



Lawrence Silverman

Professional CV

Energy Automation and Digital Communications Technology

Successful achievements throughout more than 40 years of unique leading-edge solution development in energy automation, lighting and control systems, multimedia and information technology. Proven ability to create, communicate and deliver new concepts and technology, with innovative “outside-the-box” approaches to solve complex multi-dimensional problems.

Conceived, developed and manufactured technology that has enjoyed significant worldwide mass-market impact, including:

- Developed and patented the first energy conservation and automation systems for digital lighting control in 1972-75;
- Computerized interactive building lighting automation in the 1973-77;
- Conceived and launched first US video music network (StarStream) in 1977-80;
- Developed and produced a series of advanced building automation, energy and lighting management and communications systems throughout the 1970s, 80s and 90s;
- Since the mid-1990s, Mr. Silverman has focused on developing internet-based lighting, energy and smart grid automation technology utilizing advanced M2M communications and adaptive artificial intelligence techniques for utilities and energy consumers, to deliver mass-deployable user-friendly software, applications and system to conserve energy and water and create sustainable structures and communities worldwide.

Energy and Building Automation Technology

Led co-development effort with Raytheon Co. for Demand-side Energy Management technology in 1993-97 at LightMedia Corporation. The resulting ECS-2000 system was used by utilities including Central and SouthWest, Southern Co., Detroit Edison and others, as well as the Wisconsin Bell Div. of Ameritech.

This work was continued with the Electric Power Research Institute (EPRI) in 1997-2000, in the Energy Network Computer (“en|c”) project, a collaboration between EPRI and Oracle’s Network Computer group. Demonstration systems were fielded with several utilities including PECO and DTE Energy. Other non-utility projects during this period included the design and engineering of integrated systems for the estates of the co-founder and former Chairman of Apple Computer, and for the Seattle home of a co-founder of Microsoft.

Mr. Silverman founded Broadband Energy Networks Inc. in April 2002 to develop commercial technology leveraging the convergence of broadband networks and electricity distribution. GRIDPLEX NETWORKS LLC was formed in 2009 to apply Broadband Energy’s web-based, customer centric automation to “Smart Grid” and “Intelligent Micro-Grid” deployments.

Several patents and pending applications cover recent development work in the Internet, communications, lighting and energy automation and information technology fields. A visual overview of his professional career is available on the web at www.lawrencesilverman.com.

Professional Overview

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| 1971-1977 | Digital Lighting Corporation , NY, NY – founder and President – interactive lighting control and automation systems. Technology acquired by Lightolier Inc. (Div. Genlyte) in 1977 as the foundation for Lightolier Controls, now a Division of Philips BV. |
| 1978-1993 | Transtek International Ltd. , NY, NY, London UK and Mexico City Mexico – founder and President – developer, systems integrator and building system installation for large-scale international projects in hotels, conference centers and cruise ships worldwide. Full-scale integrated lighting control, building communications and automation systems in over 40 major projects using automation technology developed by Mr. Silverman. |
| 1985-2002 | LightMedia Corporation , Upper Darby PA – founder & CEO – systems and applications for automation in buildings and homes; energy management systems and software (www.lightmedia.com). Technology licensed to GRIDPLEX NETWORKS LLC. |
| 2002-2008 | Broadband Energy Networks Inc. – founder and President – interoperable energy and information systems to manage energy and other resources – see www.broadbandenergynetworks.com |
| 2009-date | GRIDPLEX NETWORKS LLC – Chairman and Chief Scientist – automated web-based interoperable networks for Conservation of Energy and Water to empower Green Communities Worldwide www.gridplexnetworks.com . |

Special Expertise

- **Artificial intelligence based Automation, Building and Lighting Control and Adaptive Interoperable Systems** – technology to integrate new automation control and communications technology with legacy systems, products and protocols
- **Adaptive Technology Development and Manufacturing** - machine-to-machine communications and networking, embedded monitoring and control automation systems and software
- **Information Decision support Energy Portals, Products and Systems** – energy information portals and consumer-centric conservation applications
- **Advanced Meter Designs** - standards and communications for innovative smart meters and related equipment
- **Integrated and/or Cross-cutting Systems** – including extension of “Smart Grid” and integration of “Smart Micro-Grid”, DG and DR, and extensions of “Smart Grid” technology to enable end-users and sustainable communities to reduce their consumption of electricity, water, natural gas and consequent carbon emissions.

Education: Graduated Phillips Exeter Academy, Exeter New Hampshire in 1963; entered MIT at 16 in Physics and Computer Science/Cybernetics (1963-67). MIT varsity wrestling team – New England Championship. Pursued supplemental studies in electronic media and communications at the New School University in NYC 1968-69.

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Professional Background- detail

Digital Lighting Corporation, NY, NY (1971-77), Founder & President

Founded company, incorporated in 1971. Developed and patented a computerized multimedia lighting and energy control system, installed in high profile projects throughout the US. Systems used in architecture and design, film, theater, entertainment and building energy management. Operated 40-person manufacturing facility for company's products, including UL testing and certification. Established distribution and rep network, as well as OEM programs with major lighting manufacturers. Digital Lighting originated the concept for the LyteMode products and systems that sold by Lightolier (Div. Genlyte-Thomas) as their premium architectural lighting control system. Company sold in 1977-8 to Lightolier-Genlyte; operates today as Lightolier Controls.

Co-holder of US Patent 3,869,699 issued Mar. 4, 1975.

Digital Lighting automation and control products — Design and development of modular commercial, architectural and entertainment lighting control products and systems distributed internationally.

Products designed and manufactured by Digital Lighting under Mr. Silverman's direction included:

- **PDC 6x9 Programmable Lighting Controller** – Interactive Control System User Interface (UL and NYC listed)
- **PDC – D2.4kW Programmable Dimmer Control** - power module and rack (UL and NYC listed)
- **LM System II Programmable PreSet Controllers** – including preset mastering system, remote preset panels, special effects panels, assignor panels and automatic inputs from timeclocks, photocells and sensors
- **PDC-3 System** – integrated programmable control system and power unit (UL). Sold by Altman Stage Lighting as "Galaxy" and by Swivelier as "StarTron".
- **Autofade** (for Lightolier) – programmable control unit – first product in what became Lightolier Controls
- **Video Replay and Display System** - Digital Video-to-Analog computerized lighting control system array – installed to operate scoreboard in Cleveland Stadium, used two Digital Equipment PDP-11s in parallel, digital dimmers connected to a 22,000 lamp display. Co-development with General Electric Lamp Division.
- **LyteMode** – (for Lightolier, now Genlyte Thomas) original designs and specifications for the programmable architectural lighting control network, sold as the top-of-the-line architectural system by Lightolier Controls.

Digital Lighting Projects — Digital Lighting automation technology used in projects in 1971-1977 including:

- **Broadway musicals** — New York City. Custom electronic lighting systems and controls for **Chicago, Pippin, Dancin', Jesus Christ Superstar, Hair** (touring productions).
- **Tavern-on-the-Green** — Lighting controls and design for the facility in Central Park, New York, NY.
- **Studio 54** — NY, NY. Interactive electronic lighting control system for the most sensational discotheque in the world.
- **Saturday Night Fever** – Robert Stigwood Productions; lighting consultant for original NYC production. Film won Academy Award for Best Actor (1977).
- **Thank God It's Friday** – Columbia Pictures; lighting consultant for Los Angeles production. Film won Academy Award for Best Song (1978).
- **Playboy Club** — Multimedia entertainment systems throughout facility, New York, NY.
- **Hollywood Palace** — Founded and developed concept for multimedia music TV theater & club, LA
- **Lightolier, Inc.** — Design of the LyteMode™ and Autofade™ Architectural lighting control products and systems
- **Independence Hall** — Philadelphia, PA. Automated Light & Sound spectacular for the US Bicentennial.
- **General Electric Lighting Institute** — Nela Park, Ohio. Computerized lighting energy management system at G.E. Lighting headquarters, Nela Park, Cleveland OH.
- **Cleveland Stadium Scoreboard** — Cleveland, Ohio. One of the world's first digital video computerized scoreboards capable of instant replays. Automated digital control system to control 22,400 lamps for digital video display 240x80. Collaboration with GE Lighting (1977-79).
- **Windows on the World** — Lighting systems and automated controls for the facilities at the top of the World Trade Center, New York, NY.

Awards:

- **Illuminating Engineering Society (IESNA) — Outstanding New Product** recognition from the IESNA in 1974 and 1975
- **Illuminating Engineering Society (IESNA) —** nomination for highest industry system award in 1977 for programmable building lighting automation project.
- **Industry committees: Illuminating Engineering Society of North America (I.E.S.)** - Member of the Progress Committee for Electronic Controls from 1975-80.

Transtek International Ltd., NY, NY (1980-1993), President

Design-build integration of lighting and building automation systems for international projects in hotels, corporate and convention centers and other public facilities. Projects included design, engineering, specification and supply of energy management, interior and exterior lighting and building communications systems.

1980 Winter Olympic Games — Lake Placid, New York. Official Consultant Olympic Village.

Televisa Networks — Mexico City Studios – Computer Automation Systems

Hotel Fiesta Americana Hotels — Guadalajara, Cancun, Tijuana, Mexico.

Pemex Tower — Mexico City, Mexico.

Sheraton International Hotels — Mexico City, St. Maarten, Rio de Janeiro, Cancun, Ixtapa

Hyatt International Hotels — Gibraltar

Hilton International Hotel — Barcelona, Spain

Scott Paper Headquarters — Philadelphia, PA

Pennsylvania State House — House and Senate Majority Caucus Rooms, Harrisburg, PA

Franklin Institute Science Museum — Philadelphia, PA

Cunard Lines — Princess, Countess, Sagafjord and Vistafjord luxury cruiseliners.

Nikko Hotel — Japan Air Lines - Mexico City, Mexico.

The Hollywood Palace — Hollywood, CA

Kings Mountain Estate Theater — Woodside, CA

LightMedia Corporation, Upper Darby PA (1985-2002), President

Technology company affiliated with Transtek International, LightMedia designed and manufactured the advanced automation and control systems installed in Transtek projects listed above. Lighting Automation products developed and manufactured under Mr. Silverman's direction included:

- **LightMatrix™ - DMR 2400x4** – 2kW Digital Architectural Dimming System with integrated 10kW Power Controls
- **LightMatrix™ - PGM 4x4 and REMx4** - User Interface programming and control panel for multiple presets integrated with daylight sensors, occupancy sensors, scheduling controls and building automation systems.
- **Developed the world's first Echelon-based control and automation systems, designed, manufactured and installed as the original test-bed of the LONWorks technology at the Residence of Founder Mike Markkula, Kings Mountain Project** — Woodside, CA – 1992-94. Design, engineering and development of systems and controls for Mike Markkula, founder of Echelon Corporation and co-founder and former Chairman of Apple Computer. This project provided the original test-bed for the Echelon control and communications technology, and included development of a LONWorks dimming system:
 - **LightMatrix-LON™** – Echelon-based LONworks Integrated Lighting and Equipment preset controls
 - **LON Controls** for curtains, windows and other motorized devices.

Neuron-based LONworks Automation Control Systems and Software — 1992-97. Developed integrated hardware and software platform for interactive home and building automation. Prototyped TV-based automation and control systems in collaboration with RCA for use in hotels and hospitals as universal interface.

Ameritech — Wisconsin Bell – 1993-94. Design and engineering of energy management and control systems using LONWorks™ technology in a Building Automation project to demonstrate remote network control of building systems on the Ameritech campus.

Lakeside Residence — Medina, WA – 1993-94. Development work for the "people-tracking" system, an RF smart card system for the residence of one of the founders of Microsoft, as the primary input to the home automation and control system (not for public disclosure).

Utility Demand-side Energy Management Networks – 1994-97. Led co-development with Raytheon of Energy Management and Communications Systems for electric utilities, the ECS-2000. User-interface and software design team developed a small-scale Energy Management and Intelligent Information System installed in thousands of residences and businesses by energy utilities around the US, including Central & SouthWest (TX) – 80 unit DSEM deployment; Detroit Edison Intelligent Link (Detroit MI), Southern Co. (Atlanta GA), and others.

The ECS-2000 Energy Management System delivered control signals, information and messaging over existing electric wiring for control of lighting, HVAC, electric hot water heating and pumps and motor loads and documented peak reduction of up to 30% and reductions in overall energy use of 12-15%. Personally developed many of the user-screens for the Raytheon ECS-2000 User Interface Module, and managed the overall

technology and software development effort. First implementation of “Customer Choice and Control system that combined and optimized end-user requirements and utility grid management.

Collaboration with Electric Power Research Institute (EPRI) and Oracle Network Computer Inc. (NCI) Div. — 1997-99. Partner in three-way “Energy Network Computer” project to develop a mass-deployable energy automation system for lighting, HVAC and other commercial and residential systems. Conceived and developed user-friendly automation and control systems, applications and services for information appliances, aimed at small-to-medium business and homes. Produced unique graphical user-interface and navigation system, using the NCI-OS protocol for interactive “thin-clients”, including information appliances and set-top boxes.

These “smart energy systems” were deployed in demonstration projects with energy utilities around the US, including Detroit Edison, PECO, and Central SouthWest, as well as several overseas clients.

Awards:

- **International Lighting Design Award - Edwin F. Guth International Illumination Design Assn. (I.I.D.A.) 1986 Award of Excellence** - Illuminating Engineering Society and the American Assn. of Interior Designers
- **International Hotel Design Magazine Award** for lighting – 1988 from the AIA (Am. Institute of Architects)
- **Pennsylvania Governor's Award for International Business Development** – 1991
- **Philadelphia 100** – recognition as one of the Philadelphia region’s fast growth companies – 1991
- **U.S. Small Business Administration PA/MD region - "Exporter of the Year"**– 1992

Industry committees:

Standards Committee participation including the **Electronic Industry Assn. (EIA) Consumer Electronics Bus (“CEBus”) Committee** (1988-90) and **Echelon LonMark® Committee** (1993-94), establishing standards for network interoperability and operating protocols.

Broadband Energy Networks Inc., Upper Darby PA (2002– 2008), Founder & President

Networked energy, information and automation applications and services for lighting control, energy automation and digital communications. Broadband Energy focused on the future conversion of energy, automation and broadband Internet-based communications.

In Dec., 2002, Broadband Energy acquired the assets of Coactive Networks Inc. Coactive had received investment of over \$42M from JP Morgan, 3COM, SAP, eON and others, and was a recognized leader in combining local multi-protocol control systems with Internet-based data management. Acquired selected assets of Motorola’s PowerCom Prepaid Metering Division (LON-based meter with remote read-out) in 2004. Integrated advanced metering and control technology developed at LightMedia with new developments in automation and control to create real-time feedback and energy management applications.

Developed C2k Utility Automation Computer – a multi-protocol universal gateway including LON, ModBus, ZWave, Zigbee & c gateway for IP integration with PLC, RF and wired media into an integrated system accessible for local automation as well as Internet-based control and cloud-based application management.

Provided End-User systems for the original IBM-CenterPoint Energy “Smart Grid Demonstration Laboratory” in Houston TX in 2005-6, including AMR, AMI, Demand Response and Customer Service systems and applications, as well communicating thermostats, lighting controls, meter information displays, air quality monitors, security camera systems and smart appliances.

Automated Demand Response demonstration systems installed in an EPRI-funded project at Rochester Public Services, Rochester MN in 2006 for the automated control of lighting, HVAC and major equipment to meet utility demand response requirements.

Invited Speaker and Presenter at several Conservation-centered International Conferences:

- CleanTech Conferences in 2006-8 in Washington DC and Shanghai China
- Broadband Utility BPL Conference – Hong Kong 2007 and 2008
- Grid InterOp – Policy and Technology Presentation - 2008

GRIDPLEX NETWORKS LLC, Upper Darby PA (2009 – present), Chairman and Chief Scientist

GRIDPLEX NETWORKS LLC continued the work begun at Broadband Energy, acquiring that company’s assets and intellectual property in 2009. GridPlex integrated artificial intelligence and adaptive automation with lighting, HVAC and related building equipment, along with solar and renewable energy systems and sensor networks, to create a fully-automated system that would “learn” the operation of a building or other facility and optimize its operation to

achieve maximum efficiency and meet system operating goals with minimal user supervision required. The mission of GridPlex is to provide Conservation Applications and Systems for Energy and Water that will “Empower Green Buildings and Sustainable Communities” in the Global Built environment.

Developed customer-centric system for “Intelligent MicroGrids” that empower energy consumers and the Smart Grid – integrated solutions that include local renewable generation, storage and energy automation. In addition to the adaptive AI-based automation systems, the company provides and integrates realtime submetering and a wide range of sensors, such as photocells, occupancy sensors, air-quality and other environmental monitors, along with advanced lighting and controls, to produce “green, sustainable systems” that are energy efficient and provide customers with rapid paybacks. Public and private “Energy and Conservation Portals” developed by the company enable customers to display and promote the Environmentally-friendly energy conservation and sustainability performance of these systems on a realtime basis, enhancing the image of the property in the local community as well as on a national scale.

Collaborating with several manufacturers of lighting , HVAC, sensors, communications, building equipment and renewable energy systems to develop and deploy next generation adaptive automation for a wide range of applications, incorporating state-of-the-art technology such as advanced solar RV, microgrids, LED and high-efficiency lighting and related “green and sustainable” products and systems interfaced with the local utility distribution grid to interactively optimize both grid performance and in-building efficiency in real time.

Adjunct member of the GridWise Architecture Council funded by the US DOE, a standards and technology organization working to create a unified framework for integrating energy-efficient end-user systems with smart grid technology. Expert Advisor to the Philadelphia Energy Center located at the Navy Yard in Philadelphia.

Collaborator with the Galvin Electricity Initiative (www.galvinpower.org) working to create a 21st century electrical distribution system. Kurt Yeager, former CEO of the Electric Power Research Institute and Managing Director of the Galvin organization, introduced the “Smart Grid” concept to the US Congress. Mr. Yeager is a member of the Board of GridPlex.

Patent Pending: “Variable Incentive System and Virtual Market” including adaptive automation system technology for conservation and sustainability linked to a virtual market incentive system (filed May 2009); additional patents currently in development.

Exhibit A: Energy Automation and Smart Grid Project Experience

PROJECT EXPERIENCE – PRINCIPALS OF GRIDPLEX NETWORKS LLC

| Energy Utility Automation and Conservation Projects | | | | | |
|--|-----------------|--|---|--|---|
| <u>Project name</u> | <u>Timeline</u> | <u>Client</u> | <u>Project partners</u> | <u>Description</u> | <u>Elements provided</u> |
| Laredo Project – Laredo TX | 1995-97 | CSW (now AEP) | LightMedia, Raytheon | 2,200 homes passed; 850 fully equipped plus 35 businesses | Operating software & GUI for all systems including UIM, H/W, HVAC and load nodes |
| Chatelaine Project - Atlanta GA | 1997-98 | Southern Co. | LightMedia, FirstPacificNetworks-Raytheon | 430 units in a multi-building apartment complex | Operating software & GUI for all systems including UIM, H/W, HVAC and load nodes |
| Ameritech-Wisconsin Bell BAEFT Project | 1995-96 | Ameritech | LightMedia, Wisconsin Bell | Commercial building campus automation | Energy management hardware and software for corporate campus |
| Detroit Edison Intelligent Link Detroit MI | 1995-99 | Detroit Edison (now DTE Energy) | LightMedia / Coactive | Energy management services for home and business customers in Detroit | Provided user interface web access and control equipment |
| Energy Network Computer Project Palo Alto CA | 1997-2001 | Electric Power Research Institute (EPRI) | LightMedia /EPRI/ Oracle | Web-based Energy Information and Management platform for homes & buildings | Developed user interface, service package and operating software |
| Salt River Project | 2001 | Motorola | RCS/Coactive | 300 Homes in Phoenix AZ | Advance Graphical Display Thermostat/user interface |
| NY State Demand Response Pilot | 2003-04 | NYSERDA | Broadband Energy ECONergy | 125 commercial; 100 homes (incl. 75 MDUs) in Rockland County NY | Complete Demand Response System, including gateways, stats, control modules, head-end and user software |
| IBM-CenterPoint BPL Center | 2005-7 | CenterPoint Energy | Broadband Energy | Corporate Center to Showcase new “Smart Grid” Initiatives to Corp. Executives, Utilities, Politicians, Press and Customers in Houston TX | AMR, Demand Response, remote monitoring & control, AQM and other hardware and software |