

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC.  
Petitioner

v.

INVT SPE LLC  
Patent Owner

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Case No. 2018-01474  
U.S. Patent No. 7,206,587

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**DECLARATION OF DR. ANDREW C. SINGER**

I, Andrew C. Singer, hereby declare the following:

## I. INTRODUCTION

1. I, Andrew C. Singer, have been retained by counsel for Petitioner as a technical expert in the above-captioned case. Specifically, I have been asked to render certain opinions in regards to the IPR petition with respect to U.S. Patent No. 7,206,587 (the “’587 Patent”). I understand that the Challenged Claims are claims 3 and 4. My opinions are limited to those Challenged Claims.

2. My compensation in this matter is not based on the substance of my opinions or the outcome of this matter nor do I have any financial interest in the outcome of this proceeding. I am being compensated at an hourly rate of \$500 for my analysis and testimony in this case.

3. In reaching my opinions in this matter, I have reviewed the following materials:

- Exhibit 1001 – U.S. Patent No. 7,206,587 to *Miyoshi et al.* (the “’587 Patent”)
- Exhibit 1002 – File History of U.S. Patent No. 7,206,587
- Exhibit 1004 – “CDMA/HDR: A Bandwidth-Efficient High-Speed Wireless Data Service for Nomadic Users,” Bender, et al. (“*Bender*”)
- Exhibit 1005 – U.S. Patent No. 4,747,104 to Piret (“*Piret*”)
- Exhibit 1006 – U.S. Patent No. 6,470,470 to Jarvinen et al. (“*Jarvinen*”)
- Exhibit 1007 – U.S. Patent No. 6,289,485 to Shiomoto (“*Shiomoto*”)
- Exhibit 1008 – U.S. Patent No. 4,908,827 to Gates (“*Gates*”)
- Exhibit 1009 – U.S. Patent No. 4,589,112 to Karim (“*Karim*”)
- Exhibit 1010 – U.S. Patent No. 5,274,646 to Brey et al. (“*Brey*”)
- Exhibit 1011 – U.S. Patent Application No. 2001/0014612 to Uesugi (“*Uesugi*”)

- Exhibit 1012 – Burt Masnick, Jack Wolf, *On Linear Unequal Error Protection Codes*, IEEE Transaction on Information Theory, Vol. IT-3, No. 4, October 1967 (“*Masnick*”)
- Exhibit 1013 – John C. Proakis and Masoud Salehi, *Communication Systems Engineering*, Prentice Hall (1994) (“*Proakis*”)
- Exhibit 1014 – Michael Andersin, Zvi Rosberg, *Time Variant Power Control in Cellular Networks*, Hifa Research lab., Science and Technology, MATAM, 31905 Haifa, Israel (August 1996) (“*Andersin*”)
- Exhibit 1015 – Vijay K. Bhargava, Qing Yang, David J. Peterson, *Coding Theory and its Applications in Communication Systems*, Defense Science Journal, Vol. 43, No. 1, January 1993 (“*Bhargava*”)
- Exhibit 1016 – Adem Durak, *Evaluation and Methods to Reduce Co-Channel Interference on the Reverse Channel of a CDMA Cellular System*, Naval Postgraduate School (March 1999) (“*Durak*”)
- Exhibit 1017 – Daniel A. Spielman, *The Complexity of Error-Correcting Codes*, Lecture Notes in Computer Science #1279, pp. 67-84 (September 1997) (“*Spielman*”)
- Exhibit 1018 – Rachel L. Pruitt-Billingsley, *Analysis of Digital Cellular Standards*, Naval Postgraduate School (June 1996) (“*Pruitt-Billingsley*”)
- Exhibit 1019 – Leycheoh Lim, *Chip for Interleaving CDMA Cellular Systems*, Graduate Department of Electrical and Computer Engineering, University of Toronto, Canada (May 1997) (“*Lim*”)
- Exhibit 1020 – Hang Liu, Magda El Zarki, *Transmission of Video Telephony Images Over Wireless Channels*, Wireless Networks 2, 219-228 (1996) (“*Liu*”)
- Exhibit 1021 – Ezio Biglieri, Dariush Divsalar, Peter J. McLane, Marvin K. Simon, *Introduction to Trellis-Coded Modulation with Applications*, Macmillan Publishing Company, 1991 (“*Biglieri*”)
- Exhibit 1022 – *Digital Computer*, McGraw-Hill Encyclopedia of Engineering, 2nd Ed. 1993 (“*Mcgraw-Hill*”)
- Exhibit 1023 – Andrew J. Viterbi, *CDMA Principles of Spread Spectrum Communciation*, Addison-Wesley Publishing Company, 1995 (“*Viterbi*”)
- Exhibit 1024 – U.S. Patent No. 5,828,662 to Jalali et al. (“*Jalali*”)
- Exhibit 1025 – U.S. Patent No. 6,101,399 to Raleigh et al. (“*Raleigh*”)

**A. Background and Qualifications**

4. I am currently a Professor in the Department of Electrical and Computer Engineering, where I hold a Fox Family endowed Professorship. I also serve as Associate Dean for Innovation and Entrepreneurship for the College of Engineering at the University of Illinois at Urbana Champaign.

5. I received a Bachelor of Science degree in Electrical Engineering and Computer Science from Massachusetts Institute of Technology in 1990; a Master of Science degree in Electrical Engineering and Computer Science from Massachusetts Institute of Technology in 1992; and a Ph.D. in Electrical Engineering from Massachusetts Institute of Technology in 1996.

6. Since 1990, I have been active in the signal processing and communications fields. I have authored and/or co-authored numerous publications, including books and refereed journal publications and conference articles on the topic of signal processing and communication systems and devices. A focus of many of these publications is on methods for the design and analysis of digital communication systems that employ data transmission, modulation, and detection at the physical layer. These include the development of algorithms, architectures, and circuits that map binary information onto channel symbols, such as QAM, PSK or other modulation formats, as well as the analysis of the transmission performance, error rates, and error control coding for such systems

7. I have designed, built, and patented various components of communication and signal processing systems. These include various radio-frequency, SONAR, LIDAR, air-acoustic and underwater acoustic signal processing systems as well as wire-line, wireless, optical and underwater acoustic communication systems. An important aspect in many of these systems is the design of signal processing, modulation, and coding algorithms, architectures and circuits for data encoding, mapping, modulation, detection, and decoding.

8. I have taught both undergraduate and graduate level courses in signal processing, and communication systems. For example, I have taught Digital Signal Processing and Embedded DSP Laboratory classes. Additional examples of courses I have taught at the University of Illinois at Urbana Champaign include: Advanced Digital Signal Processing; Digital Signal Processing; Digital Signal Processing Laboratory; Probability with Engineering Applications; Random Processes; Optical Communication Systems; Advanced Lectures in Engineering Entrepreneurship; Embedded DSP Laboratory; Developing Design Thinking; Technology Commercialization; and Senior Design Laboratory. I have also overseen numerous PhD and Master's students researching topics related to signal processing and communication systems.

9. I was the co-founder and CEO of Intersymbol Communications, Inc., a communications component manufacturer focused on the development of signal

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