



Structural Daydreaming and a Hollywood Beauty

By Michael J. Martin, PMP

This is a true and astonishing story. Did you know that the original idea and patent that led to today's cellular telephone technology comes from a famous Hollywood movie star named Hedy Lamarr?

Her invention, which formed the basis of what was to become spread-spectrum communications, was classified as "top secret" for many years.

Actress Hedy Lamarr was one of the most glamorous stars of Hollywood's golden era in the 1930s and '40s. She starred in numerous films including "Samson and Delilah" and "Ziegfeld Girl". Lamarr was often billed as "*the most beautiful woman on earth*".

So, how did she do it? Lamarr's solution began when she learned all about weapons of war by discussing the topic with her first husband, Fritz Mandl. He was an arms manufacturer. Mandl had become increasingly involved in deals with the Nazis and Lamarr objected to these dealings. So she left her husband and made her way to London and then onward to Hollywood.

She kept these armament discussions in mind when she heard about the problems of radio-controlled missiles. It was too easy to block the simple control signal. She realized that if the signal jumped from frequency to frequency quickly (like changing channels on a TV or radio) and both sender and receiver changed in the same order, then the signal could never be blocked by someone "listening in" who didn't know how the frequency was changing.

In the days before the transistor was invented, it was difficult to design a way for this to be accomplished. Lamarr's friend, music composer George Antheil suggested using something similar to piano rolls, from player pianos, to keep both sides in synch. Together, he and Lamarr were awarded patent #2,292,387 for the "Secret Communication System" in 1942. At that time the idea of using the paper rolls to synchronize was too cumbersome to be practical.

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When the transistor did become available, the US Navy used the idea in secure military communications and when transistors became really cheap the idea was used in cellular phone technology. By the time the US Navy used the idea, the original patent had expired and Lamarr and Antheil never received any royalty payments for their idea.

The spread-spectrum concept forms the basic principle that enables the simultaneous multi-channel operation of modern digital cellular telephony.

The same characteristics that made their technique jam-proof, through a mathematical phenomenon, creates an extraordinary efficiency of transmission such that extremely low-power transmitters can be used over extraordinary distances, and many transmitters and receivers can occupy the same band of frequencies at the same time. This extraordinary efficiency is enabling inexpensive wireless access to high-bandwidth TCP/IP telecommunications, frequently radically altering the economics of setting up Internet-connected LANs. For example, the new IEEE 802.11b Wi-Fi standard uses spread-spectrum.

In 1997 Hedy Lamarr was honoured with an award at the Computers, Freedom, and Privacy conference for "blazing new trails on the electronic frontier." Lamarr died on January 19, 2000. Lamarr was not a communications engineer. But she and her partner adeptly used familiar structures found in their own worlds to solve a major communications engineering problem, and in doing so, left us a legacy that remains strong to this day. Lamarr had great beauty for sure, but she also had brains, and more importantly, dared to dream and use her imagination.

"The most beautiful thing we can experience is the mysterious. It is the source of all true art and all science. He to whom this emotion is a stranger, who can no longer pause to wonder and stand rapt in awe, is as good as dead: his eyes are closed." Albert Einstein.

So, how does this wonderful story about a Hollywood beauty offer any meaning to you today? Let's say that your senior management has just directed you to build a new broadcast facility. The powers that be have placed radical and taxing constraints upon your project. You have been given an insufferable budget, a preposterous time frame, unattainable quality objectives, and operational expectations that must be met – no matter what! Does this description fit, *another day in your life as a typical broadcast engineer?* It does not really matter whether you work in radio, cable, telecom, television, or for a major national company or a small local operator. The challenges that we all face today are widespread and universal.

You are expected to do more, with less, and do it better and faster - simple really.

But, how do you find a solution when faced with these complicated business requirements? How do you begin your project? What if your undertaking has never been done before? You have no benchmarks. You cannot duplicate any other approach in this situation. Where can you get help?

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Very often, the first step to solving a complex technological problem is to choose a suitable architectural structure as your foundation. But, which approach, and where do you find it?

One of the best places to search for a new idea is to look at the physical world. As a technical person you already know instinctively that we all live in a world built upon structures. The earth is an amazing organization of structures all functioning in perfect harmony.

The same could be said of the human body, which is one unified and complex system enabling you to walk, talk, touch, feel, listen, learn, love, and basically, live. Can your own anatomy be used in some manner as the model for a new system? Is this guy nutty? Maybe.

Structures exist everywhere around us. These physical structures can be used as fitting models when designing and engineering new broadcast systems. The next time that you are creating a new system, why not benchmark from an unorthodox source? You will amaze yourself at how truly creative and inventive you can be when constructing a technology-based facility from a model used in other “systems” found outside of the boundaries of our normal communications industry.

Here are a few organizational structures that might be useful to consider when planning your next HDTV transmitter, news studio, uplink, edit suite, mixing or layback theatre, headend, monitor and control facility, or master control room.

- **Centralized structures** Controlled from a single place or by a single organization.
- **Distributed structures** To divide (something) among several or many points, or to spread or scatter (something) over an area.
- **Structural Arrays** A cluster of equal elements organized to combine harmoniously into a greater single unit. The sum of the parts is greater than any one element.
- **Parallelism, or structures with lateral relationships** Independent elements occurring on a parallel or common timeline, but not necessarily connected to one another.
- **Bus, Star, Ring, and Mesh structures** The organization of interrelating connections or pathways into a unified structure that permits efficient sharing with minimal or managed conflict and congestion.
- **Hybrid structures** A combination of two or more structures in order to gain the beneficial aspects of each structure into a single, greater arrangement.



- **Combined or stacked structures** Elements that are harmoniously coexisting or sharing the same physical place for efficiency.
- **Matrix and three-dimensional structures** A multi-dimensional array utilizing more than one element on several dimensions simultaneously – space, time, and frequency for example.

Consideration should also be given to your structural needs based on ideas such as consolidation, flattening, and simplifying. Try looking deep into the granularity or blocking of your system. Can these blocks be translated or replicated?

It is said that, “imitation is the ultimate form of flattery”, so why not imitate nature? It offers you the ultimate set of designs and structural principles to work with. Search your project for clues to guide you towards a suitable structure, such as complementary or contrasting patterns, time relationships, functionality, and different levels are hierarchically dependency.

When dealing with people, consider divisions of labour, unity of command, authority and responsibility, spans of control, and of course, always add contingency factors. Should you use a strategy that is task-based, technology-based, or people-focused? Daydream about the answer. But, it is vital to not stray too far from your company’s objectives.

Analogous daydreaming is a way to nurture creativity, better define an idea, and discover a solution to a problem. Ideas come when they are needed. It is said that they tend to come at some of the oddest times, like when you are sleeping, in the shower, or sitting under a tree. The author’s own approach is to stop working, sit back, sip a cup of orange pekoe tea, and then just ponder a design problem until the answer reveals itself. You might be able to solve your own problems in the same way. Maybe you will be the next great inventor? So, clear your mind, find a quiet place, and dream your problems away, you never know...

Footnote: *Excerpts incorporated from The Associated Press, March 1997 and Chris Beaumont of www.ncafe.com*

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