

UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Hays *et al.*  
U.S. Patent No.: 5,659,891  
Issue Date: August 19, 1997  
Appl. Serial No.: 08/480,718  
Filing Date: June 7, 1995  
Title: Multicarrier Techniques in Bandlimited Channels  
IPR: IPR2016-00768

**DECLARATION OF DR. JAY P. KESAN**

1. My name is Dr. Jay P. Kesan. I understand that I am submitting a declaration for Mobile Telecommunications Technologies LLC (MTel”), offering technical opinions in connection with the above-referenced *Inter Partes* Review proceeding pending in the United States Patent and Trademark Office for U.S. Patent No. 5,659,891 (the “’891 patent”), and prior art references relating to its subject matter. My current *curriculum vitae* is attached as Appendix A.
2. I also provide selected background information here relevant to myself, my experience, and this proceeding.
3. I am a Professor at the University of Illinois at Urbana-Champaign, where I am appointed in the College of Law, the Department of Electrical and Computer Engineering, the Coordinated Science Laboratory, and the Information Trust Institute. I have a Ph.D. in Electrical and Computer

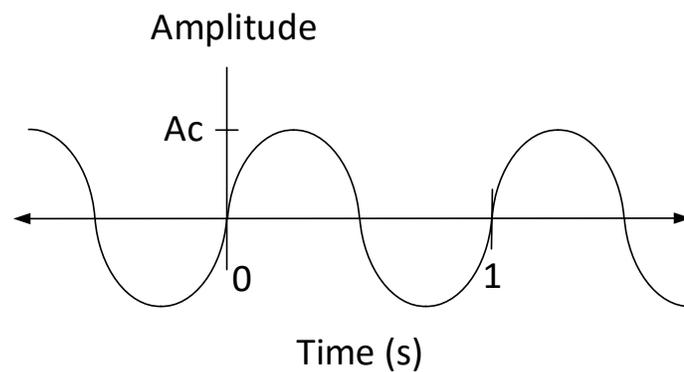
Engineering from the University of Texas at Austin and a J.D., *summa cum laude* from Georgetown University. I have also worked as a research scientist at the IBM T.J. Watson Research Center, and I am a named inventor on several United States patents. I have also served as a technical expert and legal expert in patent infringement lawsuits. I have been appointed to serve as a Special Master in patent disputes.

Additionally, I have been appointed as a Thomas Edison Scholar at the United States Patent and Trademark Office (“USPTO”).

4. My opinions in this report are based on my experience and expertise in the field relevant to the Asserted Patents. To prepare this Report, I have reviewed and considered materials shown in Appendix B and referred to herein, principally including the ‘891 patent and its file history, the Petrovic reference, and the extrinsic evidence cited.
5. I anticipate using some of the above-referenced documents and information, or other information and material that may be produced during the course of this proceeding (such as by deposition testimony), as well as representative charts, graphs, schematics and diagrams, animations, and models that will be based on those documents, information, and material, to support and to explain my testimony before the Board regarding the validity of the ’891 patent.

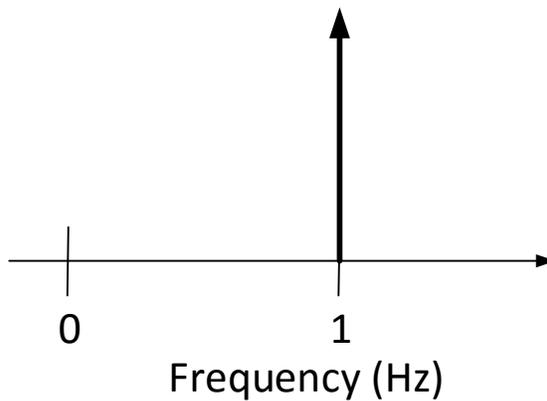
6. This report is based on information currently available to me. To the extent that additional information becomes available (whether from documents that may be produced, from testimony that may be given or in depositions yet to be taken, or from any other source), I reserve the right to continue the investigation and study. I may thus expand or modify my opinions as that investigation and study continues. I may also supplement my opinions in response to such additional information that becomes available to me, any matters raised by and/or opinions provided by MTel's experts, or in light of any relevant orders from the Board.
7. Throughout this report, I cite to certain documents or testimony that support my opinions. These citations are not intended to be and are not exhaustive examples. Citation to documents or testimony is not intended to signify and does not signify that my expert opinions are limited by or based solely on the cited sources.
8. I am an attorney, registered to practice before the United States Patent and Trademark Office, and a legal expert in United States Patent Law.
9. A person of ordinary skill in the art at the time of the invention (POSA) of the '891 Patent would possess a bachelor's degree in electrical engineering or its equivalent and about four years working in the field of wireless telecommunications networks and would possess knowledge

- regarding frequency, amplitude, and masks as used in telecommunications, or equivalent education and work experience.
10. The '891 Patent is directed to the field of telecommunications and to systems and methods for operating paging carriers.
11. A brief background on carriers is helpful in understanding how the '891 Patent is operating carriers.
12. Most simply, in telecommunications an unmodulated carrier is, in general, sinusoidal waveform. Drawing 1 below illustrates a carrier with a frequency of 1 Hz and an amplitude  $A_c$ .



Drawing 1

13. Drawing 1 depicts an ideal carrier in the time domain. However, in telecommunications, it is frequently useful to view carriers in the frequency domain. In the frequency domain, the ideal carrier of Drawing 1 has just a single frequency of 1 Hz. Drawing 2 below illustrates the carrier of Drawing 1 as shown in the frequency domain.



Drawing 2

14. In Drawing 2, the carrier is shown as an impulse with a single frequency.

This is because the sinusoidal waveform of Drawing 1 is ideal.

15. In the real world, it is not possible to transmit an ideal sinusoidal waveform even for an unmodulated carrier. Additional unwanted frequencies are generated. As a result, even in the frequency domain, a carrier has more than one frequency.

16. In Drawing 2, the y-axis is not specified. In telecommunications, the frequencies of a carrier are often plotted in relation to their peak intensities or their power levels. These types of plots can be referred to as an emission spectra. Drawing 3 below illustrates an emission spectrum for a real world carrier.

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