The Technology Transfer Office (TTO) was established in 1990 to facilitate the commercialization of university intellectual property, including patents and copyrights.

The TTO works with researchers and students in every college to ready new inventions for the patenting process and potential licensing opportunities. TTO's work allows for a sustained focus on transferring cutting-edge research and innovation to the commercial marketplace, generating revenue and diversifying the economy.

Our office has a knowledgeable and professional staff with specialized backgrounds, who work in collaborative teams in the areas of marketing, patent prosecution and licensing to direct the movement of new ideas, discoveries and innovation into the commercial and public sectors. TTO endeavors to educate and promote innovation, the result of which is products, jobs and technologies utilized in the public interest.

USF was recently ranked in the Top 20 of American Universities for technology transfer by the prestigious Milk-en Institute. With 114 new utility patents issued in 2016, USF ranks fifth among American public universities and 11th among universities worldwide in generating new U.S. patents, according to the National Academy of Inventors (NAI) and Intellectual Property Owners Association (IPO). This past year, the university had a record 133 license and option agreements, ranking 9th nationally among individually reporting schools (comparison to the most recent available published data – AUTM 2015 survey). USF also had 9 new startup companies in FY 2016, and has facilitated the formation of 50 startup companies in the last 5 years. TTO endeavors to educate and promote innovation, the result of which is products, jobs and technologies utilized in the public interest.

http://www.usf.edu/research-innovation/pl/
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Fiber-Optic Temperature Sensor

This sensor is simple, versatile and novel in design with an electrically inert tip. The self-heating capability of the probe compensates for poor thermal contact with the sample and conducting heat loss. As a close-loop system it can follow a temperature profile which is a valuable capability for numerous industrial applications.

**USF Tech ID 04A018**
**US Patent 7,104,683**

Fabrication of 3-D Ion Optics Assemblies by Metallization of Non-conductive Substrates

The technique simplifies the fabrication and assembly of cylindrical ion traps (CITs) for mass spectrometers and other ion/electron beam instruments using new materials such as low temperature co-fired ceramics (LTCC). This invention has the capability to improve the precision as well as control the patterning of the conducting layers while reducing the complexity involved during fabrication.

**USF Tech ID 05A006**
**US Patents 7,700,911; 8,188,422**

Thermally Compensated Tandem Differential Thermometer

A thermally compensated thermometer capable of highly accurate determination of surface temperature. This technology uses a probe with a single crystal of Yttrium Aluminum Garnet fiber terminating in a laser heated phosphor. The thermometer developed is immune to electromagnetic interference.

**USF Tech ID 06A063**
**US Patents 7,789,556; 8,011,827**

UV-LED and Laser Fluorescence for Monitoring Water Quality

An innovative method for detecting trace levels of dissolved organic contaminants and potentially harmful substances in drinking water by use of a deep ultra violet light emitting diode LIF system. The system consumes approximately one thirteenth of the average laser power making it cheaper, compact and portable. This highly sensitive system does not use reagents or chemicals making it superior to systems currently on the market.

**USF Tech ID 06B106**
**US Patents 7,812,946; 8,467,059**
Fiber Optic Probe Capable of Simultaneous Absorption and Emission Measurements

A dual sensing system that simultaneously absorbs and emits measurements using a single fiber optic probe. An unclad fiber is immersed in the medium of interest and absorption of the evanescent wave extending into the medium is observed. Also, the fiber can be coated with a polymer which produces a much higher concentration of the solute in the region surrounding the fiber, making it easy to get a clear signal either in the absorption or emission mode.

USF Tech ID 07A046
US Patent 7,855,780

Method and Apparatus for Projecting an Image in Free Space

An optical device that projects a 3D image into free space in front of the device, allowing an observer to focus on the reflection much closer to their eyes. It uses a pair of parabolic mirrors placed in a unique orientation. This invention is can be utilized in so many applications such as perfecting the pose during sports practice.

USF Tech ID 07A054
US Patent 8,210,694

Interferometric Optical Bench System on a Chip

A self-contained Micro-Optical Electro-Mechanical based Interferometer Optic Bench System (MIOBS) designed to quickly detect chemical signatures by use of its laser sources, semiconductor photo detectors, refractive/reflective optical elements and specialized optical transmission paths. This technology is applicable in industries such as engineering and life sciences where there is a need to detect chemical species as well as biochemical compositions.

USF Tech ID 08A044
US Patent 8,269,974

Angularly Partitioned Evanescent Wave Absorption Sensor

The evanescent wave absorption sensor is based on the principle that any propagating ray in the core of an optical fiber penetrates slightly into the cladding, and therefore will be attenuated if the cladding is absorbing. If the cladding is replaced by a sample chemical, the absorption characteristics of the sample can be studied. This invention is capable of measuring a much larger range of absorptions with high accuracy for a fixed interaction length.

USF Tech ID 09A013
US Patent 8,592,768
Portable Light Emitting Diode (LED) Photometer for Colorimetric Measurements

A device that provides an inexpensive and accurate way to perform colorimetric measurements in the field. For each measurement, the LEDs are activated alternately and the signal of all wavelengths are sent to a microcontroller for data processing. This device is easy to operate, highly accurate, and precise. It can be widely used in aquarium management, aquaculture, and for teaching purposes.

USF Tech ID 12A037
US Patent Pending

Microfluidics Platform for Microsphere Positioning

A device with a novel fluid channel designed to enable the microsphere to be easily and reversibly positioned for optical sensing, without the need for a stem. As a result the platform can be reused for measuring multiple microsphere resonators or those coated with targeted bio-species. Such a platform lessens the bulkiness of the device and significantly reduces the time required for calibration.

USF Tech ID 12B118
US Patent 9,687,847

Compact, High–Efficiency Sensor Node for Embedded Wireless Monitoring

A compact, energy-efficient, passive and wireless vibration sensor node for embedded monitoring. The compactness and high efficiency of the node were achieved by employing 3-D, machined-substrate small antennas on the transceiver. The field tests for this invention have revealed it to be potentially useful in long range embedded passive sensing.

USF Tech IDs 12B128 and 13B137
US Patent 9,093,741

Hydrogen Sensor Using Magnetic Heterostructures

This novel device uses magnetic multilayers which change the magnetization state of the system when exposed to hydrogen. Optical measurements to sense hydrogen allow the operation of this device without utilizing any external power. Thus, this sensor can be used in applications that need deployment and remote sensing.

USF Tech ID 13B190
US Patent 9,097,677
Detecting the Presence of a Lead Contaminant

- Fast and accurate detection of contaminant exposure
- Portable and able to detect contamination on site
- Can be engineered to detect other heavy metal contaminants
- Detects lead in a simple, inexpensive and accurate way

**Technology Description:**
University of South Florida researchers have developed a novel lead detection system that is capable of detecting the presence of a lead contaminant on a surface, such as skin. The system is comprised of an infrared (IR) light source, a detector, and a coupling device that is in communication with the light detector. The reflected signature of this light can be analyzed by the computing device to determine which lead contaminants, if any, are present on the surface. It is a fast, accurate, and simple test that can be carried out by any personnel.

**USF Tech ID 14A092**
US Patent 9,823,188

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Chemical Sensors Using Micro-Cavity Technologies

This is an ultra high sensitivity chemical sensor which can be used in chemical, pharmaceutical, food, and beverage industries for quality control purposes. Its compactness and durability make it suitable for space missions where chemical sensors are in a great need. Additional applications include biomedical experimentation, water monitoring, and air recycling.

**USF Tech ID 15A045**
US Patent Pending

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Continuous Wireless Powering of moving Biological Sensors

A system for wirelessly powering moving biological sensors without the need of batteries. The system is able to deliver a constant power supply, eliminating power related drifts and their corresponding recalibration procedures.

**USF Tech ID 15A052**
US Patent Pending
3-D Imaging System with Pre-Test Module

A 3-D imaging system for underwater profiling that is capable of minute definition. The system uses a novel angular relationship to establish the connection between the image features and the system, which is displayed by the virtue of calculations. In addition to the static surfaces, moving surfaces may be studied and corrections due to turbidity and platform position easily compensated for.

USF Tech ID 03B066
US Patent 7,796,809

Full-Color Full-field Optical Coherence Tomography

This is a method for surface and sub-surface imaging of tissues. The imaging method is applicable to the diagnosis of diseases, especially in the critical areas of optical coherence tomography (OCT) such as ophthalmic and dermatological imaging. The invention provides a full color 3D microscopic imaging system and method utilizing wide-field optical coherence tomography resulting in a machine capable of lateral and longitudinal resolution, subsurface penetration of diffuse media and full natural color representation.

USF Tech ID 03B111
US Patents 7,317,540; 7,095,503

Variable Tomographic Scanning With Wavelength Scanning Digital Interference Holography

This technique allows non-invasive imaging of tissues such as retina, skin and gastrointestinal epithelial tissues with speed and enhanced capabilities. This process improves the approach for calculating images of tomographic microscopy. This technology enables clinicians to visualize the anatomic structure and evaluate the functional performance of the body’s internal organs and tissues in a more flexible scanning range.

USF Tech ID 05A065
US Patent 7,486,406

Total Internal Reflection Digital Holographic Microscope

Total Internal Reflection Holographic Microscopy (TIRHM) is a method capable of overcoming the challenges of noise reflected from the cell body during conventional cell surface morphology. This technology is able to generate quantitatively precise images of live cell-substrate interface. This process observes ligand-receptor interaction for purposes of drug discovery.

USF Tech ID 07A018
US Patents 7,812,959; 7,880,891
**Full Color Holographic Camera Technology**

- Complete 3D information
- Inherently faster processing
- Simple, compact design
- Cost effective and versatile

**Technology Description:**
University of South Florida researchers have developed a novel optic system that measures and compensates aberrations in an optical imaging system. This technology has the capability of capturing color holographic 3D images under all common illuminations including outdoor, daylight, room light, halogen, LED, and others. With color self-interference incoherent digital holography (CSIDH), this device has better resolution, inherently faster processing speeds, and the potential to record video. This device has potential applications in many areas including as security, inspection, scientific imaging, and online advertising.

**USF Tech IDs 12A040, 13A029; 14B101**  
**US Patents 9,377,758; 9,360,299; 9,417,610**

**Data Processing for Incoherent Digital Holography**

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**Quantitative Phase-Contrast, Line-scanning Confocal Microscope**

This technology includes a system that can be used to capture high-quality intensity images of optical sections and obtain a quantitative phase map for each optical section at a high speed. This is achieved by combining the merits of line-scanning confocal systems with digital holography imaging.

**USF Tech ID 14A089**  
**US Patent Pending**

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**Adaptive Optics Ophthalmic Imager without Wave Front sensor or Corrector**

A novel adaptive optics ophthalmic imager that does not require the use of separate hardware devices has been developed. This will ultimately reduce manufacturing and maintenance costs. The waveform sensing and correction has almost full resolution of the CCD camera. In addition, the new aberration correction system can be easily incorporated into a conventional fundus camera to achieve high resolution imaging of retinal cone mosaic.

**USF Tech ID 10B110**  
**US Patent 9,179,841**
Smart Conducting Polymer Composite Actuator in Moist Air

This invention is a flexible electrochemical composite polypyrrole (PPY) film which actuates with moist air. The free standing PPY–composite film responds to moist air by freely moving forward and backward, indicating that it can be easily integrated in toys. Our film can also be used as a humidity sensor, capacitor, and robotic parts.

USF Tech ID 14B156
US Patent Pending

Manufacturing Micro-Or Nanostructures by Means of Wet Chemistry in a Confined Space

A novel technique has been developed to fabricate ZnO nanowires inside an array of high aspect ratio deep trenches. Such a structure may be beneficial when Zinc Oxide nanowires are used as an electrode material for devices like DSSCs, supercapacitors or any other electrochemical device.

USF Tech ID 12B093
US Patents 9,443,662; 9,691,554

New Method for Producing Flexible Conducting Polymer and Polymer Nanocomposite Films

This is a new method for producing flexible conducting polymers and polymer nanocomposite films. This invention address previous problems by devising a method which allows the transfer of thin PANI (Polyaniline), other conducting films, and polymer nanocomposite films to flexible polymer, copper, aluminum, and other substrates.

USF Tech ID 14A072
US Patent Pending

Template Electrodeposition of Free-Standing Aluminum-Manganese

For the first time, the feasibility of template electrodeposition of Al-Mn nanorods has been demonstrated. This has been shown using micro-tubes and micro-pillars with tunable sizes and compositions. By combining the easy processing routes, inventors have developed intrinsic scalability. This presents immediate contribution in numerous applications such as plasmonic pixels in color display, anodes for Li ion batteries, and energy absorbers.

USF Tech ID 14B145
US Patent Pending

Smart Conducting Polymer Composite Actuator in Moist Air

This invention is a flexible electrochemical composite polypyrrole (PPY) film which actuates with moist air. The free standing PPY–composite film responds to moist air by freely moving forward and backward, indicating that it can be easily integrated in toys. Our film can also be used as a humidity sensor, capacitor, and robotic parts.

USF Tech ID 14B156
US Patent Pending
Electrodeposition of Al-Ni Alloys and Al/Ni Multilayer Structures

This is a feasible and cost-effective alternative method to fabricate Al alloys and multilayer structures by electrodeposition in non-aqueous room-temperature ionic liquids. Specifically, our inventors have identified a method of dissolving NiCl₂ in 1-Ethyl-3-methyl Imidazolium Chloride/Aluminum Chloride electrolyte to provide good conductivity, low vapor pressure, and a wide electrochemical window (all of which are limited in current conventional practices).

USF Tech ID 15A033
US Patent Pending

Novel Processing for High Specific Capacitance in Supercapacitor Applications

This approach is transformative and fundamentally different from any existing nanocomposite electrode formation processes, yielding a higher specific capacitance for supercapacitor applications. This process can be applied to the fabrication of battery and supercapacitor electrodes using various conducting polymer composites and conducting polymer materials.

USF Tech ID 16A014
US Patent Pending

Design of a Linear Bistable Compliant Crank-Slider Mechanism

This is a new model for a linear bistable compliant mechanism, as well as design guidelines with step-by-step procedures for customization. This type of design can be used in Shape Shifting Surfaces as an attachment to provide greater stability to its surfaces.

USF Tech ID 15A087
US Patent Pending

Biocompatible Hybrid Sorbent for the Extraction and Enrichment of Catecholamine Neurotransmitters

This is a metal oxide-based biocompatible hybrid sorbent for the extraction and enrichment of catecholamine neurotransmitters. These sorbents can be advantageously employed in the extraction and enrichment of catecholamines and their metabolites which represent important biomarkers for neuroendocrine tumors.

USF Tech ID 16A106
US Patent Pending
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<th><strong>Shape-Morphing Space Frame (SMSF) Using Unit-Cell Bistable Elements</strong></th>
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<td>This is a method to allow for the design of a structure, termed the Space-Morphing Frame, that can change from one specific shape to another using unit-cell bistable elements.</td>
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| **USF Tech ID 15B172**  
**US Patent 9,783,977** |

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<th><strong>Design and Kinematic Optimization of a Waterproof Shape-Shifting Surface</strong></th>
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<td>This is the combined structural integrity of a Shape-Shifting Surface (SSS) with the water-tight seal of a flexible plastic sheet to create a surface which would be strong, flexible, and waterproof. Solid mechanisms theory was used to analyze the behavior of the technology using the virtual work method.</td>
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| **USF Tech ID 15A069**  
**US Patent Pending** |

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<th><strong>A Limina-Emergent Cone Using Bistable Collapsible Complaint Mechanism</strong></th>
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<td>This invention is a cone structure using bistable collapsible complaint mechanism technology. The transformation from a planar lamina shape to a cone shape requires only a small pulling or compressing force to switch between the two states. It will provide useful functions such as switches and relays, and can be manufactured on a microscale.</td>
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| **USF Tech ID 16A031**  
**US Patent Pending** |

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<th><strong>Shape-Morphing Space Frame (SMSF) Using Linear Bistable Elements</strong></th>
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<td>This is an improved structure that provides a predictable and controllable space-frame change. This allows the morphing of one specific shape into a different shape. The ability to change the surface profile upon actuation can be implemented in various applications, such as deployable antennas, airplane wings, morphing, and fluid flow controller. There is a potential for this method to be manufactured at the micro-scale and used in medical applications such as in intravascular stents.</td>
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| **USF Tech ID 15A088**  
**US Patent 9,783,978** |
### Load-Adjustable Constant-Force Mechanisms

This is a compliant device with adjustable constant-force output. In order to fulfill the need for precise force output control in robotic systems, our inventors have designed a CFM that is easily adjustable in a way that directly affects the output force. Robotic armatures could also employ this system in their joints to maintain static balance in a wide range of positions, therefore improving power efficiency.

**USF Tech ID 16B130**

**US Patent Pending**

### Dual Ligand Sol-Gel Sorbent Combining Superhydrophobicity and π-π Interaction

These are silica-and germania-based sol-gel sorbents containing two organic ligands characterized by superhydrophobicity and π-π interaction with the analytes. The created sol-gel sorbents provide a stable, consistent performance in the extraction of analytes from saline and non-saline aqueous matrices. This new material is optimal for solid-phase microextraction and is easy to couple with many modern analytical techniques.

**USF Tech ID 16B181**

**US Patent Pending**

### Thermoelectric Flow Cloaking via Metamaterials

This is a method based on transformation optics for unprecedented control of thermoelectric flow. Transformation optics have proven to be a versatile approach to achieve novel outcomes relying on materials with highly anisotropic and inhomogeneous properties.

**USF Tech ID 16B194**

**US Patent Pending**

### Electrochemical 3D Printing and Soldering

This technology involves a method which improves upon electrochemical 3D printing and soldering techniques for fast printing methods. This invention allows low-cost metal printing on conductive or non-conductive substrates. This technology can be widely used for the manufacturing of integrated circuits, PCBs, and electronic components.

**USF Tech ID 17A002**

**US Patent Pending**
Microencapsulated Thermochromic Materials for Self-Cleaning and Energy Efficient Coatings

- Energy efficient
- Self-cleaning
- Can be used with a wide range of temperature and building applications

Technology Description:
University of South Florida researchers have developed microencapsulated thermochromic materials with self cleaning properties to create energy efficient coatings. The encapsulated material is highly reflective above a designed temperature and absorptive (emissive) at lower temperatures. This color shift decreases the energy needed to heat and cool the interior of the building. This material also reacts with air components to destroy organic pollutants, giving it self cleaning properties.

USF Tech ID 17A003
US Patent Pending

Phase Change Nanoparticles for Li-ion Battery Safety

- Accurate temperature control inside lithium-ion batteries
- May be made from organic or mineral materials
- Will help to avoid the thermal runaway process in Li-ion batteries
- May help to give the battery a more efficient charge storage and battery life

Technology Description:
University of South Florida researchers have developed a novel and unique approach to control the temperature inside lithium (Li) ion batteries to avoid their combustion. Specifically, this invention concerns nanoparticles with a melting point near 80 °C. High specific latent heat is used as an additive to the electrolyte or the electrodes of Li-ion batteries. The idea is to absorb the excess heat inside a rechargeable battery by the nanoparticles to limit the temperature and avoid thermal runaway process in the batteries.

USF Tech ID 17A018
US Patent Pending
A Distributed Control Mechanism for Heterogeneous Multiagent Systems with Unknown Leaders

- Distributed control of heterogeneous (in dynamics and dimension) linear time-invariant multiple systems
- A new approach involving distributed controlled design which is independent of the external disturbances and leader dynamics
- Uses a fundamental theorem for linear time-invariant systems to link input-output stability and internal stability

Technology Description:
University of South Florida researchers have developed a novel control system that utilizes a distributed approach to allow a group of heterogeneous dynamic systems (e.g., aerial and ground vehicle teams) to work in coherence, even when having non identical dynamics and dimension. The approach uses a fundamental converse theorem for linear time-invariant systems to link input-output stability and internal stability.

USF Tech ID 17A070
US Patent Pending

Programmable Magnetic Energy Minimizing Co-Processor (MEMCOP)

- An alternative to quantum computing
- Potential to yield fast solutions to computationally-complex problems
- Can be applied to a wide range of non-convex quadratic optimization problems that arise in many scientific domains
- Solves difficult computational problems with a single input-output cycle

Technology Description:
University of South Florida researchers have developed a novel physics-inspired computation that maps quadratic energy minimization problem spaces into a set of interacting magnets. This allows the energy between the problem variables to be proportional to that of the energies between the corresponding magnets. Optimization is accomplished by the relaxation physics of the magnets themselves, and solutions can be read-out in parallel.

USF Tech ID 15A103
US Patent 9,720,599
Micro-Wireless Integrated Environment Sensor and Transmitter System

- Flexible modification based on stimuli
- Integrated environmental sensor and transmitter functions
- Scalable to attain a higher or lower frequency of operation
- Environmentally sensitive

Technology Description:
University of South Florida researchers have developed a novel sensor and sensor system. The system utilizes radio frequency IC adapted as an environment micro system for the sensing of environment stimulus and communications. The overall system combines sensor and communication functions to provide data for the surrounding environment. Possible applications in nearly every major industry. Developers have been finding new ways to incorporate data sensors to increase functional flexibility by implementing sensor technology with communication systems, allowing for wireless and remote sensing capabilities.

USF Tech ID 01B085
US Patent 7,386,289

RF Microwave Circuit and Pulse Shaping Method

This is a new pulse shaping method for pulse shaping, referred to as the Multiport Circuit for simultaneous Shaping of Sub-Nanosecond Pulses (MCS3P). This technology involves the use of coupled transmission lines, which work by isolating the pulse generator from the pulse-shaping network.

USF Tech ID 07B140
US Patents 8,134, 394; 8,248,125

Integrated MEMS Wireless System in 3D Package

This is a highly miniaturized wireless transceiver employing WLAN technology that offers flexible integration with a multiple generic sensing technique. It can be readily integrated with existing sensing technology to enable direct sensor-to-internet communication in environments where wired connections are impractical.

USF Tech ID 04A026
US Patent 7,656,673
Dynamically Reconfigurable Bandpass Filters

This is a RF filter in which frequency tuning is accomplished by movable microfluidic loads consisting of metal (in either liquid or solid form) and dielectric solution volumes. The highly linear nature of the tuning mechanism makes these novel filters well suited for high-power RF applications. Additionally or alternatively, the filter can be fabricated to have a miniature footprint making it suitable for small appliances.

**USF Tech ID 12B158**
**US Patent 9,325,047**

Microelectromechanical Slow-Wave Phase Shifter

This is a device and method that improves upon the capacitance-only TTD device architecture. The slow-wave device, in accordance with the present invention, produces true time delay phase shifting that enables large amounts of time delay without significant variation in the effective characteristic impedance of the transmission line.

**USF Tech ID 03B108**

Dual Polarized Feed Antenna Apparatus and Method of Use

This is a novel method and device for the collection of electromagnetic energy using a dual polarized antenna for the collection of solar energy. This invention overcomes the identified deficiencies of prior systems. The device intercepts randomly polarized electromagnetic waves that are excited through an aperture by using two well-isolated orthogonal feeds. This invention will be most beneficial in the energy and communication industries.

**USF Tech ID 05A034**
**US Patents 7,619,570; 7,362,273**
An Aperture Rectenna for Converting High Frequency Wave Radiation into DC Power

The invention allows the collection of solar radiation from the wave property of light, and the conversion of this electromagnetic wave energy into direct current electrical energy by the use of an integral ultra high frequency rectifier. It offers an integrated approach, at the nano-scale level, to fabricate a slot or aperture antenna integrated with a MIM quantum tunnel diode. This forms a building block element in an array of rectenna elements for harvesting electromagnetic energy.

**USF Tech ID 03A023**
**US Patent 7,091,918**

Zero-Order Energy Smart Antenna and Repeater

This is a novel invention for a device that consists of two smart ZOE Antenna which will be configured for optimum signal reception at power up. They will then be sampled and reconfigured at user defined time intervals. The antenna performs these adjustments while consuming approximately zero DC energy.

**USF Tech ID 05B122**
**US Patent 7,720,437**

A Dual-Feed Series Antenna Array with Frequency Independent Beam Angle

This is a method for antenna array design that enables the direction of signal transmission and/or reception to remain fixed as the operating frequency changes. The functionality is useful for frequency hopping communication applications to maintain the communications link when the transmitting frequency changes.

**USF Tech ID 08A006**
**US Patent 8,063,832**

Flexible Low Profile Microwave Antenna

This is an innovative antenna that uses a flexible substrate with embedded elements to provide frequency tuning. The design consists of a printed dipole that is loaded with two parallel sleeves, an has parasitic capacitive loading at the ends of the dipole arms. The loading elements offer miniaturization of the design. This design is attractive due to its high radiation efficiency and inherently broad bandwidth.

**USF Tech ID 09B103**
**US Patent 8,872,725**
Periodic Spiral Antennas

- Constant capacitance allows for maintained performance of the antenna
- Significant impedance control
- Uniform spacing
- Volumetric miniaturization of ultra-wideband spiral antennas

Technology Description:
University of South Florida researchers have developed a novel periodic spiral antenna that utilizes a combination of the z-direction and a tapered substrate profile to provide for volumetric miniaturization of Ultra-Wideband (UWB) spiral antennas. The interleaved spirals form multiple turns of the antenna and the turns are equally spaced from each other throughout the antenna. These antennas have a height (z) dimension that is used to inductively load the antenna while maintaining uniform capacitance.

USF Tech ID 13A106
US Patent 8,922,452

Mechanically Reconfigurable Antennas

This is a design of adiabatic dynamic differential logic for differential power analysis (DPA). This technology has a wide range of applications and may be used with virtually any cost sensitive secure integrated chip.

USF Tech ID 11B196
US Patent 9,263,803

Microfluidic Enabled Low Cost Beam Scanning Arrays

This novel microfluidic reconfiguration technique alleviates the need for active RF switching devices. This is done by utilizing antenna elements consisting of liquid metals or metalized plates movable within interconnected microfluidic channels placed at the focal surfaces of microwave lenses. This invention can be widely used in commercial millimeter-wave applications such as satellite communications and microwave imaging. It also can be utilized for military and meteorology applications.

USF Tech ID 13A003
US Patent 9,716,313

A CAD view of the antenna

Perspective Top View of a Periodic Spiral Antenna
GPS-based Real-time Location-based Services Applications
A real-time transit navigation system to track the location of public transit riders (who might or might not be familiar with their route) and transit vehicles by providing notifications based on comparisons of the location of the riders and vehicles. This technology promotes the use of public transportation thereby lessening traffic congestion, reducing consumer travel costs, and reducing environmental pollution.

USF Tech IDs 04B083, 05A060 and 07A055
US Patents 8,138,907; 8,169,342; 8,600,674; 8,751,162

Evacuation Zone Finder System and Application
This is a mobile application that actively determines the user’s current location, compares it with data from the Geographic Information Systems (GIS) maps, and then notifies the user with the corresponding evacuation zone designation with necessary instructions for adequate reaction. In so doing, the application assists in safe and timely evacuation of persons in at risk areas.

USF Tech ID 05B097
US Patent 8,145,183

Systems and Methods for Efficient Real-time Location-aware Applications
This is an intelligent software implemented in state machines that dynamically adjusts software parameters in Location-based Services (LBS) applications in real-time based on environmental conditions. Control of the changes of state in an LBS system saves power by reducing polling intervals of location technology at times when they are not necessary. This software also increases application performance and reduces network bandwidth consumption.

USF Tech IDs 07B079; 07B080
US Patents 8,249,807; 8,036,679

Navigation System for Obstructed Signals
This technology includes a system and method of manipulating device positioning systems to reduce the impact of harsh GPS environments on its battery life when located at an obstructed location. Devices in such locations are identified based on historical data collected on the mobile device over time.

USF Tech ID 11B151
US Patent Pending
Open-Path/Free Space Optical Communication System Using Reflected or Back Scattered Light

This system is a free space optical (UV, visible, IR) communication system that is ideal for indoor and outdoor communication between two or more locations that can not “see” each other directly due to line-of-sight interfering objects. It uses open path free space optical beams reflected from walls, trees, or clouds.

USF Tech ID 00B069
US Patent 7,751,716

Open Path Laser /Optical Communication Systems and Methods utilizing Wavelengths between Atmospheric and Gaseous Absorption Lines

This technology is a multi-channel optical communication technique using laser or optically generated beams through the atmosphere. It is cheap, and provides channel isolation. Therefore, it is able to prevent cross-talk between adjacent wavelength channels, and does not require fine tuning.

USF Tech ID 00B077
US Patents 7,646,987; 7,126,971

TCP-based Transport Layer Protocol

This technology is an end-to-end protocol based on TCP Selective Acknowledgment-based (SACK) called SF-SACK. It is smooth enough for streaming applications while implementing the known flow and congestion control mechanisms available in TCP. Furthermore, if SF-SACK is used by both streaming and data-orientation applications, complete fairness is achieved. SF-SACK is easy to implement, requiring only sender side modifications and is simpler than TFRC.

USF Tech ID 04A040
US Patent 8,036,112

Architecture for Ultra Wideband Radio

Technology for generating, transmitting, detecting and processing radio signals that mitigate the challenges often associated with UWB communication implementations. One technique includes utilizing a transmitted reference approach, wherein the radio signal includes pairs of UWB pulses, each separated by a fixed time delay. This technology enables a low cost implementation with flexibility, improved logic resource efficiency, and simplified processing requirements.

USF Tech ID 04B090
US Patents 8,351,483; 8,588,270
**System and Method of Exploiting Location Awareness**

A novel way of extracting major wireless channel statistics through absolute location information and digital topographical data. The location information and topographical data combine to work together to improve the performance and efficiency of wireless cognitive radio by delivering more precise and accurate statistical information to the cognitive engine.

USF Tech ID 07A006  
US Patent 8,295,859

**Cognitive Positioning System**

An innovative cognitive positioning system that provides arbitrary positioning accuracy with optimum complexity in both indoor and outdoor environments. This system is based on the Adaptive Time-of-Arrival concept and consists of two major components: bandwidth termination and hybrid overlay and underlay dynamic spectrum access (H-DSM) algorithms.

USF Tech ID 07A007  
US Patent 7,956,807

**Side Lobe Suppression of OFDM-based Cognitive Radio Systems Using Adaptive Symbol Transmission**

Using licensed frequency bands through cognitive radio systems as a solution to spectral crowding problem. With only a small increase in the useful symbol energy, this technique reduces interference to adjacent signals significantly. Interfering side lobe suppression is achieved by adding an extension to OFDM symbols that is calculated using optimization methods to minimize adjacent channel interference while keeping the extension power at an acceptable level.

USF Tech ID 07B092  
US Patents 8,571,136; 9,426,010; 9,106,324

**Cognitive Radio Transceiver for Dispersed Spectrum Utilization**

This novel technology transmits information over multiple dispersed bands in contrast to transmitting the signal over a single band. A cognitive radio transceiver is developed for the implementation of dispersed spectrum utilization technique. In addition, an equation that facilitates the relationship between the conventional whole spectrum utilization and the invented dispersed spectrum utilization is derived. The results show improved performance of systems that can potentially increase revenue for wireless service providers.

USF Tech ID 08A009  
US Patent 8,064,836
Increasing the Reliability of OFDM-based Communication Systems

Implemented to improve probability of successful reception at the receiver and transparent self-healing and fault-tolerance of the communication. Inventors have employed diversity coding across OFDM sub-channels to improve spectral efficiency, transmission rate, throughput and performance during multipath fading, without requiring rerouting or retransmission of lost information. DC-OFDM provides the best performance when the probability of link error is high or when a link (sub-channel) fails.

USF Tech ID 12B147
US Patent Pending

Digital Coding Scheme for Data Transmission

A novel technology that combines the two widely used approaches of Direct Sequence Spread Spectrum (DSSS) and Turbo coding. By combining these two technologies iteratively, decoding can take place between the DSSS block and the Turbo decoder. As a result, the overhead required to carry the turbo code information is drastically reduced, allowing for a much greater bandwidth for a given bit error rate (BER) at the receiver.

USF Tech ID 08A014
US Patent 8,295,326

Automatic Selection of Optimal Local Communication Channel from a Plurality of Channels

This technology selects the channel with lowest energy consumption that also meets a specific performance threshold. For a PC that has both Ethernet and Wi-Fi interfaces, this automatically tests for link bottlenecks and then selects either Wi-Fi or Ethernet in such a manner as to reduce energy use. For a smart phone with both Wi-Fi and cellular data service, this optimally selects either Wi-Fi or cellular data service. This invention will be very useful in environments where energy is scarce, costly, or experiences data rate fluctuation.

USF Tech ID 12A001
US Patent 9,106,559

Interference Identification with Interference Spectrogram for OFDM-Based Systems

The method maintains the advantages of the cyclic prefix (CP) but prevents unauthorized exploitation of the CP for synchronization by adaptively changing the size of the CP depending upon channel conditions. Random signals are appended to some of the OFDM symbols to scramble the correlation peaks in the time domain. The method provides secure data transmission, high data transmission rates, and decreased power consumption.

USF Tech ID 12A053
US Patent 9,065,710

Increasing the Reliability of OFDM-based Communication Systems

Implemented to improve probability of successful reception at the receiver and transparent self-healing and fault-tolerance of the communication. Inventors have employed diversity coding across OFDM sub-channels to improve spectral efficiency, transmission rate, throughput and performance during multipath fading, without requiring rerouting or retransmission of lost information. DC-OFDM provides the best performance when the probability of link error is high or when a link (sub-channel) fails.

USF Tech ID 12B147
US Patent Pending
User-specific QoS Scheduling for Wireless Systems

User-specific Quality-of-Service (QoS) scheduling which can improve the number of supportable users by incorporating user-specific QoS requirements, while maintaining an acceptable Mean Opinion Score (MOS) level. Furthermore, when targeted to maximize spectrum utilization and combined with voice codecs matched to the auditory characteristics of users, higher system capacity may be achieved. Simulation and analytical research show that user-specific QoS study can be a very promising research field to improving the quality, capacity, and performance of the wireless systems.

USF Tech ID 14B108
US Patent 9,826,541

Suppressing Alignment in OFDM-Based Systems

This technology is a novel approach called Suppressing Alignment to reduce the out-of-band interference and peak-to-average power ration of Orthogonal Frequency Division Multiplexing (OFDM) systems.

USF Tech ID 14B154
US Patent 9,780,985

Information Beamforming for Visible Light Communication

This is a technique in which beamforming is performed in the information domain without hurting the illumination. The invention addresses the controlling of the data directionality in VLC without hurting the ability to illuminate a space.

USF Tech ID 14B159
US Patent Pending

A Windowing Technique for Optimal Time-Frequency Concentration and ACI Rejection in OFDM-Based System

This is an alternative solution for reducing OOB radiation by using a method of concentrating the spectrum of windowing functions into a given bandwidth while achieving maximum suppression in the out-of-band region. This approach preserves the main structure of OFDM receivers and addresses back-compatibility issues which are important for existing OFDM-based systems.

USF Tech ID 15A029
US Patent Pending
Variable Screening Apparatus for Selective Admittance of Light

This is a solar shading technology that uses the properties of flexible materials to form a screen that changes shape to create openings that vary in size according to desired needs. These novel shades are made from materials such as wood, metal, polymers, textiles, and composites. They have the ability to stretch, bend, and twist to adapt to lighting needs and passive energy strategies, as well as furthering the enrichment of architectural space.

USF Tech ID 09B074
US Patent 8,960,259

Integrated Desalination and Power Generation

This is a new method of desalinating sea water and producing power at the same time using low grade heat sources such as waste heat/solar energy. The system could also be used to treat concentrated brine such as shale gas mining frac water and coal bed methane produced water. The system could be ideal for remote island fresh water and power generation from seawater applications.

USF Tech ID 11A071
US Patent Pending

System and Methods for Converting Carbon Dioxide into Chemical Feedstock

This is a new method for the management of carbon dioxide. This method may be implemented to reduce greenhouse gas emissions and turn carbon dioxide into useful feedstock.

USF Tech ID 12A026
US Patents 8,999,283; 9,815,702

Removal of Heavy Metal Ions from Fluids Using Dendrimer-based Composite Materials

This is a novel method that can be used for the removal of heavy metal ions from fluids using dendrimer macromolecules as environmental metal chelators. This technology is applicable to many emerging industries which focus on the removal of heavy metals. It could be used in wastewater treatment plants, pharmaceutical industries, and environmental remediation.

USF Tech ID 12B151
US Patent Pending
Mask-Stack-Shift Method to Fabricate Organic Solar Arrays by Spray

This technology utilizes organic semiconductors that can be dissolved into appropriate solvents and form not only photo-active solutions, but also electrical-active solutions. Transparent-contact solar panel utilizes a solution based technology to fabricate solar panel in an inexpensive inert gas instead of a high vacuum and high temperature environment. This technology will allow novel photovoltaic cells with enhanced transparency and minimal human involvement, therefore reducing variation.

USF Tech ID 13A018
US Patent 9,722,180

Mini Notched Turbine Generator

This turbine can convert flow into electrical energy by using electromagnetic subsystems to transform the kinetic energy to electricity. The invention has applications in the field of wireless self-powered micro and nano devices.

USF Tech ID 13A068
US Patent 9,618,002

Immobilizing A Target Protein for Applications in Bio-Photovoltaic and Bio-Sensing System

These are novel systems and methods for immobilizing target proteins on an underlying electrode for applications in bio-photovoltaic (bio-PV) and bio-sensor devices.

USF Tech ID 13A082
US Patent Pending

Piezoelectric Based Solar Cells

This technique employs piezoelectric material in the structure of the devices and modifies the energy barrier at the interface by using either external mechanical forces or initial stress in the layer. Modifying the energy barrier can enhance the charge transfer from the photoactive layer, increasing the energy conversion efficiency in the solar cells.

USF Tech ID 15A036
US Patent Pending
Recovery of Phosphorus from the Atmosphere Using A UV Light Tool for Phosphorus Sustainability and Removal

This invention uses UV light to photolyze atmospheric phosphine to phosphate inside a chamber. Water is used to recover the phosphorus from the chamber. The recovered phosphorus can be used in various agricultural industries including phosphate fertilizers.

USF Tech ID 15B160
US Patent Pending

Concentrating and Harvesting Mechanisms for Photo Bio-Reactors

This is a novel passive mechanism for concentrating the culture using gravity settling and taking advantage of gases produced during cultivation for dewatering. This invention would regulate the release of gases to better control the dewatering. It also requires less energy and chemical inputs for downstream processing.

USF Tech ID 15B168
US Patent Pending

Survey of Soil Surface

This invention provides a fast, contactless alternative Kelvin Probe to measure electric potential of the soil or soil filler surface. The probe can provide assessment of the corrosion condition of embedded metallic components such as soil reinforcement, and also serve to monitor cathodic protection in soils without disturbing the soil surface.

USF Tech ID 16A021
US Patent Pending

The BullHorn

This is a high performance geological sampling device. The device is capable of maintaining at least 18 inches from the sampling area. It also minimizes cross-contamination between samples, weighs less than 15 pounds, and can perform in underwater environments. This soil sampling device, which can be used manually or robotically, is capable of use in traditional geological sampling, under water sampling, and even on asteroids in space.

USF Tech ID 16B151
US Patent Pending
A Single Active Layer Electrochromic Device

An electrochromic device with a single active layer without sacrificing any functionality. The composition and thickness of the active layer has the ability to be varied in order to produce reversible color change at various voltages. This electrochromic device is easier to fabricate, as it does not require vacuum deposition equipment, and cost effective.

USF Tech ID 17A004
US Patent Pending

Performance of NiMg/Ce0.6Zr0.4O2 Cylindrical Pellet Catalysts for Biogas Tri-Reforming

A method for economical and efficient production of syngas from biogas using extruded NiMg/Ce0.6Zr0.4O2 catalyst pellets. These pellets exhibit catalytic performance with both surrogate and landfill biogas with high resistance to carbon deposition, sintering, and attrition. Furthermore, this pellet formation method is suitable for use in large-scale reactors.

USF Tech ID 17A052
US Patent Pending

Using Sunlight to Produce Hydrogen Fuel: Novel p-m Based Photoelectrochemical Cell

A photoanode that uses alpha-hematite (α-Fe₂O₃), which has a much lower band gap than TiO₂. The use of alpha-hematite is very attractive as it provides an efficiency of 16% when converting solar energy to hydrogen. In addition to low band gap, other benefits to using alpha-hematite are low cost, high chemical stability, nontoxicity, and abundance of materials.

USF Tech ID 17A056
US Patent Pending

Catalyst and Process for Enhanced Low Temperature Conversion of CO₂ to CO

A more efficient process and catalyst for converting waste CO₂ to CO, called reverse water gas shift chemical looping (RWGS-CL). This process is capable of converting carbon dioxide to CO at a low temperature of 600°C with unprecedented rates using a LSF-silica composite catalyst developed by the researchers. Mixed metal oxides used in the catalyst achieve a 100% selective generation of CO from CO₂.

USF Tech ID 17A082
US Patent Pending
Multi-lobed, Cooled Teething Device

This is a multi-lobed teething device that can be periodically refilled with a cold liquid, thereby eliminating a requirement for the device to be placed in a cold environment for a predetermined period of time prior to each use. The detachable lobbed protrusion may be replaced with a pacifier to further increase the versatility of the teething device.

**USF Tech ID 13A117**
**US Patent 9,744,104**

Modern Dice and Dominoes

This is a novel system of groves to act as a numbering system for each of the six sides of the die, or each of the two sides of the domino. This creates a simple, clear and new look fit for a game piece in the modern era. The physicality of the grooves allow the user to not only see, but to feel the numbers, allowing for an advance in the accessibility of the interpretation of game pieces. This tactile feature also helps the visually impaired person to identify the numbers on a die or domino piece.

**USF Tech ID 14A100**
**US Patents 9,415,298; 9,737,793**

Picture Hanging Dot

This is an alternative hanging system that utilizes the butterfly style drywall anchor combined with a monofilament. The novel invention removes the real apparatus altogether and allows for a nearly invisible hanging system which eliminates distractions to the display of art and the architecture that houses it. This system also has an extremely low cost due to its relative simplicity and can be installed in the ceiling or wall.

**USF Tech ID 13B119**
**US Patent 9,541,112**

String Vibration Frequency Altering Shape

The application of this invention is in musical acoustics and might also help in force sensing through vibration analysis, such as using it as a strain gage or force sensor. A prototype device has been constructed to illustrate the concept of the musical kinetic shape. The prototype is controlled by a computer and can be easily programmed to rotate the kinetic shape into a desired position to produce specified and exact notes. By moving the platform and plucking the string, songs can be played using the unique and novel instrument.

**USF Tech ID 13B175**
**US Patent 9,520,110**
**Cyber Security: Authentication and Biometric Systems**

**Biometric and Dynamic-Code Protected Token Decryption Method and Device**

Compact and portable authentication/decryption device that incorporates a fingerprint biometric, token, and decryption key that attaches to the USB port of any computer. This device is used for various physical security measures.

**USF Tech ID 05A052**
**US Patent 8,127,142**

**Reconstruction of Biometric Image Templates Using Match Sets**

A novel paradigm to reconstruct face templates from match scores while increasing security and privacy by utilizing a linear approach.

**USF Tech ID 07A044**
**US Patents 8,165,352; 8,331,632**

**Systems and Methods for Co-Authentication Using Multiple Devices**

A co-authentication system where at least two registered devices collaboratively authenticate a user. This allows multi-factor security with single-factor convenience.

**USF Tech ID 14A079**
**US Patents 9,659,160; 9,380,058**

**Orientation Invariant Gait-Matching**

A novel orientation invariant gait-matching algorithm that allows accurate gait recognition irrespective of the sensor orientation without prior training. This can be used to build a robust gait model using wearable devices (smartphones, etc.) which can be utilized as a biometric for various purposes such as authentication.

**USF Tech ID 14B164**
**US Patent 9,877,668**
Cyber Security: Diagnostic Tools for Evaluating Network Vulnerability

Cybersecurity Analytical Methods to Determine Overall Network Security Risk

A stochastic model to quantify the risk associated with a computer network. This methodology provides a ranked list of priorities so network administrators can make software patch decisions.

USF Tech ID 16B141
US Patent Pending

Change of Risk Factor Over Time

Cyber Security: Nonlinear Stochastic Models for Predicting the Exploitability

Statistical models for assessing the risk of a cyber-security risk at time “t” in application and system platforms.

USF Tech ID 16B171
US Patent Pending

Cybersecurity-Statistical Predictive Model for Expected Path Length

Statistical model that predicts the number of steps an attacker will take to compromise a system (expected path length). Using this information network administrators can take precautions to minimize vulnerabilities.

USF Tech ID 17A014
US Patent Pending

Stochastic Modeling of Vulnerability Life Cycle and Security Risk Evaluation

Statistical model that can give accurate probability of a vulnerability being exploited as a function of time.

USF Tech ID 17A015
US Patent Pending
Design of Adiabatic Dynamic Differential Logic for DPA-Resistant Secure Integrated Circuits

A low cost method of producing secure integrated chips resistant to differential power analysis (DPA) side channel attacks which are used to break cryptosystems.

USF Tech ID 13B129
US Patent 9,531,384

Converter-Gating for Efficient and Secure Power Delivery

Dynamic power management techniques and voltage converter architectures were created to provide a secure and efficient on-chip power delivery system which is resistant to side channel attacks.

USF Tech ID 14A066
US Patents 9,812,954; 9,748,837

Aging-Sensitive Recycling Sensors for Chip Authentication

Specifically crafted sensors based on tailored to amplify the aging mechanisms and detect recycling of integrated chips of hours to days.

USF Tech ID 14B117
US Patent Pending

Security-Adaptive Voltage Conversion as a Lightweight Countermeasure Against LPA Attacks

A low overhead and lightweight countermeasure to prevent leakage power attacks (LPA) used to crack cryptographic circuits.

USF Tech ID 17A059
US Patent Pending
### Channel-Based Coding for Wireless Communication

An advanced novel transmission scheme based on channel precoding and adaptive antenna subset selection in MISO wireless systems for highly secure and resilient communication links between the legitimate transmitter and receiver.

**USF Tech ID 14A018**  
US Patent 9,722,841

### Joint Physical Layer Security and PAPR Reduction with Irrelevant Data for OFDM Systems

Signal design technique combining physical layer security and peak-to-average power ratio (PAPR) mitigation for Orthogonal Frequency Division Multiplexing (OFDM) based waveforms.

**USF Tech ID 14B149**  
US Patent 9,479,375

### Friendly CP Jamming for Physical Layer Security

Friendly CP jamming is a simple method which broadcasts a jamming signal during the cyclic prefix (CP) to interfere with the signal an eavesdropper receives, which prevents him/her from decoding the information correctly. Since the signal is only sent during the CP the message is properly decoded by the legitimate recipient.

**USF Tech ID 15A034**  
US Patent Pending

### Physical Layer Security for Wireless Implantable Medical Devices

Novel authentication mechanism for implanted or wearable medical devices to protect against adversaries malicious attempts to control them.

**USF Tech ID 15B112**  
US Patent 9,749,086
A System Architecture for the Detection of Security Threats in Big Data Systems

Two new systems for detecting insider attacks (e.g. authorized IT administrators) and other process level intrusions of big data systems.

**USF Tech ID 16A061**  
US Patent Pending

Runtime Methods for Detecting Attacks in Big Data Systems

A method for real-time detection of insider attacks in big data platforms during runtime.

**USF Tech ID 16B197**  
US Patent Pending

Systems and Methods for Generating Symmetric Cryptographic Keys from Possibly Different Inputs, Through Cypher-Text Communications

- Secure communication
- Time-and-location limited cryptographic keys
- Compatible with NIST and PCI guidelines
- Confidential information transmitted in cipher-texts

Technology Description:

University of South Florida researchers have developed a novel system and method to enable multiple devices, such as Internet-of-Things (IOT) devices, to generate symmetric cryptographic keys. This system protects the devices from attackers. This invention enables Internet-of-Things devices within a building to generate strong, time-limited cryptographic keys, unavailable to attackers outside the building. Cipher-Text communications are used to establish confidential communication channels via self-generated time-and location-limited symmetric cryptographic keys.

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