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WEB & WIRELESS TECH

Hedy Lamarr

The Inventor Behind Spread-Spectrum Wireless

Glamour, Genius, and the Signal That Wouldn't Stay Still

Hedy Lamarr (1914-2000) occupies a strange place in history: she was simultaneously one of Hollywood's most celebrated leading ladies and a genuinely innovative inventor. Born in Austria and later becoming an American citizen, she built a public image entirely around glamour, even as she filled her private hours tinkering with engineering problems she had taught herself to understand.

The problem that drew her attention during World War II was the vulnerability of radio-guided torpedoes. A torpedo steered by a single radio frequency could be defeated if the enemy detected that frequency and flooded it with noise, a tactic called jamming. Lamarr reasoned that a signal which refused to stay on any one frequency would be far harder to jam or intercept.

Together with the avant-garde composer George Antheil, she designed a system in which transmitter and receiver would hop in synchronized fashion across a range of frequencies, following a shared pattern that an outsider would not know. Antheil, who had experimented with automatically synchronized player pianos, helped translate the concept into a workable mechanism. The pair received U.S. Patent 2,292,387 for the idea in 1942. Today the technique is known as frequency hopping spread spectrum.

The invention was ahead of its time, and for decades Lamarr received little recognition as an engineer; the public could not reconcile the image of a movie star with that of a serious inventor. The mathematics of spread spectrum, however, proved foundational. Rapidly changing frequencies in an unpredictable but reproducible sequence is exactly what allows many modern wireless systems to share the airwaves resiliently.

Her core idea now underlies WiFi, Bluetooth, and GPS, technologies that quietly shape daily life. In 2014, more than seventy years after the patent, Lamarr was inducted into the National Inventors Hall of Fame, and she is now widely, if informally, honored as 'the mother of WiFi.'

Part 1 · Comprehension & Analysis

1. Explain the specific vulnerability in radio-guided torpedoes that Lamarr set out to solve.

2. What role did George Antheil's background play in developing the invention?

3. Why does the passage describe the invention as 'ahead of its time'?

4. According to the passage, why is an unpredictable but reproducible frequency sequence useful for modern wireless?

Part 2 · Quantitative Challenge

Model the Spread Spectrum

A frequency-hopping system uses 8 available channels and hops 10 times per second. Its repeating secret sequence is: 5, 2, 7, 4, 1, 6, 3, 8, then it starts over. Show your work and verify every calculation.

1. How many hops does the system make in 6 seconds?

2. The sequence is 8 hops long. In those 60 hops, how many complete sequences occur, and how many hops are left over?

3. Using the pattern, which 4 channels are the leftover hops (hops 57 through 60), and therefore what channel is the system on at hop 60?

4. An eavesdropper randomly guesses one channel for each hop and must guess correctly on two consecutive hops to intercept. Assuming independent guesses among the 8 channels, what is the probability of guessing both correctly?

Part 3 · Discussion & Extension

Lamarr's contribution was overlooked for decades partly because she was seen as a glamorous actress rather than a serious inventor. To what extent do public image and stereotypes still determine whose ideas get taken seriously today? Argue a position and support it with reasoning and examples.