IoT Developer Survey
April 2016
Survey Introduction

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

• The survey was open from February 11 until March 25, 2016. A total of 528 individuals participated in the survey. Each partner promoted the survey to their communities through social media and web sites.

• A similar survey was conducted in 2015 by the Eclipse IoT Working Group. Details are available at http://www.slideshare.net/IanSkerrett/iot-developer-survey-2015
KEY FINDINGS
**Key Findings**

46% of respondents are delivering IoT solutions today

An additional 29% have plans to deliver an IoT solution in the next 18 months.
Key Findings

Top 5 IoT Industries

- IoT Platforms
- Home Automation
- Industrial Automation
- Energy Management
- Connected Cities
KEY FINDINGS

Top 3 concerns

SECURITY  INTEROPERABILITY  CONNECTIVITY
**KEY FINDINGS**

### Top IoT programming languages

- Java
- JavaScript (JS)
- C
- Python

### Top IoT messaging protocols

- HTTP
- MQTT
**KEY FINDINGS**

**Top IoT Operating System**

Linux

**Top IoT cloud services**

Private cloud

Microsoft Azure
Key Findings

58% actively participate in open source projects for IoT

52% use open hardware for deployment or prototyping

Open IoT
IoT Experience
What is your experience with building IoT solutions?

- 38% I develop IoT solutions for my company
- 18% I am researching IoT solutions for my company
- 15% I develop IoT solutions in my spare time
- 18% I am learning about IoT technology in my spare time
- 8% No experience
- 3% Other
What is your personal current technology focus within your organization?
**COMPANY PLANS FOR IoT**

*What is your company's plan for IoT solutions?*

- **46%** My company develops and deploys IoT solutions today
- **14%** 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
- **15%** My company has no plans to develop IoT solutions
- **11%** I don't know

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### Key Industries

**What industry or industries best describe(s) the type of IoT solutions you have built or will build?**

<table>
<thead>
<tr>
<th>Industry</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>IoT Platform/Middleware</td>
<td>40.8%</td>
</tr>
<tr>
<td>Home Automation</td>
<td>38.6%</td>
</tr>
<tr>
<td>Energy Management</td>
<td>24.8%</td>
</tr>
<tr>
<td>Industrial Automation</td>
<td>24.6%</td>
</tr>
<tr>
<td>Connected Smart Cities</td>
<td>24.0%</td>
</tr>
<tr>
<td>Building Automation</td>
<td>20.8%</td>
</tr>
<tr>
<td>Healthcare</td>
<td>18.8%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>16.8%</td>
</tr>
<tr>
<td>Automotive</td>
<td>15.8%</td>
</tr>
<tr>
<td>Environment</td>
<td>14.8%</td>
</tr>
<tr>
<td>Transportation</td>
<td>14.4%</td>
</tr>
<tr>
<td>Utilities</td>
<td>12.4%</td>
</tr>
<tr>
<td>Public Utilities</td>
<td>10.6%</td>
</tr>
<tr>
<td>Wearables</td>
<td>9.6%</td>
</tr>
<tr>
<td>Security/Public Safety</td>
<td>9.4%</td>
</tr>
<tr>
<td>Retail</td>
<td>6.6%</td>
</tr>
<tr>
<td>Security/Defense</td>
<td>6.4%</td>
</tr>
<tr>
<td>Banking/Financial/Fintech</td>
<td>5.8%</td>
</tr>
<tr>
<td>Fitness</td>
<td>5.4%</td>
</tr>
<tr>
<td>Collaborative and sharing economy</td>
<td>3.6%</td>
</tr>
<tr>
<td>Vending</td>
<td>3.0%</td>
</tr>
</tbody>
</table>
**Top IoT Concerns**

*What are your top 2 concerns for developing IoT solutions?*

- **Security**: 29.4%
- **Interoperability**: 22.3%
- **Connectivity**: 20.9%
- **Integration with Hardware**: 18.6%
- **Cost**: 16.3%
- **Privacy**: 15.7%
- **Complexity**: 13.2%
- **Performance**: 12.1%
- **Maintenance**: 11.3%
- **Data Analytics**: 6.7%
- **Certification/Conformance**: 2.5%
- **Other**: 2.5%
- **I don't know**: 2.5%
What are your top 2 concerns for developing IoT solutions?

- Security: 48.3% (Overall: 47.4%)
- Interoperability: 31.9% (Overall: 29.4%)
- Connectivity: 19.7% (Overall: 22.3%)
- Integration with Hardware: 19.3% (Overall: 20.9%)
- Cost: 16.4% (Overall: 18.6%)
- Performance: 16.3% (Overall: 21.0%)

Performance becomes #3 issue
TECHNOLOGY USED FOR IoT
For your home automation solution, what framework/platform are you using or plan to use?

- **Google Nest**: 10%
- **Apple HomeKit**: 9%
- **OpenHAB**: 5%
- **Eclipse SmartHome**: 18%
- **Smarthings Hub**: 16%
- **AllJoyn**: 13%
- **AllJoyn**: 4%
- **AllJoyn**: 4%
- **AllJoyn**: 3%
- **AllJoyn**: 4%
- **Custom framework/platform**: 18%
- **I don’t know**: 18%
- **Other (please specify)**: 18%

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Which programming languages, if any, do you use to build IoT solutions?

- Java: 51.9%
- C: 47.7%
- JavaScript: 41.8%
- Python: 37.9%
- C+: 33.6%
- Node.js: 31.5%
- C#: 11.7%
- PHP: 11.2%
- Lua: 7.2%
- Assembler: 6.3%
- Other: 6.1%
- Go: 5.8%
- Ruby: 4.7%
- SWIFT: 4.7%
Which operating system(s) do you use for your IoT devices?

- **Linux**: 73.1%
- **No OS / Bare-metal**: 23.1%
- **FreeRTOS**: 12.7%
- **Other**: 11.1%
- **Windows Embedded**: 9.5%
- **mbed**: 7.4%
- **Contiki**: 6.0%
- **TinyOS**: 6.0%
- **Don’t know**: 5.8%
- **RIOT**: 5.6%
Do you use, or plan to use, any of the following cloud service offerings for implementing your IoT solution?

- Amazon AWS: 36.8%
- Private/on-premise cloud: 34.9%
- Microsoft Azure: 20.8%
- Google Cloud Platform: 16.9%
- IBM Bluemix: 16.9%
- No cloud service is used: 16.9%
- I don’t know: 10.5%
- RedHat OpenShift: 8.7%
- Other: 8.7%
Cloud Services for IoT

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

<table>
<thead>
<tr>
<th>Cloud Service</th>
<th>Overall</th>
<th>Organizations that have deployed an IoT solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon AWS</td>
<td>36.8%</td>
<td>44.1%</td>
</tr>
<tr>
<td>Private/ On-premise</td>
<td>34.9%</td>
<td>41.2%</td>
</tr>
<tr>
<td>Microsoft Azure</td>
<td>20.8%</td>
<td>25.6%</td>
</tr>
<tr>
<td>Google Cloud Platform</td>
<td>16.9%</td>
<td>12.3%</td>
</tr>
<tr>
<td>IBM Bluemix</td>
<td>16.9%</td>
<td>17.1%</td>
</tr>
<tr>
<td>No cloud service used</td>
<td>16.9%</td>
<td>12.8%</td>
</tr>
</tbody>
</table>

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

- TCP/IP: 70.9%
- Wi-Fi: 67.0%
- Ethernet: 54.7%
- Bluetooth / Bluetooth Smart: 40.9%
- Cellular: 32.6%
- Zigbee: 25.4%
- Serial RS-232/RS-485: 24.5%
- LPWAN (LoRa, Sigfox, LTE-M, etc.): 17.3%
- 6LoWPAN: 16.2%
- UPnP: 8.5%
- Other: 8.1%
- Thread: 4.8%
- Don’t know: 3.5%
- Satellite: 3.2%
What messaging protocol(s) do you use for your IoT solution?

- **HTTP**: 61.2%
- **MQTT**: 52.4%
- **CoAP**: 21.2%
- **HTTP/2**: 19.2%
- **In-house / proprietary**: 15.5%
- **AMQP**: 13.9%
- **XMPP**: 13.2%
- **I don’t know**: 7.4%
- **Proprietary vendor protocol**: 6.2%
- **Other**: 5.3%
- **DDS**: 3.5%
- **None**: 2.3%
What messaging protocol(s) do you use for your IoT solution?

CoAP usage increased for IoT Platforms and Smart Cities
### INDUSTRIAL PROTOCOLS

**What industrial protocol(s) do you use in your IoT solution?**

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>31.9%</td>
</tr>
<tr>
<td>Don’t Know</td>
<td>26.0%</td>
</tr>
<tr>
<td>Modbus</td>
<td>18.9%</td>
</tr>
<tr>
<td>EtherNet/IP, ControlNet, DeviceNet</td>
<td>15.3%</td>
</tr>
<tr>
<td>CAN</td>
<td>14.0%</td>
</tr>
<tr>
<td>OPC-UA (IEC 62541)</td>
<td>8.4%</td>
</tr>
<tr>
<td>KNX</td>
<td>5.6%</td>
</tr>
<tr>
<td>Profibus, Profinet</td>
<td>5.4%</td>
</tr>
<tr>
<td>BACNet</td>
<td>4.6%</td>
</tr>
<tr>
<td>Other</td>
<td>3.3%</td>
</tr>
<tr>
<td>IEC 60870, 61850</td>
<td>3.3%</td>
</tr>
<tr>
<td>EtherCat</td>
<td>3.1%</td>
</tr>
<tr>
<td>DNP3</td>
<td>2.3%</td>
</tr>
<tr>
<td>FOUNDATION fieldbus</td>
<td>1.5%</td>
</tr>
<tr>
<td>SercoS</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
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: 19%
- Yes, my company prototypes IoT solutions using an open hardware platform: 33%
- Yes, I have experimented with open hardware in my spare time: 32%
- No, but I intend to experiment with open hardware in the next 6 months: 7%
- Never used open hardware: 9%
IoT Industry Perceptions
### Open Source Policy

**What is your company’s policy about using open source technology for your IoT solutions?**

<table>
<thead>
<tr>
<th>Policy</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not allowed in any part of our IoT solution</td>
<td>3.0%</td>
</tr>
<tr>
<td>Used but we do not contribute to open source projects</td>
<td>25.1%</td>
</tr>
<tr>
<td>Used and we contribute bug fixes to open source projects</td>
<td>16.6%</td>
</tr>
<tr>
<td>Used and we have developers who work on open source projects</td>
<td>16.6%</td>
</tr>
<tr>
<td>Fundamental to our business model</td>
<td>24.9%</td>
</tr>
<tr>
<td>I don’t know</td>
<td>12.6%</td>
</tr>
</tbody>
</table>
## IoT Consortia

How would you rank your organization’s perceived importance of the following IoT Consortia 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>AllSeen Alliance</td>
<td>38</td>
<td>69</td>
<td>42</td>
<td>73</td>
<td>116</td>
<td>3.47</td>
</tr>
<tr>
<td>Eclipse IoT</td>
<td>166</td>
<td>89</td>
<td>29</td>
<td>49</td>
<td>26</td>
<td>2.11</td>
</tr>
<tr>
<td>IEC</td>
<td>38</td>
<td>82</td>
<td>37</td>
<td>80</td>
<td>89</td>
<td>3.31</td>
</tr>
<tr>
<td>IEEE</td>
<td>135</td>
<td>111</td>
<td>33</td>
<td>65</td>
<td>14</td>
<td>2.20</td>
</tr>
<tr>
<td>IETF</td>
<td>104</td>
<td>81</td>
<td>30</td>
<td>66</td>
<td>54</td>
<td>2.66</td>
</tr>
<tr>
<td>Industrial Internet Consortium (IIC)</td>
<td>48</td>
<td>90</td>
<td>42</td>
<td>72</td>
<td>87</td>
<td>3.18</td>
</tr>
<tr>
<td>LoRa Alliance</td>
<td>70</td>
<td>74</td>
<td>35</td>
<td>71</td>
<td>89</td>
<td>3.10</td>
</tr>
<tr>
<td>OASIS</td>
<td>55</td>
<td>103</td>
<td>46</td>
<td>76</td>
<td>64</td>
<td>2.97</td>
</tr>
<tr>
<td>Open Interconnect Consortium (OIC)</td>
<td>42</td>
<td>79</td>
<td>39</td>
<td>86</td>
<td>94</td>
<td>3.33</td>
</tr>
<tr>
<td>OMA</td>
<td>41</td>
<td>76</td>
<td>32</td>
<td>77</td>
<td>114</td>
<td>3.43</td>
</tr>
<tr>
<td>OneM2M</td>
<td>34</td>
<td>78</td>
<td>36</td>
<td>74</td>
<td>112</td>
<td>3.46</td>
</tr>
<tr>
<td>Thread</td>
<td>34</td>
<td>81</td>
<td>41</td>
<td>71</td>
<td>108</td>
<td>3.41</td>
</tr>
<tr>
<td>W3C</td>
<td>146</td>
<td>88</td>
<td>38</td>
<td>64</td>
<td>13</td>
<td>2.17</td>
</tr>
</tbody>
</table>

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TOP IOT CORPORATE LEADERS

- Intel
- Google
- IBM
- BOSCH
- Cisco
- Microsoft
- GE
WHO RESPONDED?
JOB TITLE

- Developer: 30%
- Architect: 16%
- Development Manager: 12%
- Researcher: 10%
- Independent Consultant: 8%
- Executive: 6%
- Product Manager: 4%
- Student: 9%
- Other (please specify): 5%

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How large is the organization you work for?

- 1 to 49 employees: 50%
- 50 to 500 employees: 22%
- 501 to 5000 employees: 13%
- More than 5000 employees: 15%
Where do you live?

Europe 59%
North America 19%
Asia and Pacific 14%
Middle East, Africa 2%
South America 6%
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 **528 individuals participated in the survey;** 281 from Eclipse IoT, 130 from AGILE IoT and 46 from IEEE IoT. The remaining response came from other organizations who helped promote the survey.

Some differences emerged between the Eclipse IoT respondents and the other groups (details on next page):

- Eclipse community was more focused on embedded technology
- C and Python were top languages in the non-Eclipse respondents; Java and C being top languages in Eclipse
- MQTT usage significantly higher in Eclipse; most likely due to Eclipse Paho and Eclipse Mosquitto
- Eclipse respondents more likely to have already deployed an IoT solution today
### Key Differences between Eclipse IoT Respondents & The Other Groups

<table>
<thead>
<tr>
<th>Category</th>
<th>Combined</th>
<th>Eclipse IoT</th>
<th>AGILE IoT, IEEE IoT, others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedded Technology Focus</td>
<td>24.9%</td>
<td>30%</td>
<td>19.1%</td>
</tr>
<tr>
<td>I develop IoT Solutions for my company</td>
<td>37.9%</td>
<td>46.3%</td>
<td>28.3%</td>
</tr>
<tr>
<td>My company develops and deploys IoT solutions today</td>
<td>45.7%</td>
<td>53.1%</td>
<td>37.9%</td>
</tr>
<tr>
<td>Top Languages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Java (51.9%)</td>
<td>Java (59.6%)</td>
<td>C (50.5%)</td>
</tr>
<tr>
<td></td>
<td>C (47.7%)</td>
<td>C (45.4%)</td>
<td>Python (47.9%)</td>
</tr>
<tr>
<td></td>
<td>JavaScript (41.8%)</td>
<td>JavaScript (43.3%)</td>
<td>Java (42%)</td>
</tr>
<tr>
<td>Message Protocols</td>
<td>HTTP (61.2%)</td>
<td>MQTT (61.8%)</td>
<td>HTTP (65.1%)</td>
</tr>
<tr>
<td></td>
<td>MQTT (52.4%)</td>
<td>HTTP (58.1%)</td>
<td>MQTT (40.6%)</td>
</tr>
<tr>
<td>Key Roles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Developer (30.1%)</td>
<td>Developer (34.1%)</td>
<td>Developer (25.1%)</td>
</tr>
<tr>
<td></td>
<td>Architect (16.1%)</td>
<td>Architect (19.4%)</td>
<td>Researcher (16%)</td>
</tr>
<tr>
<td></td>
<td>Dev. Mgr (12%)</td>
<td>Dev. Mgr (12.4%)</td>
<td>Architect (12%)</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Europe (58.6%)</td>
<td>Europe (56.2%)</td>
<td>Europe (61.5%)</td>
</tr>
<tr>
<td></td>
<td>NA (19.4%)</td>
<td>NA (24.4%)</td>
<td>NA (14.4%)</td>
</tr>
<tr>
<td></td>
<td>AP (14.1%)</td>
<td>AP (13.8%)</td>
<td>NA (13.2%)</td>
</tr>
</tbody>
</table>
CONTACT INFORMATION

[Logos and links]

https://iot.eclipse.org  
@EclipseloT

http://iot.ieee.org  
@IEEEIoT

http://agile-iot.eu  
@agile_iot