



# Comcast Innovation Fund

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## **2015 Annual Report**

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Summary of the Fund's Operations for the 2015 Operating Year

# Comcast Innovation Fund At a Glance: 2015 Executive Summary

## Background

Comcast created the Comcast Innovation Fund to identify and support important research that has the potential to advance broadband, the Internet and the global open-source community. The fund (formerly the Tech R&D Fund) was established as a resource for researchers working on smaller and mid-sized technology projects that may not qualify for larger national grant programs.

Grants range from \$3,000 for smaller projects, up to more than \$100,000 for medium-term research efforts. A cross-functional team of technology and business leaders within Comcast reviews grant applications and directs funding where it is most needed, and can have the greatest impact. The fund was backed by a million-dollar commitment from several groups within Comcast in 2014 and 2015, and that level has been renewed for 2016.

Comcast recently concluded the third full year of the grant program, during which it disbursed virtually the entire annual fund across a range of deserving applicants. Combined, the fund issued grants to 22 applicants in four countries.

## Objectives and Key Criteria

The fund was created to advance the Internet and open-source technology, so we look for research projects that move technology forward by tackling difficult problems or pioneering new approaches. Particular weight is given to projects that:

- *Address critical cyber security threats*
- *Advance the deployment and adoption of IPv6*
- *Create or advance important open-source projects*

## Approach

The fund offers three types of grant:

- **General Research Grants** (*14 of 22 grants in 2015*) – These unrestricted grants are given to support researchers and at colleges and universities. They are geared toward supporting research in a range of fields relevant to the Internet and online communication.
- **Open Source Development Grants** (*8 of 22 grants in 2015*) – Comcast is an active and engaged participant in the global open source community. These grants are intended to support the creation and advancement of important open source projects, including those that may not have immediate business value, but which carry the potential for important technological development.
- **Targeted Research Grants** (*0 of 22 grants in 2015*) – Targeted research grants are set aside for research projects that may be suggested by Comcast, but which require specialized technological or academic expertise. Applicants for these grants may be organizations, academic institutions, or individuals.

## 2015 Highlights

Projects supported by fund in 2015 included:

- The **United States Telecommunications Training Institute's (USTTI)** work to provide free information and communications technology (ICT) training to technology leaders in the developing world. Funding supported training for ten officials from Botswana, the Democratic Republic of Congo, Ecuador, Ethiopia, Sri Lanka, Ghana, Tanzania, Benin, Senegal, and St. Vincent and the Grenadines.
- The **French Institute for Research in Computer Science and Automation's (INRIA)** research into advanced trouble-shooting tools for home networks.
- **Georgia Tech's** work to develop better firewall tools to help users spot and avoid malicious Domain Name System (DNS) activity.

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## Looking Forward

The grant process for the 2016 funding year has begun, and Comcast continuously reviews applications to identify new, worthy projects. For more details, or to apply visit [innovationfund.comcast.com](http://innovationfund.comcast.com).

## Grant Categories

### 1: GENERAL RESEARCH GRANTS

A General Research Grant provides an unrestricted award of funds to support researchers at colleges and universities. These grants are focused on supporting excellent technical research in a wide variety of fields that are relevant to the broadband industry. In general, applicants are encouraged to consider grants that may have a cooperative focus, whereby researchers can be matched with a Comcast engineering liaison that will be involved with the research.

### 2: TARGETED RESEARCH GRANTS

While many Targeted Research Grant ideas may be suggested or generated by our internal teams, we may also fund specific research suggested by submitters that is also of interest to Comcast or to the Internet and broadband industries. In contrast to General Research Grants, Targeted Research Grants are more narrowly tailored and typically study more specific issues. Applicants are encouraged to consider grants that may have a cooperative focus, whereby researchers can be matched with a Comcast engineering liaison that will be involved with the research. Applicants for these grants may be organizations, academic institutions, or individuals.

### 3: TARGETED OPEN SOURCE DEVELOPMENT GRANTS

Targeted Open Source Development Grants are intended to fund new or continued development of open source software in areas of interest to Comcast or of benefit to the Internet and broadband industries. This can fund a range of development, from adding specific features to an existing open source project, to general support of an open source project in which we are interested. Applicants for these grants may be organizations, academic institutions, or individuals.

## Grants Made by Geography

USA – 19  
France – 1  
Switzerland – 1  
Australia – 1

## Individual Grant Details and Progress Reports

### Columbia University

*Grant Type: General Research*

#### Internet Privacy Research

Description: The research is focused around developing a comprehensive understanding of the emergence of cross-device tracking on the Internet. The research will focus on what information is collected across devices, how those collection activities take place, and how that data is correlated relative to specific Internet users. The project will work toward publishing a research study with recommendations for addressing issues related to cross-device tracking.

**Status / Outcome: Work In Progress**

### Drexel GIGIE

*Grant Type: General Research*

#### Evolving Content Naming Processes

Description: The project focuses on the evaluation of content naming schemes, with a focus on creating more robust, scalable and searchable digital libraries. Researchers are exploring how such naming schemes can be applied to current Internet naming and address standards and infrastructure protocols. The project seeks to produce a recommendation for how specific protocol standards would be extended so as to accommodate the recommended naming schema and mapping.

**Status / Outcome: Work In Progress**

## **Drexel Quality of Experience**

*Grant Type: General Research*

### **Internet Quality of Experience Research**

Description: This project focuses on developing algorithms that relate network Quality of Service (QoS) metrics to customer perceived Quality of Experience (pQoE) metrics using empirical data. Researchers plan to develop the pQoE function using a machine learning (ML) technique known as online passive-aggressive learning model. With online passive-aggressive learning, the learner can increase its accuracy with data introduced in an online fashion. The project team has developed the algorithm and started to build an experimental testbed for collecting data that will be used to train the learning algorithm.

**Status / Outcome: Work In progress**

## **Drexel University**

*Grant Type: General Research*

### **IPv6 Programmable Routing**

Description: The research explores an emerging technology called Source Packet Routing in Network (SPRING) that incorporates the programmability component of software-defined-networking in network routing. The technology makes use of the enhanced capabilities of the IPv6 addressing space to support programmable routing approaches. Drexel has developed implementations of the technology on the open-source Apache Traffic Server.

**Status / Outcome: Work In progress**

## **French Institute for Research in Computer Science and Automation (INRIA)**

*Grant Type: General Research*

### **Home Networking Troubleshooting Research**

Description: The project aims to develop an easy-to-use home-network troubleshooting tool that can reliably identify performance and functionality shortcomings rooted in the home and propose ways to fix them. The approach builds upon recent work

by INRIA on a network measurement platform for the browser (called Fathom). Researchers intend to develop methods for collaborative troubleshooting where several instances of the tool within a single home and the home router can share measurement data to identify problems and recommend fixes.

**Status / Outcome: Work In Progress**

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**Status / Outcome: Work In Progress**

## **George Washington University**

*Grant Type: Open Source Development*

### **Maestro High Performance**

#### **Data Center Applications Project**

Description: The Maestro project is focused on exploring high-performance applications in the data center environment. Researchers approach looks at both memory and input/output as critical resources that must be appropriately managed in order to deliver maximum application performance, especially in multi-tenant environments such as large private clouds.

**Status / Outcome: Work In Progress**

## **Georgia Institute of Technology**

*Grant Type: General Research*

### **Netrisk Anti-Malware and Abuse Project**

Description: Netrisk is a startup within the Georgia Institute of Technology focused on Internet-based analysis of threats, malware, and abuse at the network edge. Funding supports Netrisk's work to map the affinities between devices, domain names, flow and Internet-events, using novel tensor analysis techniques. This technology permits network operators to inventory the devices at customer premises, perform a network-scale census of Internet-of-Things (IoT) devices, and even identify browser configurations, plugins, and general home network health.

**Status / Outcome: Work In Progress**

## **Georgia Institute of Technology**

*Grant Type: Open Source Development*

### **DNS Security and Notification**

Description: The DNSPath project is focused on addressing issues related Domain Name System security, by creating tools and procedures that can alert users if they are using malicious DNS resolvers. The work was inspired by a DNS Changer Working Group (DCWG) project, and by the need to give users better tools to check their DNS settings. The project seeks to establish tools that allow firewalls to identify unwanted connections and infections.

**Status / Outcome: Work In Progress**

## **Georgia Tech and UC Davis**

*Grant Type: General Research*

### **Study on Internet Bandwidth and Socioeconomic Development**

Description: Researchers are conducting a study into the differential effects of Internet bandwidth capacity on different aspects of socio-economic development. The study employs a unique database on bandwidth capacity within and among countries (in kbps) that combines the number of subscriptions of phone and internet with their respective bandwidth capacity (upload and download). The panel spans three decades (1986 – 2014) and includes 172

countries, corresponding to 96 % of the world's population and 99 % of the world's income. The study tests for impact beyond economic growth and tests for social impacts on crucial areas for development, like research activity, education, employment, health, cultural production, and political participation, etc.

**Status / Outcome: Work In Progress**

## **Sarthak Grover Ph.D. – Princeton University**

*Grant Type: General Research*

### **IOT Fingerprinting and Speed/Usage Research**

Description: The fund supported two separate areas of professor Grover's research:

- An examination of how increased Internet speeds impact Internet usage trends; and
- A study on the security of Internet of things devices, as well as an investigation into the potential for IoT "fingerprinting".

**Status / Outcome: Work In Progress**

## **Oleg Kalnichevski**

*Grant Type: Open Source Development*

### **HTTP 2.0 Transport for Apache**

Description: Apache HTTP Client is one of the more popular HTTP agents available for Oracle Java and Google Android platforms. It has an established user base and is widely used by open source as well as commercial applications. This project aims to develop transport components conditionally compliant with the HTTP/2 specification and to enable Apache HttpClient to transmit messages in a multiplexing mode using HTTP/2 protocol while retaining full backward compatibility with HTTP/1.1. While the HTTP/1.1 remains the most widely used protocol for Web, the next major revision of the protocol, HTTP/2, is expected to grow in both popularity and adoption and ultimately render HTTP/1.1 obsolete. HTTP/2 addresses many known shortcomings of the previous versions of the protocol and is expected to be more resource efficient, compact and secure.

**Status / Outcome: Work in progress**

*(cont.)*

## **Messaging, Malware and Mobile Anti Abuse Working Group**

*Grant Type: General Research*

### **IGF Participation**

Description: This grant supported Messaging Malware and Mobile and Anti-Abuse Working Group (MAAWG) attendance at the Internet Governance Forum in Brazil, where they worked to support IGF work on spam.

**Status / Outcome: Completed**

## **New America Foundation**

*Grant Type: General Research*

### **Wireless Spectrum and Wifi Connectivity**

Description: The Wireless Future Project, part of New America Foundation's Open Technology Institute, sought funding to develop and publish a report on the regulatory considerations and public interest benefits of opening the 5850-5925 MHz ITS band for shared, unlicensed use. NAF's Wireless Future Project is the think tank arm of a coalition of national consumer, media reform, civil rights and other groups that have advocated for expanded access to unlicensed spectrum and Wi-Fi connectivity for more than a decade. The Report's working title is *The 5 GHz ITS Band: From Spectrum Silos to Broadband Abundance*. The principal author is Michael Calabrese, director of the Wireless Future Project. Calabrese has served since 2009 on the Department of Commerce Spectrum Management Advisory Committee (CSMAC) and was a co-author of the seminal 2012 PCAST report on federal band spectrum sharing.

**Status / Outcome: Completed**

## **Progressive Policy Institute**

*Grant Type: General Research*

### **Economic Map of the Internet**

Description: The Progressive Policy Institute proposed a project to create an economic "map" of the Internet, examining linkages and value exchange between various industries and network participants. The Map project will draw from U.S. Bureau of Economic Analysis statistics, and examine

both existing linkages and areas where better data would help to deepen understanding of the Internet economy.

**Status / Outcome: Work In progress**

## **SAIS John Hopkins**

*Grant Type: General Research*

### **Support for Digital Economy Roundtables**

Description: The innovation fund provided support for the SAIS Center on Transatlantic Relations, a university think tank affiliated with Johns Hopkins University's School of Advanced International Studies (SAIS). The Center plays host to events that bring together policy and opinion leaders from the United States and Europe to examine issues related to the transatlantic digital economy.

**Status / Outcome: Work In Progress**

## **Stony Brook University, NY**

*Grant Type: General Research*

### **Detecting Man-in-the-Middle Attacks**

Description: Stony Brook University sought to develop and test a better approach for detecting and identifying Internet-based traffic interception (man-in-the-middle) attacks. Specifically, the research seeks to devise a methodology for detecting traffic interception attacks, correlate data related to such attacks from diverse sources in order to yield accurate detection and measurement, and validate those methods through collaboration with relevant technical communities.

**Status / Outcome: Work In Progress**

## **Swinburne University**

*Grant Type: Open Source Development*

### **Active Queue Management Project**

Description: The project aims to develop a modern, open-source implementation of active queue management (AQM) that could be used to address bottlenecks in routers, switches and other pieces of network equipment that experience those issues. The project is focusing on the open-source FreeBSD operating system.

**Status / Outcome: Work In Progress**

*(cont.)*



## **Dave That – TekLibre**

*Grant Type: Open Source Development*

### **Bufferbloat Mitigation Research**

Description: The TekLibre is reviewing recent development and testing focused on addressing the issue of “bufferbloat”, an industry-wide issue that potentially impacts millions of Internet users worldwide. Data typically is set in a queue in cable modems in order to deliver it more efficiently. Increasing the buffer size within a modem – as many modem manufacturers have done in recent years – increases the amount of information a modem can process, but also can cause more data to be stored in a queue, resulting in increased latency. For latency-sensitive applications like gaming or Web surfing, this can cause an unintended degradation in performance. Bufferbloat mitigation techniques involve adjusting a modem’s buffer size to optimize the balance between capacity usage and latency.

**Status / Outcome: Work In Progress**

## **Dave That – TekLibre**

*Grant Type: Open Source Development*

### **Make WiFi Fast Project**

Description: TekLibre has launched the “make-wifi-fast” project, which is exploring new algorithms to reduce the latency and improve the throughput of wifi. This work is particularly focused on advancing wifi to better function in an Internet of things (IoT) environment in which more devices creates more interference in wifi signals. The project builds on prior work by Taht, on active queue management for controlling network “bufferbloat”. The make-wifi-fast research project is a collaboration with several other companies, and the University of Karlstad in Sweden. The code produced by the project will be released as open source.

**Status / Outcome: Work In Progress**

## **UC San Diego**

*Grant Type: General Research*

### **Support for BGP Hackathon**

Description: The grant helped to support the first Border Gateway Protocol (BGP) Hackathon at the

San Diego Super Computer Center. The hackathon took place in February 2016, and focused on the development of tools to model, measure, and monitor the routing infrastructure of the Internet.

**Status / Outcome: Completed**

## **UPenn**

*Grant Type: General Research*

### **Broadband Adoption Research**

Description: Researchers will explore innovative practices that have proven successful in promoting broadband deployment in a systematic way that permits evaluating their cost effectiveness. Examples will be generated through a bottom-up process drawing on resources such as the local chapters of the Internet Society, national Internet Governance Forum groups, and industry initiatives and will encompass examples from both the developing and the developed world.

**Status / Outcome: Work In Progress**

## **US Telecom Training Institute**

*Grant Type: General Research*

### **Tuition-Free ICT Training in the Developing World**

Description: United States Telecommunications Training Institute (USTTI) offers intensive tuition-free training to individuals from developing countries who are involved, typically at senior levels, in advancing their countries’ information and communications technology (ICT) infrastructure. The funding supported ten officials from Botswana, the Democratic Republic of Congo, Ecuador, Ethiopia, Sri Lanka, Ghana, Tanzania, Benin, Senegal, and St. Vincent and the Grenadines to participate in the USTTI’s ICT Policy and Cybersecurity Training sequence. The training courses in this sequence, which were taught by subject matter expert volunteers from government and industry, provided information on how to develop National Cybersecurity strategies, establish Computer Emergency Response Teams, and mitigate the online abuse from spam, bots and malware.

**Status / Outcome: Completed**