagree on a number of important issues about globalization but, more importantly, in the sense that globalization is itself characterized by tendencies that often appear to be contradictory in nature. While it is not my intention to survey this vast literature, it is important to outline a number of issues within globalization theory that are significant for the arguments that follow, concerning the development of technology within the field of sound recording and studio networking.

In his book, *The Rise of the Network Society* (2000: 407–09), Manuel Castells argues that in the present historical moment, economic activity and information systems have been joined together to create a new kind of 'spatial logic' – a logic that he calls the 'space of flows'. Central to his argument is the notion that urban centres are today not so much 'places' as 'nodes' in a network of information flows, 'a process rather than a place' (Castells, 2000: 443). It is not that 'places', as such, or the relationship between local and global, have ceased to exist, but rather that the space of flows has emerged as a new and dominant articulation of local and global, place and process.

It is, in part, this tension between place and process that I would like to explore in relation to the recording industry and, in particular, the notion of the network studio. At its highest levels of organization, it could be argued that the record industry epitomizes many features of the modern global enterprise: although most record companies comprise numerous sub-divisions, record labels, and the like, which function semi-autonomously and are dispersed throughout the world, both ownership and financial control are concentrated in a handful of large multinational corporations and an even smaller number of urban centres, where their headquarters are located and their various activities coordinated (through digital networks and other means; see Burnett [1996] and Negus [1999]). To a large degree, professional recording studios (which have also been traditionally located in metropolitan centres) can be considered as part of an independent service industry lying on the periphery of the record industry proper: most record companies no longer maintain studios of their own and rely on outside contractors for the production of music. In their attempt to service a highly mobile clientele (the recording artists), studios have increasingly adopted recording technologies and practices that enable them to expand and coordinate their activities on a global scale. In this sense, as I will argue, the recording studio itself can also be considered as a kind of 'node' and its activities have much in common with those of other urban service industries described by Castells (2000: 410).

For Castells, as suggested earlier, the space of flows is not limited to the world of finance and its service industries: society is organized around 'flows of capital, flows of information, flows of technology, flows of organizational interaction, flows of images, sounds, and symbols' (2000: 442). In this formulation, Castells' notion of flows has much in common with Arjun Appadurai's (1996: 33–37) framework for understanding the complexities of the global economy and culture. Appadurai's global order is characterized by flows within a multidimensional landscape: 'ethnoscapes' describes the movements of people (tourists, immigrants, and so on); 'technoscapes' refers to the dissemination of technologies (both mechanical and informational); 'financescapes' represents the flow of capital; 'mediascapes' refers to the dissemination of images and information via media; and 'ideoscapes' is related to the ideologies of Western culture (freedom, democracy and so on) as they have spread throughout the world and the counter-ideologies that they have engendered.

But whereas Castells' space of flows essentially describes a single, dominant system or 'logic', each of Appadurai's landscapes is subject to its own set of possibilities and constraints, and the relationships between them are characterized by 'disjuncture' and unpredictability. In this way, Appadurai's landscapes are conceived in such a way as to take into account the many contradictions present in the global order and not simply the dominant configurations of power. This conceptual flexibility is significant, for example, in understanding the tensions surrounding the introduction and dissemination of new technologies in music – from cassettes, to compact discs (CD), to the Internet – where local production and distribution, piracy and other factors have long challenged the ability of the record industry to control the global marketplace.

For my purposes, Appadurai's notion of disjuncture is important because it allows one to understand how the recording studio, as a kind of 'technoscape', enables both the production of music on a global scale by dominant elites as well as by more regionally-based, independent or autonomously organized groups. In this sense, the networking of the recording studio may reflect the same contradictions, described by Keith Negus (1999: 171), that characterize the global circulation of popular music more generally.

Similarly, when Castells explores, in more detail, the spatial manifestations of his notion of flows, he continues to do so primarily in relation to dominant elites: he argues, for example, that elite groups within the network society construct unified, secluded spaces for themselves (international hotels, airport lounges and the like) that are essentially homogeneous in character and disconnected from the history and culture of the places in which they reside. Marc Augé (1995: 77–78) has described such architectural spaces as 'non-places': a kind of 'space which cannot be defined as relational, or historical, or concerned with identity'. For his part, however, Augé is less concerned with the spaces created by global elites than with a more general condition of modernity – or 'supermodernity' as he refers to it – that also includes the anonymous spaces of

supermarkets, automobiles and, as Michael Bull (2000) has suggested, the use of personal stereos. In this regard, the recording studio, whether one thinks of the elite studios of major metropolitan centres or the modest home studios of semi-professional and amateur musicians, should perhaps also be considered as a kind of 'non-place' – a world relinquished 'to solitary individuality, to the fleeting, the temporary and the ephemeral' (Augé, 1995: 78).

Indeed, as I will argue later, the progression from 'brick and mortar' studios of the past to the network studio ideal required that the recording studio first become a kind of 'non-space' (in acoustic terms) as well as a 'non-place'. In doing so, I will draw certain analogies between the design of the interior acoustic space of the studio and its detachment from the outside world. In this regard, I am preceded by Antoine Hennion (1989: 408) who has suggested that there is an essential relationship between the acoustic *insulation* of the studio and the desire for a perfect *isolation* from the outside world, a laboratory-like environment where musical experiments can take place: 'in this vision we are not confronted with an acoustic problem but with the plans for an idealized microcosm of creation'.[3] For Hennion, this isolation, which necessarily absents the public, provides the conditions and the rationale for the producer, as cultural 'intermediary'. In the present context, I will argue that it also provides one of the preconditions for the creation of the network studio as a 'non-place'.

The theories outlined earlier clearly overlap and complement one another in various ways. However, there also exist a number of tensions and contradictions between them that must, for the moment, remain unresolved in order to explore some of the divergent and equally contradictory tendencies present in the development of the recording studio, its architecture and technologies.

Recording Studios, Acoustic Space, and Place

In the early days of sound recording, it could hardly be said that the development of a 'proper' studio environment was an important item on the agenda of most record companies. In general, sound recordings were made in makeshift environments, the more important issue being simply to get an adequate volume of sound into the horns of the primitive recording devices. Musical ensembles had to crowd together around the recording horn and they were arranged in such a way as to balance the soft and loud instruments (see, for example, Read & Welch, 1976: 461–63). The invention of the 'Stroh' violin – a violin equipped with its own acoustic horn, thus creating a strange kind of symmetry, a mirror image of the early acoustical recording devices themselves – is certainly among the most curious attempts to deal with the problem of inadequate sound level.

The adoption of the electrical microphone and amplification in recording after 1925 to a large degree solved the problem of volume levels and, in a certain sense, allowed musicians to return to the conditions of an earlier status quo: violinists could once again play their treasured instruments and

ensembles could be recorded in more familiar (and more comfortable) seating arrangements (Read & Welch, 1976). For their part, sound engineers could retreat to the relative isolation of the 'control room' – a newly instituted space within the recording environment where they could attend to the tasks of balancing and manipulating microphone signals. But a new problem arose: the electrical recording devices were not only highly sensitive to the sound of voices and musical instruments, but also to the multiple reflections (echo and reverberation) that might be present in the recording environment. The presence of these reflections could potentially 'muddy' any recording and also contribute to the reinforcement of some frequencies over others.

Read & Welch (1976: 376–80) have described some of the attempts that were made in the late 1920s and early 30s to deal with the problem of acoustic environment – both that of the recording environment and the playback environment, that is, the home itself. Some recording engineers, especially those who came from the world of radio, preferred to record in relatively 'dead' acoustical environments and to place the microphone as close to the voice or instrument as possible. Those who wished to take advantage of the ability to record ambient information and to create an 'audience' or 'concert hall' aesthetic tended to record in more naturally reverberant spaces and often resorted to using multiple microphones. The latter practice, employed initially in order to gain greater control of the balance between instrument and reverberant sound, often resulted in even greater fuzziness and distortion in the recording.

What seems most important during this period is, first, the realization that the recording engineer could play an important aesthetic role in the creation of sound recordings and, second, that there was a need for recording environments appropriate to the purposes and aesthetics of recording. Not surprisingly, it was during the 1930s that the first recording studios, properly speaking, were designed and built: the early studios assumed an essentially divided architecture (and an attendant division of labour), with one space (the recording studio) dedicated to performing sounds and the other (the control room) devoted to their manipulation. And it is precisely within this divided architecture that the studio emerges as a kind of laboratory, in Hennion's terms, for experiments in recording.

London's well-known Abbey Road Studios, established by EMI in 1931 (and known then as EMI Studios), were reputed to be the first and largest purpose-built recording facility in the world. From the outset, Abbey Road was designed to house several separate recording studios, the largest of which could hold a full symphony orchestra and chorus. In its present configuration, the large 'Studio One' is complemented by several other studios that are suitable for smaller ensembles, and at least one is equipped with a separate vocal booth (a small room, acoustically isolated from the main recording studio), which has become essential in most contemporary pop-music recording. Significantly, the essential acoustic character of the various recording rooms at Abbey Road has remained largely unaltered over the years (thus eschewing many of the trends in the

design of studio acoustics that will be outlined later), although the technology housed within the control rooms has changed radically: each of the control rooms is now equipped with multi-track tape recorders and is centred around a large recording console outfitted with automated mixing capability. Since its inauguration, Abbey Road has been used extensively for recording classical music as well as film soundtracks, but has also been the site of many popular music recordings as well (most famously, those of the Beatles during the 1960s). Recording facilities such as Abbey Road are renowned for the unusual size and acoustic quality of the studios, the professional quality of the recording equipment, and their highly trained and experienced staff of engineers. Its stature as a 'place' in the world of music recording is also related to the length and continuity of its history (which few studios in the industry can match), its legacy of significant recordings in a variety of genres, and its location in a major centre of industrial power.

If Abbey Road set a kind of standard for the recording studio of the early 1930s, it wasn't long before other aesthetic approaches, especially those associated with more popular forms of music, were to result in significantly different design considerations. In his book, *Sessions with Sinatra: Frank Sinatra and the Art of Recording*, Charles L. Granata (1999) describes in detail some of the characteristics of the technology and early studios used by companies such as Columbia Records, RCA Victor and Decca during the 1930s and 40s. For Granata (1999: 43), the studios of this period had a special significance: 'Just as famous concert halls help to define the signature sound of the symphony orchestras that play in them, specific recording studios once played a huge role in defining the highly individual sound of the recordings created by the major record labels'. But it was not simply the acoustic quality of the recording studios that accounted for the unique sound achieved by the studio engineers: Granata (1999: 42–47) describes how, by the mid 1930s, it had already become common practice to add extra reverberation to the recording mix, especially for vocals and strings. To achieve this effect, the studios routed some of the sound of the mix to speakers in a nearby room – a men's washroom, a back stairwell or basement room – and then used microphones to pick up the reverberant information and route it back to the mixer. Similar practices were employed throughout the radio and film industries during the 1930s as well (see Thompson, 2002: 281–83), but were not used as extensively as in music recording. The growing importance of artificial reverberation techniques to the production of recorded music was perhaps signalled in 1940 when, according to Granata, RCA Victor rededicated one of its three studios, located on 24th Street in New York, exclusively for use as an echo chamber.

By the 1950s, the design and use of echo chambers or, more properly speaking, 'reverberation chambers', had become the object of much experimentation, scientific investigation and financial investment (see, for example, Rettinger, 1957). In the case of the Capitol Records' studios in Hollywood, CA, considerable time and money were spent in designing and

perfecting the chambers at both the Melrose Avenue studios and the later Tower studios, constructed at Hollywood and Vine, in 1956. In addition, Capitol's engineers developed special techniques for their use – techniques that would only come to full fruition in the age of multi-track recording: 'In order to create a realistic portrait, the engineers manipulated the reverb and controlled the amount that was used on each individual microphone' (Granata, 1999: 111). Granata's use of the term 'realistic' in this instance is curious given that the techniques employed – close-up 'miking' on the vocals, combined with strings bathed in a wash of reverberation – resulted in a highly artificial sound; however, it does suggest the extent to which studio techniques have played into, and been disguised by, notions of 'high-fidelity'. At the Capitol Tower studios, the chambers were buried deep underground and equipped with specially-selected speakers and microphones, creating a remarkably clear and smoothly decaying reverb that would become a significant component of Tower studios' 'signature sound' (Granata, 1999: 109–18).

Thus, even in the early days of studio recording, it became clear that the sound quality of a recording was the result of not only what happened in the studio proper, but equally important, what happened in the control room and ancillary spaces (the chambers) as well. The use of acoustic chambers allowed for a great deal of flexibility in the approach taken to miking and recording. In addition, their use led to a reconsideration of the design of the studio itself: in allowing them to use smaller, increasingly 'dry' studios, engineers could gain a greater level of control over instrumental, vocal and ambient sounds.

The development of acoustic chambers for the purpose of creating artificial reverberation and the corresponding increase in the adoption of acoustically muffled recording studios should perhaps be considered as one of the first steps taken towards the transformation of the studio into a kind of 'non-space': reverberation was no longer considered as the characteristic of a specific recording space per se, but rather, a 'special effect' to be added *to* the recording in a precise and controlled fashion. The ultimate significance of these architectural innovations, as was noted earlier in relation to the work of Antoine Hennion (1989: 407–08), is not only the isolation and control of the acoustic properties within the studio but, more importantly, the isolation and control of access to the studio from the outside world as well.

Ironically, the acoustic chambers themselves were still anchored to a real, physical space and, in some instances, their unique characteristics became as desirable as the recording facilities of which they were a part: the reverb created by the underground chambers installed at the Capitol Tower studios, for example, became so highly prized that producers would rent the facilities just to add the sound of the chambers to recordings made elsewhere (Granata, 1999: 117). In this regard, while the studios had become, in acoustic terms, a kind of 'non-space', they still retained some sense of 'place', if only in terms of recording aesthetics and industrial organization.

The cost of designing, constructing and maintaining acoustic chambers could be prohibitive, however, and it wasn't long before other technologies were introduced to achieve something resembling their effect in recordings. Paralleling the history of sound reproduction technologies more generally, these took the form of electro-mechanical, magnetic and digital devices, each using different technical means for multiplying and delaying the audio signal. For example, spring reverbs, first developed for use in electronic organs (and later incorporated into guitar amplifiers), were introduced into recording studios in the 1950s; large metal plates equipped with one or more microphone pick-ups were later used to create a denser, higher quality (albeit, 'tinny' sounding) reverb that became the norm in professional recording studios during the 1960s and 70s; and various magnetic tape-based devices were also used to create echo effects. Eventually, digital reverberation devices would replace all of these techniques; however, by the time they were introduced, the characteristic sound of acoustic chambers and plate reverb had become so much a part of popular music aesthetics that algorithmic imitations of them were included as part of the standard presets in most models. Digital reverb thus introduced a kind of 'second-order simulation' – an artificial device simulating the effect of a previous artificial device – into recording aesthetics (Théberge, 1997: 196).

The displacement of reverb chambers by relatively inexpensive electronic and, later, digital signal processing devices was an important step towards the development and viability of ever-smaller professional (and amateur) recording facilities. But perhaps more importantly, they also contributed to both the increasing isolation of the recording studio and its essential character, in Augé's terms, as a generic and interchangeable kind of 'non-place'.

The Decentralization of the Recording Studio

The more or less complete transformation of the recording studio into a sort of 'non-place' took at least a couple of decades to accomplish, however, and other factors than simply technical and acoustic ones played a significant role. Indeed, throughout the 1950s and 60s the sound of early rhythm and blues (R & B), rock 'n' roll and rock was often dependent upon specific recording studios as sites of experimentation and production. According to Peterson & Berger (1971), the rise of new styles of popular music from the 1950s onward created a condition of 'turbulence' within the marketplace for recorded music and this encouraged record companies to rely less on centralized, in-house production and more on outside, entrepreneurial producers. Compared with the big record company studios, many of the recording studios associated with the new forms of popular music were small, makeshift affairs, owned and operated by independent producers and engineers. Because recording studios do not exist in a musical or cultural vacuum, however, the music produced at these studios often bore the mark of the musical scenes they inhabited,

employing local session musicians and reflecting local musical styles and aesthetics.

For example, Cosimo Recording (also known as J&M Studio), owned by Cosimo Matassa, helped to establish New Orleans as a recording centre during this period. The acoustics of Cosimo's recording studio, his simple, clean recording console and straightforward approach to recording, and his access to a unique group of New Orleans-based session musicians, attracted a number of well known R & B and early rock 'n' roll artists, including Fats Domino, Joe Turner, Ray Charles and Little Richard. His studio came to be known as 'the Nashville of R & B'.

Similarly, Stax Records, operating out of a converted movie theatre in Memphis, TN (the front of the theatre also served as a record shop), was renowned during the early 1960s for its unique sound. The theatre was partitioned: home-made curtains were hung in order to partially reduce the natural room reverberation, a control room was built onto the former stage area and a bathroom was pressed into service as an echo chamber. Together with the musical contributions of a unique group of local musicians and artists, the studio played a large role in defining the sound of early 1960s soul music: for example, it was used extensively by Atlantic Records' producer, Jerry Wexler, and contributed much to the success of that label's roster of soul artists.

In addition to the sound of specific studios and their complement of session musicians, recording technology and innovative recording techniques themselves became an increasingly important factor in achieving a unique, popular sound. For example, Tom Dowd, chief engineer for Atlantic Records during the late 1950s and early 60s, was among the first to fully exploit the possibilities offered by multiple miking and multi-track recording. Dowd paid particular attention to the placement of microphones, especially on bass and drums, and on the creative uses of equalization, bringing out and emphasizing frequencies that favoured bass, on the low end, and cymbals, on the high end. In acquiring an early prototype 8-track recorder during the late 1950s (the first was created by Ampex for guitarist Les Paul, to his own specifications), Dowd was able to experiment with multi-track recording in a manner unavailable to most producers and engineers of the period: splitting the rhythm section onto separate tracks, and overdubbing and editing vocals freely.

The main development of multi-track recording, and the techniques associated with it, took place somewhat later, of course, between 1965 and 1975. Before 1965, studios were generally not equipped to deal with more than four tracks of recording; by the early 1970s, 8-, 16-, and 24-track tape recorders had been introduced. The rise of rock gave impetus to the intense proliferation of studios, roughly between 1968 and 1973: according to *Billboard*, during this period the number of new studios in the USA grew by about 70 per year. It was also during this period, according to Edward R. Kealy (1979), that the sound engineer emerged as an 'artist' in his/her own right. This 5-year period is also framed by what may be two landmarks in the history of popular music: the 1967 release of the Beatles' album, 'Sgt

Pepper's Lonely Hearts Club Band', which was certainly among the boldest uses of the recording studio of its day; and the emergence, in 1974, of Disco, perhaps the first genre of popular music never to have known an existence outside of the studio environment.

By the end of the 1970s, 24-track studios were the norm within the industry and many high-end studios were capable of recording even greater numbers of tracks; the final mix had become such a complex process that various forms of automation had begun to be implemented in mixing console design. Ironically, it was the more-or-less standard 24-track studio of the 1970s and 80s that became most clearly a kind of 'non-place'. Despite the promotional discourses that portrayed each studio as unique, they were, by and large, essentially identical in character: acoustically dead, less connected to local musicians and musical styles and more intent on reproducing music in a variety of 'international' genres, and possessing a range of increasingly sophisticated and standardized recording technologies. Among those technologies, none was more important than the recording console itself.

The Recording Console as a Communication Device and the Studio as 'Node'

While much has been written about the development of multi-track tape recording, overdubbing and the like, relatively little attention has been given to the development of mixing consoles during this period. This lacuna in the literature of popular music studies is surprising, especially given the significance accorded to remixing and 'versioning' in popular music from the 1980s onward, and the importance of mixing consoles not only in studios but also in contemporary live performance contexts (where several consoles and engineers might be employed simultaneously for house sound, stage monitoring and recording purposes). Furthermore, the rise of the 'home studio' from the 1970s onward was predicated on the availability of inexpensive multi-track recorders with integrated mixing facilities: for example, the key innovation in the development of Tascam's 4-track consumer equipment of the period was not simply the introduction of the cassette as a recording medium, but rather, its complete integration with a flexible mixer of modest dimensions. In contrast, and in recognition of the centrality of the mixing console in modern recording, the technical literature on audio engineering routinely devotes entire chapters to console design and use, often referring to it, metaphorically, as 'the heart of the recording process' or the 'nerve centre of any broadcast or recording' (see, for example, Alten [1994] and Eargle [1980]).

It is important to recognize here that the entire development of multi-track recording, and the practices associated with it, is inseparable from a simultaneous evolution in the design of mixing consoles. Indeed, every increase in the number of recorded tracks placed a new emphasis on the control room as the focal point of the recording studio, and at the centre of this development was the expansion and increased complexity of the

mixing console. Even the influence of the sheer size of modern recording consoles on control room design should not be underestimated: for example, a recent issue of *Mix* magazine describes PatchWerk Recordings, a new studio facility in Atlanta, GA, where the design of the control room had to give consideration to accommodating a console that is more than 18 feet (about 5.5 m) wide.[4] Such consideration includes not only designing the physical characteristics of the room around the console, but also the audio monitoring systems as well.

During the 1950s and early 60s it was not uncommon for engineers to build their own consoles, adapt existing ones to their needs, or have them custom built by others to their own specifications. Consoles might have included as many as 24 inputs but only three or four output busses; as the final mix was dependent on the small number of available tracks, adding reverb or equalization to individual microphones had to be done at the time of the initial recording (Eargle, 1980: 173). By the time that 16-track tape-recorders were introduced at the end of the 1960s, however, the complexity of signal routing, the need for flexible monitoring (providing for separate cue signals, or 'foldback', to the musicians during overdubbing sessions), and the large-scale implementation of equalization, compression, reverb and other special effects devices, required that mixing consoles be created by specialized designers and manufacturers. More than a simple change in the scale and complexity of console design, I would argue that these developments signal a shift in the *function* of the console from an audio 'mixer' to that of a signal processor and communications device within the studio.

Among the designers who rose to prominence during this period was Rupert Neve. Neve began making custom-designed consoles for the recording, film and broadcast industries in 1961. Operating out of a coach house in a small village, Melbourn, near Cambridge, UK, from 1964 onward, Neve's innovative transistor-based consoles established a reputation for flexibility and sound quality that was virtually unparalleled by any other manufacturer. By the end of the 60s, he had established a large factory operation, in Melbourn, and other manufacturing plants and sales offices soon followed in Scotland, the USA and Canada. Over the years, Neve's company was at the forefront in developments in console design, automation and digitization; and here it should be noted that computers were first introduced into professional studios not as aids in recording, but as part of the control mechanism in mixing consoles. In 1997, a Technical Grammy Award was bestowed on Neve, thus highlighting the importance of console design within the recording industry as a whole.

Neve dedicated his operation resolutely to the high-end, professional studios of the period, where US$100,000 (or more) for a recording console was not an unheard-of sum of money, leaving the needs of mid- and lower-end studios to the likes of Tascam and a host of other manufacturers. For many years, his only competition came from another UK-based operation, Solid State Logic (SSL). Founded in 1969, SSL was already beginning to exert a substantial impact within the professional recording market by the

mid-1970s and, in 1977, introduced a console with an integrated computer system; by the late 1980s it had expanded its operations into all areas of the music, film and broadcasting industries, manufacturing not only consoles but innovative, non-linear audio post-production technology for video.

The importance of SSL in the context of this paper, however, stems from its introduction, in 1990, of 'SoundNet', which it describes as 'the world's first multi-use digital networking system'. Given the role of modern recording consoles in facilitating communication *within* the studio apparatus, it is perhaps no accident that a console manufacturer should be among the first to pursue the idea of networking *between* studios as well. As in the case of studio acoustics (described by Hennion), there is a relationship between the role of technologies within the studio complex and outside it as well; in this case, however, the console was not used to further isolate the studio but to facilitate communications between studios in different locations.

SoundNet made use of Integrated Services Digital Network (ISDN) lines to transfer digital audio files and other information to remote locations in real time. It was used by Phil Ramone to record and mix, simultaneously, contributions from musicians in Singapore and the UK for a Jesus Jones single in 1995 (Cunningham, 1998: 360–62). The expense and complexity of technically coordinating remote recordings in real time prevented SoundNet from being widely used within the music industry; nevertheless, it represented an important step towards the realization of a technology that would satisfy aspirations within the industry to connect artists and producers anywhere in the world, and it is thus an important predecessor to more recent developments.

The idea of a completely integrated world system for recording is, in part, the by-product of the diffusion of studio technology and, more generally, the increasing global circulation of musical styles and genres since the 1970s. Even by the late 1970s, modern recording studio technology had spread to urban centres throughout the world: multi-track recorders and mixing consoles were as much a part of innovations in (and packaging of) local musical styles, such as Jamaican reggae, as they were in mainstream US pop. And as noted by William Ivey (1982), by 1975 even country music which, much like early R & B and rock 'n' roll, had previously been created by a network of local musicians in combination with a set of specific studio practices associated with the Nashville scene, could be perfectly emulated by session musicians and engineers in just about any major music centre in the world.

In this sense, as the production and consumption of popular music have become part of the global cultural matrix, the contemporary recording studio must be considered as a central component of the 'technoscape' that supports it. Furthermore, as the development of multi-track recording technology and, especially, mixing consoles and artificial effects devices (with their emphasis on the control room as the centre of musical activity) has led to a relatively standardized studio apparatus, the studio has become

not only a kind of 'non-space' in acoustical terms, but also something akin to Augé's notion of a 'non-place': a more or less generic, functional place, a place at which musical 'travellers' can stop over to make recordings whenever and wherever it suits them, and always within the comfort of a certain temporary isolation. In this regard, the earlier studios, with their close links to specific local scenes, could be thought of as existing within an earlier stage of modernity where the coexistence of the past within the present could be more clearly felt. With the advent of what Augé refers to as 'supermodernity' we have entered a different phase: indeed, the rise of the more or less generic 24-track studio as the norm of commercial production in the late 1970s, the home studio, and so-called 'residential' studios (professional recording studios located in rural or exotic locations that combine studios and living facilities, such as Le Studio in Morin Heights, Québec, AIR Studios on the island of Montserrat or Compass Point Studios outside Nassau, the Bahamas) attests to the ubiquitous and even touristic character of the recording enterprise of the time.

The role of the recording studio in the global production of popular music was perhaps most clearly illustrated by Paul Simon in his album, *Graceland* (1986). Quite apart from the political controversies that it generated as a result of violating the ban on South Africa, the album epitomized a certain notion of pop internationalism, combining a curious mixture of American rock 'n' roll, country, South African jive and Cajun zydeco. But for my purposes here, it is the technical infrastructure that allowed for the coordination and execution of the project in the first place that is of interest: recorded, in part, in Johannesburg, London, New York, Los Angeles, and Crowley, LA, the album would have been almost inconceivable in any era before the diffusion of multi-track studio technology.

If Simon had to go to places as far removed as South Africa and Louisiana to find new musical collaborators, it is perhaps because it is in such places where one still finds the vestiges of an earlier modernity. Even if one accepts the idea that these remote facilities are more rooted in local contexts and traditions, the articulation of those localities into the global production process is perhaps new, the studio functioning more as a kind of 'node' in a larger communication network than as a destination – a 'place' – in and of itself. Indeed, Castells' (2000: 417) notion of spatial flows recognizes that the 'new industrial space' requires the contribution of specialized labour forces, exhibiting a range of different social (or in this case musical) features.

For Castells (2000: 443), the essential function of the node is that it articulates the local with the global: 'Location in the node links up the local with the whole network'. Furthermore, he notes that the nodes are hierarchically organized, and in this regard, it is interesting to note that Paul Simon travelled with his own engineer on most of his recording trips (local engineers were credited only as 'Assistants' in the liner notes) and most of the finishing work for the album was done in New York. Similar articulations and hierarchies have characterized the role of multi-track recording studios in locations otherwise 'marginal' to the mainstream

industry and have been discussed by ethnomusicologists and popular-music scholars concerned with various forms of 'world music': for example, in the case of Zouk music of the French Antilles, Jocelyne Guilbault (1993) has described how basic instrumental tracks were sometimes recorded in local studios and then sent to Paris where engineers would add synthesizers and other sounds, thus tailoring the music for European sensibilities.

Digital Recording and the Network Ideal

During the 1980s and 90s, several waves of innovation in digital musical instrument and digital audio technologies contributed significantly to the idea of the studio as a kind of non-space/non-place: for example, the introduction of digital synthesizers, drum machines, samplers and musical instrument digital interface (MIDI) sequencers[5] during the early 1980s offered musicians and producers the possibility of recording complex musical arrangements without the requirement of hiring session musicians. MIDI, in particular, offered a technical standard that became the basis for the proliferation of not only digital musical instruments, but also the first generation of popular music composition software (see Théberge, 1997). By the late 1980s, MIDI hardware and software, and personal computers, had become completely integrated into many recording studios, from the highest professional levels to the most modest of home set-ups.

Indeed, a new category of studio installation emerged during this period: based on MIDI technology and the increasing quality of low-cost recording equipment, the so-called 'project studios' – often little more than large home installations that had begun to take on commercial work – were soon regarded as competitors by the larger, more professional studios. Typically, the early project studios were limited to about eight tracks of audio recording (augmented by considerably more MIDI capability) and consisted of little more than a control room and perhaps a small booth or partitioned area for occasional vocal and solo instrument recording. The increasing dependence on MIDI technology, and the prefabricated sound programs associated with it (including not only the sounds of Western musical instruments but those of non-Western traditions as well; see Théberge, 2003), led many to criticize this period as one in which much popular music began to sound the same: not only had the studio become a non-place but, in the process, it seemed that it had become incapable of producing original sounds.

It is not my intention to debate such claims here; however, it should be noted that the increasing technical quality of the recordings produced in such modest facilities and the speed with which low-cost recording equipment has been diffused throughout the world, have also created the conditions for a different kind of 'technoscape' – one that encourages largely independent, autonomous forms of local production rather than necessarily contributing to the dominant networks of power described by Castells (2000). This has become as true in the industrialized nations,

where independent music production (now aided by alternative distribution networks such as the Internet) has continued to proliferate, as it is in many underdeveloped nations. Indeed, in what may seem the most unlikely places in the world – from Africa to Oceania, Asia to Latin America – individual musicians are using low-cost studio technologies to cut and paste the sounds of global pop with local musics, thus living out the contradictions of 'global' and 'local', of culture and identity in a (super)-modern world on their own terms (see, for example, Greene's [2001] description of dance music in Nepal).

In some ways, the next generation of digital technologies has made these global contradictions even more evident, and I would like to pursue this line of thought by briefly describing two recording projects. In both cases, the projects were facilitated by the use of digital audio recording software ('Pro Tools' in these particular instances), albeit at very different levels of cost, sophistication and technical quality. This latest generation of software emerged during the 1990s and combines both digital audio recording capability and MIDI sequencing and is perhaps best exemplified in programs such as Digidesign's 'Pro Tools', Steinberg's 'Cubase VST' or Emagic's 'Logic Audio'. While digital recording hardware and software devices had been available in high-end recording studios for a number of years, this generation of software has been enabled primarily by the increased levels of processing power and storage capacity found in personal computers from the 1990s onward and it expanded the number of available recording tracks beyond previous limits, especially for the project and amateur studios (by the end of the 1990s, even a relatively modest computer set-up was capable of producing 24 channels or more of digital audio). Because these software programs simulate many elements of the traditional recording studio – from multi-track recorder, to mixing console and out-board effects processors, as well as virtual synthesizers and MIDI sequencers – a greater level of integration and standardization has been achieved than was possible with earlier recording technologies. Furthermore, because the technology is no longer based on linear, tape-oriented designs, a whole new form of non-linear editing has emerged that is marked by greater levels of precision, by the ability to synchronize material drawn from disparate sources, as well as by a more flexible approach to large-scale musical arrangement, mixing, and re-mixing.

In the case of Shania Twain's (2002) release of *Up!*, one can see the dominant logic of global marketplaces and contemporary production practices at work. The album was produced in three separate, full-length CD remixes – an unprecedented move even in the world of international pop where remixing has become a common way of tailoring songs for different media and markets – and these were made available in two, double-disc sets: one combining the 'pop' mix and the 'country' mix, for distribution primarily in the USA, and the other combining the 'pop' and 'world' mixes, intended for distribution in all other markets (each CD was further differentiated by colour – red, green and blue – and by separate promotional photos). Produced by Twain's husband, 'Mutt' Lange, the recording

of the pop and country CD was done in studios in Dublin, Ireland, in Milan, Italy, and in Nassau, the Bahamas – the case of the country mix giving further credence to Ivey's (1982) contention that the Nashville Sound (including mandolin, slide guitar and the like) can be produced just about anywhere in the world.

For my purposes, the most interesting mix, however, is undoubtedly the 'world' or 'blue' mix, produced by Simon and Diamond Duggal (previously known for their work with both mainstream and British-Asian acts such as Apache Indian). The mixes are composed of various layers of sound derived from the original Twain tracks (mostly her vocals), tracks added by Simon and Diamond themselves, and tracks recorded by a group of Bollywood session musicians and other artists in Mumbai, India. While the intention was to give the mixes primarily an 'Indian' feel, in fact, much like the country mixes, the various songs are representative of a variety of international styles and genres, including Middle Eastern, Oriental, and even Caribbean dance music.

Twain's vocals often ride over the top of these mixes, only occasionally integrating with them. This comment can be taken as both an aesthetic or musical description as well as a social and technical one: unlike Paul Simon's *Graceland*, where there existed at least some level of interaction and collaboration among the primary musicians involved in the project, Twain's involvement in the world version of her CD was by proxy – only the digital audio files of her vocal recordings, cut from the Pro Tools sessions, were required for Simon and Diamond to create their Indian-inflected remixes. In a sense, Twain's vocals – one of the most profitable commodities in recent international pop – are separated out and given differential priority, thus reflecting the larger economic and hierarchical relationships within this network of studio 'nodes', musical styles and genres, and 'local', specialized labour.

In contrast to the global logic of Twain's remix strategy, a much smaller scale, international and cross-cultural collaboration can be found in 'Veiga, Veiga', a song recorded by the 73-year-old Australian musician, Seaman Dan, on the CD *Perfect Pearl* (2003). Intended primarily for local and regional markets, the project was recorded in several studios (varying in size and technical quality) in different parts of Australia and in Papua New Guinea. The collaborative process behind the recording is described in detail by producers Denis Crowdy and Karl Neuenfeldt (2003) and involved sending individual tracks and pre-mixes (recorded with Pro Tools software and burned onto CD) between the various collaborators, slowly building up the song from initial guitar tracks and guide vocals through to the final instrumentals, background and lead vocals (recorded in two different languages).

Although digital technology made the process of what Crowdy and Neuenfeldt refer to as 'itinerant overdubs' possible, it is clear that the cross-cultural aspects of the project only made musical sense to the collaborators because of various shared assumptions and experiences and a basic knowledge of the musical traditions at play. It is important not to

romanticize this small-scale production: the recording process was, in many respects, as distant and fragmented as that employed in Shania Twain's re-mixes (often the 'Veiga, Veiga' collaborators had to create overdubs without any real knowledge of what the next individual would do or how the end-product would sound), and the studios themselves still functioned largely as individual 'nodes' in a network, with some studios (and engineers) clearly having more responsibility for the final product than others. However, it is also significant to note that the composition of the song itself evolved throughout the collaborative, overdubbing process, shifting subtly in relation to each individual contribution, and not simply as the result of an administrative act.

And it is here that the *ideal* of the 'network studio' comes into play: it extends and enhances the technical infrastructure of the 'studio-as-node' by allowing for greater levels of coordination and connectivity, and at increased speed. But as can be seen in the examples described earlier, the network ideal can operate in different ways in different contexts: at times reinforcing the pattern of information 'flows' characteristic of the dominant economic order, and at others working outside of it, facilitating a kind of autonomous production practice or, at the very least, a very different pattern of exchange.

It was into this contradictory set of contexts that the Rocket Network (mentioned at the beginning of this paper) was introduced. Founded in 1995 by musicians Willy Henshall (former member of the UK pop band, London Beat) and Tim Bran, and software developers Matt Moller and Canton Becker, the Rocket Network was a server-based technology that allowed for the transfer of digital audio data between multiple destinations. Using a standard software recording application, individual sound files and session data (including 'virtual console' settings, as well as equalization, reverberation, and other signal processing) could be uploaded to a central, remote server, and then downloaded anywhere else in the world by other participants in the recording project; additions or changes made by one participant could be immediately accessed by any other participant the next time they logged onto the system (although use of the Network was certainly enhanced by high-speed connections, users could compress files in a variety of formats to facilitate any type of Internet connection, including a conventional modem). A large part of the initial success of the Rocket Network was based on the fact that it did not attempt to develop its own proprietary approach to audio recording, but rather, it signed on existing software developers as partners: by 2002, virtually all of the major manufacturers of sound-recording software and hardware – from high-end professional systems developed by Digidesign and Waveframe, to semi-professional and consumer systems by Steinberg, Emagic and Tascam – had developed versions of their products that were compatible with the Rocket system.

The possibilities of the technology were publicly demonstrated during a 1-hour BBC television broadcast on 17 March 1999:[6] with well-known performers such as Sinead O'Connor and Thomas Dolby on hand (in

different locations) for the event, an on-air recording was made to raise funds for the charity War Child. Using the Rocket Network, tracks were contributed by artists in London, Johannesburg, Sydney, Hamburg and several locations in the USA; the entire song was completed within the 1-hour programme. In the world of television, where live satellite feeds from remote locations are part of daily fare, the event might have passed unnoticed were it not for the sheer number of locations involved and the speed with which the overdubs and final mix were prepared.

During the heyday of the dot.com industries, tens of millions of dollars (more than US$24 million in 2000–01 alone) were poured into the development of the Rocket Network by venture capitalists (Vulcan Ventures), financiers (JP Morgan Partners), Internet companies (Cisco Systems) and corporations in the audio and video industries (Avid Technology, parent of Digidesign), among others. In addition, a number of professional studios in London, New York and Los Angeles signed on as charter members of the Network: given the potential of the new technology to facilitate and enhance the 'space of flows', it is not surprising that high-end studios located in the centres of record industry power would be among the first to adopt the technology.

But part of the appeal of the Rocket Network was that it promised to connect not only professionals within the industry, but semi-professional and amateur recording enthusiasts as well. Accordingly, the pricing structure of the Network was based on a cell-phone model: private accounts were billed on a monthly basis ranging from as little as US$10 to US$1200 per month, depending on anticipated usage, with excess usage billed at a rate of a few cents per MB. Thus, the Rocket Network was structured in such a way as to appeal to the same 'democratic' ideals that have been characteristic of both cyberculture and the marketplace for digital music technology during the past 20 years (see Théberge, 1997).

Furthermore, apart from the kinds of project outlined earlier, the most direct precedents for this type of networked activity had come from amateur musicians: for example, during the early 1990s, MIDI sequencer enthusiasts had used the Internet as a vehicle for collaborative composition. Indeed, the first software product created by the founders of the Rocket Network – a program called 'Res Rocket' – was a form of MIDI collaboration software. Interestingly, for some amateurs, the possibilities offered by online collaboration were regarded as a technological solution to the 'problem' of isolation – a problem that had previously been such a favoured technical and social characteristic of more professional recording studios: Craig Latta, coordinator of 'Netjam' (an Internet MIDI group), was quoted as saying, 'My biggest hope . . . is that networks will reverse the trend of people accumulating vast amounts of hardware, hiding in their studios, and not feeling particularly inspired'.[7]

But if the developers of the Rocket Network saw their product as the global communications solution for all studios, from amateur to professional, prominent studios of the 'brick-and-mortar' variety responded with their own strategies as well. In September of 2000, *Billboard* reported

on a movement among some of the largest, most well-known studios in the industry towards 'geographical diversification': through acquisitions, studios such as The Hit Factory in New York had opened new studios in Nashville; others, such as Metropolis Mastering in London and Sterling Sound in Manhattan, had entered into joint ventures (Daley, 2000: 58). The paper cited the Rocket Network among the forces driving studios towards 'branding' strategies and geographical expansion: 'At a time when new online services, such as the recently launched Rocket Network, as well as widespread formats such as MP3 have given even the most lowly studios a potentially global reach, establishing physical presences in new markets has become the tactic that differentiates the various castes of studios' (Daley, 2000: 58).

However, a number of professional studios did make use of the Rocket technology, albeit on projects far less ambitious than the BBC broadcast cited earlier. For example, John Oates (former member of the 1980s duo Hall and Oates) used the Rocket Network to link studios in Hollywood, Aspen and New York in the production of his solo album, *Phunk Shui* (Oates, 2002); and the band U2, stopping over at Abbey Road Studios in London while on tour, were able to review and approve surround mixes of earlier tour dates sent via the Network from New York's Effanel Studios. Outside the music industry, the technology also found use in film (sending dialogue replacement during post-production) and in television (recording remote voice-overs for commercials).[8]

Despite its successes, the Rocket Network, with very little fanfare or forewarning, ceased operation on 31 March 2003. While the company claimed that it had reached a market of some 65,000 users, it appears that few used the Network often enough to sustain its operation. In news accounts, some commentators questioned the viability of Rocket's centralized server and subscription-based service as a business model and there were occasional references to security problems as well. While the lack of an adequate 'business model' is a fairly common complaint levelled at many dot.com failures, the security issue may have been a more significant problem: in the context of Napster and the music industry's battles over copyright on the Internet, even the rumour of security problems at the Rocket Network would have been enough to cause many professional studios to hesitate to adopt the technology.

Indeed, after buying the assets of the company, Digidesign, by year end, launched its own version of some of the services formerly offered by the Rocket Network and, in its promotional material, emphasized the 'military-grade encryption' and other security features of its revamped system. Conceived as a simple file transfer service, 'DigiDelivery' is a hardware/software system that does away with subscriptions, but requires that the user purchase a server-type appliance (manufactured by Digidesign at a cost, depending on the model, of US$5000–10,000), and maintain a static Internet protocol (IP) address. Unlike the Rocket Network, the start-up and maintenance costs of DigiDelivery discourage

casual use of the technology. Indeed, the promotional material for Digi-Delivery would appear to be aimed more at professionals than at semi-professionals or amateurs, with much of the rhetoric concerning uninhibited musical collaboration largely displaced by the language of 'digital assets', producers and clients, and new features such as automated billing. For the time being at least, it would appear that the future of the 'network studio' is now in the hands of the traditional powers within the world of professional audio recording and that the technology will be used primarily to support the dominant 'space of flows' within the industry.

Conclusion

The rise and fall of the Rocket Network, described only briefly here, may eventually become little more than a footnote in the larger history of the recording studio: it was neither the first attempt, nor will it be the last, to use the Internet as a means of linking together recording studios in far-flung parts of the world. For a time, however, it did embody a certain idealized notion of the network studio – the studio as 'node' – that had evolved over a number of years within the music-recording industry and, furthermore, may have articulated it in a particularly salient way with larger trends in the organization and administration of global industries.

For the recording studio to function as a node it first had to become a kind of 'non-space' and a 'non-place' as well. In so doing, recording studios lost some of their connections with the 'local', with the places in which they reside and with the musicians and musical styles that were once a part of those places. And this is becoming as true of many centres where various world musics are produced as it is in the metropolitan centres of the West: as Louise Meintjes (2003) has argued, while studios in places such as Johannesburg still retain some connection with local traditions, they also exist as a kind of isolated, non-space in which musical identities can be re-imagined, processed and projected out into the global marketplace.

What is perhaps clear in all of this, however, is that in the (super)-modern world our concepts of space and place are essentially invented; and in this regard, what may become the most significant issue for studios as they become more integrated with one another (whether via the Internet or by other means) is the quality of the musical and social relationships that are made with and through them. As discussed earlier in the case of the Shania Twain and Seaman Dan recordings, the network studio can be used in such a way as to reinforce the status of the studio within the 'flows' that characterize the spatial logic of the dominant economic order, or it can be used to coordinate more autonomous forms of genuinely collaborative production that are at once local, regional and perhaps even global in character. In this sense, the network studio, in its various guises, is perhaps less the embodiment of Castells' dominant 'space of flows' than it is representative of the possible 'disjunctures' that exist between Appadurai's technoscape and financescape. In the future, the degree to which such

disjunctures can be exploited may give the network studio a significant role to play in contemporary musical culture – one that goes beyond simply providing the digital strands in a web of 'non-places'.

Notes

1. Online press kit, The Rocket Network, Inc., 3 April 2002. <www.rocketnetwork.com>, last accessed 22 September 2002. Since the demise of the company in the spring of 2003, the Rocket Network website no longer exists. However, a number of pages spanning the lifetime of the company can still be accessed through the Internet archive: <www.archive.org> and use their software to search for the 'Rocket Network'.
2. Quotation from The Rocket Network, Inc. online press kit (see note 1).
3. In French, the word *isolation* can, depending on the context, mean either 'insulation' or 'isolation'. In the original French version of his paper, Hennion makes his point by playing on the word *isolation*, often making it mean both things simultaneously.
4. *Mix* 26(7), June 2002: 42.
5. MIDI was a hardware/software protocol introduced in 1983 that allowed digital synthesizers to be connected to one another and to personal computers; sequencers first appeared as hardware devices and, later, in the form of computer software, and allowed for the creation of multi-track arrangements of musical material that could then be played back by synthesizers.
6. The programme was broadcast during National Science Week and contained a series of mass participation experiments: <news.bbc.co.uk/1/hi/sci/tech/specials/set99/298576.stm>.
7. Quoted in *Electronic Musician* 8(8), August 1992: 87.
8. Information on some of the uses of the Rocket Network technology can still be found on Digidesign's website: <www.digidesign.com>. Follow the links to the DigiZine archives: issues during 2002 have a column called 'Net Working' that describes various uses of Digidesign's implementation of the Rocket technology known as 'DigiStudio'.

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