IoT Developer Survey Results
April 2017
SURVEY INTRODUCTION

• The Eclipse IoT Working Group, IEEE IoT, AGILE IoT and IoT Council co-sponsored an online survey to better understand how developers are building IoT solutions.

• The survey was open from February 7 until March 17, 2017. A total of **713 individuals participated** in the survey. Each partner promoted the survey to their communities through social media and web sites.
Key findings
KEY FINDINGS - TOP 5 IOT INDUSTRIES

and trends from previous years

HOME AUTOMATION  =  IoT PLATFORM  =  INDUSTRIAL AUTOMATION  ISPs  ENERGY MANAGEMENT  ISPs  CONNECTED CITIES
Key IoT Concerns

Interoperability

Security

Connectivity
Key IoT Security Technology

Communication Security (TLS, DTLS, ...)

Data Encryption
Top IoT Programming Languages

**Constrained Devices**: C

**Gateways**: C/C++, Python

**IoT Cloud**: Java, JavaScript, Node.js, Python
Top IoT Operating Systems & Distros

Raspbian

Ubuntu
Cloud Platforms of Choice for IoT

Amazon Web Services
Microsoft Azure
Google Cloud Platform
GROWTH OF NEW CONNECTIVITY TECHNOLOGIES

LPWA Technologies
IoT EXPERIENCE
What is your primary experience with building IoT solutions?

- 35% I develop IoT solutions for my company
- 20% I am researching IoT solutions for my company
- 20% I develop IoT solutions in my spare time only
- 12% I am learning about IoT technology in my spare time
- 8% No experience
- 5% Other
What is your company's plan for IoT solutions?

- My company develops and deploys IoT solutions today: 42%
- My company plans to develop and deploy IoT solutions in the next 6 months: 14%
- My company plans to develop and deploy IoT solutions in the next 7-18 months: 17%
- My company has no plans to develop IoT solutions: 15%
- Don't know: 12%
The diagram shows the distribution of industries that respondents have built or will build IoT solutions in. The top industries are:

1. IoT platform / middleware
2. Home automation
3. Industrial automation
4. Connected / smart cities

Other notable industries include:

- Energy management: 26.1%
- Building automation: 25.5%
- Agriculture: 22.7%
- Healthcare: 21.4%
- Automotive: 20.1%
- Transportation: 17.2%
- Education: 16.4%
- Environment: 16.1%
- Utilities: 14.2%
- Security / public safety: 12.9%

Less prevalent industries are:

- Public utilities: 11.3%
- Retail: 10.9%
- Security / defense: 9.4%
- Fitness: 7.9%
- Banking / financial / fintech: 7.9%
- Vending: 7.0%
- Collaborative and sharing: 4.5%

The survey was conducted by IoT Developer Survey 2017 - Copyright Eclipse Foundation, Inc.
KEY INDUSTRIES / TRENDS 2016-2017

- IoT platform / middleware: 41.6%
- Home automation: 41.1%
- Industrial automation: 36.4%
- Connected / smart cities: 33.4%
- Energy management: 33.3%
- Building automation: 26.1%
- Agriculture: 25.5%
- Healthcare: 22.7%
- Automotive: 21.4%
- Transportation: 20.1%

Participation of other industries is growing...

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**Top IoT Concerns**

What are your top 2 concerns for developing IoT solutions?

- **Security**: 46.7%
- **Interoperability**: 24.4%
- **Connectivity**: 21.4%
- **Integration with hardware**: 19.3%
- **Standards**: 15.0%
- **Return on investment (ROI)**: 14.8%
- **Cost**: 14.7%
- **Scalability**: 14.1%
- **Privacy**: 13.7%
- **Performance**: 12.3%
- **Data analytics**: 12.3%
- **Complexity**: 9.0%
- **Maintenance**: 8.2%
- **Certification / conformance**: 4.4%
- **Other**: 3.8%
- **I don't know**: 2.4%
Top IoT Concerns / Trends 2015-2017

Security continues to be the key concern. Interoperability might be decreasing.
Technology Used for IoT
Which of the following programming languages, if any, do you use to build IoT solutions?
Which of the following programming languages, if any, do you use to build IoT solutions? (Constrained Devices)
Which of the following programming languages, if any, do you use to build IoT solutions? (Gateways)
Which of the following programming languages, if any, do you use to build IoT solutions? (Cloud Platform)
Which operating system(s) do you use for your IoT devices? (Summary)

- **Linux**: 81.5%
- **No OS / Bare-metal**: 29.5%
- **Windows**: 27.7%
- **FreeRTOS**: 17.7%
- **Contiki**: 14.9%
- **MBed**: 10.1%
- **Other**: 10.1%
- **RIOT**: 9.6%
- **TinyOS**: 9.2%
- **Other**: 9.0%
- **Zephyr**: 3.3%
Alternatives to Using Linux for IoT

Windows, FreeRTOS and Contiki experience steady growth.
Which operating system(s) do you use for your IoT devices? (Devices)

- Linux: 44.1%
- No OS / Bare-metal: 27.6%
- Windows: 14.6%
- FreeRTOS: 15.0%
- Contiki: 13.4%
- MBed: 8.9%
- Other: 7.8%
- RIOT: 8.4%
- TinyOS: 8.0%
- Zephyr: 2.9%
Which operating system(s) do you use for your IoT devices? (Gateway)
**IoT Operating Systems / Linux Distros for IoT**

If you are using Linux, what distribution do you typically use for your IoT solution?

- **Raspbian** 45.5%
- **Ubuntu / Ubuntu Core** 44.0%
- **Android** 21.8%
- **Yocto Project** 14.1%
- **Other** 12.4%
- **Android Things** 10.3%
- **Don't use Linux** 9.2%
- **OpenWrt or equivalent** 9.0%
- **uClinux** 3.8%
- **Huawei LiteOS** 1.7%
- **Tizen** 1.5%
- **Ostro Linux** 1.1%

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**IoT Hardware Architectures**

What hardware architectures are you using for your IoT constrained device(s)?

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARM Cortex-M3 / ARM</td>
<td>36.9%</td>
</tr>
<tr>
<td>Cortex-M4</td>
<td></td>
</tr>
<tr>
<td>ARM Cortex-M0 / ARM</td>
<td>33.4%</td>
</tr>
<tr>
<td>Cortex-M0+ / ARM</td>
<td></td>
</tr>
<tr>
<td>Cortex-M1</td>
<td></td>
</tr>
<tr>
<td>16-bit MCU</td>
<td>27.7%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>22.8%</td>
</tr>
<tr>
<td>ARM Cortex-M7</td>
<td>22.4%</td>
</tr>
<tr>
<td>8-bit MCU</td>
<td>22.3%</td>
</tr>
<tr>
<td>Other</td>
<td>6.6%</td>
</tr>
<tr>
<td>Don’t use constrained</td>
<td>4.6%</td>
</tr>
<tr>
<td>devices</td>
<td></td>
</tr>
</tbody>
</table>

IoT Developer Survey 2017 - Copyright Eclipse Foundation, Inc.
**IoT Hardware Architectures**

What hardware architectures are you using for your IoT gateway(s)?

- **Intel x86_64 (Cortex-A 32 bits)**: 32.5%
- **ARM v7-A (Cortex-A 32 bits)**: 27.8%
- **Intel x86 (Cortex-A 64 bits)**: 21.8%
- **ARM v8 (Cortex-A 64 bits)**: 20.7%
- **Don't know**: 19.6%
- **ARM v7-M (Cortex-M)**: 17.4%
- **ARM v6**: 11.1%
- **ARM v7-R (Cortex-R)**: 9.3%
- **Don't use gateways**: 7.4%
- **MIPS**: 6.2%
- **Other**: 3.6%
**IoT Security Technologies**

*Which of the following security-related technologies do you use in your IoT solution?*

- **Communication security**: 48.3%
- **Data encryption**: 43.2%
- **JSON web token or similar token**: 34.4%
- **Public key infrastructure**: 27.2%
- **OAuth & OpenID**: 24.3%
- **Over the air update**: 18.5%
- **No security technology is used**: 16.4%
- **Secure boot**: 11.4%
- **Use of Hardware Security Module**: 10.6%
- **Use of Trusted Platform Modules (TPM)**: 10.0%
- **Don't know**: 9.3%
- **Other**: 2.5%
# Hardware Components in IoT Solutions

What hardware components are included in your IoT solution?

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensors</td>
<td>86.8%</td>
</tr>
<tr>
<td>Actuators</td>
<td>50.8%</td>
</tr>
<tr>
<td>Gateway / hub device</td>
<td>50.2%</td>
</tr>
<tr>
<td>Edge node device</td>
<td>36.2%</td>
</tr>
<tr>
<td>Camera / video capture</td>
<td>35.1%</td>
</tr>
<tr>
<td>LCD display</td>
<td>33.5%</td>
</tr>
<tr>
<td>Touch screen</td>
<td>25.4%</td>
</tr>
<tr>
<td>Audio playback / speaker</td>
<td>17.4%</td>
</tr>
<tr>
<td>None</td>
<td>4.5%</td>
</tr>
<tr>
<td>Other</td>
<td>4.1%</td>
</tr>
</tbody>
</table>
SOFTWARE FEATURES IN IoT SOLUTIONS

What software features are included in your IoT solution?

- Data analytics: 52.6%
- Mobile application: 47.0%
- Integration with existing back-end systems: 43.9%
- Cloud hosted application: 43.5%
- User application running on a device: 37.4%
- Machine learning: 29.5%
- Computer vision: 19.9%
- Trusted execution environment: 13.4%
- Voice recognition: 13.2%
- None: 5.5%
- Other: 3.1%
Cloud Services for IoT

Do you use, or plan to use, any of the following cloud service offerings for implementing your IoT solution?

- Amazon AWS: 42.7%
- Microsoft Azure: 26.7%
- Google Cloud Platform: 20.4%
- Private/On-premise cloud: 18.4%
- IBM Bluemix: 15.6%
- None: 13.2%
- OpenStack (On-premise): 12.3%
- Don’t know: 11.9%
- Other: 9.1%
- Red Hat OpenShift: 7.9%
- Cloud Foundry (On-...): 7.3%
- GE Predix: 5.7%
TRENDS OF CLOUD SERVICES FOR IOT 2016-2017

AWS, MS and Google continue to dominate; Significant decline in private cloud
**Connectivity Protocols**

**What connectivity protocol(s) do you use for your IoT solution?**

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP/IP</td>
<td>67.0%</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>66.4%</td>
</tr>
<tr>
<td>Ethernet</td>
<td>54.0%</td>
</tr>
<tr>
<td>Bluetooth / Bluetooth Smart</td>
<td>48.2%</td>
</tr>
<tr>
<td>Cellular</td>
<td>31.8%</td>
</tr>
<tr>
<td>Zigbee</td>
<td>27.6%</td>
</tr>
<tr>
<td>Serial RS-232/RS-485</td>
<td>24.6%</td>
</tr>
<tr>
<td>LPWA (LoRa, Sigfox, LTE-M, etc.)</td>
<td>22.4%</td>
</tr>
<tr>
<td>6LoWPAN</td>
<td>21.4%</td>
</tr>
<tr>
<td>UPnP</td>
<td>8.2%</td>
</tr>
<tr>
<td>Other</td>
<td>7.8%</td>
</tr>
<tr>
<td>Thread</td>
<td>6.4%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>3.8%</td>
</tr>
<tr>
<td>Satellite</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
GROWTH OF NEW CONNECTIVITY PROTOCOLS

- TCP/IP 70.9%
- Wi-Fi
- Ethernet
- Bluetooth / Bluetooth Smart
- Cellular
- Zigbee
- Serial RS-232/RS-485
- LPWA (LoRa, Sigfox, LTE-M,...)
- 6LoWPAN
- UPnP
- Thread

Steady growth of Bluetooth, LPWA, 6LoWPAN; Thread appears to be lagging
What messaging protocol(s) do you use for your IoT solution?

- HTTP: 60.1%
- MQTT: 54.7%
- CoAP: 26.7%
- In-house / proprietary: 18.4%
- HTTP/2: 16.8%
- AMQP: 15.0%
- XMPP: 10.3%
- Other: 7.1%
- Don’t know: 7.1%
- Proprietary vendor protocol (specify below): 4.9%
- DDS: 4.0%
- None: 3.6%
What industrial protocol(s) do you use in your IoT solution?

- **None**: 32.1%
- **Modbus**: 22.6%
- **Don’t know**: 20.0%
- **CAN**: 18.0%
- **Industrial Protocol (EtherNet/IP, ControlNet,…)**: 14.7%
- **OPC-UA (IEC 62541)**: 12.5%
- **Profibus, Profinet**: 6.8%
- **KNX**: 6.4%
- **BACnet**: 6.4%
- **EtherCat**: 5.7%
- **IEC 60870, 61850**: 3.7%
- **Other**: 3.3%
- **DNP3**: 3.1%
- **FOUNDATION fieldbus**: 2.2%
- **Sercos**: 1.1%
Which text editor(s) or IDE(s) do you use when building IoT solutions?

- Eclipse Desktop...: 47.5%
- Arduino IDE: 29.3%
- Vim: 25.7%
- Android Studio: 22.4%
- Visual Studio...: 20.8%
- Other: 17.5%
- Atom: 16.5%
- IntelliJ IDEA: 14.3%
- Sublime: 10.8%
- Emacs: 9.0%
- Don't know: 6.7%
- Platform.io: 5.1%
- Eclipse Orion: 3.7%
- Eclipse Che: 3.7%
Have you ever used any open hardware platforms like Raspberry Pi, Arduino, BeagleBone, etc.?

- Yes, my company deploys IoT solution using an open hardware platform (31%)
- Yes, my company prototypes IoT solutions using an open hardware platform (20%)
- Yes, I have experimented with open hardware in my spare time (7%)
- No, but I intend to experiment with open hardware in the next 6 months (9%)
- Never used open hardware (33%)
Open Source Policy

Which of the following statement(s) best describes your IoT open source project participation?

- No experience with IoT open source projects.
- Report bugs and feature enhancements to open source projects that provide IoT technology.
- Committer on an open source project that builds technology for IoT solutions.
- Experimented with IoT open source technology, but don’t use it in IoT solutions.
- Organization uses open source technology in our IoT solutions.

Other

3.4%

15.8%

18.8%

21.6%

27.5%

46.1%
# IoT Consortiums

How would you rank your organization’s perceived importance of the following IoT Consortiums to your IoT strategy? (1 = Important, 5 = Never heard of them)

<table>
<thead>
<tr>
<th>Consortium</th>
<th>Important</th>
<th>Neutral</th>
<th>Not Important</th>
<th>Don’t Know</th>
<th>Never heard of them</th>
<th>Average Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE</td>
<td>233</td>
<td>125</td>
<td>30</td>
<td>51</td>
<td>9</td>
<td>1.83</td>
</tr>
<tr>
<td>Eclipse IoT</td>
<td>201</td>
<td>101</td>
<td>50</td>
<td>64</td>
<td>27</td>
<td>2.13</td>
</tr>
<tr>
<td>Apache Foundation</td>
<td>183</td>
<td>118</td>
<td>43</td>
<td>68</td>
<td>25</td>
<td>2.16</td>
</tr>
<tr>
<td>W3C</td>
<td>178</td>
<td>116</td>
<td>41</td>
<td>55</td>
<td>31</td>
<td>2.16</td>
</tr>
<tr>
<td>IETF</td>
<td>140</td>
<td>112</td>
<td>35</td>
<td>80</td>
<td>57</td>
<td>2.53</td>
</tr>
<tr>
<td>LoRa Alliance</td>
<td>99</td>
<td>113</td>
<td>55</td>
<td>83</td>
<td>79</td>
<td>2.84</td>
</tr>
<tr>
<td>Industrial Internet Consortium (IIC)</td>
<td>89</td>
<td>117</td>
<td>40</td>
<td>91</td>
<td>92</td>
<td>2.95</td>
</tr>
<tr>
<td>OASIS</td>
<td>50</td>
<td>117</td>
<td>55</td>
<td>100</td>
<td>90</td>
<td>3.15</td>
</tr>
<tr>
<td>Open Connectivity Foundation (OCF)</td>
<td>75</td>
<td>91</td>
<td>42</td>
<td>89</td>
<td>117</td>
<td>3.20</td>
</tr>
<tr>
<td>OneM2M</td>
<td>54</td>
<td>95</td>
<td>49</td>
<td>88</td>
<td>120</td>
<td>3.31</td>
</tr>
<tr>
<td>Thread Group</td>
<td>41</td>
<td>107</td>
<td>53</td>
<td>88</td>
<td>120</td>
<td>3.34</td>
</tr>
<tr>
<td>OMA</td>
<td>44</td>
<td>103</td>
<td>42</td>
<td>101</td>
<td>126</td>
<td>3.39</td>
</tr>
</tbody>
</table>
# European Research Consortiums

[Asked to European Respondents Only]

How would you rank your awareness for the following IoT related EU Research initiatives? (1 – Active Participant, 5 – No Knowledge)

<table>
<thead>
<tr>
<th>Consortium</th>
<th>Active participant</th>
<th>Highly aware</th>
<th>Moderately aware</th>
<th>Somewhat aware</th>
<th>No Knowledge</th>
<th>Rating Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIWARE</td>
<td>5</td>
<td>25</td>
<td>37</td>
<td>27</td>
<td>149</td>
<td>4.19</td>
</tr>
<tr>
<td>IERC - European Research Cluster on the IoT</td>
<td>7</td>
<td>22</td>
<td>33</td>
<td>35</td>
<td>146</td>
<td>4.20</td>
</tr>
<tr>
<td>IoT-EPI - The European Platforms Initiative for the IoT</td>
<td>12</td>
<td>20</td>
<td>23</td>
<td>30</td>
<td>158</td>
<td>4.24</td>
</tr>
<tr>
<td>AIOTI - The European Alliance of IoT for Innovation</td>
<td>10</td>
<td>17</td>
<td>27</td>
<td>30</td>
<td>161</td>
<td>4.29</td>
</tr>
<tr>
<td>Hypercat</td>
<td>2</td>
<td>7</td>
<td>26</td>
<td>25</td>
<td>180</td>
<td>4.56</td>
</tr>
</tbody>
</table>
Top IoT Corporate Leaders

IBM

Amazon Web Services

Intel

Google

Cisco

Bosch

Microsoft

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WHO RESPONDED?
What is your job title?

- Developer: 28%
- Architect: 14%
- Testing: 1%
- Development Manager: 6%
- Product Manager: 5%
- Sales / Business Development: 2%
- Executive: 5%
- Researcher: 19%
- Student: 7%
- Independent Consultant: 6%
- Currently unemployed: 1%
- Other: 6%
How large is the organization you work for (# employees)?

- 1-49: 42.7%
- 50-500: 20%
- 501-5,000: 19.6%
- 5,000+: 17.7%
Where do you live?

North America: 18.5%
South America: 7.3%
Europe: 51.6%
Africa + Middle East: 3.6%
Asia + Pacific: 19.0%
DIFFERENT RESPONDENT POOLS
The Survey was jointly sponsored by the Eclipse IoT Working Group, IEEE IoT and the AGILE IoT research project. Each sponsor group promoted the survey to their community.

A total of 713 individuals participated in the survey. There were 255 respondents from the Eclipse community and 257 from the IEEE community. Given the size of these respondent pools, it is interesting to look at the differences between these two community.

The next page provides the details on the main differences. In general,

- It appears the experience within the IEEE community is more focused on research, while the Eclipse community was more likely to be working in deploying IoT solutions.
- The language of choice in the Eclipse community was Java/C and in the IEEE it was C/Python.
- MQTT was a lot more popular in the Eclipse community.
- It would appear usage of AWS and Private Cloud is more popular within the Eclipse community.
- For connectivity protocols, LPWA, 6LoWPAN and Bluetooth are all more popular in the IEEE community.
# Differences between IEEE and Eclipse IoT

<table>
<thead>
<tr>
<th>Topic</th>
<th>All</th>
<th>IEEE</th>
<th>Eclipse IoT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience with IoT</td>
<td>Develop IoT Solutions (34.6%)</td>
<td>Develop IoT Solutions (26.5%)</td>
<td>Develop IoT Solutions (39.6%)</td>
</tr>
<tr>
<td></td>
<td>Research IoT Solutions (20.2%)</td>
<td>Research IoT Solutions (27.6%)</td>
<td>Research IoT Solutions (11.4%)</td>
</tr>
<tr>
<td>Language Usage</td>
<td>Java (60.8%)</td>
<td>C (62.5%)</td>
<td>Java (73.5%)</td>
</tr>
<tr>
<td></td>
<td>C (60.5%)</td>
<td>Python (54.8%)</td>
<td>C (56.6%)</td>
</tr>
<tr>
<td></td>
<td>C++ (48%)</td>
<td>C++ (52.9%)</td>
<td>JavaScript (42.8%)</td>
</tr>
<tr>
<td></td>
<td>Python (46.6%)</td>
<td>Java (51.4%)</td>
<td>C++ (41.3%)</td>
</tr>
<tr>
<td>Security</td>
<td>Comm (48.3%)</td>
<td>Encryption (44%)</td>
<td>Comm (51.8%)</td>
</tr>
<tr>
<td></td>
<td>Encryption (43.2%)</td>
<td>Comm (40%)</td>
<td>Encrypt (40%)</td>
</tr>
<tr>
<td></td>
<td>OTA (18.5%)</td>
<td>OTA (14%)</td>
<td>OTA (22.3%)</td>
</tr>
<tr>
<td>Cloud Provider</td>
<td>AWS (42.7%)</td>
<td>AWS (39.7%)</td>
<td>AWS (49.4%)</td>
</tr>
<tr>
<td></td>
<td>MS Azure (26.7%)</td>
<td>MS Azure (25.6%)</td>
<td>MS Azure (29.6%)</td>
</tr>
<tr>
<td></td>
<td>GCP (20.4%)</td>
<td>GCP (22.1%)</td>
<td>Private (21.6%)</td>
</tr>
<tr>
<td></td>
<td>Private (18.4%)</td>
<td>Private (14.1%)</td>
<td>GCP (20.4%)</td>
</tr>
<tr>
<td>Message Protocol</td>
<td>HTTP (60.1%)</td>
<td>HTTP (52.8%)</td>
<td>MQTT (66.7%)</td>
</tr>
<tr>
<td></td>
<td>MQTT (54.7%)</td>
<td>MQTT (43.6%)</td>
<td>HTTP (61.8%)</td>
</tr>
<tr>
<td></td>
<td>CoAP (26.7%)</td>
<td>CoAP (24.6%)</td>
<td>CoAP (24.8%)</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Bluetooth (48.2%)</td>
<td>Bluetooth (50.5%)</td>
<td>Bluetooth (43.2%)</td>
</tr>
<tr>
<td></td>
<td>LPWA (22.4%)</td>
<td>6LoWPAN (26.8%)</td>
<td>LPWA (19.1%)</td>
</tr>
<tr>
<td></td>
<td>6LoWPAN (21.4%)</td>
<td>LPWA (25.8%)</td>
<td>6LoWPAN (11.7%)</td>
</tr>
<tr>
<td></td>
<td>Thread (6.4%)</td>
<td>Thread (5.8%)</td>
<td>Thread (4.3%)</td>
</tr>
</tbody>
</table>
CONTACT INFORMATION

iot.eclipse.org
@EclipseIoT

iot.ieee.org
@IEEEIoT

agile-iot.eu
@agile_iot

theinternetofthings.eu/
@robvank