# Mark V Bertolina

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Objective: Continued development as an engineering professional. Opportunity to work with a group of like minded people on industry disruptive technology.

## Summary


An accomplished R&D director and engineering manager with experience translating corporate strategic plans to successful engineered products. Ongoing deep direct work in software, electronics, wireless, instrumentation, manufacturing engineering, hazardous (explosive) area certification, and IT. Formally educated as an Electrical Engineer concentrated in Signal Processing and Systems Modeling. Direct engineering experience in embedded systems design and construction, scientific research, and resource constrained software development. Skilled technical writer and presenter, successfully lead a cross-skilled small team in formulating and convincing executives of a technical and offer pivot. A responsible, self-starting, multi-tasker who works well in teams with experience forming, leading, and managing technical as well as business teams.


## Related Experience

**Director of R&D, Field Devices** (Schneider Electric, Foxboro MA) Mar 2020 – Present

- Responsible for R&D teams of five major offer families of industrial process automation field devices. Includes the functions of Development (Mechanical, Electrical, Software, Test, Certification), V&V, and Continuous Engineering. Ensure positive people management and group dynamic through a team of managers and their teams, mitigate risks.
- Balanced resource allocation for Maintenance of Line (MoL), Productization of new features and enhancements, as well as Innovation with new product introduction. Custodian of budget management. Report to R&D SVP and executive matrix.
- Worked closely with Global Supply Chain, Industrialization, Procurement and Quality groups to simultaneously move a number of manufacturing lines and component suppliers in support of a factory site closure.
- R&D process improvement leader through LEAN, Six Sigma, and Theory of Constraints (ToC) based continuous improvements. Focused KPIs are on-time delivery, high quality (low released defect density), short cycle release trains.
- Re-organized R&D group around technical discipline teams and shared services model from product and geographic oriented teams, wound-down site in Europe and built new team and lab in India.
- Volunteered as supply chain crisis R&D leader, responsible for representing all of the business unit's products, coordinate with peer R&D directors, mitigate risk and minimizing severity of shortages. Coordinate and integrate to corporate initiatives and programs, prepare executive reports.
- Selected for task force which investigated, recommended and then won executive support to implement a re-organization of R&D at the business unit level to achieve more responsiveness in the Offer Creation Process and new Innovation Lab, while balancing the iron tail of supporting and improving legacy offers. (Industrial control systems often are expected to be maintained for 25+ years.)
- Selected for technical fellow program (SE Edison), used distinction to constantly (2 years) present vision for business unit level pivot combining IT & OT with new revenue models, allied a team of marketing and technical peers, won support of executives and now help manage a program of pilots and PoCs to develop and iterate with customers.
- Present innovation concepts of new products to customers in sales process, engaged in early problem statement identification with customers in consultative role.

**Chief Architect & Head of Engineering, Field Devices** (Schneider Electric, Foxboro MA) 2019 – Mar 2020

- Continued responsibilities of role in new parent company and integration to SE agile work process, controls, etc.
- Distribution of responsibilities into specialized groups across a global matrix organization, IT responsibilities, product test, Industrialization for Manufacturing, Legal, Product and Project Management, etc
- Conformance and certification expansion for new product family as well as customer feedback based feature build out.
- Organized training and process changes to support cyber-secure software development life-cycle practices (62443)
- Salesforce training and on-site customer demonstrations

**Chief Architect \ Senior Engineering Manager** (Adaptive Wireless Solutions, Hudson MA) 2009 - 2018
**RF & Industrial Metrology Engineer** Oct 2005–2009
**Intern Engineer** (Adaptive Wireless Solutions \ Adaptive Instruments Corp., Hudson MA) Jan-May 2005

• **Expanded engineering department** forming and leading team(s) to focus on entirely new developments :

•• **Industrial wireless instrument family**

••• This multi year project was based on a business strategy co-developed with the company President and then implemented as a new product innovation building out into engineered reality a group of technology driven value propositions, leading to eventual company acquisition. Lead designer, team tool selection and workflow organization, as well as direct implementer / engineer for some components. Along with planning the engineering project and road map, forming and running the technical team, and directly implementing the product architecture and WiFi software / hardware portions, numerous presentations were also given on the product to end users and potential acquirers.

••• Bluetooth Low Energy, WirelessHART & WiFi meeting 60079-11 Intrinsic Safety and instrument accuracy targets

••• 10+ year battery life over -40 to +85C

••• Instrument primary variables of pressure (gauge, absolute, differential), temperature (RTD, TC), 40kHz ultrasound

••• Synthetic instruments for machine health monitoring via edge processing software drawing on local MEMS chips scale sensors (9-axis accelerometer, gyroscope, magnetometer, ambient temperature, barometric pressure, microphone, remote bolometer, light sensor).

••• Low power 64Gbyte NAND local storage for years of reading trends, edge processing, and diagnostic logs

•• **Active Object Framework** researched, chose and standardized embedded software team workflow to object oriented design patterns utilizing UML graphical hierarchical state machine layout tool, C 99 MISRA compliant code output , asynchronous message based event loop for minimizing power consumption. (Quantum Leaps QP/C & QM)

•• **Octave band industrial acoustic instrument** for coal mill efficiency optimization, customer specific project

• **BLE wireless network** concept stage architecture and presentation created utilizing novel wireless multi-hop routing & streamlined Cloud integration via GATT proxying allowing integration of standard BLE devices and equipment

• **"No Internet" WiFi / Browser UI** Architected, implemented, and tested for an industrial instrument focusing on usability in a harsh environment with restricted human motion (protective clothing). The UI web page was a real time display and control served from constrained device (file size and bandwidth), mixing traditional web-page methods HTML 5, CSS 3, JavaScript, SVG animation along with minimizing the instrument computational load (packed binary structures instead of JSON). Implemented server in uProcessor C 99 for both dynamic event streams and an embedded file system (NANDFS & BLE network filesystem) mapping. Implemented test suite in node.js

• **Low cost test harness** Designed and implemented for testing groups of wireless networked instruments, based around a Raspberry Pi. Each RPI harness attached to the DUT controlling power, SWD programming, serial port debug interface, BLE, & WiFi . Harnesses were grouped over wired ethernet PoE and set as targets to continuous integration build and test server. WirelessHART was tested via serial debug commands to DUT and HART/IP commands to a central gateway. Provided example node.js script for each function then directed and reviewed other engineers to develop modular framework and test scripts.

• **One Time Pad (OTP) encryption system** Design utilized a mathematically proven perfect encryption method with novel applications to low power wireless sensor networks. (USPTO pending) Conventional HMAC utilized for message integrity. Incorporated feedback from professional independent cryptographer review.

•**IoT gateway** Architect and prototyped a quick but fully functional reference system leveraging in house industrial BLE instruments and GATT proxying, using Raspberry Pi (RPI) / Raspbian, SIG Bluetooth Internet Gateway & GATT REST API, self written node.js code to translate to separate MQTT and MODBUS/TCP streams, two concurrent UI's on Ignition Historian / HMI and Microsoft Azure IoT Hub with realtime cloud web-page.

• **Patch-wise linear least squares polynomial surface fit** Designed and implemented method for MEMS piezo-resistive pressure sensor characterization. Researched and chose an open source C linear algebra package (CSparse) small enough to fit on embedded uProcessor (ARM Cortex-M3) with excellent code quality and documentation implementing QR decomposition to perform matrix inversion for choosing the best fit surface. This allowed for development of in the field "calibration upgrades" to the instrument (USPTO pending) .

• **Over The Air update** Designed system's security component based on ECDSA signatures layered within a hierarchical package of update files. Evaluated and chose embedded C library balancing system resource constraints, code quality, and open source community momentum. (ARM MBED TLS / PolarSSL). Reviewed integration project to our embedded system coded by another engineer. Separately implemented WiFi / HTTP server and browser based user interface to upload the update package to the embedded system.

• **Pressure Calibration Stand** Designed, implemented, commissioned next generation 0-15 to 0-3000 PSI pressure instrument calibration system for Manufacturing group. Batch accuracy goals went to NIST traceable 0.05% FS over -40 to +85C. Emphasis was placed on modularity, and forming common APIs over slow to age out interfaces. PoE wired ethernet conversion of all devices, TCP/IP control API, node.js control logic and UI server, JavaScript web page client. JSON templates for non-programmer changes.
• **Hazardous Area Product Certifications** Consolidated to single NRTL / auditor FM, from group of FM, CSA, Sira, UL. Saves documentation work, diverging certifications of the same product families, many extra audits.
• **Department Management** Ongoing engineering department management, strategic planning, cost accounting.
• **Documentation System** Developed and implemented documentation system for engineering and production groups that was low cost, easy to use and manage, and achieved all quality and regulatory requirements.
• **Created supplier workmanship standards**
• **Co-taught product technical training course** 1 week course presented three times to approximately 25 students per class. Created from scratch visual, written, and lab materials for product training and review of electromagnetism.
• **Field Work** Ability to operate effectively and professionally in hazardous and remote environments during extended travel. Ex: Successfully identified and quickly resolved wireless installations for customer in arctic Alaskan North Slope as well as priority domestic and international customers.
• **Standards Organizations** Represented company at ISA 100.11a (SP100 Wireless Systems for Automation).
• **Product Improvements** Designed and implemented wireless product improvements such as a multi-factor frequency reference stability.
• **Design Verification Testing** Designed procedures for, collected, and analyzed data to characterize existing product specifications such as power consumption and temperature dependencies.
• **Production Equipment** Designed and built in-house simulation and test circuits, maintained and improved product factory equipment.
• **Sustaining Engineering** Assessed and chose replacements for product sub-components, power supplies, batteries, RS-485 transceiver ICs, radio components, etc.

**IT Consultant \ Compeffi.com** (Self-employed) 1994-2020
• **Colo / Cloud / Serverless** Experience utilizing hosted servers and function services including:
•• **Amazon Web Services** – AWS (EC2, S3, Route 53, Glacier, etc)
•• **Microsoft Azure** – (Virtual Machines, App Services, IoT Hub)
• **VDI** Internet delivered Virtual Desktop Infrastructure
• **Virtualization** Hypervisor based virtualization, onsite as well as Internet delivered services (VMWare ESXi, Hyper-V, KVM, QEMU, VirtualBox)
• **Networks** Advanced network configurations and troubleshooting with managed switches, VLANs, routing, CARP, etc
• **Storage** NAS design and deployments with traditional RAID controllers, appliances, and ZFS based OSs.
• **Setup** PC, server, and network planning, installation, & configuration
• **Database** administration & conversion
• **DR** Disaster planning, testing recovery. Virus recovery.
• **Infrastructure** IT hardware installation: PCs, wireless APs, server racks, collocation facilities, network cabling, security / fire alarms, telephony / PBX / VoIP
• **Web Development** by hand and with systems like Sharepoint, WordPress, etc. Configuration & maintenance of plethora of web hosts as well as Amazon AWS

**IT One Man Band** (Adaptive Wireless Solutions \ Adaptive Instruments Corp., Hudson MA) 2008 - 2020
• **Maintain written IT strategy** and review with company President & CFO.
• **Ongoing maintenance** for ~25 person company with office staff, 2 remote workers, and production floor centered around custom PC based production stations.
• **Maintain documentation** of system hardware, configuration & settings, and problem history and fixes.
• **SPAM** Removal of backup ISP IP address from automated spam blacklists.
• **Internet Gateway** Replaced routing and Internet access appliance with hardware redundant OpenBSD systems. Multi-path ISP implemented without BGP, configured Internet & service redundancy for email, voice, VPN, internal web-access, etc. Low cost solution with enterprise features.
• **Migration of Win 2000 Server** for legacy production line. W2K virtual machine on VMWare ESXi, maintain legacy production environment involving DOS, Windows 95, ISA bus machine controllers. $0 cap-ex solution.

• **Web based remote worker password management** OWA registry settings and custom C# program scheduled to run nightly that emails users for 7 days before the password expiration based on LDAP AD user property lookups.
• **VoIP** Researched and implemented conversion to SIP phone provider from traditional T1s, also implemented IP PBX with traditional PBX trunked into it. Low capex, lowered monthly bills, maintained parts of existing phone system while implementing new features such as dial-in meet-me room.
• **AD** Company-wide conversion to Windows 2008 Active Directory, Active Directory, SQL, Exchange, etc.
• **Virtualization** Company-wide conversion to VMWare ESXi hypervisor from traditional server configuration

**Intern Engineer** (Space and Naval Warfare Systems Center, San Diego CA) [SPAWAR SSC Pacific] Jun-Sep 2005
• **Underwater Communication Systems** Supported research projects through the design and production of complex experimental apparatus. (ex, Acoustic MIMO Transmitter)
• **Anechoic Pool** Characterization of acoustic transmitter at SPWAR TRANSDEC
• **Field Research** Operated experimental apparatus during intensive two week schedule aboard Research Vessel Kilo Moana, part of larger Makai Experiment 2005 off the coast of Kauai's PMRF.
• **Collaboration** Interacted with staff scientists, engineers, contractors, and US NAVY personnel

**Research Assistant** (WPI Center for Sensory and Physiologic Signal Processing) 2002-2004
• **Data Capture System** Created general purpose multi-channel signal conditioners for EMG experiment data capture. From high-level circuit design to specific component selection, schematics, PCB layout, enclosure, and documentation. Wrote Matlab program to record and preprocess sessions. Units still in use.
• **Research Conference** Presented research findings at the IEEE 30th Annual Northeast Bioengineering Conference.
• **Teamwork** Worked in a team research environment contributing to biomedical research, ex. adaptive equalization filters.

**Computer Technician** (Digital Systems Design Group, Pompano Beach FL) 1997-1999
• PC & Server configuration, network installation, and systems management.

**Computer Technician** (MicroAge, East Rutherford NJ) Summer 1996
• Work mostly consisted of VAR PC configurations.

## Education

SE TSL 4 (Business Model Innovation / Blue Ocean Strategy) 2020
INSEAD, certificate course

Graduate Studies, Electrical Engineering 2004-2005
Worcester Polytechnic Institute

Bachelors of Science with distinction, Electrical Engineering 1998-2003
Worcester Polytechnic Institute, ABET accredited

Senior project, 3 course equivalent 2002-2003
Active Power-Line Interference Attenuation in Bioamplifiers; Designed and built a circuit which reduces noise in human muscle recordings; Part of a successful three person team.

## Skills

Ability to communicate engineering to a variety of audiences in both written and verbal form.
Comfortable communicating technical summaries or details in settings from informal conversations and co-worker meetings to delivering planned presentations.
Speed in absorbing new materials and domains do to a life-long desire to learn broadly and understand at a deeper level.

Modeling and simulation:

R / Shiny, SciPy, NumPy, SciLab, Excel / Calc, MATLAB, Maple, SPICE / LTspice, Xilinx ISE, Multisim, Tanner EDA, AutoCAD, Mathematica, SolidWorks, Altium, KiCad

Software Programming:

Languages : ECMA (JavaScript), C (x86 OS + embedded bare metal), python, C#, Perl, Java, SQL, C++, x86 assembly, MS Visual Basic, TI DSP in C and assembly, Pascal, SmallTalk
Scripts : bash & ksh shell, DOS & NT .BAT scripts, Windows PowerShell
Full Stack web page : HTML5,CSS3, JavaScript, SVG | node.js, PHP, WordPress, LAMP, ASP.NET, MySQL, PostgreSQL
Version Control : git, GitHub, SourceSafe, Sharepoint
Ability to comment code meaningfully and build hierarchical modules others can use.
Software development models and lifecycles, waterfall, Agile, and well and cuber-security based software development lifecycles (62443)

Electronics design:

Analog – signals, power, noise, electromagnets (RF), safety, instrumentation accuracy by design & by automated characterization stations (electrical, temperature, pressure, etc). Digital - combinatorial logic, sequential circuits, microprocessors, VHDL. DSP. Schematic capture in Altium, KiCAD, Multisim and OrCAD. PCB laminate layout in Altium, PADS, and Ultiboard CAD. Prototypes with bread-board, vector-board, FPGA. Completed class in VLSI design. Assemble, test, and troubleshoot with common lab equipment and self teach use of specialty equipment. In-depth experience in the circuit practices and electromechanical design for industrial process instruments. Experience in EMG recording systems. High power electric appliances and equipment. Environmental testing with hot/cold chambers, humidity, salt mist, HALT/HASS accelerated aging. Start to finish Intrinsically Safe design and certification for hazardous areas (explosive atmospheres) for US, CA, and ATEX conformance. Familiarity with EMC compliance testing and registration for intentional transmitters (US FCC, Canada ISED, EU RED) . Familiarity with functional safety (SIL) design practices.

Protocols Experience :

Bluetooth (4.0, BLE, Mesh)
802.3 (10BASE2, CAT3/5/6, jumbo frame, VLAN)
802.11 (b,g,n WiFi, AP and client implementations)
802.15.4 (WirelessHART, Dust, SmartMesh, Zigbee, 6LoWPAN)
IPv4/6, TCP, UDP, DHCP, DNS, SIP, RTP, SMTP, HTTP, WebSockets
Modbus (RTU TCP)
MQTT
HART / WirelessHART

High proficiency in configuring and using Information Technology:

Linux for desktop (Arch, Ubuntu, etc), FreeBSD including appliance distributions (OPNsense, NAS4Free) ARM64 automation devices (RPI) and internet instances (Scaleway), Supermicro servers and workstations with IPMI, PC's with MS Windows, HP DL* & Netservers, Sun Netra, RAID, Ethernet and TCP/IP networking hardware, Windows Server (NT 3.5 – 2016, Hyper-V) networks and services such as Active Directory, DHCP, DNS, IIS, CA, Exchange, MS SQL, MySQL, PostgreSQL. NAS design, iSCSI, ZFS. OpenBSD, VMWare, Linux, DEC Alpha & Digital Unix, DOS, Cygwin, UPS including APC Symmetra and Clary, PLC and VFD programming

Mechanical:

Electronics soldering, wire-wrap, hand tools, machine shop, 19" rack installation, communications wiring, control cabinets, NEC knowledge especially related to Hazardous Areas (classified flammable or combustible), physical testing regimens for 61010, 60079, IPxx & NEMAx ratings, design for injection molding, pressure safety (NACE & PED)

## Publications

Edward A. Clancy, Hongfang Xia and Mark V. Bertolina, "A Preliminary Report on the Use of Equalization Filters to Derive High Spatial Resolution Electrode Array Montages," International Symposium on Neuromuscular Assessment in the Elderly Worker, ISBN 88-7992-191-6, February 20-21, Torino, Italy, 2004.

M. V. Bertolina, E. A. Clancy, D. Farina and R. Merletti, "Observations and Analysis of Long-Duration, Constant-Posture, Force-Varying, Fatiguing EMG," Proceedings of the IEEE 30th Annual Northeast Bioengineering Conference, IEEE, Springfield, MA, pp. 73-74, 2004.

Edward A. Clancy, Hongfang Xia and Mark V. Bertolina, "Preliminary Results on the Use of Equalization Filters for High Spatial Resolution Electrode Arrays," Proceedings of the Fifteenth Congress of the International Society of Electrophysiology and Kinesiology, ISBN 0-87270-136-0, Boston, MA, pp. 58, June 18-21, 2004.

## Certifications

DSOP \ BATC refinery safety & TSA TWIC (ID card)
FCC licensed amateur radio operator, Technician class, call sign: KB2VPS
Radio Amateur Civil Emergency Service (R.A.C.E.S.) operator
Emergency planning, damage assessment, hazardous materials (HAZMAT) first response, first aid, OSHA compliance.

## Extracurricular

Home Vinter – Intense fusion of chemistry, biology, agriculture and the art of wine making. bertolinawines.com
Former president of both the WPI Wireless Association and WPI Astronomy Club.
Received basic training on theory and operation of nuclear reactors, operated WPI research reactor under observation.

US Citizen

References on Request