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Making Mobiles African

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Mobile telephones and Africa have become a feel-good story of sweeping technological and social transformation and of the rapid acceptance of modernity by a continent long plagued by a surfeit of bad news. This is why, for example, African journalists Tolu Ogunlesi and Stephanie Busari could write a piece for CNN entitled "Seven Ways Mobile Phones Have Changed Lives in Africa."[1] Their narrative is simple: The mobile phone has transformed the continent. Education, health care, activism, disaster management, entertainment, banking: There seems to be no section of the African economy that has escaped the magic of the telephone. The article paints a picture of innovative solutions to specific challenges facing the continent, from countering the scourge of fake drugs in Ghana to election monitoring in Kenya using the Ushaidi platform. How did this happen, especially given the historical challenges other large technological infrastructures (such as electrical power) faced at adoption? This chapter argues that to understand the relative success of the mobile phone in Africa, we must understand the cultural and epistemic processes through which the African mobile emerges.

Mobiles and Place

What does it mean to examine how mobiles are being made African? Surely, mobile phone culture is a global phenomenon and a technology that has been adopted widely by various countries around the world, as evidenced by the high global demand for Apple's iPhone. However, upon careful inspection, unique dimensions of mobile telephony can be observed in individual nation-states and geospatial areas. Culture, national politics, geography, and available infrastructure all contribute to shaping mobile networks. Therefore, Ito, Matsuda, and Okabe (2005) can argue convincingly that the Japanese *keitai* is a different sociocultural object from the cellular phone in the United States (which Ito argues is defined by technical infrastructure) or the mobile in the United Kingdom (defined by the move away from the predetermined locations that landlines represented). Roughly translated, *keitai* means "something you carry with you." For Ito, the keitai is "not so much about a new technical

capability or freedom of motion but about a snug and intimate technosocial tethering, a personal device supporting communications that are a constant, lightweight and mundane presence in everyday life" (Ito, Matsuda, and Okabe 2005, 1).

Ito thus makes the compelling argument that though mobile telephony systems in different nations may be technologically analogous, they possess different social histories and may occupy very different sociocultural niches. In a somewhat similar vein, the ethnography of Horst and Miller (2005, 2006) clearly describes the cultural construction of the cell phone in Jamaica. These studies of localized specificity in patterns of use and mobile culture are useful and important contributions to our understanding of the relationship between technology and society, and this chapter will attempt to do likewise in its examination of the state of mobile telephony in Nigeria and the broader implications of the Nigerian experience when we consider the continent of Africa.

Recent work on mobiles in Africa (de Bruijn, Nyamnjoh, and Brinkman 2009; Zegeye and Muponde 2012) have conceptualized the device in various ways to show how it is co-constituted with Africa. For example, de Bruijn, Nyamnjoh, and Brinkman (2009) in their comprehensive review show how various practices on the continent are generating new uses and innovations, such as in healing practices (van Beek 2009). Like many authors writing about science and technology from Africa (e.g., Mavhunga 2014), this chapter proceeds with an analysis from the viewpoint of Africans themselves (in this case, Nigerians) and seeks to explore their own practices and understandings of mobile technologies.

First, though, it is important to remember that the term *phone* (or in this case, *mobile telephony system*) is linguistic shorthand for institutions (mobile operators, regulatory bodies), technologies (GSM, CDMA), people, and practices (Sterne 2003). This heterogeneity requires that any robust examination of the telephony system *should not* be limited to the artifact that individual mobile users carry around and present when they are asked for their "phones." Rather, a thorough examination of mobile culture must also include an examination of regulatory practice, network design, and engineering culture, as well as the practices and behaviors of mobile users. In a quite literal sense, each phone is merely a node in an extensive sociocultural-material network, linked wirelessly to other mobile network devices, institutions, and people. Every *phone* (i.e., hardware that mobile users utilize in interacting with the mobile system) is engaged in a seamless, elegantly scripted, bidirectional, electromagnetic duet with other network nodes. In addition to these material elements, the heterogeneous mixture represented by *phone* includes the software and hardware engineers that specify and build the mobile telephony network, the multiplicity of mobile phone users, possibly a state-appointed regulator, billing and other financial arrangements, various mobile phone companies along with the expertise and human capital they contain, and, of course, the legal statutes that govern the behavior of the entire amalgam. In other words, any description of African mobiles must demonstrate how the various elements of this heterogeneous mixture are invested in the process.

Constitutive Appropriation: An Analytical Perspective

The question of possible analytical frames in the study of mobile phone use culture is an important one, because analytical frames and conceptual modes do much to guide research questions and illuminate unique aspects of the case being investigated. Thus does Donner's (2007) choice of adaptive structuration theory emerge from his study of beeping practices, and the theory does much to illuminate the analysis that follows. Similarly, Horst and Miller (2006) use the concept of "communicative ecology" to great effect in their study of Jamaican cell phones. This chapter utilizes the concept of constitutive appropriation, building on the work of Eglash (2004), Jones and Twidale (2005), Bar, Pisani, and Weber (2007), and von Hippel (2005). A full treatment of constitutive appropriation has been undertaken elsewhere (Odumosu 2009); nevertheless a discussion of the salient points will be useful in analyzing the case under consideration in this chapter.

The concept of appropriation has been employed before by African authors writing about mobile phones (Zegeye and Muponde 2012). Eglash (2004) describes it as a focused examination of the "lay public as *producers* of technology and science" and against an understanding of the public as "merely passive recipients of technological products and scientific knowledge" (vii). For Eglash, appropriated technologies are critical because of "their potential contribution to sociopolitical resistance and social reconfiguration" (x).

Constitutive appropriation argues that consumption and production should be seen as analytical categories that are imposed on the messiness of the observed phenomena. They are both fully present simultaneously in the act of appropriation. The act of *using* a technological system entails *producing knowledge* about its possible and varied uses, constituting cultural practices around the artifact or system, the formation of community, and in some cases even the reconfiguration of the artifact or system itself—all activities subsumed in the term *consumption*. In a similar vein, the creation of a technological artifact involves production that always utilizes a resource, whether it be labor or goods and/or services, encompassing the design of the artifact, institutional arrangements that help define what the artifact is, the building of networks that give the artifact meaning, the creation of discourses that shape perceived acceptable and unacceptable uses, and sometimes imagining and creating the very publics that will be using said artifact.[2] In *The Grundrisse*, Marx argues similarly that "production is also immediately consumption. Twofold consumption, subjective and objective ... Consumption is also immediately production, just as in nature the consumption of the elements and chemical substances is the production of the plant" (Marks and Engel 1978, 228)

The point being made here is not that production and consumption are not useful concepts, but that each is contained in the other, and that when in mundane speech we refer to *production* or *consumption*, we are willfully highlighting one aspect of the phenomena and downplaying the other. This insight is important because of the traditional way in which "consumptive" and "productive" acts are viewed. Appropriation works by inverting our

vision of the phenomena in question, highlighting the productive elements in acts that are usually viewed as consumptive in nature.

The framing of appropriation as the activity users undergo as they embed a technological system/artifact into their lives or social, economic, and political practices resonates with a media studies understanding of "domestication" (Silverstone and Hirsch 1992). Within their theory of the "moral economy of the household," Silverstone and Hirsch identify four distinct phases in the dynamics of this moral economy, of which appropriation is the first, followed by objectification, incorporation, and conversion. For Silverstone and Hirsch, *appropriation* is the point at which an object leaves the world of commodities and is taken possession of by individuals or households and owned. As noted by Oudshoorn and Pinch in the introduction to their edited volume, media and cultural studies have "recognized the importance of studying users from the very beginning. Whereas historians and sociologists of technology have chosen technology as their major topic of analysis ... cultural and media studies have focused primarily on users and consumers. Their central thesis is that technologies must be culturally appropriated to become functional" (Oudshoorn and Pinch 2003, 12).

In summary, a few points emerge as pertinent to a theory of appropriation—a theory that, for the purpose of differentiation, I assign the label *constitutive appropriation* (I have appended the adjective *constitutive* as a reminder of the productive nature of the act of appropriation):

1. Constitutive appropriation can be described as the process whereby one or more users makes a technological artifact or system theirs, integrating it into their sociocultural world and in the process transforming said artifact or system to serve the user's ends (Eglash 2004; Oudshoorn and Pinch 2003).
2. Constitutive appropriation by definition, then, is not necessarily circumscribed to studies of the marginal. It can be used in a more general sense (von Hippel 2005; Jones and Twidale 2005; Bar, Pisani, and Weber 2007).
3. Consumption and production should not be viewed as opposite ends of a continuum; there is much to be gained by seeing them as operating simultaneously (von Hippel 2005; Marx and Engels 1978).
4. Constitutive appropriation is seen clearly in the mundane processes of integrating systems and artifacts into the lived experiences of individuals and *communities*. Any description of this process should attend to possible reconfigurations of social life (Silverstone and Hirsch 1992).

With this analysis in place we can proceed with an examination of the process of making mobiles African. I offer here two "selfies"[3](by which I mean captured moments of self-reflection) of this process as it took place in Nigeria during fieldwork conducted in Lagos and in the Nigerian capital of Abuja from 2006 to 2008.

The first selfie, following the work of Nkomo and Khumalo (2012) on the linguistic impact of mobiles on Zimbabwe, is a discussion of the linguistic and epistemic difference between landlines and mobile phones in Nigeria. The second is an exploration of how Nigerian mobile

network engineers came up with innovative solutions to the unique challenges of building mobile networks in Nigeria and the reverberations that had on the design of global mobile network systems.

Is That a Landline in Your Pocket?

Her name was Jumoke. I met her a few weeks before I arrived in Lagos to start fieldwork. She was the first to introduce me to the dissonance between conceptual maps of mobile phones and land-phones, as opposed to the general meanings attached to those terms in the United States. I was invited into her kitchen; I found her seated at the kitchen table with three devices that all looked like phones and, at least to me, were inherently mobile—that is, lacking wires and possessing a small form factor. She was busy working on all three phones. Two of the devices had their batteries out, and the last one was being used to place a call. While carrying on a conversation on one mobile phone, she motioned for me to seat and wait. As I complied, she proceeded to attend to multiple tasks. Talking on one of the phones, she simultaneously swapped small electronic cards in the other two. When she was finally done talking, I asked her what she had been doing with the other two phones and why she had three phones. She patiently explained that she was moving the SIM card from one of her mobile phones to the other, while speaking to her fiancé on her "landline." I pointed out that all three phones were capable of being moved from one place to the other; indeed, a stranger examining all three devices would probably not detect any major differences in their shapes, forms, or use possibilities. Such a stranger would most probably therefore conclude that all three devices would fulfill any reasonable criteria to qualify as mobile phones. Jumoke agreed with this observation, then patiently explained to me the differences among the three phones. Two of them, she said, were mobile phones—GSM phones. The last was a "landline"—a CDMA line. The reason she was swapping SIM cards was that one of her mobile phones' batteries had lost its charge and she wanted to use the "credit" on the other "line" to place a call.

Speaking the Language

In the course of my field work, I became intimately familiar with terms like *SIM card*, *GSM*, *CDMA*, *credit*, *landline*, and *mobile line*. They are terms that most Nigerians have come to understand intuitively. They require no explanation in Lagos, or elsewhere in Nigeria. These terms have become part of the lexicon of everyday speech on the streets of Lagos, perhaps best described by Bourdieu's notion of *doxa*, in which natural and social worlds appear to be self-evident (Bourdieu 1977, 164). To anyone immersed in the specific mobile phone culture of Lagos, knowledge of these terms and their meanings has become innate—a testament to the pervasiveness and widespread adoption of telecommunication technologies. For example, the argument can be made that *credit* was a commonly used word in Lagosian parlance before 2001. Since the advent of mobiles, though, the term "credit" now has an added meaning.

A point that quickly becomes apparent to the stranger visiting Lagos is that people living there perceive a marked difference between GSM/mobile and CDMA/landline and use the terms interchangeably in daily mundane conversation; that is, GSM is analogous with mobile and CDMA is at times analogous with landline. Here, the term *GSM* or *mobile* does not imply mobility, but rather a type of small, portable phone that possess an eleven-digit number and is capable of functioning anywhere in Nigeria. On the other hand, *CDMA* or *landline* implies a small, portable phone that has a seven-digit number and is usually only functional in a certain geographic region (for example, the state of Lagos). The argument could therefore be made that in Lagos, Nigeria, the term *mobile phone* does not even mean the same thing as it does elsewhere in the world. In other places, the *mobile* in *mobile phone* usually refers to the mobility of the communication device (phone), which is historically understood in contrast to the immobility of the preexisting, widely available copper telephony infrastructure. In Lagos, the historical nonexistence of such a nationwide copper-based telephone network has had a different effect, and mobility (defined here as a lack of wires) per se is not seen as a salient feature; indeed, in most cases it is assumed to be constitutive of telephony technology and not particularly interesting. The historical context in Nigeria has thus led to the state of affairs in which the term *mobile* more often than not references a particular technological configuration and not necessarily the mobility or immobility of a particular device.

This difference in meaning attached to *mobile* is particularly interesting, especially in the light of particular research trajectories of scholars working predominantly in countries with a history of widely available copper lines, where a significant portion of the research design has historically focused on the "mobility" of these new communication devices and the subsequent implications of this new mobility (Katz and Aakhus 2002; Katz 2006). Mobility would probably not be as interesting in the same way to a researcher working from a country like Nigeria, because most Nigerians view the mobility of communication technologies not as a new feature that may possibly reconfigure social life, opening up new ways of being, but as an integral part of any contemporary telecommunication infrastructure. This point also calls into question the inherent problematic of the discourse of "technological leapfrogging," in which countries like Nigeria are celebrated as having "skipped" the copper phase and moved to an all-wireless state of affairs. This way of framing presupposes the centrality of the technological history of a number of wealthy countries and evaluates developments elsewhere on that basis. It is only in such an analysis that a nation can leapfrog copper and move straight to wireless. A much more nuanced picture emerges when technological choices and sensibilities are evaluated within the specific histories of the countries within which they emerge.

During field work, I regularly met people who carried multiple phones around with them. A typical response to my questioning of this behavior was that one phone was a landline and the other a mobile phone. Nigerian users thus appear to use different terms to describe different aspects of the devices they carry around with them. Closer attention to these terms reveals a sophisticated complexity and grasp of not only the materiality of the technologies

in use, but also a fluidity in the normative meanings attached to concepts like landline and mobile phone, GSM and CDMA. It therefore is useful to probe these concepts and their areas of overlap and divergence.

Mobiles, Language, and Technological Understanding

Upon initial inspection, it appears that there are two classificatory systems at work here. One addresses the underlying technology that a device utilizes—GSM or CDMA—and the other is more concerned with the use of the device, mobile (portable) or landline (fixed). Although these classificatory schemes overlap, it would be wrong to infer that they are synonymous. What does it mean to identify a device as a mobile phone to a Nigerian user? Why did some of the people I spoke with respond to the question, "Is that your landline?" with, "No, it is my GSM." As always, meaning is contingent and contextual.

In Nigeria's "communicative ecology" (Slater and Tacchi 2004), users appear to categorize mobile operators according to the technologies they deploy in their networks. Currently, the marketplace is dominated by two distinctive technologies, GSM and CDMA. This bifurcation is transparent to Nigerian users in obvious ways.

First, GSM networks have different numbering schemas from CDMA networks. GSM numbers in Nigeria are eleven digits long. CDMA lines have traditionally been only seven digits long, along with a state code that identifies the calling area in which the number resides. In contrast, landline numbers and cell phone numbers in the United States, for example, are indistinguishable based on the length of the number, and it is impossible to determine the underlying technologies based on an evaluation of mobile phone numbers.

Also in Nigeria, the user-side hardware (the actual phone) is different under each system. The GSM (mobile) phones are usually more sophisticated, and there is a larger selection available than there is in the CDMA system. From the user's perspective, the most visible differentiator between CDMA and GSM (as of 2006) appeared to be the SIM card. The phones themselves are interestingly more transient; most of the people I spoke with had previously owned more than one phone and were always on the lookout for an opportunity to upgrade their phones. When asked, "How can you tell landlines from mobile phones if they are both easily carried around?" the standard response was, "Mobile phones have SIM cards, landlines do not."

In other parts of the world, when asked about the differences between landlines and mobile phones most people would probably respond that landlines are connected to a local phone company through physical wires, whereas mobile phones are wireless. Although the reality of this insight is slowly changing, driven by services from nontraditional VOIP companies, one suspects that the majority of telephony users in nations with extensive copper wire infrastructure still hold this view. In addition, most VOIP users still connect traditional phone sets to their "landlines" in their homes, and thus *home phone* is usually synonymous with *landline*. In the Nigerian case, in which a fixed copper infrastructure was only available

to few and has retrograded to the point of near obsolescence, a different understanding of what a landline is has emerged. Here, the idea of a landline is closely correlated with lower tariffs, eight-digit numbers, CDMA technology, and phones that are usually light on features compared to their GSM counterparts. Landlines can be mobile, or they can be fixed. They can be fixtures in homes or can possess the same level of mobility as "mobile phones."

Thus, in Nigeria, although GSM and CDMA are seen as competing technological standards (developed in Europe and the United States, respectively), they are also identifiers of competing wireless network operators. Similarly, the concepts of mobile and landline do not refer to the mobility or immobility of devices or even to the presence or absence of a copper infrastructure, but rather to many different things: tariff structure, underlying technological standard, numbering scheme, and regional versus national service coverage. This is not to suggest that there is market parity between the two systems; GSM dominates the market and in many ways is the predominant standard, shaping user expectations of CDMA networks.

Configuring a "Nigerian" Mobile Network

The second selfie is a tale of engineering culture and presents a situated perspective that is unique to the Nigerian experience. This is a tale that resonates with me, inhabiting as I do the hybrid identity of being an engineer and STS scholar. It requires seeing the mobile system from a privileged viewpoint—that of a core network engineer. It is important to qualify the kind of engineer, because there are different types of engineering work involved in making any mobile system function. The engineers we are concerned with here are responsible for maintaining the core network: They specify, build, and optimize all the elements in the switching subsystem (also known as the *core network*). These elements include mobile switching centers (MSCs), base station controllers (BSCs), home and visitor location registers (HLRs and VLRs), and other specialized network equipment. Figure 7.1 presents a simplified diagram of a typical mobile telephone system network topology, with the relevant core network elements circled.

The core network is so named because it is the heart of the mobile telephony system. The elements outside the circle are the base transceiver stations (BTSs) and individual mobile terminals—that is, phones (users are not shown on diagram because they are not typically indicated in diagrams of this sort that engineers utilize). Individual mobile phones communicate with the BTS, which is the interface between mobile phones and the network. The BTS is primarily a collection of transmitters and receivers that communicate with individual phones. BTSs have limited local intelligence and are directed and controlled by the BSC. BSCs monitor and control several BTSs and are in turn monitored and controlled by an MSC, which is the primary controller and processing hub of the network. If a wireless network can be described as having a heart or a brain, the MSC would fulfill both functions. The other elements in the diagram are ancillary and work as supportive agents for the MSC. The HLR is a database system of sorts that stores information about individual subscriber identities, and

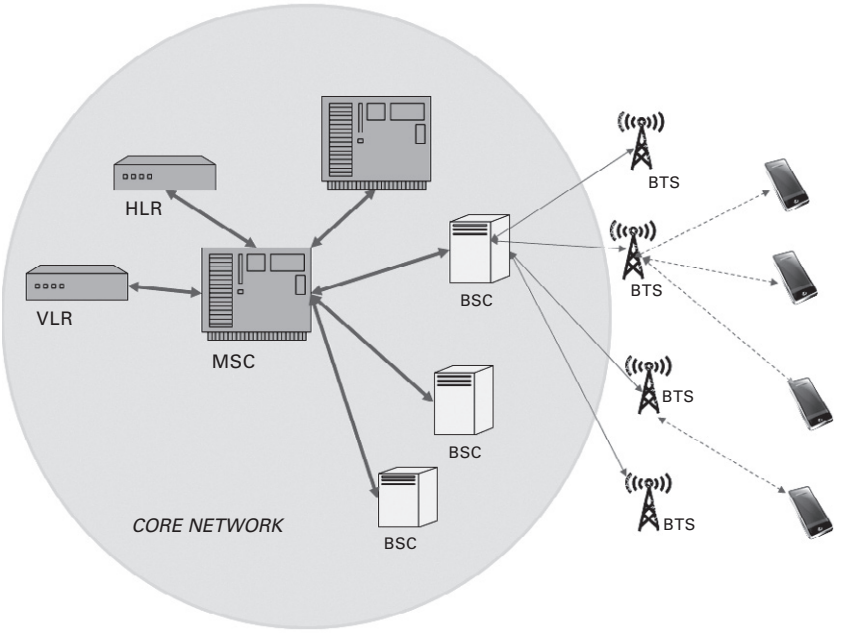

Figure 7.1
Typical network topology, showing elements in the core network.

the VLR is a similar system that caters to visitors to the network (e.g., roaming "guests" from other countries). This simplified diagram leaves out a number of elements because they are not necessary for telling the tale.

In order to appreciate the story to come, it is important to know a little about how a mobile telephony network handles calls. Telephone calls on GSM mobile networks are complicated things. Each call requires a number of operations and generates multiple control messages between the phone and the rest of the network. When a mobile user dials a number, the network sends information back and forth in a process referred to as the *call setup procedure*, which prepares and makes available a *voice channel* that will carry the conversation between both parties of the call. This *setting up* process involves a number of database queries to determine the last known position of the party being dialed in order to get the phone on the other end to ring. All this activity on the network is called *signaling traffic*—differentiated from *voice traffic*, which is traffic that is billable and thus earns money for the mobile operator. Signaling traffic is a continuous phenomenon, occurring in the background; as long as a mobile phone is switched on, it is required to constantly update the network about its geographical location and status. However, signaling traffic intensifies when a call is in the process of being placed.

In conversations with radio and network engineers at MTN (the largest network operator in Nigeria), I learned that when it came to configuring the mobile network in Nigeria, the traditional rules that were invoked as standard and conventional failed miserably. Following generally accepted rules and practices, MTN engineers designed and configured their network to handle the specified number of users on their network, taking into account the geography of the coverage area, frequency selection, size of each cell, and other important variables. However, the network that resulted from the outcome of this design process quickly ran into problems as crucial sections of the core network became saturated and acted as bottlenecks to the flow of traffic, bringing the network to its knees. These problems elicited complaints from users all over the country; in response, the Nigerian Communication Commission (NCC) put pressure on MTN and other operators. In response, MTN stopped accepting new subscribers for a time while they tried to figure out the root cause of the problems.

As I reconstructed their efforts over the course of multiple interviews, a picture of what they were up against emerged. It turns out that mobile users in Nigeria behave differently from mobile users elsewhere, and it was this different behavior that made all the old rules of *dimensioning* (an engineering term that refers to the process of generating specifications based on particular constraints) the network irrelevant. As the engineers responsible for dimensioning the network quickly discovered, the standard rules did not apply. Their solution was *overdimensioning* the network (i.e., going beyond the standard recommended values). This was achieved by using more BSCs, and fewer BTSs per BSC, increasing the number of MSCs, and upgrading the data link communication channels between core network elements (represented in figure 7.1 by solid lines; the radio connections are represented by dotted lines). It was only after these substantial and expensive changes that the network was sufficiently robust and capable of handling the *kind* of traffic that Nigerian users generated. In the words of a top executive at MTN who managed the network directly, "What is really strange in Nigeria is that we have a very high busy hour call attempt ... whereas in a country like South Africa and a lot of other developed nations you see between 1 and 1.5 busy hour call attempts, the average here is about 3.6 or 3.9." The CTO added: "In Nigeria what you find is that subscribers have quite short Mean Hold Times. 19 seconds for outgoing calls and 32 seconds for incoming calls" (MTN executive, personal communication, July 3, 2008).

These two indices—mean holding time (MHT) and busy hour call attempts (BHCA)—are ways of describing mobile phone user behavior. They also have a tremendous impact (at least in Nigeria) on the way networks are designed. The MHT index on the MTN network was woefully small and measured in seconds, whereas according to the CTO, European indices are usually measured in minutes. MHT reflects the average amount of time users spend on a call. Nigerian MTN users stay on the phone for an average of roughly nineteen seconds per call. In essence, they spend a short time on the phone speaking if they initiate the call and roughly one and a half times as long if they receive the call. This discrepancy between time spent when receiving a call and time spent when making a call may be explained in some measure by the fact that the policy of mobile phone billing in Nigeria is the same as in

Europe (the calling party pays); the effect of this is that the party placing the call shoulders the entire cost and the party on the receiving end pays nothing.

BHCA is a teletraffic measure that represents the number of calls attempted at the busiest hour of the day by all users. In experiential terms, a BHCA of 3.9 means that Nigerian subscribers at the busiest hour of the day, when confronted with a busy signal, will retry four more times before giving up. "Developed nation" (in the words of the MTN CTO) users, on the other hand, usually try just one more time and then give up upon receiving a busy signal. By interpreting both indices, a picture emerges of the average user during peak periods.[4] In addition, the high prevalence of *flashing* (cf. Donner 2007)—a practice that uses missed calls to communicate—also qualifies average Nigerian users. The average Nigerian mobile phone user only stays on the phone for nineteen seconds once connected. If the line is busy, said user tries immediately to make another call and, if unsuccessful, keeps on trying at least four more times. In addition, if said user is able to make a connection, they sometimes drop the call almost immediately and use the opportunity to "flash." As mentioned previously, each time a call is initiated the network needs to locate the mobile phone of the receiving party (which it does by querying its databases) and then actively select and devote voice channel resources to the call. All this requires substantial processing by the MSC and utilizes valuable bandwidth as messages travel back and forth among the various network elements in their effort to accomplish this process, which in engineering speak is referred to as *call setup*. These processes utilize the processing capacities of the MSC, HLRs, and VLRs, *even if the call does not go through* (i.e., is unsuccessful for whatever reason). Taking into account the high BHCA and the low MHT, it is easy to see how the network can quickly become saturated, as subscribers who are unable to get through have precious limited resources allocated to them. They keep on trying, tying up further network resources, only to get through and spend a short time on the phone before making another call.

The result of attempting traditional dimensioning methodology was that though the network could *theoretically* (here, the basis of the theory was the behavior of a well-known quantity, the average South African or European user) handle all the traffic, the processing capacity limit was being reached quickly, and very few calls (if any) were being successfully routed. MTN had to go back to the drawing board and redesign the network (based on the real Nigerian user). This resulted in the network being over-dimensioned with respect to the old standard. In effect, this meant using more MSCs and BSCs and implementing high-speed links between them.

It is important to point out that overdimensioning the mobile network was not driven by the need to handle larger amounts of mobile traffic than was expected, but rather by the need to handle a *different kind* of traffic. In engineering vernacular, the *traffic profile* of Nigerian users required a fundamentally different kind of network. As MTN built out (produced) its network, what was being used up (consumed)? This question naturally leads to an examination of the relationship between MTN and its suppliers. As a large transnational corporation with substantial buying power, MTN operates in a relatively small market (there are not

that many mobile operators in the world) and as such enjoys a closer coupling with suppliers and has much greater input into the design cycle of the businesses from which it purchases its equipment. It was therefore inevitable that the challenges of building GSM networks in places like Nigeria would be brought to the attention of MTN's suppliers—in this case, the Swedish global telecommunication giant Ericsson. Observations about the strange behavior of Nigerian users were communicated to Ericsson by MTN. The challenge was that Ericsson's designs for mobile network devices were predicated on the existence of a specific kind of user (e.g., users in South Africa), and the implied traffic profile guided design decisions relating to network processing capacity. Because Nigerians used their mobile phones differently, it quickly became apparent that the standard processing capacities were inadequate to deal with the traffic profile, hence the need to overdimension: buying more devices than usual in order to provide the network with greater processing capabilities.

Ericsson and other core network equipment manufacturers have since developed new designs for their network devices (based on blade server architecture) that allow their end users (the mobile operators) to upgrade specific portions of the hardware.[5] These new designs allow for selective upgrades to the processing capabilities of mobile networks. As an example of constitutive appropriation, this example highlights the importance of paying attention to the dualism of production and consumption. It is true that the MTN engineers were in many respects the designers of the mobile network. However, it is also true that the Ericsson representatives I spoke with in London saw and spoke of the MTN engineers as *their* users. The MTN network engineers, when faced with different mobile user behavior (in the form of unique traffic profiles, short mean call times, high BHCA, and flashing), adapted by deploying core network elements in new configurations, ignoring standard rules of network dimensioning. Even more interestingly, by problematizing particular aspects of the architecture of the MSC (i.e., processing capacity vs. switching capacity) and communicating that information to their suppliers, the network engineers at MTN may have catalyzed the development of new switch architectures that led to scalability of MSC processing power—affecting the design of future individual mobile network components (MSCs and BSCs).

How should we make sense of these two selfies, and what insights do they provide in understanding how the African mobile is being made?

Conclusion

One important point is that as Nigerian engineers and system designers encountered the behavior of actual Nigerian users, they determined that a fully functional *Nigerian* network has to take into account real users and their particular use practices. The result of their constitutive appropriation was a mobile network that was materially, topologically, and instrumentally dissimilar to networks of similar size and membership elsewhere in the world. The case studies presented in this chapter also reverse the traditional role of engineering system designers solely as productive actors.

In addition, the cases point to the innovative paths that mobile network technology proceeds upon, on which new challenges and practices inspire new language, new understandings, designs, and innovative solutions (overdimensioning) that can then be folded into the upstream design process in tangible and substantial ways—such as new blade server designs! It is clear that following the actors and artifacts (at least in this example) requires us to rethink our classical assumptions about the categories of *users* and *producers*. In this case, they are not ontologically reified; rather, these categories *describe functional relationships*. In other words, the Nigerian engineers and system designers here are simultaneously users *and* producers.

Returning our attention to the question of the "African mobile," what does it mean to say that mobiles have been made African? The Nigerian case clearly illustrates that local context can affect the shape and outline of national mobile telephony design, yet it is also true that there are similar factors in various African nations that can materially contribute to the design of mobile telephony networks. For example, the challenge of delivering electrical power to various base stations is a common challenge faced across most of the continent. In some areas, the problem lies in a troublesome electrical grid; in other areas, there is no grid. These common challenges have exerted an influence over how mobile networks in Africa are designed and run. In particular, lower-power, high-efficiency base stations that are resistant to wide voltage variability have become a design criterion. Although it is perhaps too early to conclude that the African mobile, like the Japanese *keitai*, is a singular sociocultural construct, it is clear that the social, political, and infrastructural peculiarities of the continent are shaping the design and development of mobile telephone networks there. There is no singular African mobile, but we can expect a family resemblance among the various national instantiations. Furthermore, the emergence of this African mobile owes much to the innovative solutions and creative problem solving of thousands of African mobile network engineers. After all, the essence of engineering is creative problem solving.

This chapter contains two examples of Nigerians and Nigerian society engaging in acts of appropriation, and thus we may fruitfully inquire: Does this happen because there is something unique about the Nigerian situation? For example, the overdimensioning of the mobile system by network engineers is indicative of the type of appropriation of traditional practice that Dosunmu (2005) points out is occurring in Wole Soyinka's play *Death and the King's Horseman*.

Although it is difficult to delineate direct causal links, what is undeniable is that Nigeria has a history of being innovative. From the post–World War II Onitsha Market School of novelists,[6] responsible for the boom in indigenous pop culture novels during the 1980s, to "419 scams" (Odumosu and Eglash 2010) that utilize emails and faxes to prey on people for money, either through sympathy or greed, Nigerians seem to have a knack for embracing technologies and making them their own. We can also add to this list the exponential growth of the Nigerian home movie industry—Nollywood (Marston, Woodward, and Jones 2007)—which began by utilizing video recording equipment designed for making movies at home to

tell traditional and contemporary stories through the popular VCD format. This practice has clear historical roots in the traditional Yoruba culture of drama and dance (Dosunmu 2005). Perhaps the Nigerian cultural history of innovating has some role to play in the dynamism of the examples discussed here. It is important to note that all of these practices have a few things in common, not the least of which is the political history of colonization and the abject failure of the mechanisms of the state. The fact that the bustle and excitement of Nollywood, the 419 scams, and the ingenuity of overdimensioning the mobile network all emerge from the same history is instructive.

Notes

1. See http://www.cnn.com/2012/09/13/world/africa/mobile-phones-change-africa/.

2. Callon's (1987) study of the electric vehicle (VEL) in France illustrates the point that engineers involved in the design did not just design the vehicle, but also imagined the society in which it was to be used, including the role of users and their anticipated behavior.

3. My use of the term *selfie* is deliberate. To take a selfie is to use a mobile phone as a tool of self-inspection and representation—that is, to turn the gaze of the camera back on one's self. As an African, an STS scholar, and an engineer, this term is particularly useful for me in this text.

4. Of course, said "average user" is a fiction generated by these numbers. In reality, Nigerian citizens vary widely in their use of mobile technology, with some users spending much longer on calls and others spending shorter amounts of time on calls. For more on the construction of both users and nonusers, see Wyatt 2003.

5. I tried in vain to establish direct causal links between the concerns of organizations like MTN about the need to overdimension their networks and the new initiatives from Ericsson to introduce new product architecture that allows for specific upgrades as required. I visited Ericsson offices in London and Lagos, and in the course of conversations with various engineers and project managers I was able to establish that the design cycle directly utilized user feedback (here, the users are the mobile operators), but there were other considerations that led to these substantial changes, including advances in computer hardware technology. In other words, Ericsson engineers were hesitant to fully attribute their new design decisions to the kinds of user feedback described here. They did, however, concede that "emerging markets" like those in Africa were crucial to their ongoing success, and as such the needs of such markets were influential in the decision-making process.

6. Cypian Ekwensi, probably the most prolific Nigerian author of all time, is associated with this school.