

# Lime Microsystems Programmable Radio - extended hackathon

Organised by BT Infinity Lab

First entries by 9<sup>th</sup> June 2017

Final entries by 30<sup>th</sup> June 2017



Call for entries.



# Briefing

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- At EE and BT we are developing the next generation of wireless networks for outdoor and indoor deployments. We are looking for new approaches that accelerate innovation and new service introduction, increased flexibility and efficiency and allow sustainable development costs for use cases which cannot be addressed today
- We believe that future networks must be flexible and programmable to this end, EE and BT are collaborating with the Lime Micro Software Defined Radio (SDR) solution and ecosystem as a means of evaluating the maturity this new ecosystem and clearly marking the steps required to implement the future network model
- In 2016 EE backed successful crowd-funding campaign, which led to over 3000 development kits being sourced around the world
- Those kits have now been delivered and this hackathon aims to test-drive this new ecosystem of Network developers and programmers
- The majority of the 100 developer kits sourced by EE will be provided to Universities and academia and EE /BT actively support and encourage the use of these kits to provide coursework /projects or tutorials

# Overview of use cases for the hackathon

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- EE and BT have developed a number of key use case of particular interest to the business as suggestions and guidance to participants: these provide examples of problems we are looking to solve, but are not obligatory: other use cases will also be considered
- EE and BT are also happy to receive entries from any participants who develop any use case which they feel adds value to our customers
- A set of high-level specifications are given in this document which will be used to evaluate the entries
- **We are looking for teams who have ideas or experience in developing innovative solutions. Development will culminate in a show and tell / hack event at the end of July 2017, exact date tbc.**
- **First prize in each category will go to the team who best developed their idea, and there will be an opportunity to work with BT and EE to further develop and test their solution through the TIP acceleration centre**

# Lime Microsystems – what is the Lime Programmable Radio

## LimeSDR

- low cost
- open source
- apps-enabled software defined radio (SDR)
- **Field-programmable RF**

**Supports most types of wireless communication standard. Protocols it can transmit and receive include ;**

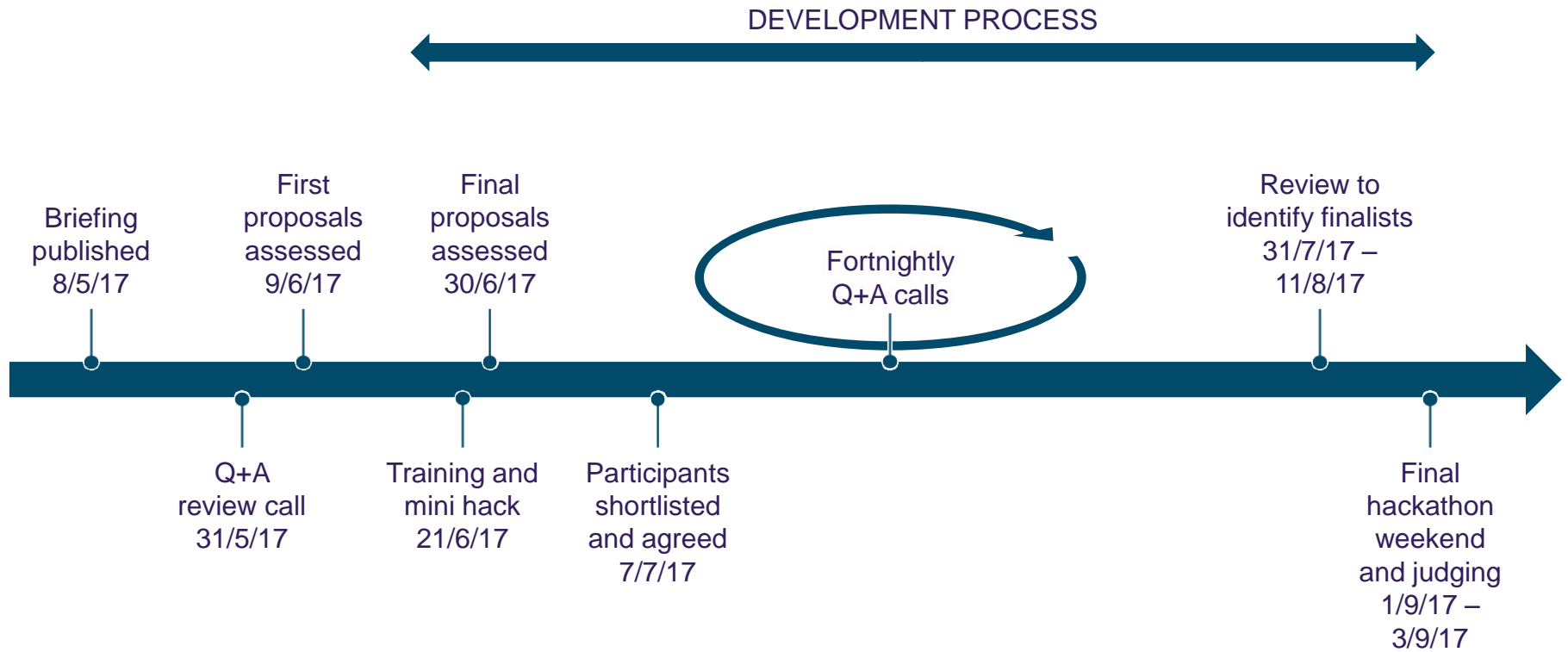
- UMTS
- LTE
- GSM
- LoRa
- Bluetooth
- Zigbee
- RFID
- Digital Broadcasting



For more information including full specification, drivers, applications, and tutorials, see

<https://wiki.myriadr.org/LimeSDR>

# Timeline



# Hackathon categories

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Hackathon entries will be judged according to one of the following three categories. At least one winning entry will be selected from each category :

## **CATEGORY A: Replicating now, faster**

Best implementation of an existing feature/solution using the LIME development kit while optimising Cost of development, Time to market and/or performance/efficiency.

Entries classed in this category will be used to benchmark the maturity of the new ecosystem versus the existing one, based on the 3 criteria above plus overall SW quality/stability.

Following the Hackathon, a report will be published to highlight the relative maturity of the new ecosystem and to identify areas which require focus, as well as proposing an optimal path to maturity. The report will also attempt to estimate an approximate maturity date. **We believe this will be the world's first report of this kind.**

## **CATEGORY B: Critical scenarios for BT/EE**

Best application of LIME development kits to solve an existing problem (see list of suggested problem areas)

## **CATEGORY C: Amaze us!**

Most imaginative and effective use of the programmable features of the LIME SDR chip

## Suggested Problem areas for Category B Use cases

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1. Disaster Recovery
2. Remote Connectivity – “Last Mile” Innovation
3. Indoor Enhancements
4. Enterprise
5. Entertainment
6. Other



## 1. Disaster Recovery

### a. **Autonomous ad-hoc networks :**

Following a large-scale natural disaster other event which has caused a regional or local outage, demonstrate how your solution could allow network elements to re-organise set-up a local/regional autonomous network without connectivity to the central core. How could basic services be provided temporarily in the affected area without compromising sensitive customer data or security? How could these network elements re-organise in an optimal way to ensure the widest possible coverage with sufficient capacity, using meshed networking, airborne solutions or similar techniques

### b. **Self-Healing networks :**

In the event of a local or regional outage demonstrate how your solution could be used to provide a remote connection for troubleshooting or fault diagnosis of remote elements which have lost contact with the OSS system through normal channels. How could your solution speed up diagnostics and fault analysis and help prioritise actions? Could your solution be used to remotely reboot network elements and also to reconfigure equipment to adjust physical parameters such as antenna tilts in order to mitigate coverage gaps due to the outage?

### c. **Search and Rescue :**

Following a natural disaster which has caused regional or local network outage, demonstrate how your solution could be used to detect users in distress by picking up signals from their smartphones and pinpointing the individuals locations. Could the solution be enhanced through airborne installation, allowing one or more supporting drones to fly over a remote rescue area, either autonomously or released in a “cluster” from a Search and Rescue team helicopter?



## 2. Remote Connectivity / “Last Mile” Innovation

### a. **Improve Indoor Coverage / “Last Mile” innovation :**

Develop a solution to improve indoor connectivity to homes where there are some/weak macro coverage outside, but no high speed broadband connection indoors – especially in remote / rural areas where a sustainable cost model is challenging.

### b. **10MHz of TDD at 1900MHz :**

EE and BT has 10MHz of 3GPP TDD spectrum at 1900MHz. Propose a solution to maximise use of this spectrum to enhance coverage or performance for remote / rural areas, transport routes, embarked solutions or any other innovative use case.

### c. **Tethered Drone :**

Jack in a box or tethered drone, tethered for power, but maybe also for backhaul. Wake the drone to be released only when there's an indication that a prospective user is coming into range.

### d. **Remote coverage :**

Providing managed coverage for a very remote area. Including functions such as being able to automatically kick off or severely limit individual users that use too much bandwidth

### e. **Device to Device :**

Propose a solution using device-to-device and/or relaying that can allow better connectivity in and around the home. Could they devices relay off each other back to the network?

## 3. IoT hub

### a. In Home :

A combined Wi-Fi and NB-IOT module for in home deployment. As well as the hub, are there any in-home IOT solutions that you can demonstrate?

### b. NB-IoT gateway :

A stand-alone NB-IOT gateway, with all local IoT data being aggregated, and sent over 4G.

### c. Remote Monitoring

Demonstrate how EE might be able to remote monitor sites more cost effectively. Can IoT be used to allow for remote configuration and maintenance of a base station? If a base station goes down, could IoT be used to diagnose and repair the fault?

## 4. Enterprise: Network as a Service

### a. Cloud RAN

Examples of architectures giving greater flexibility and / or lower costs, for example enabling multiple carrier remote radio heads.

Demonstrating the ability to deploy infrastructure whose resources can be utilised and reconfigured dynamically, dependent on changing demands

### b. Converged networks

Approaches to balancing traffic seamlessly and dynamically across multiple bearer protocols and links, for example Wi-Fi + LTE + Ethernet

### c. SD-WAN

Method to enable the Lime unit to connect into a corporate overlay VPN using zero-touch configuration and centralised policy control of the Lime's routing of VPN traffic over WiFi and LTE or Ethernet interfaces. The unit could run an available SD-WAN solution e.g. Nokia Nuage, Viptela, Velocloud etc, as a Virtual Network Function (VNF) or an original SD-WAN solution could be built from open source components e.g. netopeer.

### d. Ethernet Interfaces

Method to support Ethernet connectivity via a USB adapter so that the unit can support mixed fixed and wireless connections. Particularly useful for Enterprises using combinations of fixed and wireless methods in the SD-WAN use case.

## 5. Entertainment: Large-scale TV delivery

### a. 4G to 5G Broadcast and multicast evolution

Could mobile technology complement or replace fixed DTT transmissions? To date, LTE-Broadcast has not been widely deployed. However, increasing pressure on spectrum means that there is a huge commercial benefit to positioning 5G as a generic technology for all digital radio-based services, including mainstream TV.

The starting point could be to create an open source baseline LTE-B system as the starting point for 5G broadcast development.

### b. Dynamic use of multicast

Multicast Operation On Demand (MooD) offers the potential for highly efficient use of LTE multicast capability. For example, when a popular sports event is on, there will be a huge increase in linear viewing. Can we use broadcast or multicast capability dynamically to ensure the best use of spectrum when such events occur?

## 6. Other

### a. Your activity using Lime Microsystems SDR

BT and EE are very interested to understand what other scenarios you may be investigating using the Lime Micro SDR. Where those overlap with thinking in BT or EE, we would be delighted to include the activity within the hackathon.

# High-Level Technical Specifications

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- Solutions based on 3GPP Network Technologies are preferred – multi-access solutions combining 3GPP and non-3GPP are also welcome. Solutions built only on non-3GPP technologies such as Wifi, Bluetooth, LoRA etc. will only be accepted by exception
- LTE is the preferred 3GPP technology. GSM-based solutions will also be accepted where beneficial due to the relative maturity of the open-source SW stack
- The EE / BT licensed frequencies are preferred. For LTE these include 800/1800/2100/2600 FDD bands and 2600 TDD band. For GSM these include 1800 band. The exact band allocations are available from public sources such as Ofcom.
- LTE-based unlicensed or mixed technologies such as LTE-U, LAA, LWA and MulteFire will also be accepted
- Required output power levels will be defined by each specific use case but applicants must comply with UK regulatory requirements
- All entries must comply with UK and EU health & safety regulations
- Some PoCs may require an E2E implementation – others may demonstrate the radio front-end only

# Software Options

## **BT and EE have provided a number of options to obtain the SW required to participate in this Hackathon**

- LimeSDR SW, related drivers and documentation is available from Myriadrf.org - <https://myriadrf.org/projects/limesdr/>
- GSM stack and LTE radio protocols will be available from LimeSDR App store, which will be going live soon.
- EPC SW can be obtained from Quortus (see slides 21 – 23)
- Any applicant can download any network SW as an application from the Ubuntu Snappy platform. Preferential terms for Hackathon participants have been agreed for most of the SW on the platform - [https://wiki.myriadrf.org/LimeMicro:LimeSDR\\_App\\_Store](https://wiki.myriadrf.org/LimeMicro:LimeSDR_App_Store)
- We are particularly interested in automation and orchestration capabilities – our recommended tools for configuration and management are YANG/NETCONF e.g.
  - YANGcli <https://www.yumaworks.com/yangcli-pro/>
  - anetopeer: <https://github.com/CESNET/netopeer>



## Why Should I participate in BTEESDRHack

- A great opportunity to present to a jury full of innovators, scientists, engineers and public figures, and to get your talents known on a wide scale (the jury will be made public during the Summer)
- At least 1 winner from each category will be invited to enter the TIP Ecosystem Acceleration Centre (TEAC) recently announced by BT and Facebook
- Participants in Category A will be included in the benchmark report on the Status of the Programmable Networks Open Development Ecosystem. We believe this will generate global interest and increase visibility for you/your company.
- It's a great opportunity to meet new people who share your mindset but come from different sectors and cultures with different skillsets.
- You'll get regular support from our partners, as well as exchanging ideas with other participants.
- The hack organisers are long-time innovators who want to work with you.
- You love creating cool stuff which is useful.

# Outcomes

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- BT will write up the event in a white paper, describing how software definable radio can impact future network and proposition development for mobile operators.  
This will include examples from notable entrants as well as a write up of all finalists invited through to the final.
- BT will fast track one or more finalists in each category through the Facebook TIP Ecosystem Acceleration Centre
- Where appropriate, BT will introduce participants into the Scottish Innovation Programme

# How to contact us

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To apply, visit ;

<http://bit.ly/BTEESDRHack1>

For more information, please send ;

- Your name, e-mail, contact number, and contact address
- Your organisation name (if you have one)
- A short description of the work you are, or would like to carry out using the Lime Micro SDR
- A timescale from now to July, showing what would be demonstrable when [note: EE and BT have events before June where there may be an opportunity to demonstrate your PoC]
- The number of Lime SDR units you already have, and whether you need any more for the proposed PoCs
- What additional software you are already using from which companies
- Any additional software you would like to have access to from which companies

... to [infinitylab@bt.com](mailto:infinitylab@bt.com)

# FAQ

## **Are BT and EE looking to develop deployable commercial products from this Hackathon?**

The main objective is not necessarily to develop immediately deployable products at this stage, but ideally looking for Proof of Concepts that could be further trialled and / or tested. However, any viable products will be considered for rapid deployment.

## **How important is the video?**

It is not essential but does help us understand your product or capability. We do not assess the production quality. **You will not be penalised for not having a video.**

## **What sort of support is offered?**

Lime Microsystems will provide support as part of their standard process for all participants that have purchased a Lime Micro SDR. Quortus will be available on our regular Hackathon briefing / Q+A calls, and documentation is available.

## **What is expected from us?**

We are looking for companies that share our ambition and will work collaboratively to develop new agile approaches to wireless networking during May, June, and July. We work out of the TechHub office in London but we don't expect you to be resident. We can offer hot desks and meetings rooms at TechHub.

## **Do we have to be resident in the UK?**

No. We are happy to receive entries from anywhere in the world. Briefing calls will be arranged at times that work for participants, and we are looking to support video participation in the final.

## **What will happen at the finals?**

As physical space is limited, BT and EE, in conjunction with each participant and our partners Lime Microsystems, Amarisoft, Quortus, and EIT Digital, will agree which participants will attend the final hackathon event.

At the finals, participants will have the opportunity to present informally to other participants and refine their demonstrators, before presenting to the judges.

## **Can I enter more than once?**

Absolutely, though each entry must be a different category or scenario within category B.

## **What are the prizes?**

There is no cash prize. Please see the outcomes slide for details of how winners will be helped



# Venue (TechHub)



BT Infinity Lab @ TechHub – 20 Ropemaker St. London

Ingenious



# Our Partners

# Quortus

**Quortus**

EPC + ECX

Ingenious







- Participants will be able to download\* the new 'PocketEPC' from Quortus
- Available as a 'SNAP' from the Ubuntu App Store
- Providing basic 3GPP compliant LTE EPC functionality as a collapsed executable binary – with industry leading processor and memory efficiency
  - S1 to SGi interface
  - Collapsed MME, SGW, PGW & HSS
- Free SIM cards (x2) provided with each download
- Support via private WiKi and user forum

\*Standard download fees apply - £150 per deployed instance



ubuntu

Quortus



- Participants will be offered the opportunity to install Quortus' fully featured EPC at a special Hackathon rate\*
  - For the duration of the hackathon
- Providing 3GPP compliant LTE EPC functionality as a collapsed executable binary – with industry leading processor and memory efficiency
  - Fully featured collapsed MME, SGW, PGW, HSS, PCRF & IMS-lite
  - Roaming interfaces
  - Inter MME handover
  - Programmatic SOAP interface
- Free SIM cards (x2) provided
- 10 hours technical support via Quortus' online support service



\*£3000 per deployed instance + £1500 support



EIT Digital

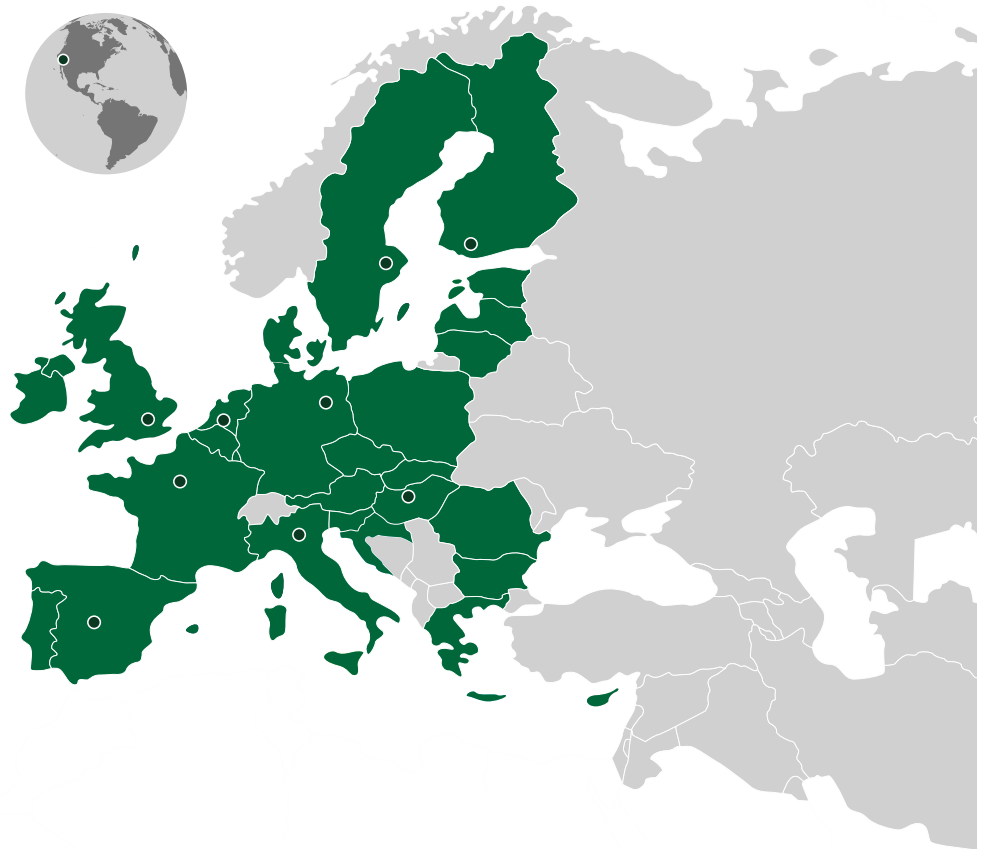
Ingenious



# Pan-European Ecosystem

## *Digital Innovation & Entrepreneurial Education*

- Pan-European Ecosystem (9 Nodes and co-location centres)
- Serve whole of Europe via ARISE
- 130+ Partners (Industry, Academic, Institute/ecosystem)
- Silicon Valley Hub, extending global outreach



# Innovation & Entrepreneurship

## *Grow & Go (to Market)*

- Create over 200 commercially available products and services
- Coach over 300 scale-ups
- Raise 150 million euros VC



Digital  
Industry



Digital  
Wellbeing



Digital  
Cities



Digital  
Infrastructure