Final Project: Internet of Things Thesaurus

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Introduction

Information System, Domain & User Group

Technology is all around us, and people are interacting with it in new ways. Some of the new uses for technology depend on sensors, which connect people to devices, that gather data to be reported and analyzed. Internet-connected devices used in this way are a part of the "Internet of Things" (IoT). As with any other new area of interest, the accepted terminology is subject to a gradual standardization, according to usage. There are complex concepts being discussed in an emerging body of professional and technical literature, and a robust collection of observations and articles by amateurs who have an interest in a field of knowledge that touches everyone who uses any portable device connected to the internet.

The IoT has become a focus for many people, in their personal and professional lives, and concepts in the field have a great deal of potential to change our lives, today and in the future. It is rare for technology to be so relevant to so many people, who all have a place in an ongoing conversation about the IoT. To be part to the conversation, users must speak the language. While some users are already familiar with common terms and jargon used within the domain, others continue to be perplexed, and ask themselves what, exactly, the IoT is and whether it can really be defined at its current level of development.

The “Internet of Things” (IoT) domain represents a world of complex ideas and use over a number of interconnected disciplines. It’s broad scope ranges from abstract concepts like “ubiquitous computing” and “cyber security”, to highly specific technical components and processes, such as “smart semantic middleware” and “autonomous data capture”. This domain is also impacted by the rapid evolution of technology, which will generate a growing number of resources. In turn this affects the information needs of this group, which are also rapidly evolving over time. We determined that there is a definite need for a thesaurus to help users navigate the most common terms used in the IoT domain.

To satisfy that need, we built a thesaurus which could be used as a tool to provide an overview of common ideas, and provide access to terms used frequently in works written about IoT. A primary user group for this thesaurus are IoT novices and students who are unfamiliar with the domain, who seek guidance when faced with new terminology and information. The right thesaurus could help them expand searches into unfamiliar territory and also help them gain familiarity with the subject matter. To help such users, we designed a thesaurus that is focused on common terms from articles at different levels of difficulty: for example, users will gain insight into the relationships of common terms like “smart devices” (a general term describing any device connected to the internet) and more specialized terms like “Haptics” (touch-technology used in the world of smart devices).

That is not to say that our thesaurus would not be useful in a professional or academic environment. Our intent was to design a thesaurus that was broad in scope, while drilling down in areas of popular or emerging interests. The end result is a thesaurus that could easily be used to index academic papers (especially for dissemination in an Open Access or survey-level academic environment), or construct

browse taxonomies in a professional or e-commerce setting. While the thesaurus we constructed might be useful to experts who are trying to expand a search into areas, their needs are not our primary focus. Highly specialized domain work would require extending the specialized associative and hierarchical relations (which it was constructed to support).

Thesaurus Form & Usage

There are standard practices for designing a thesaurus, which were especially useful to us as we explored the Internet of Things. Those who use the thesaurus may not be familiar with the language of the IoT, but they should be able to recognize the terms used in the primary facet, which were developed by the Classification Research Group for common usage (Aitchison, 2000). Fundamental facet terms that we have chosen to use in our thesaurus separate each primary term into one of the following categories: Abstract Entities, Artifacts and Components, Complex Entities, Operations, or Processes. Users who may not be familiar with one of the facet terms should be able to deduce their meaning when they see which terms are grouped where. If a user finds the category "Artifacts & Components" confusing, for example, they might begin to understand its meaning when they see that it includes groups of objects like "Drones" or "Sensors."

Our target users are not likely to know experts on the IoT, and we did not find experts available for interview. Their written works, though, are readily available, and provide important information about what words and phrases are considered "natural language" in the domain of the IoT. Our target user group, which includes educated amateurs, would have access to the internet. They might find

information in dictionaries or encyclopedias, in popular articles or scholarly articles, all of which can be accessed online.

The list of 100 preferred terms might be considered the most important part of the thesaurus. Preferred terms include words and phrases that are most commonly found in scholarly articles, general articles, and reference tools within the IoT domain, and were selected based on a principle called "Literary Warrant" (Svenonius, 2003). The core literature was reviewed carefully, for words that would be the best candidates for our thesaurus. Words that are consistently used to represent the same concepts in the literature could safely be used in the thesaurus.

Search & Indexing Rules

Users who already know the word that they are seeking might be best served by starting with the alphabetical index. It is a listing of all the terms in the thesaurus, both preferred and non-preferred, in alphabetical order to help users search within the thesaurus for key words. Once that key word is found, it is a simple matter to find out how it might be used in the literature of the IoT. "Body area network" for instance, has an abbreviation, shown in the following example.

Body area network (BAN)

SN: Does not include long-distance communication, primary focus on personal Smart devices

BT: Wireless Personal Area Network, Medical body area network

RT: Wireless sensor networks

The alphabetical index will also point out the scope of the term's usage, as a Scope Note (SN), and users will also find Broader Terms (BT), and Related Terms(RT) which aren't as common as Preferred terms, but are found in the literature fairly often. Users that have found their term in the alphabetical schedule should easily be able to locate it in the classified schedule.

In this example, in addition to scope notes and broader and related terms, we see other abbreviations. Non-preferred terms and are notationally represented in the thesaurus by the acronym "UF," which means 'use for.' "Healthcare IoT" is an equivalent term, which could be used for the term "Internet of Medical Things."

Internet of Medical Things (IoMT)
SN: Broad term, see Medical body area network
UF: Healthcare IoT
BT: Internet of Things
NT: Assisted Living, Bioelectronics, eHealth, Medical body area network, Smart health
Medical body area network

Structural Example & Practical Usage.

Users will find the IoT thesaurus most useful in retrieving information about related subjects, where the language of the domain will show logical connections between ideas. For example, a user who hears or reads about EHealth might be expected to infer that eHealth is another way of referring to the same thing. If they consult the IoT thesaurus, though, they will find that there is a broader term for EHealth (BT) "Internet of Medical Things" that opens up a whole new area of investigation.

EHealth (eHealth, e-Health) 1.1.3.2.

SN Refers to support of medical processes specifically, also see Body Area Network

BT Internet of Medical Things 1.1.3.

RT Assisted living

Bioelectronics

Medical body area network

Related terms (RT), like Assisted living, Bioelectronics, and Medical body area network also do a great job leading users to new, but relevant, information. Narrower Terms (NT) are considered to be a narrower version of the preferred term. For example, all “Constrained Devices” are “Devices” so “Constrained Devices" is a narrower term. If a word does not fit this paradigm it is probably a related term (RT).

Scope notes(SN)-relate to the noun form of a primary term, and represent one and only one meaning. They are sometimes helpful in referencing other terms, within the thesaurus. For example:

Building automation 4.1.2.

SN For general discussion see **Automation** 4.1.

If a word might be defined a different way under different circumstances, a definition might be added in the place of a scope note. The thesaurus definition (D) is not meant to be a general meaning of the word that you would find in a dictionary: it is meant to define the meaning of the word, as it is used within the context of an IoT conversation.

Special & Non-Traditional Features

Users may notice that our alphabetical index contains a number of definitional scope notes (annotated as: SN (D)). Because our target user is the entry-level IoT researcher/practitioner, we felt that it would be beneficial to include a more comprehensive set of notes and definitions. This allows user to quickly contextualize domain areas with which they may be unfamiliar.

Additionally, our named authority file focuses specifically on IoT Companies. Operating within the constraints of this project, we decided it would be better to offer a focused authority file, covering a single group of named entities, as opposed to peppering users with ten disparate entities. Ideally, additional authority files could be constructed around products, people, and specific systems implementing IoT. This authority file has been supplemented with references to the classified schedule in order to assist with finding and indexing within the domain, and building conceptual bridges between our thesaurus and the multidisciplinary nature of IoT.

Source Discussion

Three researchers gathered data on the most common vocabulary in the IoT domain. The main goal of our IoT thesaurus is to help connect users to information, and so every effort was made to ensure that the sources used in constructing the thesaurus matched the sources available to intended users. The articles and essays which were reviewed in the initial analysis of the domain are all available to potential online users, and would all be likely destinations for someone who is interested in learning

about the IoT. Also, the fact that different user patterns were considered from the beginning helps to ensure that the final thesaurus is relevant to the largest-possible group of users, who approach problems in different ways.

For example, a user might search for a dictionary first, and find a reference source like the Aeris Internet of Things Dictionary (http://www.aeris.com/iot-dictionary/). Businesses that are selling goods or services in the IoT world have a special interest in standardization efforts, and can be great resources for terminology. Many IoT words have definitions that overlap into business and personal applications, and we found that business sites are a great help for determining common usage of IoT terms, and in many cases they defined terms that were not available in a traditional dictionary. Glossaries are another great source of information about domain-specific words, and one online source that some users might have missed in a general search, is the Web of Things Interest Group (https://www.w3.org/WoT/IG/wiki/Terminology). They are seeking to reduce confusion by standardizing terminology, and we found their terms to be current and useful.
Students who are writing a paper or need to cite sources might need articles, and so those were also considered. Articles published by users and experts were helpful and easily accessed, like this one published by Cisco (http://www.cisco.com/c/dam/en_us/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf). We checked books, forums, social media sites and even infographics: anywhere that might be considered part of the IoT Domain. Once the most common terminology was assembled, then we were able to begin to sort out the top Preferred Terms, to construct the most useful thesaurus possible.

Alphabetical Index

The following alphabetical index contains both preferred terms an non-preferred lead-in terms for

Codes:

BT: Broader Term
NT: Narrower Term
RT: Related Term
SN: Scope Notes
(D) Definitional Scope Notes
USE: Preferred Term
UF: Used For

A

Accelerometer 3.2.1.1.
SN Includes apps and devices used to track movement.
BT Embedded Sensors 3.2.1.
RT Smartphones 3.1.1.2.1.
Wearable devices 3.1.1.2.2.

Access control 4.3.
SN Assign also related terms involving security, building access, Smart homes, and the industry serving security needs using IoT devices.
UF access control list ACL
Authorization
Security credentialing
NT Authentication 4.3.1.
RT Cybersecurity 1.4.

Access control list (ACL):
USE **Access Control** 4.3.

Active RFID
USE **RFID** 5.1.

Activity trackers 3.1.1.2.2.1

SN Broad term. References specific terms; for example, Smart watches.
BT Wearable devices 3.1.1.2.2.
RT Accelerometer 3.2.1.1.
Internet of Medical Things 1.1.3.
Smart watches 3.1.1.2.2.2.

Ambient intelligence

USE **Ubiquitous computing** 1.10.

Ambient networks

USE **Wireless personal area network** 2.7.1.

Analytics 5.2.

SN (D) Access, Manipulation and analysis of data, including Big data
UF data analytics, data mining, diagnostic analytics, prescriptive analytics, predictive Analytics
NT Data Acquisition 5.2.1.
Sensor analytics 5.2.2.
RT Big data 1.2.
Cloud computing 1.3.
Machine learning 1.8.

Artificial Intelligence (AI)

USE **Machine learning** 1.8.

Assisted living 1.1.3.1

SN (D) Deployment of IoT technology in an assisted living context, esp. with elderly Or disabled
BT Internet of Medical Things 1.1.3.
RT EHealth 1.1.3.2
Smart homes 3.1.4.

Authentication 4.3.1.

SN Excludes aspects covered in personal use of connected devices.
BT Access control 4.3.
RT Data security 1.4.1.
Identity data 2.6.

Authorization

USE **Access Control** 4.3.

Automated identification technologies 3.3.1.

SN Electronic means only, does not include barcodes
BT Identification technologies 3.3.
RT Automation 4.1.
RFID 5.1.
Smart labels 3.1.2.2.

Automated factories

USE **Factory Automation** 4.1.2.1

Automated provisioning 4.1.1.

SN Focuses on business applications
UF Self-service provisioning
BT Automation 4.1.
RT Cloud Computing 1.3.

Automation 4.1.

SN Includes general observations in the subject. Does not include factory or
Production not related to IoT
NT Automated provisioning 4.1.1.
Building Automation 4.1.2.
RT Autonomous data capture 5.2.1.1.
Event-driven computing 4.5.
Industrial internet of things 1.1.2.

Autonomous data capture 5.2.1.1.

SN D General capture of data by IoT devices.
BT Data acquisition 5.2.1.
RT Automation 4.1.
Cybersecurity 1.4.
Big data 1.2.

Autonomous vehicles

USE **Smart cars** 3.1.3

B

Big data 1.2.
SN Focus is on opportunity and solutions over enumeration of problems. Large scale data and associated operations.
RT Analytics 5.2.
Autonomous data capture 5.2.1.1.
Cloud computing 1.3.
Business process management 5.3.

Biochip transponder
USE **Injectable ID chip** 3.4.1.

Bioelectronics 3.4.
SN Coverage includes both electronics in medicine, and biological influences in technology.
UF Biosensors
NT Injectable ID chip 3.4.1.
RT EHealth 1.1.3.2.
Wearable devices 3.1.1.2.2.
embedded sensors 3.2.1.
Medical body area network 2.7.1.1.1.
Internet of Medical Things 1.1.3.

Biosensors:
USE **Bioelectronics** 3.4.

Bluetooth 3.5.
SN Broad term. References technology useful mainly for close-communication.
UF slave devices
NT Bluetooth low energy 3.5.1.

RT Connected devices 3.1.1.1.
constrained devices 3.1.1.1.1.
Personal area network 2.7.

Bluetooth low energy (BLE) 3.5.1.
SN (D) Lower energy consumption than bluetooth and also lower price.
UF Bluetooth Smart
Bluetooth LE
BT Bluetooth 3.5.
RT Connected devices 3.1.1.1.
constrained devices 3.1.1.1.1

Bluetooth LE
USE **Bluetooth low energy** 3.5.1.

Bluetooth Smart
USE **Bluetooth low energy** 3.5.1.

Body area network (BAN) 2.7.1.1.
SN Does not include long-distance communication, primary focus on personal Smart devices
BT Wireless Personal Area Network 2.7.1.
Medical body area network 2.7.1.1.1.
RT Wireless sensor networks 2.11.

Botnet 2.2.1.
SN Different from Device to device communication mainly in its application and intended use.
BT Distributed intelligence 2.2.
RT Cybersecurity 1.4.
Network of Things 1.1.5.
Peer-to-peer 4.6.

Building automation 4.1.2.
SN For general discussion see **Automation** 4.1.
BT Automation 4.1.
NT Factory automation 4.1.2.1.
RT Industrial Internet of Things 1.1.2.

Smart meters 3.1.2.3.
Smart homes 3.1.4.
Smart bulbs 3.1.2.1
Smart grids 2.9.

Business process management 5.3.
SN (D) Includes technologies related to general business and management processes
NT Quality of service
RT Cybersecurity 1.4.
Dashboards 2.1.
Industrial Internet of Things 1.1.2.
Intranet of Things 1.1.7.

C

Cloud computing 1.3.
SN Does not include IT-related terms or technical issues.
UF Platform as a service (PAAS)
NT Virtual things 1.3.1.
RT Big Data 1.2.
Cloudlet 3.7.

Cloudlet 3.7.
SN (D) Different from Cloud computing mainly in terms of scale and device-support goals
RT Cloud computing 1.3.

Computational learning
USE **Machine learning** 1.8.

Connected devices 3.1.1.1.
SN Broad term. Also see **Smart homes** 3.1.4.
UF Connected Objects
BT Devices 3.1.1.
NT Constrained devices 3.1.1.1.1.
RT Connectivity management 5.4.

Connected Objects

USE **Connected devices** 3.1.1.1.

Connectivity management 5.4.
SN (D) All operations related to the management and maintenance of IoT networks

RT Business process management 5.3.
Connected devices 3.1.1.1.
Dashboards 2.1.
Machine-to-machine communication 4.4.
Peer-to-peer 4.6.
smart grids 2.9.

Constrained devices 3.1.1.1.1
SN (D) References connected devices have restricted capabilities, generally in memory, CPU, or power consumption
UF Resource constrained devices
BT Connected devices 3.1.1.1.

Cybersecurity 1.4.
SN Specific focus on device-to-device communication and network security vulnerability management
NT Data security 1.4.1
RT Access control 4.3.
Autonomous data capture 5.2.1.1.
Botnet 2.2.1.
Business process management 5.3.
Intranet of Things
Network of things 1.1.5.

D

Dashboards 2.1.
SN (D) Refers to the tools that allow people to access IoT data, see **Analytics** 5.2.
RT Analytics 5.2.
Big Data 1.2.
Connected devices 3.1.1.1

Business process management 5.3.

Data acquisition 5.2.1.
SN (D) All data collected using IoT devices
UF Data loggers
BT Analytics 5.2.
NT Autonomous data capture 5.2.1.1.
RT Machine learning 1.8.
Telemetry 4.7.

Data analytics
USE **Analytics** 5.2.

Data loggers
USE **Data acquisition** 5.2.1.

Data mining
USE **Analytics** 5.2.

Data security 1.4.1.
SN Specific focus on data transfer security
BT Cybersecurity 1.4.
RT Access control 4.3.
Authentication 4.3.1.

Decentralized computing
USE **Peer-to-peer** 4.6.

Device to device communication (D2D) 4.4.1.
SN Especially as used to describe Event driven computing
BT Machine to machine 4.4.
NT Near field communication 4.4.1.1.
Event-driven computing 4.5.

Devices 3.1.1.
SN Broad term, refers only to items connected to the internet.
UF IoT device
WoT Device
BT Things 3.1.

NT Connected devices 3.1.1.1.
Smart devices 3.1.1.2.
Wearable devices 3.1.1.2.2.
RT Constrained devices 3.1.1.1.1.

Diagnostic analytics
USE **Analytics** 5.2.

Distributed intelligence 2.2.
SN Refers to "Live" data control and capability for real-time decisions using IoT data.
UF Distributed logic
NT Botnet 2.2.1.
RT Machine learning 1.8.

Distributed logic
USE **Distributed intelligence** 2.2.

Driverless vehicles
USE **Smart cars** 3.1.3.

Drones 3.1.5.
SN Refers to unmanned vehicles
UF unmanned aerial vehicle (UAV)
unmanned aircraft system (UAS)
BT Things 3.1.
RT Smart devices 3.1.1.2.
Geographic information systems 2.3.
Embedded computer systems 3.6.1.

E

EHealth (eHealth, e-Health) 1.1.3.2.
SN Refers to support of medical processes specifically, also see **Body Area Network**
BT Internet of Medical Things 1.1.3.
RT Assisted living 1.1.3.1.
Bioelectronics 3.4.
Medical body area network 2.7.1.1.1.

Electronic Control Unit 3.6.1.1.

SN Mainly refers to embedded systems responsible for controlling electrical systems In smart vehicles

BT Embedded computer systems 3.6.1.

RT Smart cars 3.1.3.

Electronic product code (EPC) 3.3.2.1.

BT Unique identifier 3.3.2.

RT Industrial Internet of things 1.1.2.
RFID 5.1.
Smart labels 3.1.2.2.

Embedded computer systems 3.6.1.

SN Focuses on real-time computing

UF Embedded systems

BT Firmware 3.6.

NT Electronic control unit 3.6.1.1.
Smart semantic middleware 3.6.1.2.

Embedded sensors 3.2.1.

SN Broad topic, Focus in this use is mainly business and production-oriented Sensorization, sensors

NT Accelerometer 3.2.1.1.

RT Haptics 1.6.

Embedded systems

USE **Embedded computer systems** 3.6.1.

Energy consumption awareness 4.2.1.

SN (D) Refers to IoT tools related to energy consumption, like Smart bulbs

UF Green PC

BT Energy management practices 4.2.

RT Energy-efficient production 4.2.2.
Home energy management 4.2.3.
Smart bulbs 3.1.2.1.

Energy management practices 4.2.

SN (D) The general environment supporting the development of energy management tools

UF Energy efficiency
NT Energy consumption awareness 4.2.1.
Energy-efficient production 4.2.2.
Home energy management 4.2.3.
RT Smart Grids 2.9.

Energy efficiency
USE **Energy management practices** 4.2.

Energy-efficient production 4.2.2.
BT Energy management practices 4.2.
RT Energy Consumption Awareness 4.2.1.
Industrial Internet of Things 1.1.2.

Event-driven architecture (EDA) 1.5.
SN (D) Real-time systems controlling events based on triggers, usually in a business context
UF Message-driven architecture
RT Device to device communication 4.4.1.

Event-driven computing 4.5.
SN D Automatic processes depending on device-to-device trigger events
RT Automation 4.1.
Device to device communication 4.4.1.
Machine to machine 4.4.

F

Factory Automation 4.1.2.1.
SN Does not include robotics.
UF Automated factories
Lights out manufacturing
BT Building Automation 4.1.2.
RT Industrial internet of things 1.1.2.

Firmware 3.6.
SN Technical focus on Read Only Memory
BT Embedded computer systems 3.6.1.

RT Smart devices 3.1.1.2.
Smart cars 3.1.1.3.

G

Geographic information systems (GIS) 2.3.
SN (D) Device that bridges users with spatial or geographic data
UF GI Science
RT Data acquisition 5.2.1.
Drones 3.1.5.
Global positioning systems 2.4.
Telemetry 4.7.

GI science
USE **Geographic information systems** 2.3.

Global Navigation Satellite Systems (GNSS)
USE **Global positioning systems (GPS)** 2.4.

Global positioning systems (GPS) 2.4.
SN (D) Navigation system connected to satellites
RT Geographic information systems 2.3.
Telemetry 4.7.

Green PC
USE **Energy consumption awareness** 4.2.1.

H

Haptics 1.6.
SN (D) Technology that responds to a user's levels of touch in interface
UF Kinesthetic communication
RT Embedded sensors 3.2.1.
Smartphones 3.1.1.2.1
Smart watches 3.1.1.2.2

Healthcare IoT

USE **Internet of Medical Things** 1.1.3.

Heterogeneous networks (HetNet) 2.5.
SN Includes networks of computers and other devices using different access technologies
UF Heterogeneous Sensor Networks
RT Interoperability 1.7.
Network of Things 1.1.5.
Ubiquitous computing 1.10.
Wireless personal area network 2.7.1.

Heterogeneous Sensor Networks
USE **Heterogeneous networks** 2.5.

Home automation
USE **Smart homes** 3.1.4.

Home energy management (HEM) 4.2.3.
SN Includes automatic and remote control
BT Energy management practices 4.2.
RT Smart Grid 2.9.
Smart Home 3.1.4.

I

Identification technologies 3.3.
SN (D) Verifying identity for the secure use of IoT devices
NT Automated identification technologies 3.3.1.
Unique identifier 3.3.2.
RT Authentication 4.3.1.
Cybersecurity
Identity data
Identity of things 1.1.1.

Identity data 2.6.
SN (D) Data gathered to support Identification technology needs.
RT Authentication 4.3.1.
Cybersecurity 1.4.
Identity of Things 1.1.1.

Identification technologies 3.3

Identity of Things (IDoT) 1.1.1.
SN (D) Refers to ID information and metadata assigned to devices
BT Internet of Things 1.1.
RT Authentication 4.3.1.
Cybersecurity 1.4.
Identity data 2.6.
Identification technology 3.3.

Industrial Internet of Things (IIoT) 1.1.2.
SN (D) Focuses specifically on manufacturing and industrial logistics
BT Internet of Things 1.1.
RT Business process management 5.3.
Energy efficient production 4.2.2.
Intranet of Things 1.1.7.

Injectable ID chip 3.4.1.
SN Refers to future technology
UF Biochip transponder
BT Bioelectronics 3.4.
Identification technologies 3.3.
RT Identity of Things 1.1.1.

Intelligent devices
USE **Smart devices** 3.1.1.2.

Intelligent transportation 1.1.4.1.
SN Current IoT applications in the field
RT Smart cars 3.1.3.
Smart grid 2.9.
Traffic management 5.5.

Internet of Medical Things (IoMT) 1.1.3.
SN Broad term, see Medical body area network 2.7.1.1.1.
UF Healthcare IoT
BT Internet of Things 1.1.
NT Assisted Living 1.1.3.1.
Bioelectronics 3.4.

eHealth 1.1.3.2.
Medical body area network 2.7.1.1.1.
Smart health 2.10.

Internet of Things (IoT) 1.1.
SN Broad term referring to devices or machines that provide information to a network without requiring direct human-to-computer interaction.
Includes all versions of "Internet of"...
NT Industrial Internet of Things 1.1.2.
Internet of Medical Things 1.1.3.
Internet of Vehicles 1.1.4.
Network of Things 1.1.5.
Social Internet of things 1.1.6.
Intranet of Things 1.1.7.

Internet of vehicles 1.1.4.
SN Refers mainly to future applications
BN Internet of Things 1.1.
NT Intelligent Transportation 1.1.4.1.
RT Smart cars 3.1.3.

Interoperability 1.7.
SN (D) An ability or characteristic of a product or system to exchange and interpret data with another product or system
RT Heterogeneous networks 2.5.
Network of Things 1.1.5.

Intranet of things 1.1.7.
SN (D) Similar to IoT, but limited to a corporate network.
RT Industrial internet of things 1.1.2.
Business process management 5.3.
Cybersecurity 1.4.

J

K

Kinesthetic communication
USE **Haptics** 1.6.

L

Linked data 2.8.1.
SN Includes data from diverse domains
UF Structured data
BT Semantic Web 2.8.
RT Web 3.0 1.11.

Lights-out manufacturing
USE **Factory automation** 4.1.2.1

M

Machine learning 1.8.
SN (D) In the Computer Science field
UF Computational learning
Artificial Intelligence
RT Analytics 5.2.
Data acquisition 5.2.1.
Distributed intelligence 2.2.

Machine-to-machine communication (M2M) 4.4.
SN This term is preferred over the commonly used abbreviation, M2M
RT Device to device communication 4.4.1.
Connectivity management 5.4.
Peer-to-peer 4.6.

Event driven computing 4.5.

Medical body area network (MBAN) 2.7.1.1.1.

SN (D) Specific to Medical application in close proximity
BT Body area network 2.7.1.1.
RT Internet of Medical Things 1.1.3.

Message-driven architecture

USE **Event-driven architecture** 1.5.

N

Nanosensors 3.2.2.

SN Related to sensors, but focus on minute particles
BT Sensors 3.2.
RT Injectable ID chip 3.4.1.

Near Field Communication (NFC) 4.4.1.1.

SN Wireless connectivity, similar to Personal area network
BT Device to device communication 4.4.1.
RT Smartphones 3.1.1.2.1.
Smart watches 3.1.1.2.2.2.
Personal area network 2.7.

Network of Things (NoT) 1.1.5.

SN Refers to IoT devices connected to sensors, often in a home setting.
UF LAN
BT Internet of Things 1.1.
RT Botnet 2.2.1.
Cybersecurity 1.4.
Heterogeneous Networks 2.5.
Internet of Things 1.1.
Interoperability 1.7.
Scalability 1.9.

O

P

Passive RFID 5.1.1.
SN RFID tag that does not have an independent power supply; Abbreviated form Is abbreviated
UF Passive tag
BT RFID 5.1.
RT Semi-Passive RFID 5.1.2.
Smart labels 3.3.1.1.

Passive tag
USE **Passive RFID** 5.1.1.

Peer-to-peer (P2P) 4.6.
SN This term is preferred over the commonly used abbreviation, P2P
UF Decentralized computing
RT Connectivity management 5.4.
Cybersecurity 1.4.
Botnet 2.2.1.
Machine to machine 4.4.

Personal area network (PAN) 2.7.1.
SN Wireless connectivity, similar to Near field communication
UF Wireless ad hoc networks
NT Wireless personal area network 2.7.1.
RT Bluetooth 3.5.
Body area network 2.7.1.1.
Near field communication 4.4.1.1.

Pervasive computing
USE **Ubiquitous computing** 1.10.

Platform as a service (PAAS)
USE **Cloud computing** 1.3.

Predictive analytics

USE **Analytics** 5.2.

Prescriptive analytics

USE **Analytics** 5.2.

Q

Quality of service (QoS) 5.3.1.

SN Broad term specifically referring to quality requirements ensuring IoT functionality.

BT Business process management 5.3.

RT Analytics 5.2.

R

Radio frequency identification

USE **RFID** 5.1.

Resource constrained devices

USE **Constrained devices** 3.1.1.1.1.

RFID 5.1.

SN Radio frequency identification, Abbreviated form is preferred

UF Radio frequency identification

Tags

Active RFID

NT Passive RFID 5.1.1.

Semi-passive RFID 5.1.2.

RT Automated identification technologies 3.3.1.

Near Field Communication 4.4.1.1.

Smart labels 3.3.1.1.

S

Scalability 1.9.
SN (D) Concerned with the growth and maintenance of IoT technologies at scale.
RT Cloud computing 1.3.
Cybersecurity 1.4.
Network of Things 1.1.5.

Security credentialing
USE **Access Control** 4.3.

Self-service provisioning
USE **Automated provisioning** 4.1.1.

Semantic Web 2.8.
SN (D) Use of semantic annotation, ontologies, in an IoT context
NT Linked Data 2.8.1.
RT Big Data 1.2.
Web 3.0 1.11.
Machine to Machine 4.4.

Semi-passive RFID 5.1.2.
SN (D) Battery-powered RFID tags that rely on external devices to communicate; Abbreviated form is preferred
BT RFID 5.1.
RT Automated identification technologies 3.3.1.
Passive RFID 5.1.1.
Smart Labels 3.3.1.1.

Sensor analytics 5.2.2.
SN (D) The process of converting collected sensor data into actionable analytics.
UF Sensor data analytics
BT Analytics 5.2.
RT Big Data 1.2.
Sensors 3.2.

Sensor data analytics
USE **Sensor analytics** 5.2.2.

Sensors 3.2.

SN (D) Devices used to gather information to be transformed into electronic data.
NT Embedded sensors 3.2.1.
Nanosensors 3.2.2.
Wireless sensors 3.2.3.
RT Connected Devices 3.1.1.1.
Sensor analytics 5.2.2.
Telemetry 4.7.

Smart bulbs 3.1.2.1.

SN (D) Internet connected and capable of being controlled remotely. Smart light bulbs
BT Smart Objects 3.1.2.
RT Energy consumption awareness 4.2.1.
Smart homes 3.1.4.
Smart grids 2.9.

Smart cars 3.1.3.

SN Includes discussions of traffic safety
UF Autonomous vehicles
driverless vehicles
BT Things 3.1.
RT Electronic control unit 3.6.1.1.
Intelligent transportation 1.1.4.1.
Internet of Vehicles 1.1.4.

Smart devices 3.1.1.2.

SN (D) Devices in this context refer specifically to computing devices, for IoT objects see: **Smart objects** 3.1.2.
UF Intelligent devices
connected devices
BT Devices 3.1.1.
NT Smartphones 3.1.1.2.1.
Wearable devices 3.1.1.2.2.
RT Smart watches 3.1.1.2.2.2.
Activity trackers 3.1.1.2.2.1.

Smart grids 2.9.

SN Does not include renewable energy

RT Energy management practices 4.2.
Home energy management 4.2.3.
Smart homes 3.1.4.
Smart meters 3.1.2.3.

Smart health 2.10.
SN (D) Refers to smart devices gathering health-related data.
RT Ehealth 1.1.3.2.
Medical Body Area Network 2.7.1.1.1.
Internet of Medical Things 1.1.3.
Wearable devices 3.1.1.2.2.

Smart homes 3.1.4.
SN Broad term; see Home Energy Management, Access Control
UF Home automation
RT Dashboard 2.1.
Home energy management 4.2.3.
Smart bulbs 3.1.2.1
Smart grids 2.9.
Smart meters 3.1.2.3.
Network of Things 1.1.5.

Smart labels 3.3.1.1.
SN (D) More advanced than bar codes. Usually refers to QR codes or RFID
BT Smart Objects 3.1.2.
RT Identity of Things 1.1.1.
RFID 5.1.
Passive RFID 5.1.1.
Semi-passive RFID 5.1.2.

Smart light bulbs
USE **Smart bulbs** 3.1.2.1

Smart meters 3.1.2.3.
SN Does not include Sensors. Referenced devices measure and display resource consumption
BT Smart Objects 3.1.2.
RT Home energy management 4.2.3.
Smart grids 2.9.

Smart homes 3.1.4.
Telemetry 4.7.

Smart objects 3.1.2.
SN non-computing, typically single-usage IoT connected objects
BT Things 3.1.
NT Smart bulbs 3.1.2.1.
Smart labels 3.1.2.2.
Smart meters 3.1.2.3.
RT Connected devices 3.1.1.1.

Smartphones 3.1.1.2.1.
SN (D) "Smart" items are connected to the internet, and may provide data about their users
BT Smart devices 3.1.1.2.
RT Connected devices 3.1.1.1.
Haptics 1.6.
NFC 4.4.1.1.

Smart semantic middleware 3.6.1.2.
SN Focus is on use in addressing challenges caused by Ubiquitous computing and Complex systems
BT Embedded computer systems 3.6.1.
RT Heterogeneous networks 2.5.
Industrial Internet of things 1.1.2.
Interoperability 1.7.

Smart watches 3.1.1.2.2.2.
SN (D) Mobile computing devices that typically share the form factor of traditional wristwatches
BT Wearable devices 3.1.1.2.2.
RT Smart Devices 3.1.1.2.
Activity trackers 3.1.1.2.2.1.
Haptics 1.6.
NFC 4.4.1.1.

Social Internet of Things 1.1.6.
SN D The establishment and management of social relationships between objects, derived from the application of social networking principles to IoT Objects

BT Internet of things 1.1.
RT Heterogeneous networks 2.5.
Ubiquitous computing 1.10.

Structured data
USE **Linked data** 2.8.1.

T

Tags
USE **RFID** 5.1.

Telemetry 4.7.
SN (D) An automated process by which data is remotely collected and transmitted to a remote receiver
RT Wireless sensor networks 2.11.
Data acquisition 5.2.1.
Sensors 3.2.
Smart meters 3.1.2.3

Things 3.1.
SN Broad term used for all artifacts and components containing IoT technology
NT Devices 3.1.1.
RT Internet of things 1.1.1.

Traffic management 5.5.
SN (D) Refers to connections through the IoT to People, and also to vehicles.
RT Intelligent transportation 1.1.4.1.
Smart grids 2.9.

U

Ubiquitous computing 1.10.
SN (D) Computational ability embedded into everyday objects, foundational concept in IoT
UF Ambient Intelligence
Pervasive Computing
RT Distributed intelligence 2.2.
Heterogeneous networks 2.5.

Wireless sensor networks 2.11.

Unique Identification number
USE **Unique identifier** 3.3.2.

Unique identifier (UID) 3.3.2.
SN Numeric or alphanumeric
UF Unique Identification number
BT Identity data 2.6.
NT Electronic Product Code 3.3.2.1.
RT Identity of Things 1.1.1.
Sensors 3.2.

Unmanned aerial vehicles (UAV)
USE **Drones** 3.1.5.

Unmanned aircraft systems (UAS)
USE **Drones** 3.1.5.

V

Virtual things 1.3.1.
SN (D) Data gathered is not measurable by a single device.
BT Cloud computing 1.3.
RT Automated provisioning 4.1.1.

Vulnerability management
USE **Cybersecurity** 1.4.

W

Wearable devices 3.1.1.2.2.
SN (D) Refers to technology integrated into clothing or accessories
UF Wearable computers
Wearable tech
BT Smart devices 3.1.1.2.
NT Activity trackers 3.1.1.2.2.1.
Smart watches 3.1.1.2.2.2.
RT Bluetooth 3.5.

Bluetooth LE 3.5.1.
Body area network 2.7.1.1.

Wearable computers
USE **Wearable devices** 3.1.1.2.2.

Wearable technology
USE **Wearable devices** 3.1.1.2.2.

Web 3.0 1.11.
SN Evolution of Web technologies characterized by data and semantic connection
RT Linked Data 2.8.1.
Semantic web 2.8.

Wireless ad hoc network
USE **Personal area network** 2.7.

Wireless autonomous system
USE **Wireless sensor networks** 2.11.

Wireless personal area network (WPAN) 2.7.1.
SN (D) Broad term for an individual's device connections (not Health devices found in
Medical body area network)
UF Ambient networks
Personal area network
NT Body area network 2.7.1.1.
RT Bluetooth 3.5.

Wireless sensor networks (WSN) 2.11.
SN (D) Devices use Sensors to monitor their environment and users wireless
Autonomous system
RT Heterogeneous networks 2.5.
RFID 5.1.
Smart homes 3.1.4.
Wireless sensors 3.2.3.

Wireless sensors 3.2.3.

SN (D) Refers to tools that are within devices, and gather data about users or environments
UF ISM band
BT Sensors 3.2.
NT Nanosensor 3.22.
RT Wireless sensor networks 2.11.

X

Y

Z

Named Authority File

The following list represents a small selection of named instances relating to Internet of Things (IoT). Specifically, this is an IoT company authority file. Operating within the constraints of this project, we decided it would be better to offer a focused authority file, covering a single group of named entities, as opposed to peppering users with ten disparate entities. Ideally, additional authority files could be constructed around products, people, and specific systems implementing IoT. This authority file has been supplemented with references to the classified schedule in order to assist with finding and indexing within the domain.

IoT Companies

Fitbit - Fitbit is an American consumer electronics company that specializes in creating activity trackers (3.1.1.2.2.1.) and other wearable devices (3.1.1.2.2.).
Garmin - Garmin produces smart devices (3.1.1.2) used in aviation, fitness, marine areas, including sensors (3.2) used in drones and GPS navigators (2.4) for drivers. Activity trackers (3.1.1.2.2.1) like SmartWatches (3.1.1.2.2.2)and Wellness products like Smart Scales are great examples of connected devices.

iSmartAlarm - Offering Smart Home (3.1.4) and security packages, iSmartAlarm offers smart switches and sensors (3.2) that can allow remote control of lamps, electronics, appliances for home energy management (4.2.3) and security cameras within the home network (1.1.5).
Japan Radio Co. Ltd - A leading wireless (3.2.3) company supporting a range of smart devices (3.1.1.2), Japan Radio Co. offers products like Embedded (3.6.1) GPS (2.4) modules, marine devices like sonar, and fish finders, and many more.
Measurement Specialties - Sensors (3.2) are what makes it possible for connected devices (3.1.1.1) to interact with and share information with people. Measurement Specialties sensors measure things like pressure/force, position, vibration, and temperature.
Modular Robotics - Recognized by the National Science Foundation, Modular Robotics builds robot cubes that have sensors (3.2) and complex programming that allow them to sense and act on input from their environment, and practice machine to machine (4.4) communication with other linked cubes.
Nest Labs - Nest Labs is a smart home (3.1.4.) company that specializes in creating smart meters (3.1.2.3.) and other devices (3.1.1.) for home energy management (4.2.3.). Nest labs is a subsidiary of Alphabet Inc., Google's parent company.
Omron - Medical devices, like a Smart Blood Pressure Monitors (2.7.1.1.1) are made at Omron. Personal, portable health devices like pedometers (2.10) and medical-grade EKGs are great examples of how the IoMT (1.1.3) can be an important part of everyday life.
Toshiba - Ultrasound imaging systems are only one of the many connected devices made by Toshiba. They also offer barcode solutions for retail applications and power systems (4.2) that are important for Health applications part of the IoMT (1.1.3) and Industrial applications in the IIoT (1.1.2).
Wolfram - Wolfram is a computer, web, and cloud (1.3) software company that has been responsible for great advances in the technology behind the IoT, and especially in Connected Devices (3.1.1.1), Personal Analytics (5.2), and Artificial Intelligence (1.8).

Classified Schedule

The following classification schema can be used to index and sort informational objects related to the Internet of Things.

1. **Abstract Entities (Concepts & Ideas)**
    1.1. Internet of Things

1.1.1. Identity of Things
1.1.2. Industrial Internet of Things
1.1.3. Internet of Medical Things
1.1.3.1. Assisted living
1.1.3.2. eHealth
1.1.4. Internet of Vehicles
1.1.4.1. Intelligent transportation
1.1.5. Network of Things
1.1.6. Social Internet of Things
1.1.7. Intranet of Things
1.2. Big data
1.3. Cloud computing
1.3.1. Virtual things
1.4. Cybersecurity
1.4.1. Data security
1.5. Event-driven architecture
1.6. Haptics
1.7. Interoperability
1.8. Machine learning
1.9. Scalability
1.10. Ubiquitous computing
1.11. Web 3.0

2. **Complex Entities**
2.1. Dashboards
2.2. Distributed intelligence
2.2.1. Botnet
2.3. Geographic information system
2.4. Global positioning system
2.5. Heterogeneous networks

2.6. Identity data

2.7. Personal area network

2.7.1. Wireless personal area network

2.7.1.1. Body area network

2.7.1.1.1. Medical body area network

2.8. Semantic Web

2.8.1. Linked data

2.9. Smart grids

2.10. Smart health

2.11. Wireless sensor networks

3. **Artifacts & Components**

3.1. Things

3.1.1. Devices

3.1.1.1. Connected devices

3.1.1.1.1. Constrained devices

3.1.1.2. Smart devices

3.1.1.2.1. Smartphones

3.1.1.2.2. Wearable devices

3.1.1.2.2.1. Activity trackers

3.1.1.2.2.2. Smart watches

3.1.2. Smart objects

3.1.2.1. Smart bulbs

3.1.2.2. Smart labels

3.1.2.3. Smart meters

3.1.3. Smart cars

3.1.4. Smart homes

3.1.5. Drones

3.2. Sensors

3.2.1. Embedded sensors

- 3.2.1.1. Accelerometer
  - 3.2.2. Nanosensors
  - 3.2.3. Wireless sensors
- 3.3. Identification technologies
  - 3.3.1. Automated identification technologies
    - 3.3.1.1. Smart labels
  - 3.3.2. Unique Identifier
    - 3.3.2.1. Electronic product code
- 3.4. Bioelectronics
  - 3.4.1. Injectable ID chip
- 3.5. Bluetooth
  - 3.5.1. Bluetooth low energy
- 3.6. Firmware
  - 3.6.1. Embedded computer systems
    - 3.6.1.1. Electronic control unit
    - 3.6.1.2. Smart semantic middleware
- 3.7. Cloudlet

4. **Operations**

- 4.1. Automation
  - 4.1.1. Automated provisioning
  - 4.1.2. Building automation
    - 4.1.2.1. Factory automation
- 4.2. Energy management practices
  - 4.2.1. Energy consumption awareness
  - 4.2.2. Energy-efficient production
  - 4.2.3. Home energy management
- 4.3. Access control
  - 4.3.1. Authentication
- 4.4. Machine-to-machine communication

4.4.1. Device to device communication

4.4.1.1. Near field communication

4.5. Event driven computing

4.6. Peer-to-peer

4.7. Telemetry

5. **Processes**

5.1. RFID

5.1.1. Passive RFID

5.1.2. Semi-passive RFID

5.2. Analytics

5.2.1. Data Acquisition

5.2.1.1. Autonomous data capture

5.2.2. Sensor analytics

5.3. Business process management

5.3.1. Quality of service

5.4. Connectivity management

5.5. Traffic management

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