UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SQUARE, INC.
Petitioner

v.

4361423 CANADA INC.
Patent Owner

Patent No. 9,016,566
Inter Partes Review No. 2019-01649

DECLARATION OF IVAN ZATKOVICH

I, Ivan Zatkovich, declare as follows:

I. Introduction

1. My name is Ivan Zatkovich. I am over the age of eighteen and am competent to make this Declaration.

2. I make this Declaration on behalf of the Patent Owner in connection with Square's request for *inter partes* review of U.S. Patent No. 9,016,566 ("the '566 Patent," Ex. 1001). I have been engaged by the Patent Owner to review the underlying materials and to provide my opinion on certain matters alleged by Square in its Petition, as well as to respond to certain allegations in the Declaration of Bruce McNair (Ex. 1003).

3. I am being compensated at my standard hourly consulting rate of $575. My compensation is in no way contingent on the results of these or any other proceedings relating to the '566 Patent. I have no expectation or promise of additional business with Patent Owner in exchange for the positions explained herein.

4. I have personal knowledge of the matters set forth herein, and if I am called to testify, I could testify competently thereto.

II. Background and Qualifications

5. My curriculum vitae, attached as Exhibit A, provides a detailed description of my professional qualifications, including a listing of my professional activities. Below, however, is a short summary of those qualifications.

6. I am a Computer Scientist and Technology Consultant specializing in Telecommunications, Mobile Network communications, Point of Sale, and Secure financial transactions. I have over 30 years of experience in a diverse set of technologies including credit card transaction processing, e-wallet validation, payment gateways, point-of-sale devices including NFC/RFID, magnetic stripe, magnetic secure transmission (MST) and chip readers, wireless communications (wifi, Bluetooth, GSM, and broadband), and mobile payment applications. I also have extensive experience with implemented methods of privacy and fraud protection including but not limited to encrypted wireless communications, tokenization, authentication, and authorization. My clients include eTrade, Citicorp, Smith Barney, Capital One, Deustche Telekom, PTT Netherlands, Apple, and Facebook. I implemented wireless and network infrastructure for clients including GTE / Verizon, Bell Canada, Qwest telephone, Deutsche Telekom, Citicorp, GEICO.

7. I am a frequent industry speaker/presenter and, perhaps of particular relevance, a certified ecommerce solutions expert. I have developed multiple credit card payment methods and payment gateway solutions for e-commerce clients such

as Warner Brothers, Wachovia Bank, and Pro Marine; developed high-speed wireless communications using wifi mesh networks and Bluetooth communications; implemented applications for wireless data communications using 802.11 and Bluetooth on wireless, and local secure networks; developed audio data encryption for VoIP, fax and modem application; developed data transaction authentication and verification (to identify tampering, or modification) technology; and developed secure online systems for payment transactions and insurance policyholder claims processing. I also developed the first version of the ETrade securities trading system for ETrade Online Trading.

8. I have been a testifying expert for over 60 cases including patent litigation, ITC, IPRs, and CBMs for secure financial transactions, point-of-sale, mobile and wireless payment authentication.

III. Materials Considered and Bases for my Opinions

9. The focus of this Declaration is to opine on specific priority issues raised by Petitioner Square in its Petition for *inter partes* review of the '566 Patent. I have reviewed the '566 Patent (Ex. 1001), the file history including the provisional application (Ex. 1005), Square's Petition, the Declaration of Bruce McNair (Ex. 1003), and other documents and materials cited herein. My opinions in this declaration are based on my review of these documents, as well as upon my education, training, research, knowledge, and experience.

IV. Legal Standards

10. I am not an attorney and I offer no opinions on the law itself. My understanding of the relevant legal principles is based on information provided to me by counsel for Patent Owner.

11. I understand from counsel that a patent applicant, as part of the bargain with the public that entitles him to a patent, must describe his invention so that the public will know what it is and that he has truly made the claimed invention. I understand that this is referred to as the "written description requirement" of the Patent Act, which is judged from the perspective of a person of ordinary skill in the art at the time of invention. I understand that compliance with the written description requirement does not require that the description use exact words or spell out every detail of the invention, but is satisfied if the invention disclosure as filed reasonably conveys to a person of ordinary skill in the art that, as of the filing date sought, he or she was in possession of the invention claimed. I also understand that a person of ordinary skill in the art can rely on information that is well known in the art for the purpose of evaluating the written description requirement.

12. I understand that, here, the patent claims priority to the Provisional Application filed on February 10, 2009, and thus the Provisional Application must show the inventors' possession of the claimed invention as of that date. While the

later applications must also show possession, that does not appear to be in dispute in this case.

V. Description of the Relevant Field and the Relevant Timeframe

13. Having reviewed the '566 Patent and its supporting materials, I agree with Petitioner's expert, Bruce McNair, that the relevant timeframe is on or before February 10, 2009, which is the date of the Provisional Application. I also agree that the relevant general fields for the purposes of the patent are analog modems, telephone networks, cellular networks, financial systems, transaction cards, magnetic stripe and smart cards, and security, encryption, and authentication technology.

VI. The Person of Ordinary Skill in the Relevant Field in the Relevant Timeframe

14. The opinions I offer herein are based on what a person of ordinary skill in the art ("POSITA") in the relevant technical field would have understood at the time of the invention of the challenged claims. As to the priority issues addressed herein, my opinions consider what that POSITA would have understood from the Provisional as it relates to the issued claims of the '566 Patent.

15. On the subject of the level of "ordinary" skill possessed by the hypothetical POSITA, I agree with Mr. McNair that a POSITA in the field of the challenged claims would have been someone with good working knowledge of device interfaces and the integration of devices involving digital and analog signals.

The POSITA may have a Bachelor of Science in Electrical Engineering or Computer Engineering, or the equivalent and have at least one to two years of relevant experience in the fields of embedded systems and mobile communication device interfaces, or otherwise equivalent industry experience in the relevant field. Less work experience may be compensated by more education, and vice versa. I have extensive experience working with payment solution systems and devices that qualifies me to judge and consider the position of a POSITA for the relevant field at the time.

VII. Technical Background and State of the Art

16. The '566 Patent relates to an apparatus and method for commercial transactions using a payment transaction device such as a credit/debit card reader for use with a mobile communication device, such as a cell phone or tablet, for the purpose of effecting commercial transactions. It includes 2 independent claims (Claims 1 and 3) and 2 dependent claims, for a total of 4 claims.

17. I understand from the Petition and Mr. McNair's Declaration that Petitioner contends that the '566 Patent's Provisional does not support the following aspects of the claim limitations: (1) "the recited functions of 'a sensor' in claim 1, namely 'producing an analog signal indicative of the recorded information' and 'converting said analog signal to a format suitable for transmission to a jack of a mobile communication device'; (2) the recited "providing said analog signal

indicative of the recorded information … to said mobile communication device for further processing by circuitry contained in the mobile communication device" in claim 3; and (3) the recited "smart card having recorded information stored on an integrated circuit incorporated into the card" in claims 1 and 3. I disagree and address these issues below.

VIII. Priority

A. The Provisional adequately discloses "Producing an Analog Signal Indicative of the Recorded Information" and "Converting Said Analog Signal to a Format Suitable for Transmission to a Jack of a Mobile Communication Device."

18. The Provisional expressly conveyed that, at the time of filing, the inventors possessed a card reader that would communicate with a mobile phone using a signal in analog audio format for the purpose of achieving secure financial transactions. It explained, among other things, that the invention's focus was on achieving secure transactions through the inventor's card reader device communicating with a mobile communication device such as a mobile phone using this specific format. *See* Ex. 1005, Provisional, at [300] ("The device communicates with mobile phone 13 via phone jack 10 using analog tone. It allows secure electronic fund transfer, debit/credit card 8 transactions over mobile phone. Currently the device communicates with mobile phone via phone jack 10 using audio signal."). As one of ordinary skill in the art would know, this would require circuitry and its associated logic (e.g. a smart card reader interface, software/firmware) to

retrieve the card information when it is either inserted or held near the reader and convert that information to be transmitted in an analog format suitable for a phone or audio jack. One way to do that is converting to the audio signal format as discussed in the Provisional. Ex. 1005 ("The device communicates with mobile phone 13 via phone jack 10 using analog tone.") The Provisional mentions that the method is data over voice channel. Therefore, the sensor initially senses/captures/reads the information for the purpose of ultimately producing the analog signal that is transmitted to the phone.

19. The Provisional disclosed a "secure microprocessor" that would not only perform the conversion, but control the operation flow of the device, perform the necessary encryption, and transmit those signals in an analog form suitable for transmitting to the jack of a cell phone. *See* Ex. 1005 at [300] and [500]. One of ordinary skill in the art at the time would have understood that the Provisional's disclosure of the smart card reader with the disclosed microprocessor shows possession of the claimed "sensor" and "circuitry" for "producing an analog signal indicative of the recorded information" and "converting said analog signal to a format suitable for transmission to a jack of a mobile communication device," as well as the associated hardware/software to perform the encryption of the credit card info. Once the credit card information is captured from the credit card/smart card reader it would be rendered in a digital format in order to be received by the

microprocessor ('controller 50' in the patent). It would be well understood by a person of ordinary skill, the many well known methods of encrypting credit card information (single key symmetric, asymetric public key/private key, etc). Once encrypted, the microprocessor would convert the encrypted card data into an analog audio form capable of being received by the disclosed jack of the mobile phone. Secure microprocessors available on the market at the time would have included the capability to perform all of these functions. In addition, one of skill in the art would understand from the reference to a "smart card reader" that this circuitry could be included in the sensor structure – such as with "smart sensors" that were available on the market at the time containing its own built in microprocessor that processes received 'sensed' signals – or elsewhere in the device as with a standard "dumb" sensor that simply receive and relay 'sensed' signals such as magnetic pulses (also available on the market at the time).

20. Such a microprocessor also would have had the capability of limiting the signal to ensure it falls within the bandwidth accepted by the hands-free jack of a cell phone, which would significantly increase the chances of sending the converted signal that will meet success rate requirements for card payment systems.

21. A person of skill in the art would understand that disclosure of the secure microprocessor in connection with achieving the appropriate analog format signal suitable for transmission to the disclosed jack of a mobile communication

device shows that the inventors possessed, at that time, the same invention that is claimed today. The Provisional's description of the interactions between the analog jack of the mobile phone with the card reader equipped with secure microprocessor (with circuitry and associated software/firmware to perform the encryption and conversion functions on the way to sending the converted card information in a signal with analog-audio form to the mobile phone's audio jack) would have been well-understood and enough for an ordinarily-skilled person to understand the signals that would be generated and the conversions that would need to be done. The disclosure shows possession of what is claimed.

B. Square has Already Admitted, and the Board has Already Found, that the Provisional Discloses "Further Processing" in the Communication Device.

22. I understand that Square told the Board previously that the Tang Provisional disclosed providing an analog signal "to the cell phone for further processing contained in the cell phone" by providing a chart as follows:

[7d] *providing to the cell phone for further processing by circuitry contained in the cell phone* a particular attenuated *analog signal* indicative of particular magnetically recorded information stored on a particular magnetic stripe of a particular card swiped by the read head.	With respect to Figs. 7 and 8, Tang states that "the controller 51 of the mobile phone 14 is the controller of the assembly 16'. As such, in this embodiment, installation of a software application controller 51 is necessary. This software application is used to convert between audio and digital signal and to

	receive and transmit and [*sic*] audio data to and from the hands-free interface 41." Exh. 1006 at 10:40-45; *see* Exh. 1007 at Sections 300, 400, and 600. Further, as set forth *supra*, Tang states that "[t]he analog signal from the magnetic card 24 is sent via the hands free interface 41 [to the cell phone] where the software application of the controller 51 converts the received signal back to binary data for example as stored on the magnetic card 34." *Id.* at 10:50-57; *see* Exh. 1007 at Sections 300, 400, and 600.

See Ex. 2001 (Square's Corrected Petition for Inter Partes Review) at 00052-53. I agree.

23. Even apart from Square's statements, the fact is that the Provisional discloses a credit card reader that sends an analog signal to the jack of a cell phone or other mobile communication device, with the intent that the cell phone transmits the signal or information on to a server to conduct a financial transaction. Since the communication is data over voice, it is clear that the cell phone needs to do some processing to send the signal or information on to a server. The later, non-

Provisional application describes in detail one example of processing in the cell phone (as Square noted in its comments in the Morley proceedings), but an ordinarily-skill person in the art at the time absolutely would have read the Provisional to show possession of an invention that provided for processing in the cell phone in order to provide the further transmission, whether that processing is in further conversions, sampling, limiting signals, etc.

24. Additionally, this same disclosure applies in the context of a smart card reader. That is, the Provisional clearly teaches to convert the initial information/signal to an analog-audio formatted signal suitable for transmission to the jack of a mobile communication device. By the time the signal reaches the jack of the mobile phone or other mobile communication device, it is in analog form and does not matter whether it was read by a smart card reader from a smart card, or by a magnetic stripe reader from a magstripe card; in other words, that does not affect the additional processing that takes place in the cell phone. Thus, the same disclosure supports the claims with regard to the smart card reader and smart card information as in the '566 patent.

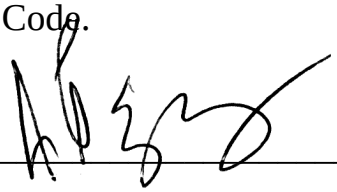
C. **The Provisional Supports the Recited "Recorded Information Stored on an Integrated Circuit" on the Smart Card.**

25. Petitioner claims that the Provisional does not disclose reading "recorded information stored on an integrated circuit on a smart card." A person of ordinary skill in the art would view that argument as just plain silly. Certainly, a

person of ordinary skill in the art would read the Provisional's disclosure of a smart card reader 7 and 8 credit card/debit card from which a smart card reader captures information – *see* [100], [200], [300], [500] – to show possession of a card designed to store information on an integrated circuit, and the smart card reader reading the recorded information stored on the integrated circuit of the smart card. What else would the smart card reader read to get information from a smart credit card or smart debit card? This is the only option, and that was true back in February of 2009.

26. As a person of ordinary skill in the art would have known at the time of the invention, a smart card – by definition – stores recorded information on an integrated circuit. Thus the Provisional's reference to a "smart card" sufficiently shows possession of a card designed to store recorded information on an integrated circuit. One ordinarily skilled in the art would know that the "smart card reader" aspect of this invention, as disclosed in the Provisional, was intended to read and process the recorded information captured from the smart credit card or smart debit card's integrated circuit. In short, a person of ordinary skill in the art would read and understand the Provisional to clearly convey that the inventors at the time of the Provisional possessed a smart card reader device, and would understand that term to include cards that provide for recorded information stored on an integrated circuit.

I declare that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United States Code.

By Ivan Zatkovich: 

Date: Feb 13, 2020

Exhibit A

ecomp CONSULTANTS
INFORMATION TECHNOLOGY & PATENT LITIGATION
TELECOMMUNICATIONS ▪ INTERNET ▪ EFORENSICS

Ivan Zatkovich

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Mr. Zatkovich is a Computer Scientist and Technology Consultant specializing in Telecommunications, Mobile Network communications, Point of Sale, and Secure financial transactions. Ivan brings over 30 year's experience in a diverse set of technologies including Credit Card transaction processing, eWallet validation, Payment Gateways, Point of Sale devices including NFC/RFID, Magnetic Stripe, MST, and Chip readers, Wireless communications (WiFi, Bluetooth, GSM, and Broadband). Also implemented methods for privacy and fraud protection, encrypted wireless communications, tokenization, authentication and authorization. Companies consulted for include eTrade, Citicorp, Smith Barney, Capital One, Deustche Telekom, PTT Netherlands, Apple, and Facebook.

Ivan has been a testifying expert for over 60 cases including patent litigation, ITC, IPRs, and CBMs for secure financial transactions, Point of Sale, Mobile and Wireless payment authentication. Providing expert reports, deposition, and trial testimony. Ivan testified in a mobile payment authorization case in South Africa where the judge sided with (and cited) Ivan on all points of contention. Ivan's expert analysis was also instrumental in reaching a $35 million settlement for I2 against Oracle in a Network Transaction patent litigation.

Director / Project Manager	13 years	Managed 6 to 35 member teams. Software development, systems Integration, critical path management, PMP/CMM methodologies.
Telecommunications, Mobile / Wireless	11 years	Computer Telephony Integration (CTI) since 1984. Wireless Messaging and Transaction Systems, Cell phone provisioning and updates (Verizon, Bell Canada, PTT Netherlands, and Mercury Communications).
Ecommerce, eMarketing	8 years	Large commercial ecommerce & storefront websites, digital marketing strategy, Websphere eCommerce, POS transaction systems, transaction authorization systems, credit card processing and payment gateway systems,
Financial Transactions	7 years	POS / Card Transaction systems, Implemented early version of eTrade retail trading website. Developed financial network products and electronic transactions for Smith Barney. Implemented point of sale and credit card transaction systems.
Expert Witness	9 years	Expert testimony and damage assessment for ecommerce litigation, internet & software copyright, telecommunications. Over 24 cases providing expert reports, depositions, & trial testimony.

Education:

B. S. Computer Science	1980	University of Pittsburgh
Minor in E.E. digital circuit design		
Master's study and thesis in Computer Networks, Results published in Byte Magazine		

Summary of Related Professional Experience

- **Evatone -** Developed multiple credit card payment methods and payment gateway solutions for eCommerce clients such as Warner Brothers, Wachovia Bank, and Pro Marine.
- **eComp Consultants --** developed patent claims to cover secure mobile payment transactions and account access using user id authentication. Development of high-speed wireless communications using wifi mesh networks and Bluetooth communications.
- **Verizon – Telecommunications -** Implemented applications for wireless data communications using 802.11 and Bluetooth on wireless, local secure networks. Audio data encryption for VoIP, fax and modem application. Developed Data Transaction Authentication and verification (to identify tampering, or modification)..
- **Tanning Technology** - System Architect and developer of financial systems for :
  - **ETrade** Online Trading – Developed 1st version of Securities trading system
  - **Smith Barney** - PDA Trader Access - Wireless retrieval of financial transactions information
  - **GEICO, Hartford insurance** – secure online systems for payment transactions and policyholder claims processing

Summary of Related Cases

Plaintiff v Samsung – ITC - Retained as testifying expert for mobile device technology for emulation and transmission of NFC / RFID and MST (Magnetic Secure Transmissions) transactions to payment terminals.

Black Hills v Sonos – Patent Litigation - Testifying expert for analyzing multiple audio sources, Bluetooth and mesh network protocols, and synchronized digital audio signals.

3M Futures South Africa v. Standard Bank (Patent Litigation)
Real-time credit card transaction authorization, Mobile Payment authorization, and User Authentication. Testified at Trial regarding Invalidity and Infringement in South Africa.

Alexsam v. MasterCard – Patent Litigation
Testifying expert for Multifunction credit card systems. Technology covered activation and processing of multiple transaction types from point of sale, through Credit Card network and processing hub, to Issuing Banks. Including security and tokenization features, processing points, and routing of transactions.

Paul Ware v Aldo Group, Inc, et al. - Patent Litigation
Providing expertise in eCommerce, Payment Gateways, Point-of-Sale user interfaces and Credit Card transaction interfaces

IslandIP , Inc. v. Deustche Bank - Patent Litigation – Testifying expert for bank transactions for Sweep Accounts, including features for interest bearing, FDIC insured, and Omnibus deposits and withdrawals.

Askealadin v Smart Verify, N5 – IPRs – Testifying expert for Multi-factor User Authentication for card transactions.

Professional Experience:

2000 to Present **Principal Consultant**
eComp Consultants ***Tampa, FL***

Provide consulting on design and development of software product development, and ecommerce technology. Provide technology consulting and expert support for telecommunications, internet, and ecommerce applications in the areas of:

- Cybersecurity audit methodology and security incursion testing
- Independent consulting for Alcatel-Lucent (AT&T Bell Labs) to review, recommend, and rate Alcatel's extensive Patent portfolio specifically in the area of telecommunications and web-based ecommerce.
- Patent litigation consulting for telecommunications and internet technology patents.
- Provide mobile geolocation for forensics analysis and event location.
- Development of Mesh Network technology, Mobile GUI interfaces for message routing and notification.
- Commercial websites, search engine, and web marketing strategies.
- Sample clients include: Alcatel-Lucent, LogicLink, NWI Corp, Jones Day, Finnegan Henderson, Fish & Richardson, Cozen O'Connors, Morrison Foerster

2007 to 2008 **Global Web Manager**
Smith & Nephew Inc. ***Clearwater, FL***

Smith & Nephew is a global manufacturer of medical, wound, orthopedic, and surgical supplies. Smith & Nephew has facilities in 33 countries and maintains 35 websites for different product areas and country marketing.

- Designed the Smith & Nephew corporate web architecture for all intranet, extranet, and internet sites.
- Directed a staff of web professionals in developing and managing 35 individual Smith & Nephew websites maintained in the US and 14 countries for both Smith & Nephew clients and internal users.
- Managed and maintain the 650 domains currently owned by Smith & Nephew
- Optimized search engine ranking and website meta tagging.
- Developed corporate technology and IT standards and policies including:
- Created web hosting agreements and IT service contracts (SLAs)
- Defined web development standards
- Researched page ranking, redirection, and domain optimization strategies.

2002 to 2007 **eBusiness Director**
Eva-Tone Inc ***Clearwater, FL***

Eva-Tone is a $45M commercial multimedia company specializing in ecommerce and marketing solutions, media and content customization, order processing and fulfillment, print & web publishing, CD & DVD manufacturing.

- Set strategic direction of client service offerings in ecommerce and content management.
- Consulted with clients on: web marketing strategy using personalized sales collateral. Defined client profile information to be used to generate customized presentations and brochures.
- Aggressively controlled project scope, managed project timelines, budgets and client expectations.
- Projects proposed and delivered included:

- McGraw-Hill – Enterprise Content Management and automated Web publishing system.
- ProMarine USA – B2B storefront, complex part search, order processing and fulfillment.
- Resource Rabbit – Sales collateral manager. This system retrieves user preferences and client profile information to generate customized electronic presentations and brochures.
- AAA Travel – CRM sales collateral system, instant customized brochures, print-on-demand.

1999 to 2002 **eBusiness Engagement Manager**
Tanning Technology and IMRGlobal

Tanning Technology is an international systems integrator specializing in network infrastructure and channel integration for financial markets and the insurance industry. Proposed and managed eBusiness and Internet infrastructure projects focused on client and user personalization, data mining, and web marketing practices.

Client web engagements proposed and managed:

- Eckerd Pharmacy – Developed eBusiness and web marketing for personalized client web content.
- GEICO – Developed a personalized policyholder web service that uses clients' account history and demographics to customize product literature for cross-sell & up-sell opportunities.
- Developed Integrated VoIP contact and messaging center, to cross-utilize call center resources for simultaneous Telephone, IVR, Chat room, and Call Back messaging and notification. (Geico Insurance)
- Hartford Insurance – Integrated 3 tier online claims processing & subrogation with legacy systems
- Citicorp Bank – Designed mortgage and loan payment system; managed sale of loan contracts
- Smith Barney – Developed remote access network infrastructure & wireless PDA financial system
- Medwerks – Created medical insurance clearinghouse, MDs centrally process insurance payments

1996 to 1999 **Director of Network & Customer Support**
Utility Partners, Inc. ***Tampa, FL***

Utility Partners developed and customized utility company software for scheduling service appointments, assigning and routing mobile workforce (field technicians), and dispatching and coordinating resources during power outages.

- Mobile data integration – Develop cellular and wireless data messaging for Mobile Field devices
- MobileUp – Wireless field dispatching system and Geolocation of mobile devices.
- Developed system and network monitors for real-time client system monitoring
- Received trouble calls & provided live client support for the following applications:
- TroubleUP – Power outage manager
- Smartnom – Web Gas Auction System for private gas auctions
- CAS – Customer Appointment and Call Center application

1987 to1996 **Project Manager: Telecom Software**
GTE Data Services (currently Verizon) ***Tampa, FL***

GTE was an $8B Telecommunications company and formed the Commercial Services

division to customize their telephone business software to sell to other telephone companies internationally.

- Managed large product implementations for Telecom billing, service order, and Switch management.
- Developed project proposals, and provided client pre-sales support.
- Created project plans, managed resources, and set expectations for customer delivery projects.
- Specific projects managed:
  - Mercury Communication – setup Service Bureau to bill their new intelligent network services.
  - PTT Netherlands – managed $5M inter-carrier billing project for PTT Netherlands
  - Bell Canada – developed Pricing Plan & Table Management system
  - Deutsche Telekom – designed and developed a German billing prototype system.
  - Received GTE personal best award.

1980 to 1987 **Software Engineer / Technical Lead**
Digital Equipment Corp. ***Maynard, MA***

As Technical Lead, led the development of manufacturing automation and control software. Projects Included:

- Supply Chain, CAD/CAM – Designed system to retrieve parts information from circuit board CAD design. Developed a parts ordering system based on expected volumes.
- Pick & place automation – Automatically program IC insertion machines. Developed system to determine IC insertion order, generate machine instructions, and download program to machine.

As Software Engineer for embedded controllers and video subsystems, designed and developed PDP-11 operating system and device drivers.

- Enhanced high-speed DecNet drivers for Synch, Asynch, and Parallel communications.
- Designed/developed disk firmware and drivers for floppy & Winchester disks.
- Developed and enhanced video controller firmware and layered graphics system for PRO-350.
- Developed Computer Telephony Integration (CTI) product for telephone answering machines.

Technical Tools & Environments:

- Unix, Windows, NT, Microsoft .NET, C#, C/C++, VB, Assembler
- Java, Java script, JSP, IBM Websphere, Microsoft Commerce engine, Blue Martini
- SQL, Oracle, Foxpro, DB2, Crystal Reports, Active-Reports, MQ Series, Tuxedo, Documentum, Interwoven

Certifications & Publications:

- Industry Speaker: Internet Publishing standards (Momentum conference)
- Department of Justice: Proposal for internet forensics technology
- IBM Websphere – Certified ecommerce Solutions Expert
- Byte Magazine – Published Network Design articles
- Sync Magazine – Published Programming Techniques and Tutorials
- IEEE SigGraph – Presented ICGS Computer Graphic Standards for IEEE SigGraph conference.

- CMM & PMP – Project management methodologies
- ISO and ANSI – On International ISO and National ANSI Committees for Disk and Media format standards