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Breaking the Navajo Code with Bill Toledo

Andrés Burbano

Assistant Professor

Department of Design, Design and Architecture School
Universidad de los Andes (Colombia)

Esteban García Bravo

Purdue University – West Lafayette

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Abstract

This essay explores the connection between the parallel emergence of computing and the Navajo Code-Talking in the context of the Second World War. This parallel is explored through a set of methodologies and questions overlapping social and technological aspects of cryptography. To nurture the argumentation process, the authors interviewed a former Code-Talker and complemented this research with secondary sources to discuss new vocabularies of media archaeology.

Keywords

Code-Talk, cryptography, technology, media archaeology, science and technology studies

*Descifrando el código navajo con Bill Toledo***Resumen**

En este ensayo se explora la conexión entre la emergencia paralela de la informática y el uso del código navajo en el contexto de la segunda guerra mundial. Este paralelismo se explora a través de un conjunto de metodologías y preguntas que tratan tanto aspectos sociales como

tecnológicos de la criptografía. Para nutrir el proceso argumentativo, los autores entrevistaron a un antiguo locutor del código y complementaron esta investigación con fuentes secundarias para discutir los nuevos vocabularios de la arqueología mediática.

Palabras clave

locución con código, criptografía, tecnología, arqueología mediática, estudios de ciencias y tecnología

1. Introduction

In contemporary times, when we talk about “code” in the field of technology, we are often referring to a relationship with programming languages and algorithms. The “coder” or programmer is one who communicates with machines through the use of a code. In contrast, this paper presents another type of code based on spoken word and oral tradition, as opposed to computer syntax. The study presents a rare Navajo-based, crypto-phonic code developed in the context of the Second World War and compares it to other similar technologies that were being developed at that time. We would like to focus on the idea of “code” in the context of media archaeology and discuss its possible connections with language and society. We present the Navajo code as one related to natural languages, but one that can also raise questions about software, such as how this culturally-based practice emerged as a technological innovation. Code-Talking did not rely solely on artifacts, but also used natural languages as a device that effectively encrypted secret messages.

2. Methodological perspectives

As stated by Erkki Huhtamo and Jussi Parikka, the diversity of approaches that characterize media archaeology make it impossible to assign a uniform set of research methods.¹ The authors who have contributed to this emerging field have proposed and developed a rich compendium of views, methodologies, and case studies focusing on the detailed analysis of visual, sonic, audiovisual, and interactive media devices. They have pointed out the importance of the context and cultural implications of the use and construction of some of these media technologies.² Some of the most important contributors like Siegfried Zielinski, among other theoreticians, are interested in the continuous re-examination of the meaning and the impact of the term *media archaeology*.

Media archaeology has ignited several influential processes that describe, interpret and analyze ancient, technical apparatuses. These processes allow us to relate these artifacts to present times, but at the same time to propose a valuable reflection of the notion of the apparatus itself. This is clearly exemplified in Zielinski’s analysis, *Deep Time of the Media*, which describes Athanasius Kircher’s magnetic cryptographic devices from the Baroque times, and also in Erkki Huhtamo’s book, *Illusions in Motion*, which describes the dynamics of creation and public demonstration of Panoramas in the 19th Century. Regardless of differences in each of the case studies and methodological approaches, media archaeology focuses mainly on technological artifacts. These artifacts can be physical objects, but to be more precise, they are traces of material culture associated with technical devices and apparatuses.

In this regard, media archaeology can be seen as a useful tool to understand several elements of the Code-Talkers’ story; we can consider the use of radio devices and cryptographic systems as an apparatus. However, the story of the Code-Talkers should also be examined from a social point of view. The story of the Code-Talkers furthers media archaeology in a new perspective by not only addressing artifacts and apparatuses, but also addressing what Ashmore and Mulkay define as social technologies.³

Science and technology studies (STS) are responsible for the renovation of the discourse about technology and science. For the last fifty years, STS are aware of the politics in technology, the complex cultural implications of technology, and how the social and the technological spheres are somehow intertwined. The STS could be also understood as a differentiated set of methodological views that ranges from the identification of socio-technical systems to the feminist interpretation of cyborgs, to the conception of networks of human and nonhuman actors shaping technology. A cohesive principle in those diverse theories is the idea of technology as a social construction. This is exemplified in the work of Trevor Pinch on the social history of the Moog analog synthesizers⁴ or with the

1. Parikka, Huhtamo, (2011).

2. Zielinski (2008).

3. Pinch, Ashmore and Mulkay (1997).

4. Pinch, Trocco (2004).

work of Callon, Latour and John Law in the development of actor-network theory.⁵

The need to explain the Code-Talkers' story requires considering the theories that have paid attention to the relationship between technology and society. This is why Navajo Code-Talk should be explained on both technical and social levels, answering the question of how a social group was able to design a cryptographic system as accurate as a machine – in fact, even better than any machine at that time.

2. Cryptography and code

Dorothy E. Dennings defines cryptography as “the science and study of secret writing”. In a seminal book about data security, Dennings explains the practice of cryptography and the design of algorithms to protect information for the digital age. Furthermore, she defines: “A cipher is a secret method of writing, whereby plaintext is transformed into ciphertext. [...] code is a special type of substitution cipher that uses a code book as the key”.⁶ According to these definitions, we argue that the Navajo Code-Talk fulfills both of these characteristics, being both a cipher and code. In Figure 1, we transposed Dennings' diagram of the “classical” information channel (p. 4) with the Navajo code communication process.

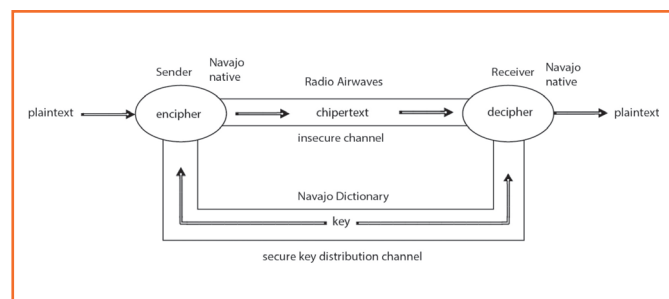


Figure 1. Dennings' diagram of the “classical” information channel superimposed with the Navajo Code-Talk process.

Dennings explains that cryptography in the context of data security “evolved rapidly since 1975” (p.V). However, we draw a parallel with an earlier data encryption technology: the Navajo Code-Talk. Instead of mathematics, Navajo Code-Talk relied on natural languages, but the mechanism for encoding (and decoding) messages may have been similar to the one proposed in the illustration. The system requires two native Navajos to turn the original message into code, using the

Navajo dictionary. This secret document was the code-book (or key) that allowed the receiver on the other side to listen and decipher the message that was transmitted through radio signals.

2.1. Decodifying

Communicating with machines through programming languages or “code” is a key practice in computing today, but the first computers that were created were not programmed with what we call computer languages. Computing originally emerged as a practice of cryptography in the context of the Second World War. Some of these algorithmic devices were mechanical, electromechanical or fully electronic. Examples include the Z1 (1938) and Z2 (1942), developed by Konrad Zuse in Germany, the Colossus, designed by Tommy Flowers (1943) and developed in the UK. Another example is the ENIAC (1946) designed by John Mauchly and J. Presper Eckert, developed in the USA.⁷

Of these remarkable machines, we would like to highlight the “Colossus” computers designed by the British code breakers. These machines were operational between 1943 and 1944 with the goal to decipher messages encrypted by the “Lorenz Cipher”, machines developed in Germany. It has been stated that Alan Turing designed the Colossus, but the machine was actually only partly based on his work. The machine that Alan Turing designed was a Colossus predecessor called “The Bombe”, a machine in charge of deciphering the Enigma Cipher. Enigma was a machine that was able to codify every line of a message with a different cryptologic principle making it almost impossible to understand in the context of a long message.⁸ We would like to stress upon the fact that Colossus is considered the first electric fully programmable digital computer, and that Turing only took part in the design at a theoretical and mathematical level. In the British scene of computer development, the main need for the emergence of computing was the need to decipher codified messages during the war. In other words, these machines could be understood as deciphering, decoding programmable machines shaped by the cryptographic tasks. The codified messages were written and then transmitted. Initially, the notion of code was mainly based on the idea of breaking a written code by a cipher machine. There were no programming languages at the time and therefore the use of the term code did not have the use that it has today. The Colossus was programmed using switches and plug panels. Two parallel and remote events of code encryption and decryption occurred concurrently. The first one is related to the latest technology at that time – the computer – and the second one is related to the use of one of the oldest ways of human communication – speech –.

5. Latour (2005).

6. Dennings (2005).

7. Rojas, Hashagen (2002).

8. Boyle (2014).

2.2. Codifying

A contrasting cryptographic story is one about the Native American Code-Talkers. This story happened parallel to the appearing of the Colossus in the UK in the context of World War II, but in the Pacific theater. The Navajo Code-Talker network can be understood as an encrypting process that operated as a sophisticated device and used archaic languages to encrypt and deliver information, even in real-time, on the battlefield.

The Code-Talkers operation is a socio-technical system both in the classic and the extended way of understanding the socio-technical system concept. The system included the Navajos, other American soldiers, and a series of technical communication devices, like radio transmitters and receivers, antennas, etc. The actor-network theory could also help to understand the distinction between the human and nonhuman actors involved in the operation. The question is, can we analyze the entire Code-Talking process as a technology, and more precisely as a media technology?

However, when we analyze the outstanding precision of this complex system encrypting messages in real-time using codified Navajo language (where messages were encoded and decoded by people instead of a particular physical machine), it is possible to state that they were something more than a network. We think that a more appropriate term to describe them is a Social Technology. This is proposed by keeping in mind the effectiveness of the Code-Talkers in such a complex process of remembering, encoding, transmitting, and decoding critical messages in the very noisy environment of the battlefield. Although Code-Talking was used by the American military in World War I, the knowledge about such a practice was kept a secret, and it did not play the prominent role that it would play during WWII.⁹

Navajo Code-Talking was originally conceived by Phillip Johnson, the son of a reservation missionary who, having heard about the Comanche Code Talkers during his participation in the Great War, thought that the Navajo could also benefit from the same. In 1941, he persuaded a colonel in the Marine Corps: – “What would you think of a device that would assure you of complete secrecy when you send or receive messages on the battlefield?” [...] “That will always be used orally, by radio or telephone, and never reduced to writing that would fall into the enemy’s hands”.¹⁰ Following the Pearl Harbor incident, the Navajo Code-Talking was approved as a pilot project. During the program, 300-400 talkers learned and used the code. The Navajo Code-Talking project remained classified until 1968, 23 years after the war ended.

This social technology was based on the task of encrypting and decrypting using Navajo language, an Athabaskan branch of the Na-Dené family language. We were particularly interested in how a natural language could be understood as an encryption device. To

understand how this whole process worked, we spent time with Bill Toledo, one of the few surviving Code-Talkers.

3. Meeting Bill Toledo

The story of the Navajo Code-Talkers remains to be a significantly intricate cultural phenomena in the 20th century. It articulated diverse concepts, such as natural language, cryptology, indigenous culture, and warfare. Code-Talkers are at this point a generation advanced in age and are not easy to contact, despite there being some organizations devoted to protect the Code-Talkers memory and legacy.

For this research, we had the opportunity to invite Bill Toledo to speak at the International Symposium on Electronic Arts - ISEA 2012 in Albuquerque, New Mexico. During the symposium, we were able to spend a few more days with Toledo learning more about his Code-Talking experience. After a three-month process of correspondence and broken telephonic conversations, we traveled to meet with Toledo. We left for Laguna, New Mexico, a small Navajo reservation about 45 minutes from Albuquerque. Toledo gave us instructions to look for a gas station on mile 114, called “Laguna Burger”, and gave detailed information about his cream-colored truck adorned with a Marine Corps license plate. The place was the only building in sight, surrounded by a landscape of trailers and RVs that conform to the Native American settlement. We showed up at the designated place and minutes later, the cream-colored truck arrived. Bill came walking to us and after shaking hands, we sat at one of the picnic tables of the Laguna Burger. There was a peaceful silence in between each sentence Bill spoke, an 88-year-old that was in great physical shape, about which he said “I exercise every day”. Toledo also belongs to the Dine Code-Talkers, a non-profit group of the Navajo Code-Talkers with the mission of outreach, education and preservation of the Navajo Code-Talker history. As part of this outreach for memory and preservation, Toledo agreed to do the interviews.

Without us having to prompt him with many questions, Toledo started providing us with rich descriptions of the context of his participation in the Code-Talkers’ program during the early 1940’s. Bill Toledo has lived in the Albuquerque area since he was young. When he was seventeen years old, a Marine recruiter came to visit his local public school. The recruiter explained a new program that had a special interest in the Navajo community. Toledo and three of his friends from the junior class in high school enlisted into the program, mostly out of curiosity. At that point in time, they had little information on what kind of special work they would do, but they were adventurous youngsters that wanted to “get out of town”. Toledo also remembered while in the service, being confused by other soldiers

9. Meadows (2002).

10. Bixler (1992).

as “ a Japanese in a Marine suit”, as he was serving in the Pacific front. It was rare to have a Native American in the Army.¹¹

4. Cosmogonic code

Using a secret code that was initiated by the US government and developed by the Navajo people, Bill and about another three hundred marines fought in the Pacific theater from 1942 to 1945. After hard physical training, Toledo and 400 other marine Navajos memorized the code that was based on translations of English letters into Navajo words. The code was created by an earlier group of Navajo-marines before Toledo joined. As a result of the work of the first Navajo group, the *Navajo Dictionary* was created. The document comprises 411 words and letters, translated from English to Navajo pronunciation with its corresponding meaning. They used native Navajo words to recall military terms and artifacts. For example, a battleship was translated to “LO-TSO” which in Navajo means “whale”. We found that several Navajo words recalled items from nature such as animals (eagle, owl, hummingbird), and others reflected the Navajo cosmogonies. For example, the Navajo word for “October,” translates to “small wind”.¹² Another type of translation consisted in the deliberate use of Navajo words and pronunciation. For example “wound” had a coded counterpart, “CAH-DA-KHI”. However, only native Navajos can pronounce this word correctly and therefore, one had to be a Navajo to both pronounce it and understand it. On the cover of the dictionary, we could see a cartoon image of a Navajo chief with a soldier helmet, supervising another one who is making smoke signals with a blanket. Other words that did not have a word in the dictionary were spelled letter-by-letter using the first letter of another word, similar to an acronym. For example, it would use just the letter “A” of “Ant” and say the Navajo counterpart for Ant: “WOL-LA-CHEE.” In this instance, we would like to highlight that the device used human memories and associations instead of algorithms as the “key” to unlock the secret message.

5. Learning an imaginary machine

In the essay “As We May Think,” engineer Vannevar Bush, who was the head of the Manhattan Project, describes in detail a theoretical machine called the MEMEX. The MEMEX proposed a novel system

of indexed files that could be accessed alphabetically.¹³ This vision played a crucial role in the theories, concepts, and development of the hypertext and the World Wide Web.¹⁴ The essay was published in 1945. Similarly, the Navajo Code-Talk consisted of an index of 411 words and letters. The purpose of both Navajo Code-Talk and the MEMEX was to communicate messages. Learning about the Navajo device, we allow ourselves to imagine other applications of this “unbreakable code”.¹⁵

More importantly, Bush claims in “As We May Think” that World War II was a war where everybody had a part: “This has not been a scientist’s war; it has been a war in which all have had a part”.¹⁶ The story of Colossus, Flowers and Turing shows that mathematicians and engineers had their place in the war, and the Code-Talkers’ story shows something less obvious – that the indigenous communities had a part, too.

6. Discussion

When we started this paper we had the idea that it would be possible to intellectually extrapolate the notion of code from the early computing story from the Code-Talkers’ story and *vice versa*. However, this assumption became problematic. The first limitation was the relation between code and programming languages. In general terms, when we think of coding and programming with computer languages, those languages are called “languages,” somewhat erroneously because they are, in fact, ways of writing, rather than languages in the sense of oral communication. Instead, the Navajo code was an oral code, a spoken one that proved to be a very sophisticated speech act based on mnemonics that strategically avoided writing. This use of the word “code” is very different, but still, we found relationships to other emerging technologies. Despite the limitations of our initial approach, we think it is important to highlight the following considerations in regard to this study:

A. The Navajo device has not had yet played a direct impact in computing, but as technologies advance, we envision systems that would allow the recognition of natural languages in the context of speech recognition and machine learning. Could new machines communicate with us without the use of coding languages? Could new systems of speech recognition allow for more natural communication with computers? This could allow for more overlaps between the humanities and computing. We would like to further

11. Toledo (2012).

12. Naval History and Heritage. *Command Navajo Code-Talkers’ Dictionary* - 1945. <<http://www.history.navy.mil>> [Accessed in September 2015].

13. Bush (1945).

14. Nyce, Kahn (1991).

15. C.I.A. *Navajo Code-Talkers and the Unbreakable Code*. <<http://www.cia.gov>> [Accessed in September 2015].

16. Bush (1945).

these questions by studying the relationships between native languages and context-based computational languages. Issues of culture, such as cosmogonies, artifacts, and identity would be addressed as a core component of these new developments. Is it possible to understand the Code-Talking example as an effective way of communication that could be used to program machines? Is it possible to have new programming languages designed especially for programming while talking? Would it be possible to code in the programming sense using voice as the Code-Talkers did? This does not only mean that we could code in Java or Python by a dictation, but if there were truly useful ways to program while speaking, this process would cross an unprecedented threshold. It would foster the need to develop computer “languages” made especially for speaking instead of spelling syntax elements, such as semicolons and other symbols. Is it erroneous to describe programming languages as languages? Code and language are sometimes interchangeable terms, but we are aware that a language is a way of communicating with people and is therefore heavily influenced by culture, while computer languages are ways of communication with machines. Moreover, computer “languages” are not spoken; they are mainly ways of writing.

- B.** Probably, the most important lesson of this story for contemporary code practices is the reflection about the essence of how natural languages work. According to Mark Baker,¹⁷ natural languages have a double nature that is remarkably visible in the Code-Talker example, as a vehicle of communication, but at the same time something that has the potential to effectively block communication. This tantalizing finding is defined by Blake as the “Code-Talker Paradox.” The case of the Navajo Code-Talker program was the result of a military strategy. Rather than utilizing these devices for warfare, we imagine new potential ways of communicating with machines, exploring social and cultural contexts. If we look at the Navajo Code-Talk as an example of a social technology, this invention took into account the Navajo social systems, the cosmogonies, ethics, and artifacts that conform to “the Navajo way”.¹⁸
- C.** The Code-Talkers’ story transposes cultural, social and technological issues simultaneously, implying a new dialog at the intersection of media archaeology and science and technology studies. This in turn furthers these areas of study by understanding Code-Talk as both an apparatus and a socially constructed technology.

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CV



Andrés Burbano

Assistant Professor

Department of Design, Design and Architecture School

Universidad de los Andes (Colombia)

aburbano@uniandes.edu.co

School of Design and Architecture

Universidad de los Andes. Office K 108

Cra 1 # 18A- 12,

Bogotá, 11001000, Colombia

Andrés Burbano holds a Ph.D. in Media Arts and Technology from the University of California, Santa Barbara. He's an assistant Professor in the Department of Design at the Design and Architecture School at the Universidad de los Andes, Colombia. He's also a Leonardo Education and Arts Forum International Representative. His current research projects are the following: James Bay Cultural Atlas, an audiovisual on-line database of the Cree communities from the James Bay in Northern Quebec; Sonorization, Visualization and Materialization of Biodiversity Data. FAPA, Grant for assistant professors at Universidad de los Andes, where he is the project leader.

CV

**Esteban García Bravo**

Assistant Professor of Computer Graphics Technology
Purdue University – West Lafayette
garcia0@purdue.edu

401 N. Grant St., Knoy Hall of Technology
West Lafayette, IN 47907

Esteban García Bravo holds a PhD in Computer Graphics from Purdue University a MFA in Studio Arts - Electronic and Time-Based Media from Purdue University and a BFA in Time Based and Electronic Media Art from Universidad de los Andes, Bogotá. His research on computer art history and digital media art practices has been featured in the annual meetings of international organizations such as SIGGRAPH, ISEA and Media Art Histories-MAH. Esteban is currently an assistant Professor in the department of Computer Graphics Technology at Purdue University, where he teaches digital imaging foundations and computational aesthetics.