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The Open-Source SDR LTE Platform for Public Safety R&D

Paul Sutton
Software Radio Systems
www.softwareradiosystems.com

SRS SOFTWARE RADIO SYSTEMS

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Posted with permission

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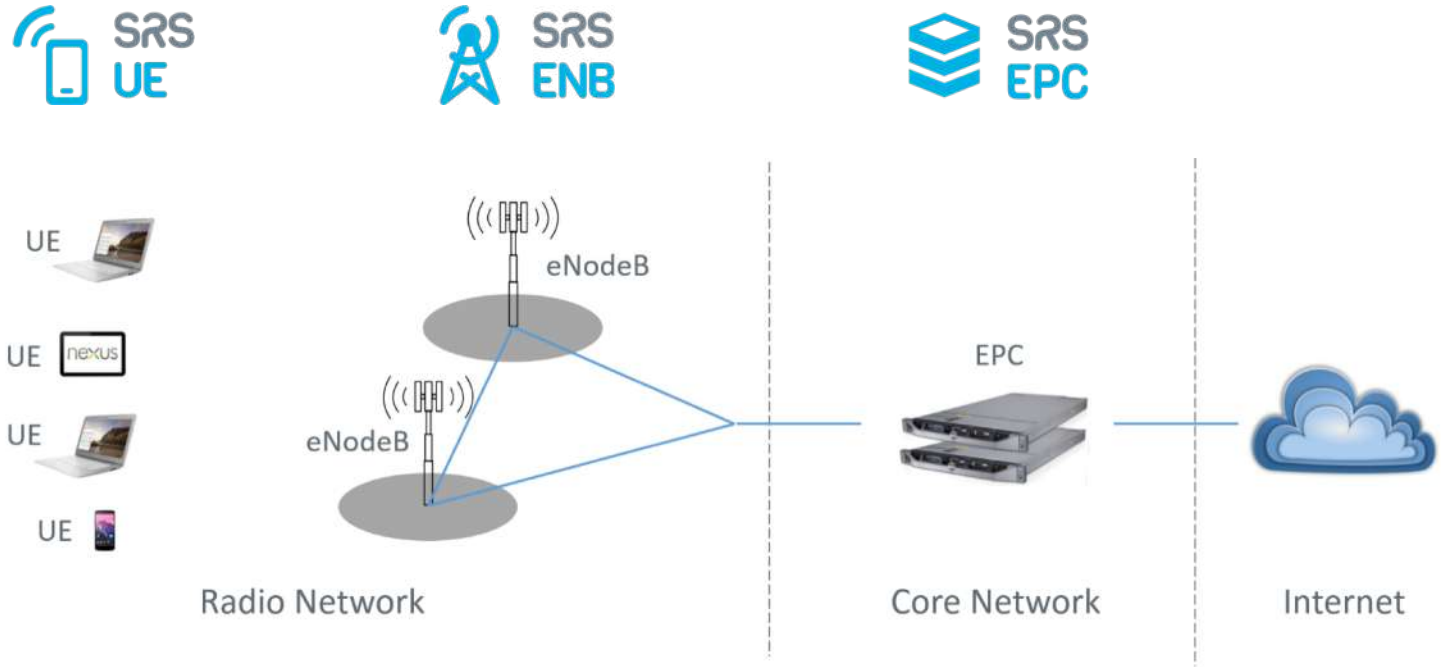
An open-source end-to-end LTE network for public safety research & development.



- A **reference implementation** of key LTE features for first responders.
- Enabling, supporting and growing the public safety broadband development **ecosystem**.
- Providing a **commercialization** path for public safety LTE using proven business models.
- Building upon the proven **srsLTE** suite of open-source libraries, tools and applications.

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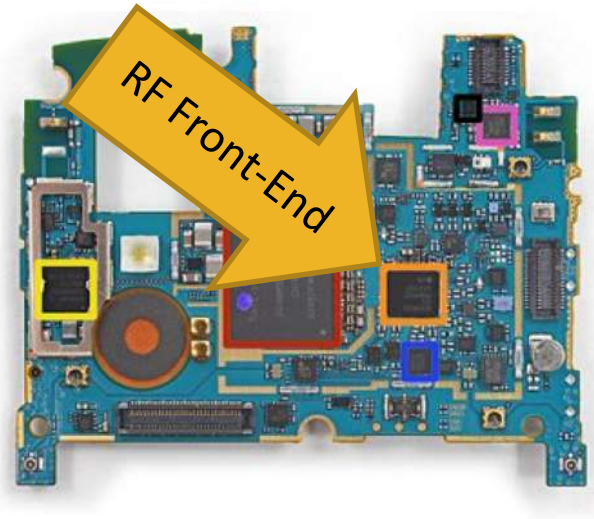
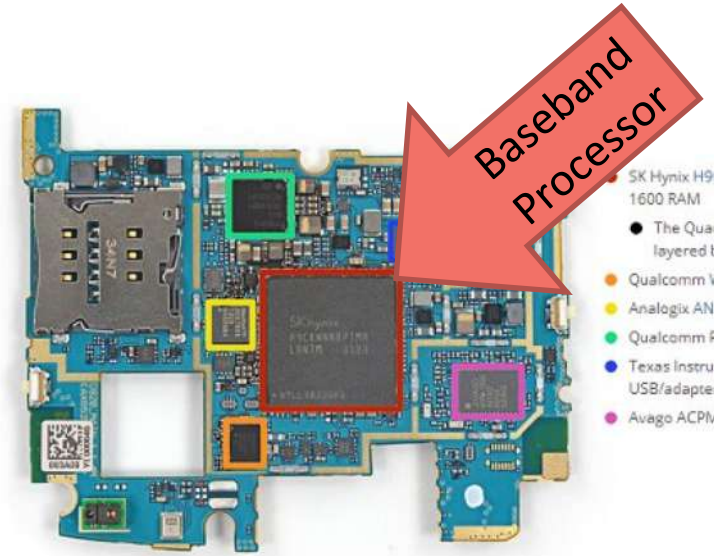
Outline

- Technology
- Requirements
- Approach
- Status & Features
- Impact

Technology – Software Radio



- Sandisk SDIN8DE4 16 GB NAND flash
- Qualcomm WTR1605L LTE/HSPA+/CDMA2K/TDSCDMA/EDGE/GPS transceiver
- Qualcomm PM8841 power management IC
- Broadcom BCM4339 5G Wi-Fi combo chip with integrated power and low-noise amplifiers (the updated version of the BCM4335).
- Avago RFI335
- InvenSense MPU-6515 six-axis (gyro + accelerometer) MEMS MotionTracking device
- Asahi Kasei AK8963 3-axis electronic compass



- SK Hynix H9CKNNNBPTMRLR-NTM 2 GB LPDDR3-1600 RAM
  - The Quad-core, 2.26 GHz Snapdragon 800 SoC is layered beneath the RAM
- Qualcomm WCD9320 audio codec
- Analogix ANX7808 SlimPort transmitter
- Qualcomm PM8941 power management IC
- Texas Instruments BQ24192 I2C controlled 4.5 A USB/adapter charger
- Avago ACPM-7600

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Technology – Software Radio

Requirements

Ease of use / Ease of programming new capabilities

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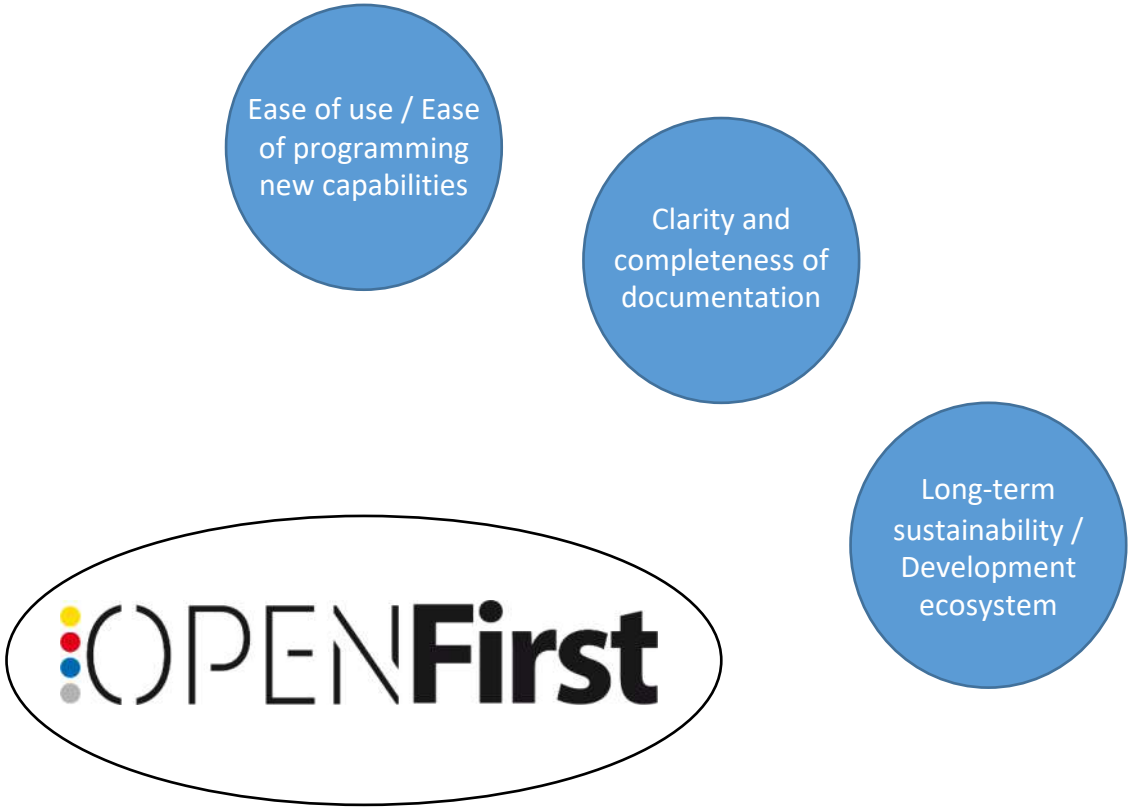
Requirements

Ease of use / Ease of programming new capabilities

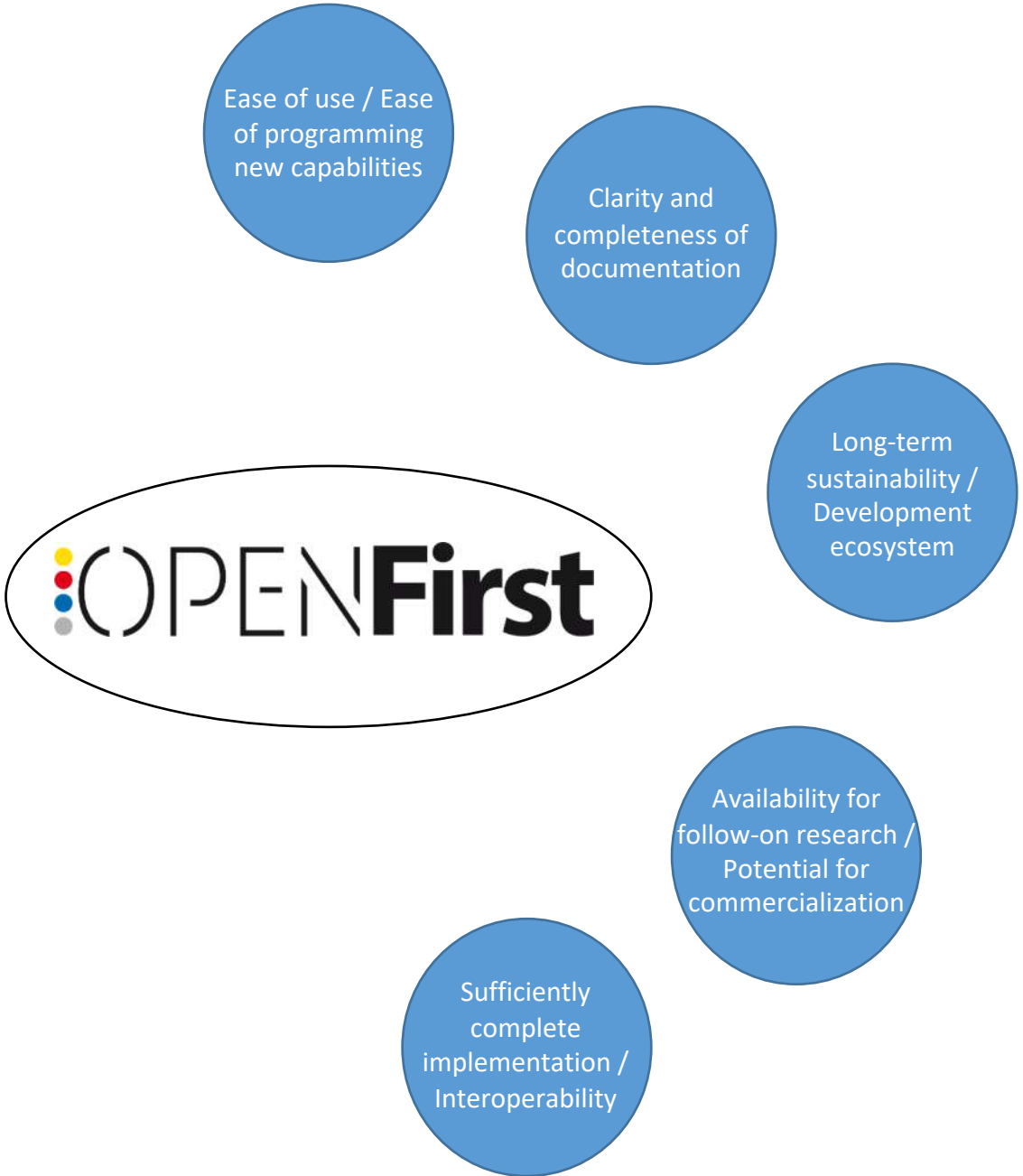
Clarity and completeness of documentation

Requirements

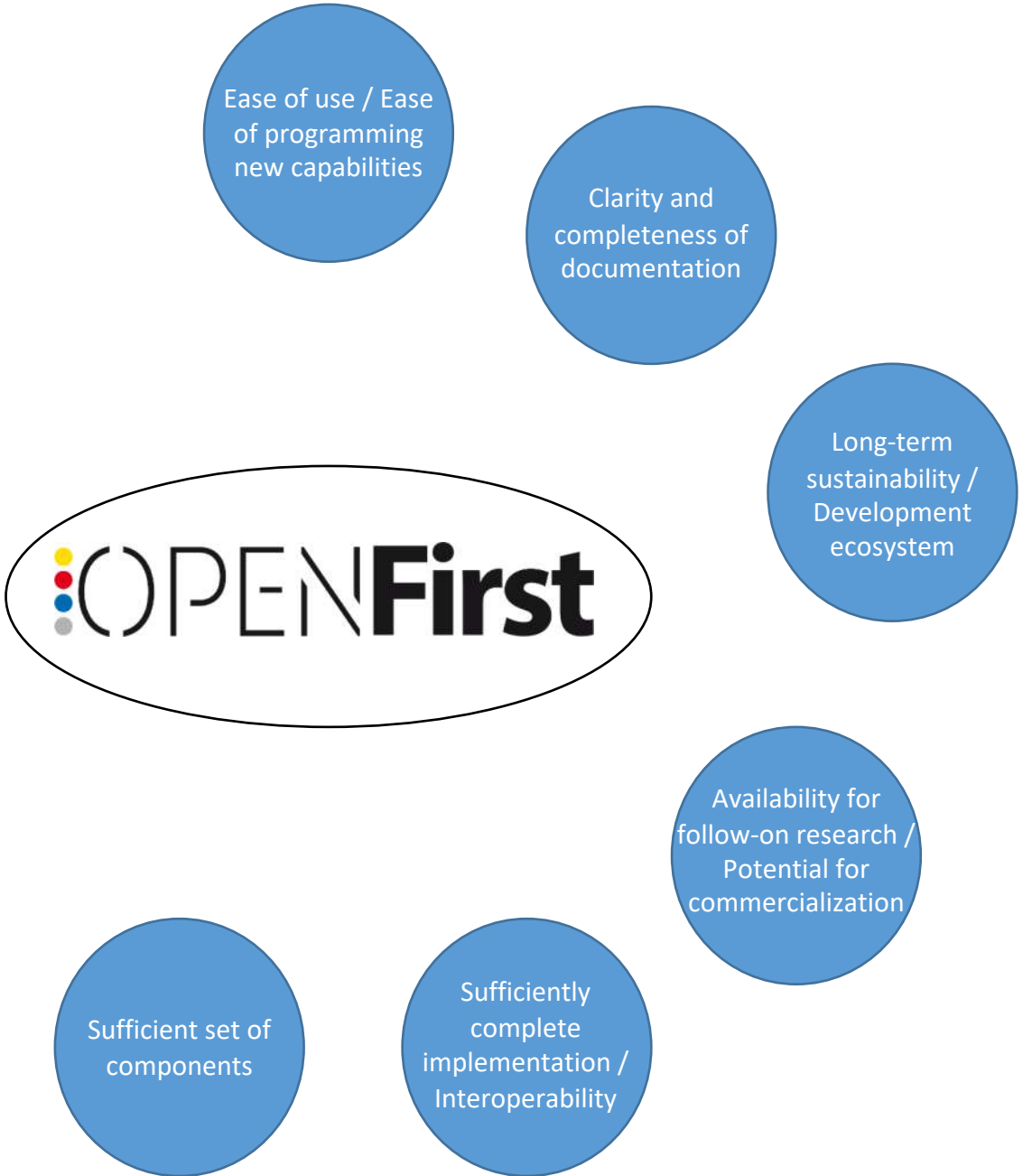


Requirements

Requirements



Requirements



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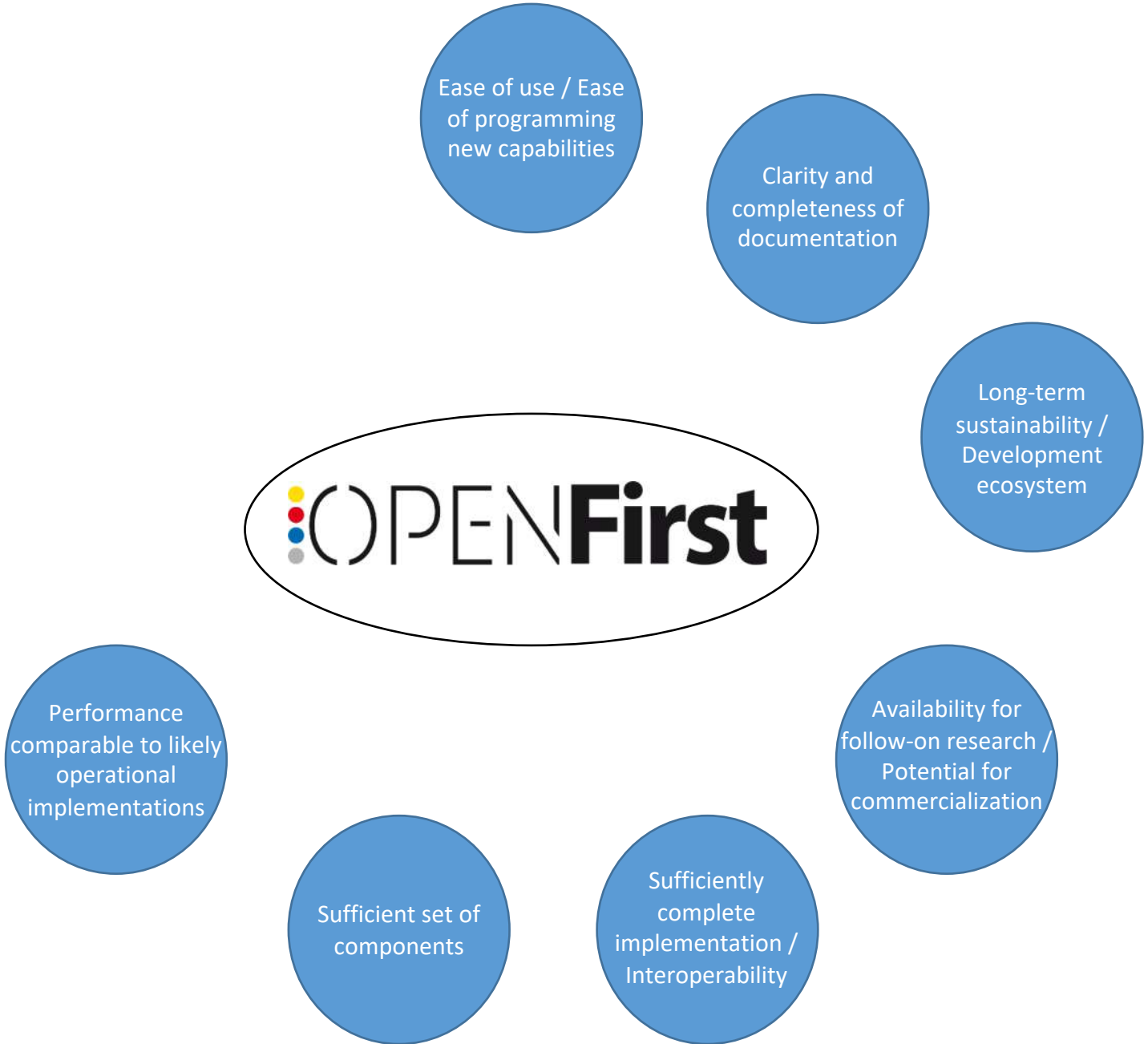
Requirements



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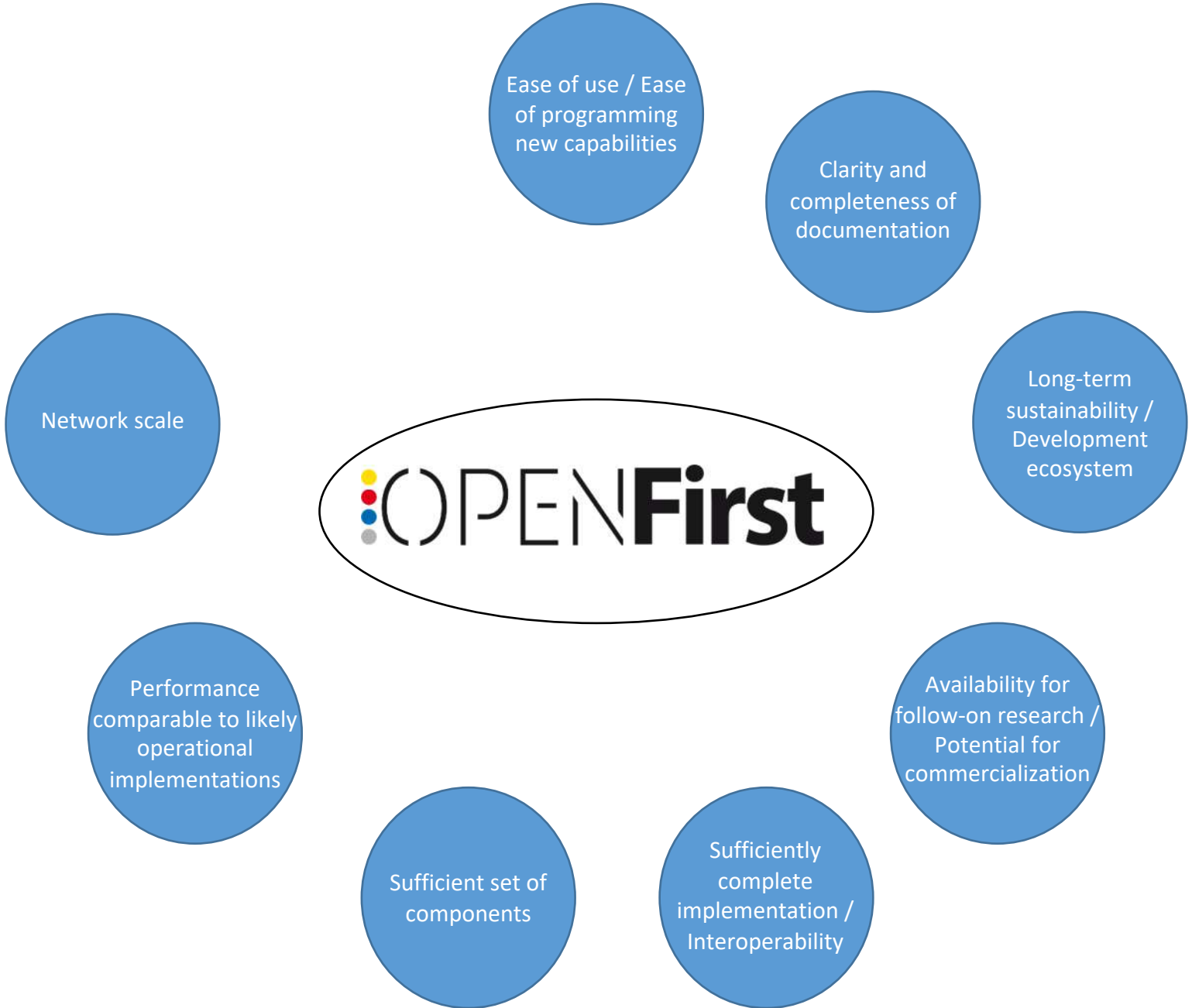
Requirements



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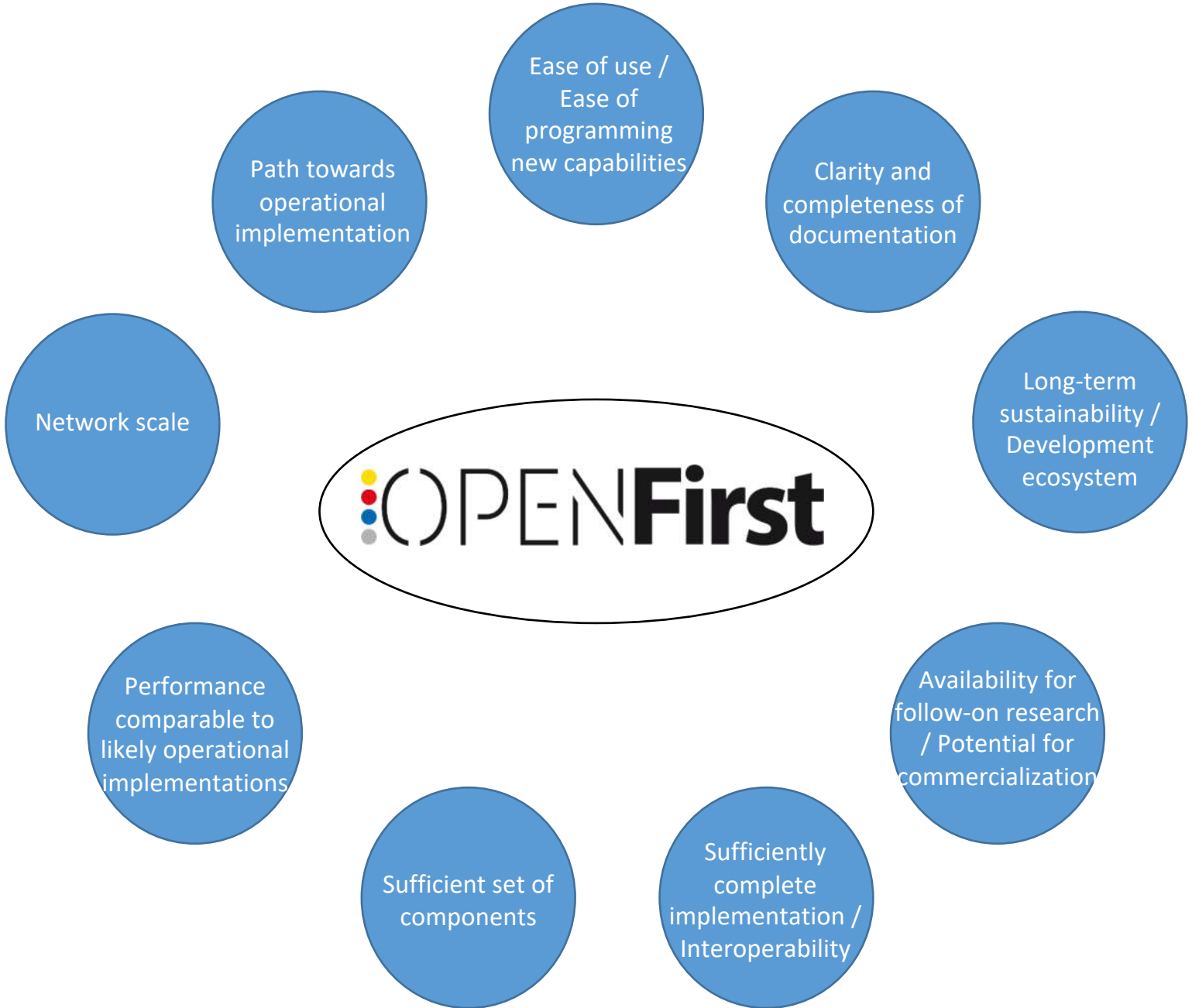
Requirements



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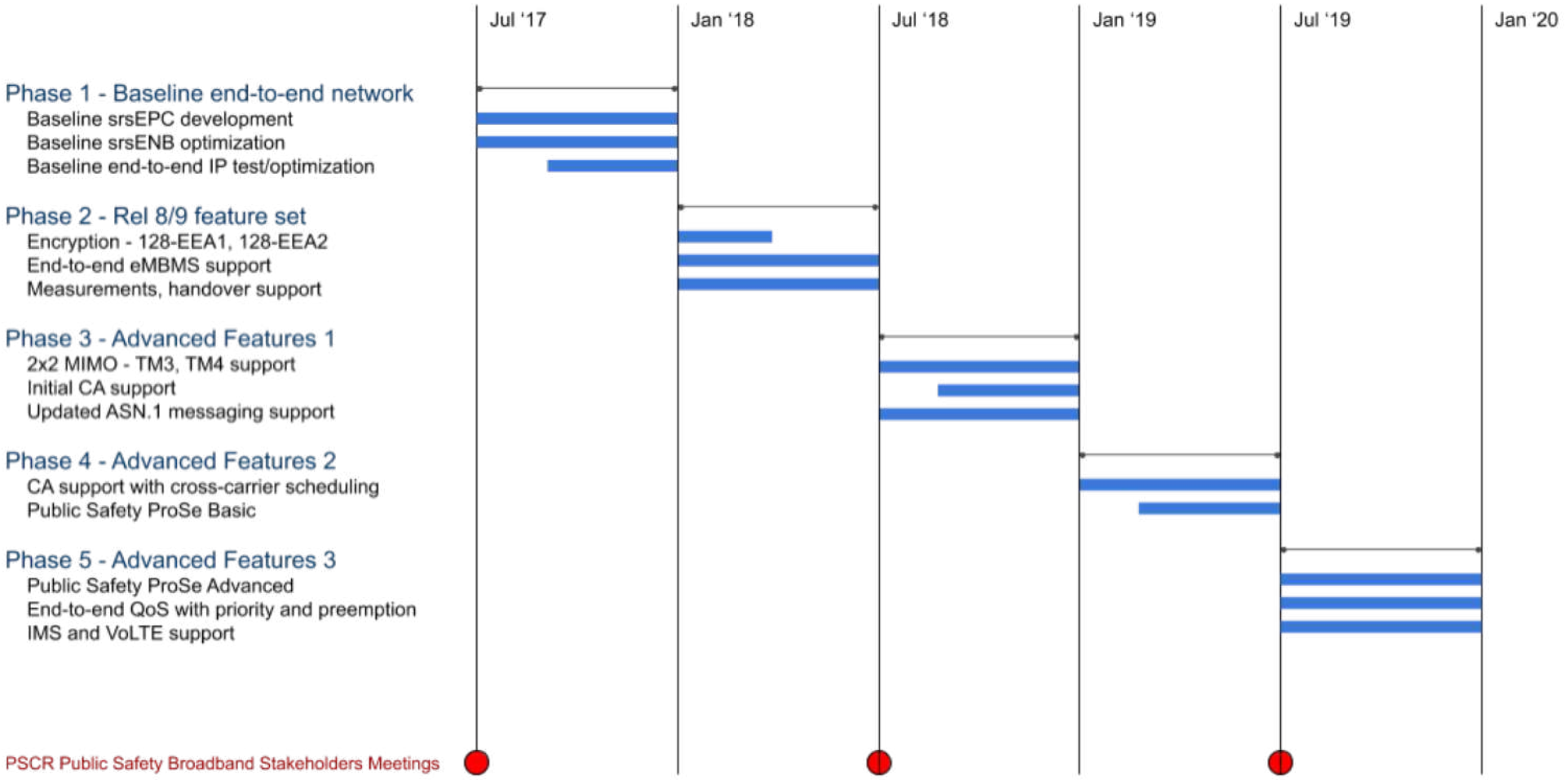
Roadmap



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SRS Team

Paul Sutton
Director

Ismael Gomez
Director

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Linda Doyle
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Xavier Arteaga
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Francisco Paisana
Senior Engineer

Pedro Alvarez
Senior Engineer

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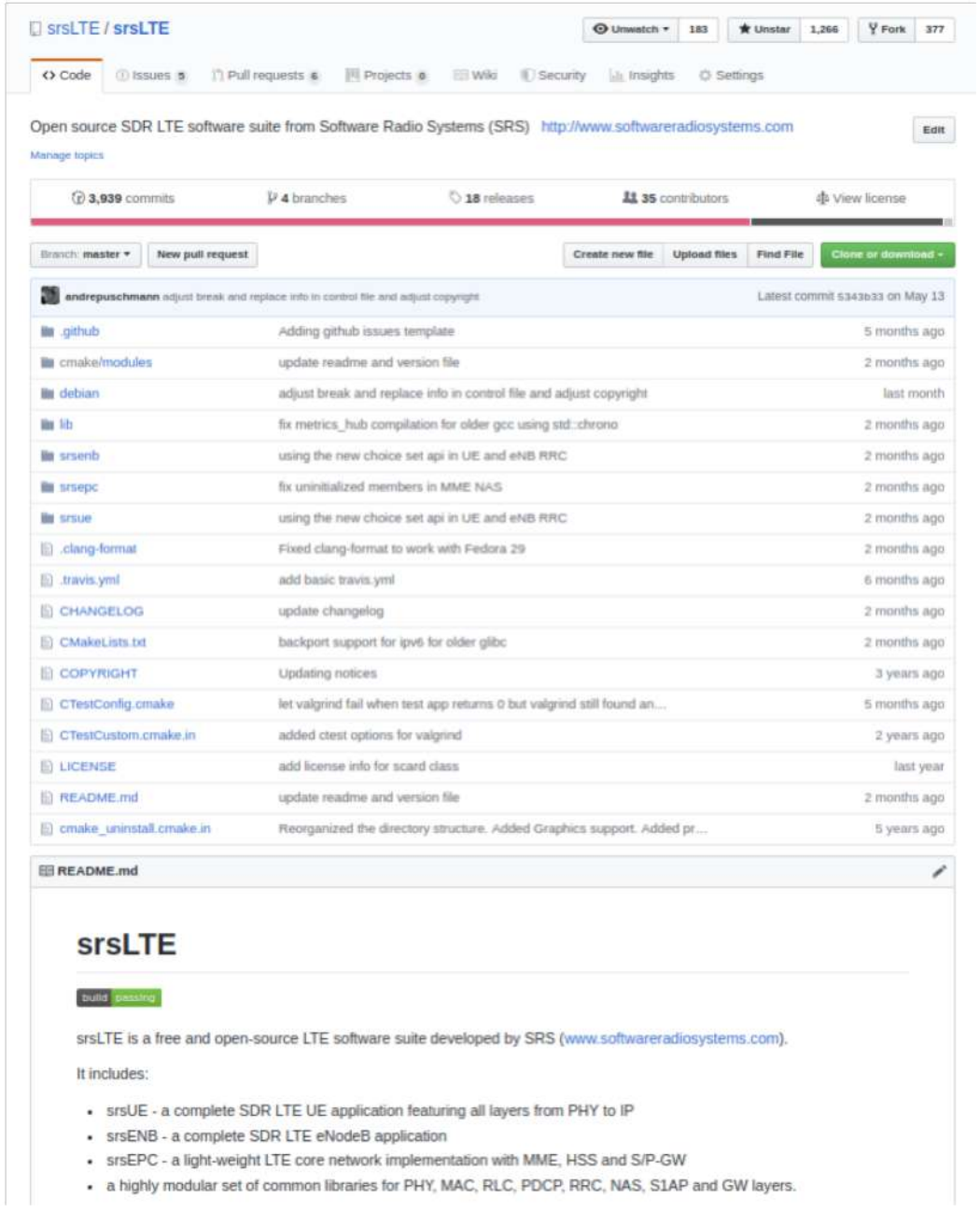

open source

- GNU Affero General Public License (AGPLv3)
- Ensuring dissemination of the technology
- Maximizing usability
- Promoting sustainability
- Safeguarding availability

www.github.com/srslte

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Proven Development Models, Languages, Tools

Jenkins

GDB
The GNU Project Debugger

GitHub

amazon web services™

C/C++

git

CMake

GCC

coverity®
A Synopsys Company

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OS Integration

Software Radio Systems

Overview | Code | Bugs | Blueprints | Translations | Answers

Releases

PPA description

```
This is the Ubuntu PPA for srsLTE, a free and open-source LTE software
suite, along with some dependencies.

For more info, please visit https://github.com/srsLTE/srsLTE
```

Adding this PPA to your system

You can update your system with unsupported packages from this untrusted PPA by adding **ppa:srslte/releases** to your system's Software Sources. (Read about installing)

```
sudo add-apt-repository ppa:srslte/releases
sudo apt-get update
```

▷ Technical details about this PPA

For questions and bugs with software in this PPA please contact Software Radio Systems.

Overview of published packages

Published in: Any series ▾ Filter

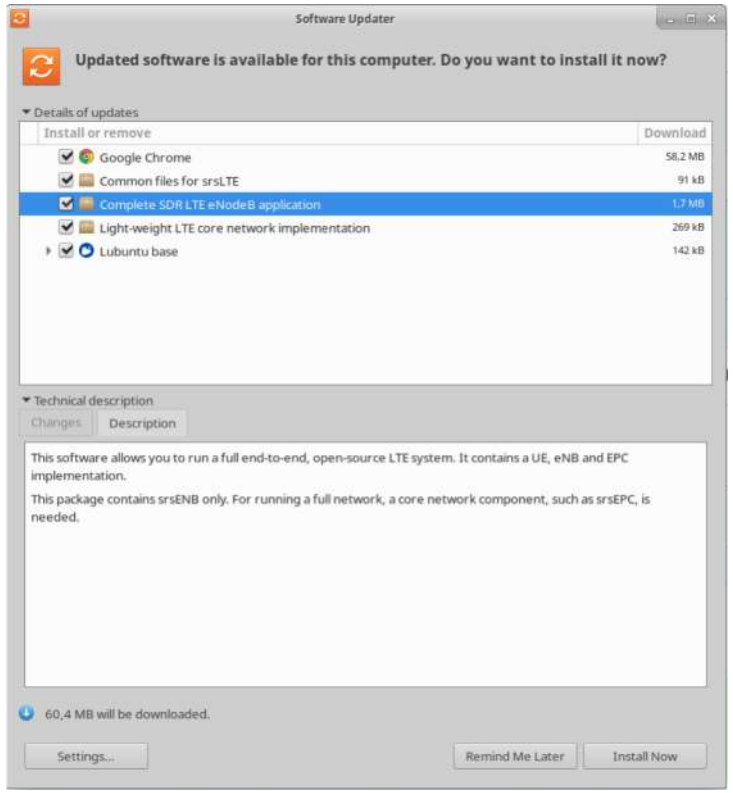
1 → 4 of 4 results

Package	Version
srslte	19.03-0ubuntu1~srslte1~19.04
srslte	19.03-0ubuntu1~srslte1~18.10
srslte	19.03-0ubuntu1~srslte1~18.04
srslte	19.03-0ubuntu1~srslte1~16.04

1 → 4 of 4 results

Install the latest srsLTE release for Ubuntu:

```
$ sudo add-apt-repository ppa:srslte/releases
$ sudo apt-get update
$ sudo apt-get install srslte -y
```



launchpad.net/~srslte

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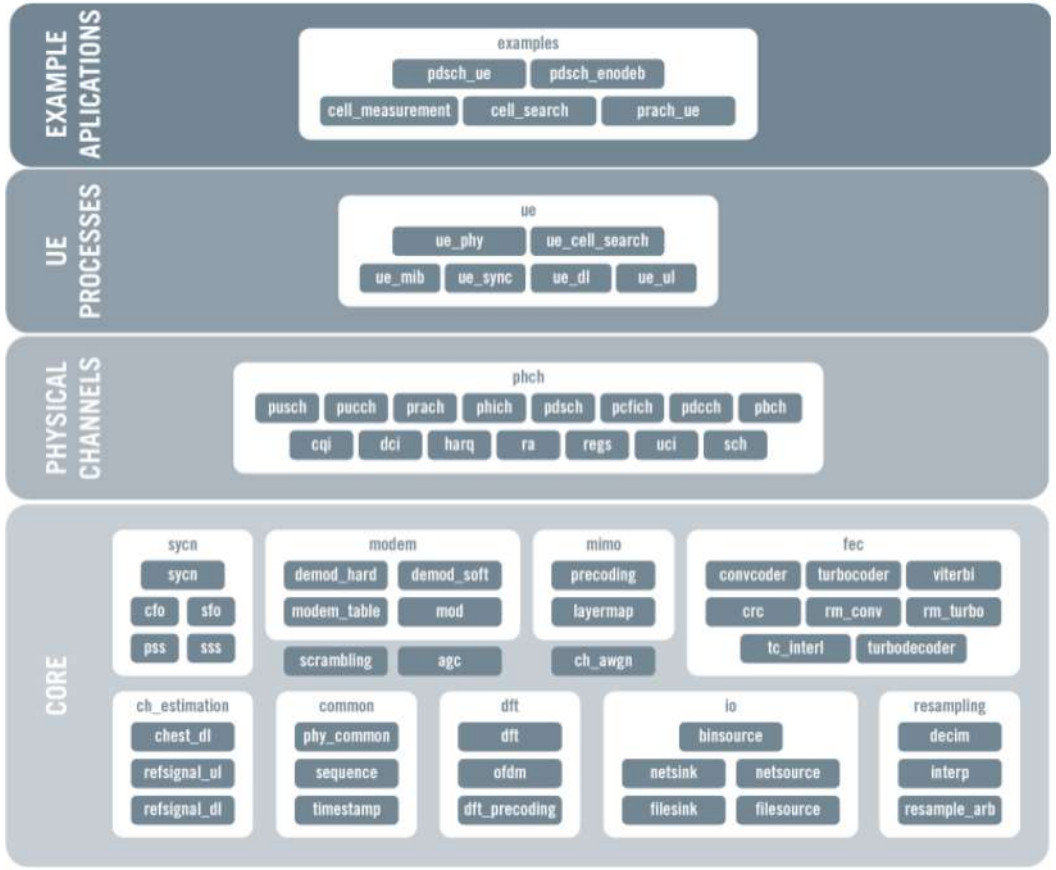
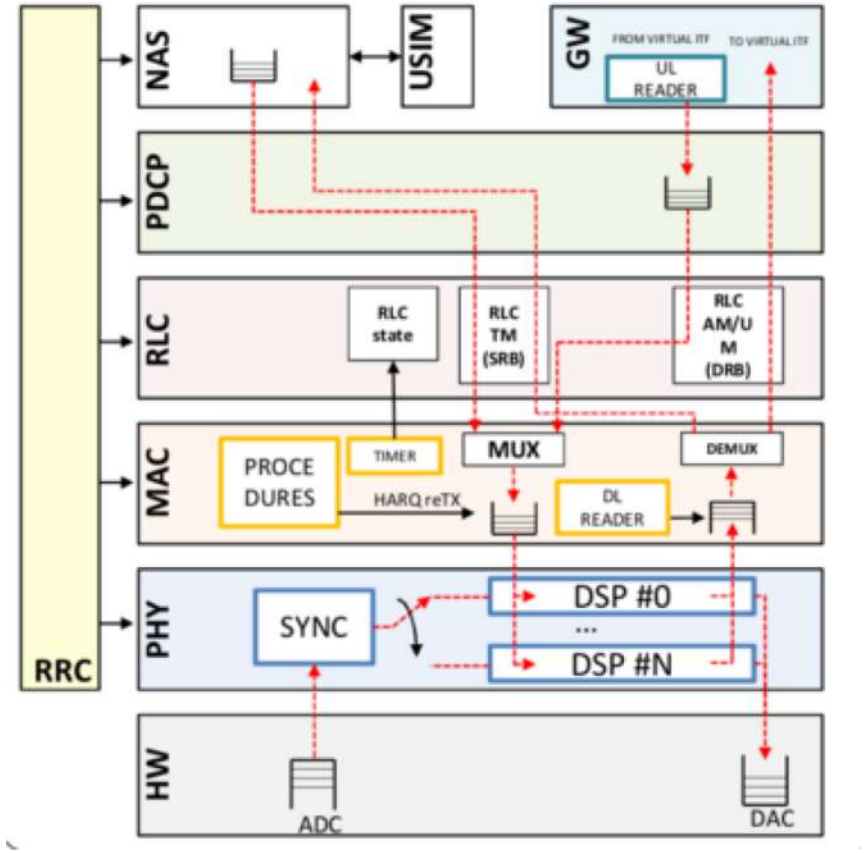
Clean Modular Architecture





Clean Modular Architecture

```
// NAS interface for UE
class nas_interface_gw
{
public:
  virtual bool attach_request() = 0;
};

// RRC interface for MAC
class rrc_interface_mac_common
{
public:
  virtual void ra_problem() = 0;
};

class rrc_interface_mac : public rrc_interface_mac_common
{
public:
  virtual void ho_ra_completed(bool ra_successful) = 0;
  virtual void release_pucch_srs() = 0;
  virtual void run_tti(uint32_t tti) = 0;
};

// RRC interface for PHY
class rrc_interface_phy
{
public:
  virtual void in_sync() = 0;
  virtual void out_of_sync() = 0;
  virtual void new_phy_meas(float rsrp, float rsrq, uint32_t tti, int earfcn = -1, int pci = -1) = 0;
};

// RRC interface for NAS
class rrc_interface_nas
{
public:
  typedef struct {
    LIBLTE_RRC_PLMN_IDENTITY_STRUCT plmn_id;
    uint16_t                        tac;
  } found_plmn_t;

  const static int MAX_FOUND_PLMNS = 16;

  virtual void write_sdu(uint32_t lcid, srslte::byte_buffer_t *sdu) = 0;
  virtual uint16_t get_mcc() = 0;
  virtual uint16_t get_mnc() = 0;
  virtual void enable_capabilities() = 0;
  virtual int plmn_search(found_plmn_t found_plmns[MAX_FOUND_PLMNS]) = 0;
```

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Active Community

srslte-users -- srsLTE users mailing list

About srslte-users

srsLTE is an open-source software radio library for the 3GPP LTE wireless interface written in C. This list is for discussion and support of the library.

To see the collection of prior postings to the list, visit the srslte-users Archives.

Using srslte-users

To post a message to all the list members, send email to srslte-users@lists.softwareradiosystems.com.

You can subscribe to the list, or change your existing subscription, in the sections below.

Subscribing to srslte-users

Subscribe to srslte-users by filling out the following form. You will be sent email requesting confirmation, to prevent others from gratuitously subscribing you. This is a private list, which means that the list of

Your email address:

Your name (optional):

You may enter a privacy password below. This provides only mild security, but should prevent others from messing with your subscription. **Do not use a valuable password** as it will occasionally be emailed back to you in cleartext.

If you choose not to enter a password, one will be automatically generated for you, and it will be sent to you once you've confirmed your subscription. You can always request a mail-back of your password when you edit your personal options. Once password will be emailed to you as a reminder.

Pick a password:

Reenter password to confirm:

Which language do you prefer to display your messages? English (USA)

Would you like to receive list mail batched in a daily digest? No Yes

Subscribe

srslte-users Subscribers

(*The subscribers list is only available to the list members.*)

Enter your address and password to visit the subscribers list:

Address: Password: ••••••••• Visit Subscriber List

To unsubscribe from srslte-users, get a password reminder, or change your subscription options enter your subscription email address:

Unsubscribe or edit options

If you leave the field blank, you will be prompted for your email address

rslte-users list run by paul at softwareradiosystems.com
rslte-users administrative interface (requires authorization)
Overview of all lists.softwareradiosystems.com mailing lists

Mailman
Version 2.1.16

PYTHON POWERED

June 2019 Archives by thread

- **Messages sorted by:** [subject] [author] [date]
- **More info on this list...**

Starting: *Sun Jun 2 12:41:41 UTC 2019*
Ending: *Tue Jun 25 13:13:34 UTC 2019*
Messages: 91

- [srslte-users] Version 19.03 PRB 100 issue *Bilal Maqsood*
  - [srslte-users] Version 19.03 PRB 100 issue *Cedric Roux*
  - [srslte-users] Version 19.03 PRB 100 issue *Ismael Gomez*
- [srslte-users] Steps to configure USIM card from sysmocom *Nehemiah Chan*
- [srslte-users] srsLTE project and questions *Mihai Craciun*
- [srslte-users] SRS eNB and UE *Saimanoj Katta*
  - [srslte-users] SRS eNB and UE *Andre Puschmann*
- [srslte-users] EPC and eNodeB in separate machine *Federico Quattrin*
  - [srslte-users] EPC and eNodeB in separate machine *Pedro Alvarez*
    - [srslte-users] EPC and eNodeB in separate machine *Pedro Alvarez*
- [srslte-users] zmq driver help *Roberto Bruschi*
- [srslte-users] Resampling on N210 *Federico Quattrin*
- [srslte-users] LimeSDR USB crash when enb *Federico Quattrin*
  - [srslte-users] LimeSDR USB crash when enb *Andre Puschmann*
- [srslte-users] Having troubles to connect srsUE with srsENB *Mohammed Jabi*
  - [srslte-users] Having troubles to connect srsUE with srsENB *Justin Tallon*
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- [srslte-users] Having difficulties on SIMcard configuration using pySim *Nehemiah Chan*
  - [srslte-users] Having difficulties on SIMcard configuration using pySim *David Rupprecht*
    - [srslte-users] Having difficulties on SIMcard configuration using pySim *Nehemiah Chan*
- [srslte-users] SRS UE connecting to commercial network *Saimanoj Katta*
  - [srslte-users] SRS UE connecting to commercial network *Andre Puschmann*
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      - [srslte-users] SRS UE connecting to commercial network *Ismael Gomez*
- [srslte-users] Troubles for configuration the mobile phone as the UE *Nehemiah Chan*
- [srslte-users] pdsch_ue fails to decode MIB when using 2 antennas *Yaxiong Xie*
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    - [srslte-users] pdsch_ue fails to decode MIB when using 2 antennas *Yaxiong Xie*
- [srslte-users] Problem with srsLTE installation with No Hardware *Shahini, Ali*
- [srslte-users] Troubles for configuration the mobile phone as the UE(updated with the log files) *Nehemiah Chan*
- [srslte-users] Advice on the USIM card configuration *Nehemiah Chan*
  - [srslte-users] Advice on the USIM card configuration *laurent91*

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srsLTE Project on Twitter

yomna 🌙 يمنى
@yomnapple

Replying to @yomnapple

- New hardware + software is needed to do research in each generation. (Shout out to @SrsSystems for enabling so much LTE security research through #srsLTE! ✨)

♡ 7 8:54 PM - May 22, 2019

See yomna 🌙 يمنى's other Tweets

Roger
@Rgoestotheshows

Replying to @AndrePuschmann @SrsSystems

I nominate @SrsSystems and #srslte to the hall of fame of #MobileSecurity research!!! It would not be possible without this tool :)

♡ 5 5:50 PM - Apr 3, 2019

See Roger's other Tweets

Domonkos Tomcsanyi
@domi007

Replying to @AndrePuschmann @SrsSystems

srsLTE is simply the perfect combination of simple & easy to understand codebase with surprisingly good amount of functionality included :) like it everyday when I use it

♡ 4 10:55 PM - Feb 23, 2019

See Domonkos Tomcsanyi's other Tweets

Andre Puschmann
@AndrePuschmann

Another great example of how #srsLTE is used.@SrsSystems twitter.com/yongdaek/statu…

> **Yongdae Kim** @yongdaek
> In this sensitive era, we got CVE from @Huawei using #LTEFuzz :-)huawei.com/en/psirt/secur…

♡ 18 7:22 PM - May 31, 2019

See Andre Puschmann's other Tweets

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Active Community

srsLTE for Research

University studies and published research involving srsLTE

Privacy attacks to the 4g and 5g cellular paging protocols using side channel information
AUTHORS: Syed Rafiul Hussain, Mitziu Echeverria, Omar Chowdhury, N...
2019

Cellular access multi-tenancy through small-cell virtualization and common rf front-end sharing
AUTHORS: Jose Mendes, XianJun Jiao, Andres Garcia-Saavedra, Felipe...
2019

Machine learning based uplink transmission power prediction for lte and upcoming 5g networks using passive downlink indicators
AUTHORS: Robert Falkenberg, Benjamin Sliwa, Nico Piatkowski, and C...
2018

User-targeted denial-of-service attacks in lte mobile networks
AUTHORS: Rami Ghannam, Filipo Sharevski, and Anthony Chung
2018

Guti reallocation demystified: Cellular location tracking with changing temporary identifier
AUTHORS: Byeongdo Hong, Sangwook Bae, and Yongdae Kim
2018

Learning from errors: Detecting cross-technology interference in wifi networks
AUTHORS: Daniele Croce, Domenico Garlisi, Fabrizio Giuliano, Nicol...
2018

Practical distributed MIMO for WiFi and LTE
AUTHORS: Ezzeldin Omar Hussein Hamed
2018

Lasr: A supple multi-connectivity scheduler for multi-rat ofdma systems
AUTHORS: Luis Diez, Andres Garcia-Saavedra, Victor Valls, Xi Li, X...
2018

Despliegue de un prototipo de red 4g-lte con openairinterface para entorno didáctico
AUTHORS: David Martínez García
2018

Maximizing the utility of radio networks through sharing mechanisms
AUTHORS: David Candal Ventureira
2018

A practical approach to cellular communications standards education
AUTHORS: Vuk Marojevic, Antonio José Gelonch Bosch, and J Reed
2018

Monitorización y estudio de redes celulares en explotación a través de dispositivos usrp
AUTHORS: Alejandro González Valle et al
2018

1 2 3 4 5 6 7 8 9 10 11

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Sustainable Business Model

Feb
15
2017

SMARTSKY NETWORKS

SRS partners with SmartSky Networks to deliver true 4G inflight connectivity

Software Radio Systems (SRS) today announced a strategic partnership with SmartSky Networks, a high-performance air-to-ground connectivity network operator, in which SRS will provide test and validation solutions for SmartSky's airborne products. Based on aviation-specific modifications to 4G wireless communications standards, SmartSky 4G delivers affordable and reliable office-like connectivity in the air. As a leading provider...

Details »

15th February 2017 / Press / By Paul Sutton

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airSCOPE

AirScope is a low-cost software radio LTE air interface analyzer. It provides real-time over-the-air decoding capabilities for network analysis using standard PC and general purpose SDR frontends. AirScope captures the DL signal of an LTE network, decodes the PDCCH channel for all active users in the cell and provides cell-wide and per-user statistics on UL/DL utilization, modulation formats, transferred bytes, etc.

AirScope is available under a commercial license. For more information, see our data sheet.

Current Features:

- LTE Release 8 compliant
- FDD configuration
- Tested bandwidths: 1.4, 3, 5 and 10 and 20 MHz
- Supported modes: TM1 and TM2 (TM3/4 available soon)
- Real-time PDCCH, PDSCH and PHICH decoding
- Hex-dump of all captured SIB and Paging messages
- Cell analytics: number of active users, throughput, time/frequency utilization, average MCS, etc.
- Signal quality measurements: RSRQ, RSRP, SINR, RSSI, CFO
- NB-IoT extension for M2M traffic

SRS SOFTWARE RADIO SYSTEMS

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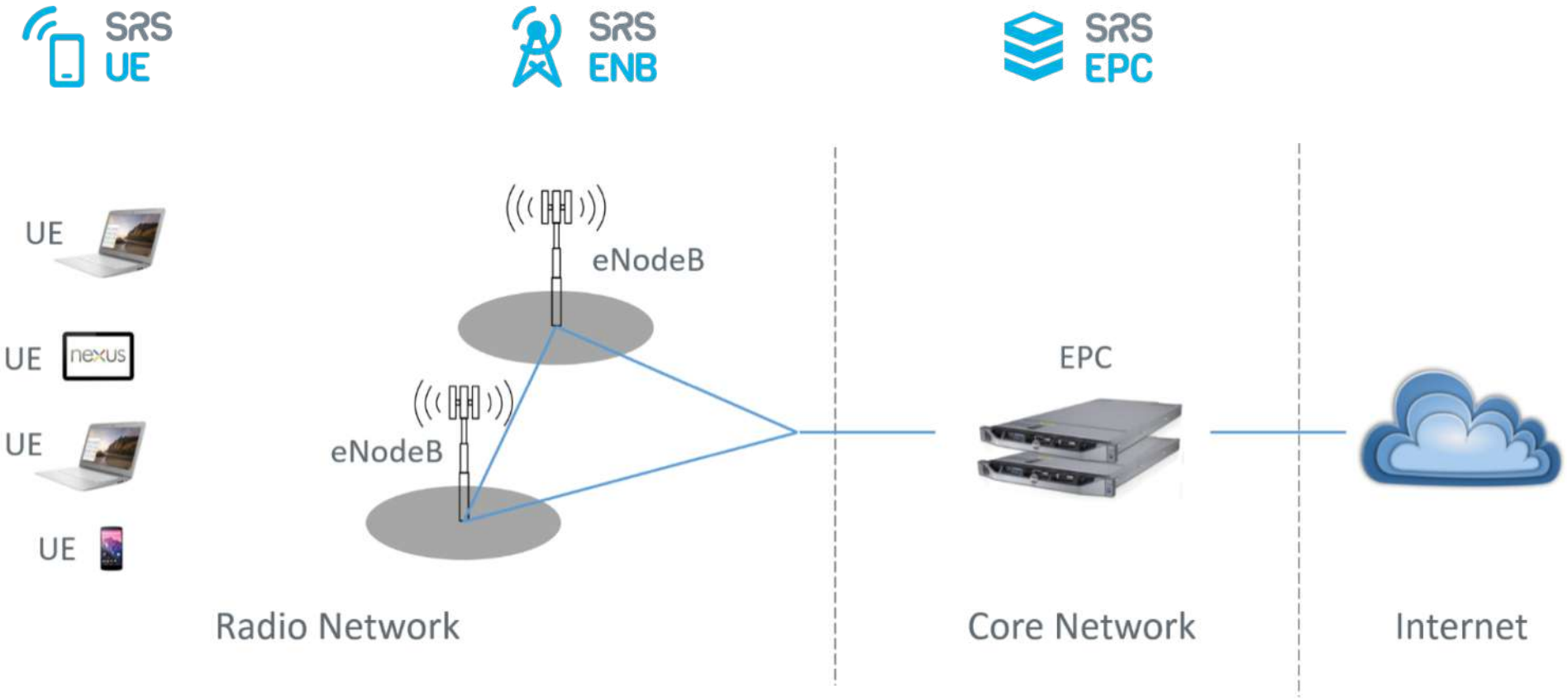
Baseline End-to-End System



SRSLTE

Current Status

Common Features

- LTE Release 10 aligned
- Tested bandwidths: 1.4, 3, 5, 10, 15 and 20 MHz
- Transmission mode 1 (single antenna), 2 (transmit diversity), 3 (CCD) and 4 (closed-loop spatial multiplexing)
- Frequency-based ZF and MMSE equalizer
- Evolved multimedia broadcast and multicast service (eMBMS)
- Highly optimized Turbo Decoder available in Intel SSE4.1/AVX2 (+100 Mbps) and standard C (+25 Mbps)
- MAC, RLC, PDCP, RRC, NAS, S1AP and GW layers
- Detailed log system with per-layer log levels and hex dumps
- MAC layer wireshark packet capture
- Command-line trace metrics
- Detailed input configuration files
- Channel simulator for EPA, EVA, and ETU 3GPP channels
- ZeroMQ-based fake RF driver for I/Q over IPC/network

srsUE Features

- FDD and TDD configuration
- Carrier Aggregation support
- Cell search and synchronization procedure for the UE
- Soft USIM supporting Milenage and XOR authentication
- Hard USIM support using PCSC framework
- Virtual network interface *tun_srsue* created upon network attach
- 150 Mbps DL in 20 MHz MIMO TM3/TM4 configuration in i7 Quad-Core CPU.
- 75 Mbps DL in 20 MHz SISO configuration in i7 Quad-Core CPU.
- 36 Mbps DL in 10 MHz SISO configuration in i5 Dual-Core CPU.

srsUE has been fully tested and validated with the following network equipment:

- Amarisoft LTE100 eNodeB and EPC
- Nokia FlexiRadio family FSMF system module with 1800MHz FHED radio module and TravelHawk EPC simulator
- Huawei DBS3900
- Octasic Flexicell LTE-FDD NIB

srsENB Features

- FDD configuration
- Round Robin MAC scheduler with FAPI-like C++ API
- SR support
- Periodic and Aperiodic CQI feedback support
- Standard S1AP and GTP-U interfaces to the Core Network
- 150 Mbps DL in 20 MHz MIMO TM3/TM4 with commercial UEs
- 75 Mbps DL in SISO configuration with commercial UEs
- 50 Mbps UL in 20 MHz with commercial UEs
- User-plane encryption

srsENB has been tested and validated with the following handsets:

- LG Nexus 5 and 4
- Motorola Moto G4 plus and G5
- Huawei P9/P9lite, P10/P10lite, P20/P20lite
- Huawei dongles: E3276 and E398

srsEPC Features

- Single binary, light-weight LTE EPC implementation with:
  - MME (Mobility Management Entity) with standard S1AP and GTP-U interface to eNB
  - S/P-GW with standard SGi exposed as virtual network interface (TUN device)
  - HSS (Home Subscriber Server) with configurable user database in CSV format
- Support for paging

Baseline End-to-End System

Baseline End-to-End System

```
Searching for cell...
Found CELL ID: 1 CP: Normal  , CFO: 0.1 KHz.
Trying to decode MIB...
 - Cell ID:         1
 - Nof ports:       1
 - CP:              Normal
 - PRB:             50
 - PHICH Length:    Normal
 - PHICH Resources: 1
 - SFN:             0
MIB received BW=10 MHz
Setting Sampling frequency 11.52 MHz
SIB1 received, CellID=1,  PLMN Id: MCC 1 MNC 1
SIB2 received
Random Access Transmission: seq=2, ra-rnti=5
Random Access Complete.     c-rnti=63, ta=1
RRC Connected
Network attach succesful.   IP: 192.168.3.2
```

Console Applications

Baseline End-to-End System

```
------DL--------------------------------UL--------------------------------
rnti   cqi ri      mcs  brate   bler   snr  phr   mcs  brate   bler   bsr
46     15  2.00    28   149M   0.5%    22    13    13    11k     0%    0.0
46     15  2.00    28   148M   0.8%    21    13    11    11k     0%    0.0
46     15  2.00    28   148M   0.9%    22    13    13   9.8k     0%    0.0
46     15  2.00    28   148M   0.8%    22    13    14    15k     0%    0.0
46     15  2.00    28   147M     1%    22    13    13   8.7k     0%    0.0
46     15  2.00    28   149M   0.6%    22    13    13   7.6k     0%    0.0
46     15  2.00    28   148M     1%    22    13    13    11k     0%    0.0
46     15  2.00    28   149M   0.3%    22    13    14   7.9k     0%    0.0
46     15  2.00    28   149M   0.4%    21    13    12   8.3k     0%    0.0
46     15  2.00    28   149M   0.5%    21    13    12    15k     0%    0.0
46     15  2.00    28   149M   0.4%    21    14    12   9.5k     0%    0.0

------DL--------------------------------UL--------------------------------
rnti   cqi ri      mcs  brate   bler   snr  phr   mcs  brate   bler   bsr
46     15  2.00    28   147M     1%    21    13   9.7    13k     0%    0.0
46     15  2.00    28   149M   0.9%    21    13    11   9.5k     0%    0.0
46     15  2.00    27   145M     2%    21    13    11    10k     0%    0.0
46     15  2.00    28   148M   0.5%    21    13    12    10k     0%    0.0
46     15  2.00    28   150M   0.2%    22    14    13    10k     0%    0.0
46     15  2.00    28   148M     1%    22    13    13    10k     0%    0.0
```

Real-Time Metrics

Baseline End-to-End System

```
13:32:25.355095 [PHY ] Info    [01696] PDSCH: rnti=0x2, Format1A, l_crb= 4, tbs=    9, mcs= 0, rv=0, crc=OK, snr= 9.1 dB
13:32:25.355104 [PHY ] Info    [01696] RAR:   RAPID=47, TA=4, RNTI=0x9080
13:32:25.355108 [MAC ] Info    [01696] New C-RNTI=0x9080 from RAR: RAPID=47, TA=4
13:32:25.355111 [PHY ] Info    [01696] PDCCH: rnti=0x2, Format1A, L=8, ncce=  0, ber=0.02
13:32:25.355184 [MAC ] Info    [01696] UL:    rnti=0x90ba, n_prb=  3, mcs= 4, tbs=26, rv=0, tpc=1, total_ul=0.21 kb
13:32:25.355190 [PHY ] Info    [01696] PDCCH: rnti=0x90ba, Format0 , L=8, ncce=  8, ber=0.00
13:32:25.355582 [MAC ] Info    [01696] UL:    rnti=0x8e04, n_prb=  4, mcs=10, tbs=85, rv=0, tpc=1, total_ul=0.87 kb
13:32:25.355588 [PHY ] Info    [01696] PDCCH: rnti=0x8e04, Format0 , L=2, ncce= 18, ber=0.01
13:32:25.356062 [MAC ] Info    [01697] UL:    rnti=0x90ba, n_prb=  3, mcs= 2, tbs=18, rv=0, tpc=1, total_ul=0.23 kb
13:32:25.356074 [PHY ] Info    [01697] PDCCH: rnti=0x90ba, Format0 , L=8, ncce=  0, ber=0.01
13:32:25.357868 [MAC ] Info    [01698] UL:    rnti=0x90ba, n_prb=  3, mcs= 4, tbs=26, rv=0, tpc=1, total_ul=0.26 kb
13:32:25.357880 [PHY ] Info    [01699] PDCCH: rnti=0x90ba, Format0 , L=8, ncce=  8, ber=0.00
13:32:25.358098 [PHY ] Info    [01699] PDSCH: rnti=0xfffe, Format1A, l_crb= 5, tbs=   13, mcs= 0, rv=0, crc=OK, snr= 7.3 dB
13:32:25.358108 [PHY ] Info    [01699] PDCCH: rnti=0xfffe, Format1A, L=8, ncce=  0, ber=0.02
13:32:25.358620 [MAC ] Info    [01699] UL:    rnti=0x90ba, n_prb=  3, mcs= 4, tbs=26, rv=0, tpc=1, total_ul=0.28 kb
13:32:25.358626 [PHY ] Info    [01699] PDCCH: rnti=0x90ba, Format0 , L=8, ncce= 16, ber=0.01
13:32:25.359143 [PHY ] Info    [01700] Cell-wide stats: cfi=2, snr=6.7 dB, rsrp=-1.3 dB, rsrq=-13.9 dB, rssi=0.1 dB
13:32:25.359688 [MAC ] Info    [01700] UL:    rnti=0x90a0, n_prb=  3, mcs= 0, tbs=7, rv=0, tpc=1, total_ul=1.25 kb
13:32:25.359694 [PHY ] Info    [01700] PDCCH: rnti=0x90a0, Format0 , L=8, ncce=  8, ber=0.00
13:32:25.360133 [MAC ] Info    [01701] UL:    rnti=0x90a0, n_prb=  3, mcs= 0, tbs=7, rv=0, tpc=1, total_ul=1.25 kb
13:32:25.360145 [PHY ] Info    [01701] PDCCH: rnti=0x90a0, Format0 , L=8, ncce=  0, ber=0.01
13:32:25.360633 [MAC ] Info    [01701] DL:    rnti=0x8ec5, n_prb=  4, mcs1= 1, tbs1=18, mcs2= 0, tbs2=11, rv=0, total_dl=0.17 kb
13:32:25.360638 [PHY ] Info    [01701] PDCCH: rnti=0x8ec5, Format2A, L=8, ncce= 16, ber=0.01
```

Detailed Log Files

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Baseline End-to-End System

No.	Time	Source	Destination	Protocol	mME-UE-S1AP-ID	eNB-UE-S1AP-ID	Info
55	0.872941			LTE RRC DL_DCCH			MAC=0xb1f107fb (96 bytes data) [101-bytes]
56	0.873828			LTE RRC PCCH			Paging (1 PagingRecords)
57	0.880070			LTE RRC DL_SCH			SystemInformationBlockType1
58	0.883784			LTE RRC PCCH			Paging (6 PagingRecords)
59	0.893731			LTE RRC PCCH			Paging (4 PagingRecords)
60	0.898199			RLC-LTE			[DL] [AM] SRB:1 [CONTROL] ACK_SN=23
61	0.901780			MAC-LTE			RAR (RA-RNTI=1, SFN=0 , SF=7) (RAPID=18[GroupA]: TA=2, UL-Grant=106008, T
62	0.913690			LTE RRC PCCH			Paging (1 PagingRecords)
63	0.923754			LTE RRC PCCH			Paging (1 PagingRecords)
64	0.931804			MAC-LTE			RAR (RA-RNTI=1, SFN=0 , SF=7) (RAPID=4[GroupA]: TA=4, UL-Grant=148504, Te
65	0.933784			LTE RRC PCCH			Paging (1 PagingRecords)
66	0.943729			LTE RRC PCCH			Paging (1 PagingRecords)
67	0.945728			LTE RRC DL_CCCH			RRCConnectionSetup
68	0.950702			MAC-LTE			RAR (RA-RNTI=1, SFN=0 , SF=6) (RAPID=47[Non-RA]: TA=2, UL-Grant=109144, T
69	0.955232			MAC-LTE			DL-SCH: (SFN=0 , SF=0) UEId=0 (Timing Advance) (Padding:remainder)
70	0.959772			LTE RRC DL_SCH			SystemInformationBlockType1
71	0.961497			RLC-LTE			[DL] [AM] SRB:1 [CONTROL] ACK_SN=1
72	0.963647			LTE RRC PCCH			Paging (1 PagingRecords)
73	0.965230			RLC-LTE			[DL] [AM] SRB:1 [CONTROL] ACK_SN=1
74	0.966699			LTE RRC DL_SCH			SystemInformation [SIB2 SIB3]

```
▾ uplinkPowerControlDedicated
    p0-UE-PUSCH: 0dB
    deltaMCS-Enabled: en0 (0)
    .... ...1 accumulationEnabled: True
    p0-UE-PUCCH: 0dB
    pSRS-Offset: 5
    filterCoefficient: fc6 (6)
▾ tpc-PDCCH-ConfigPUCCH: release (0)
    release: NULL
▾ tpc-PDCCH-ConfigPUSCH: release (0)
    release: NULL
▾ cqi-ReportConfig
    cqi-ReportModeAperiodic: rm30 (3)
    nomPDSCH-RS-EPRE-Offset: 0dB (0)
  ▾ cqi-ReportPeriodic: setup (1)
    ▾ setup
        cqi-PUCCH-ResourceIndex: 8
        cqi-pmi-ConfigIndex: 20
      ▾ cqi-FormatIndicatorPeriodic: widebandCQI (0)
          widebandCQI: NULL
        ri-ConfigIndex: 644
        .0.. .... simultaneousAckNackAndCQI: False
▾ soundingRS-UL-ConfigDedicated: setup (1)
  ▾ setup
      srs-Bandwidth: bw2 (2)
      srs-HoppingBandwidth: hbw0 (0)
      freqDomainPosition: 15
```

Wireshark Packet Captures

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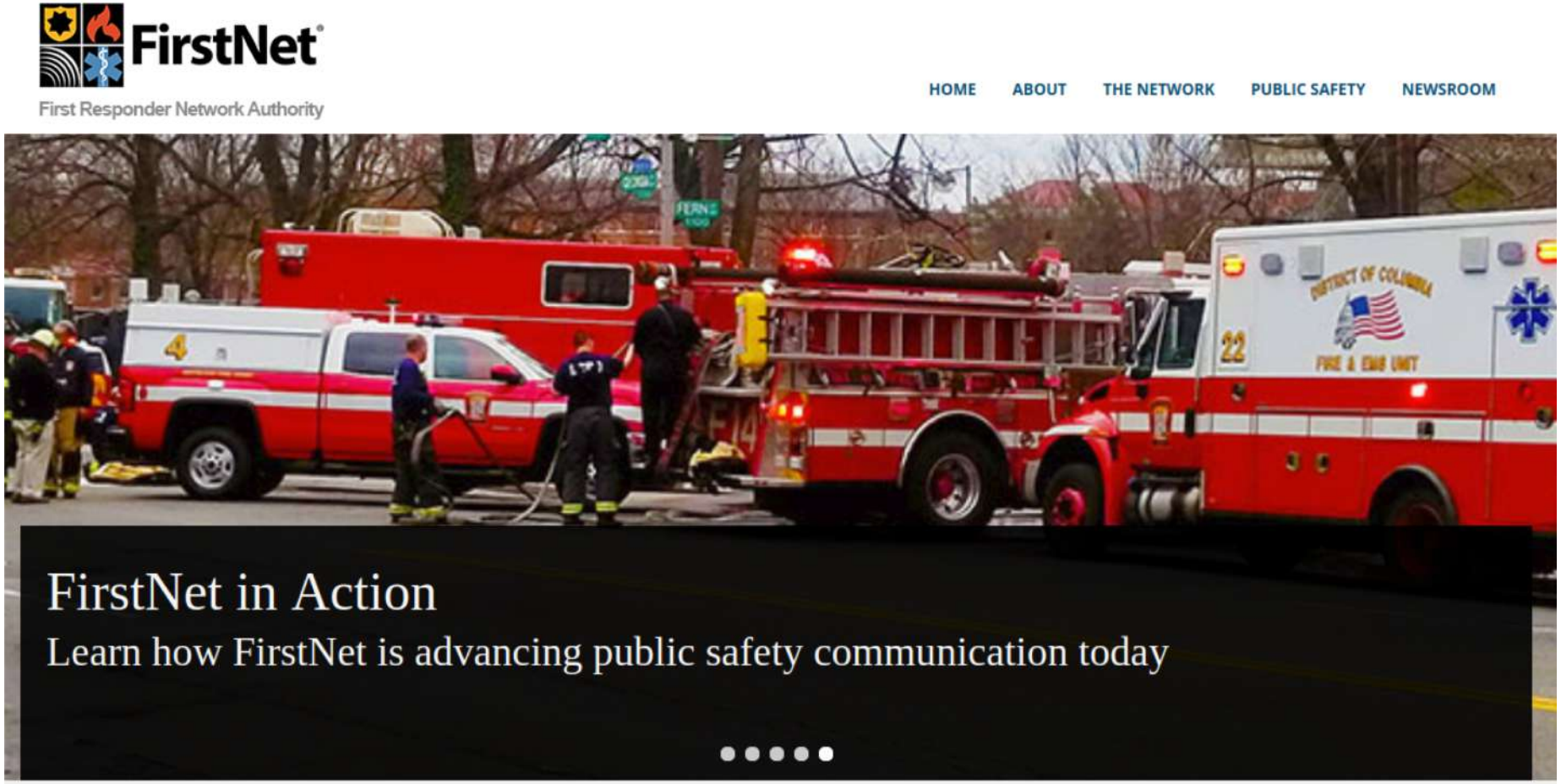
Impact



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3/28/19 4:31pm • Filed to: EVERYTHING CAN BE HACKED

13.3K 7 3

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You could intercept calls and track a phone's location.

Jon Fingas, @jonfingas
02.25.19 in Security

Comments

622
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Emergency presidential alert texts could be faked, researchers say

Fake presidential alerts could be sent to tens of thousands of phones, according to a report out of the University of Colorado Boulder.

BY CORINNE REICHERT | JUNE 20, 2019 2:29 PM PDT

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Published on June 26, 2019

Roger Piqueras Jover
Senior Security Architect at Bloomberg LP

3 articles ✓ Following

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https://www.linkedin.com/pulse/impact-open-source-mobile-security-research-roger-piqueras-jover/

Breaking LTE on Layer Two

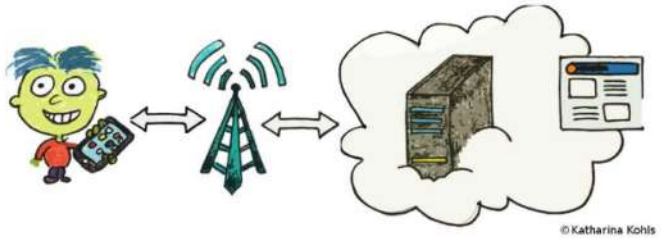
David Rupprecht, Katharina Kohls, Thorsten Holz, and Christina Pöpper

Ruhr-Universität Bochum & New York University Abu Dhabi

Introduction

Security Analysis of Layer Two

Our security analysis of the mobile communication standard LTE (Long-Term Evolution, also know as 4G) on the data link layer (so called *layer two*) has uncovered three novel attack vectors that enable different attacks against the protocol. On the one hand, we introduce two passive attacks that demonstrate an *identity mapping* attack and a method to perform *website fingerprinting*. On the other hand, we present an active cryptographic attack called *aLTEr attack* that allows an attacker to redirect network connections by performing DNS



https://alter-attack.net/

LTEFuzz

Touching the Untouchables

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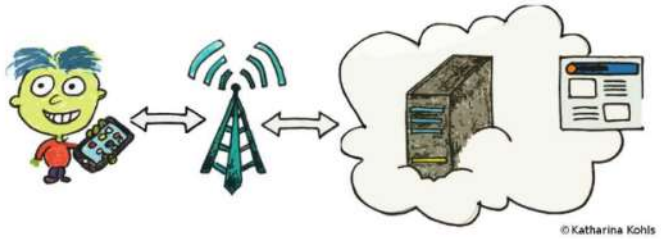

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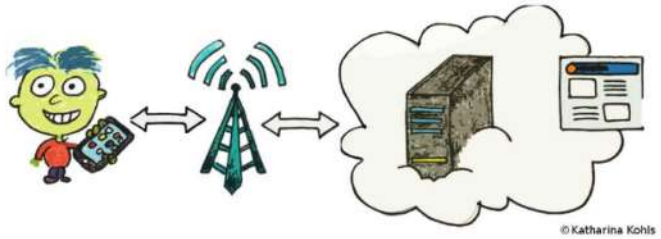

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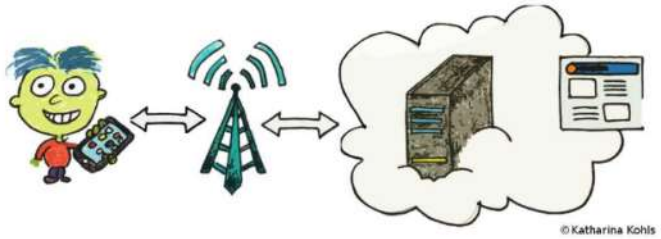

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https://www.linkedin.com/pulse/reflection-history-cellular-security-research-outlook-piqueras-jover/

"Currently srsLTE is by far the best and most widely used – both in academia and industry – tool for LTE security research"

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srsLTE Project on Twitter

yomna 🌙 يمنى
@yomnapple

Replying to @yomnapple

- New hardware + software is needed to do research in each generation. (Shout out to @SrsSystems for enabling so much LTE security research through #srsLTE! ✨)

♡ 7 8:54 PM - May 22, 2019

See yomna 🌙 يمنى's other Tweets

Roger
@Rgoestotheshows

Replying to @AndrePuschmann @SrsSystems

I nominate @SrsSystems and #srslte to the hall of fame of #MobileSecurity research!!! It would not be possible without this tool :)

♡ 5 5:50 PM - Apr 3, 2019

See Roger's other Tweets

Domonkos Tomcsanyi
@domi007

Replying to @AndrePuschmann @SrsSystems

srsLTE is simply the perfect combination of simple & easy to understand codebase with surprisingly good amount of functionality included :) like it everyday when I use it

♡ 4 10:55 PM - Feb 23, 2019

See Domonkos Tomcsanyi's other Tweets

Andre Puschmann
@AndrePuschmann

Another great example of how #srsLTE is used.@SrsSystems twitter.com/yongdaek/statu…

> **Yongdae Kim** @yongdaek
> In this sensitive era, we got CVE from @Huawei using #LTEFuzz :-)huawei.com/en/psirt/secur…

♡ 18 7:22 PM - May 31, 2019

See Andre Puschmann's other Tweets

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Security

> Home > GSMA Coordinated Vulnerability Disclosure (CVD) Programme

GSMA Coordinated Vulnerability Disclosure (CVD) Programme

GSMA Mobile Security Hall of Fame

CVD-2018	0007	Altaf Shaik	Technical University of Berlin and Kaitiaki Labs https://www.isti.tu-berlin.de/security_in_telecommunications
CVD-2018	0007	Ravishankar Borgaonkar	SINTEF Digital and Kaitiaki Labs https://www.sintef.no/en/cyber-security/#/
CVD-2018	0008	David Rupprecht Katharina Kohls Christina Pöpper Thorsten Holz	Ruhr University Bochum and New York University Abu Dhabi https://www.alter-attack.net
CVD-2018	0012	David Basin Jannik Dreier Lucca Hirschi Saša Radomirović Ralf Sasse Vincent Stettler	ETH Zurich, Université de Lorraine CNRS, Inria, University of Dundee https://arxiv.org/abs/1806.10360
CVD-2018	0014	Elisa Bertino	Purdue University https://www.cs.purdue.edu/homes/bertino/
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CVD-2018	0014	Mitziu Echeverria	University of Iowa
CVD-2018	0014	Syed Rafiul Hussain	Purdue University https://relentless-warrior.github.io/
CVD-2018	0014	Ninghui Li	Purdue University https://www.cs.purdue.edu/homes/ninghui/

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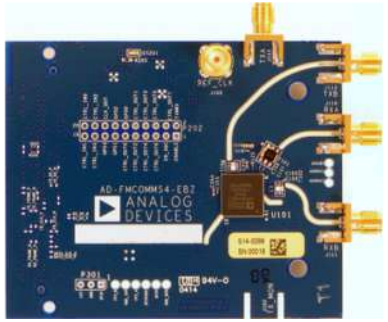
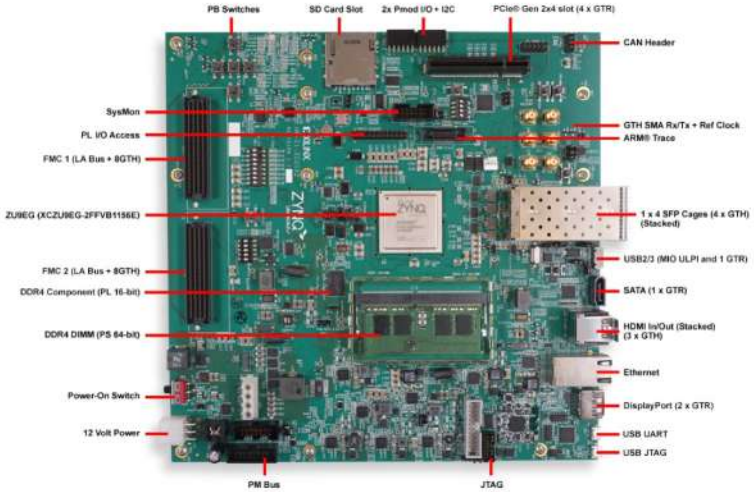
- **Target SDR platforms:** MPSoC (FPGA + multi-core CPU(s))
  - FPGA is a co-processor to accelerate selected DSP functions
    - Combination of custom HDL code + 3rd party IP cores (e.g., turbo-decoder)
  - srsLTE code will need to be (minimally) adapted (i.e., FPGA integration)

- **Design goal:** portable design
  - Support different platforms with minimal/no changes to the code

- **Starting point:** Xilinx Ultrascale+ & AD FMCOMMS4
  - FPGA is also implementing timestamping (e.g., AD936x chips)



Analog Devices AD-FMCOMMS4-EBZ FMC Board with AD9364



Xilinx ZCU102 eval board with ZU9EG Ultrascale+ MPSoC

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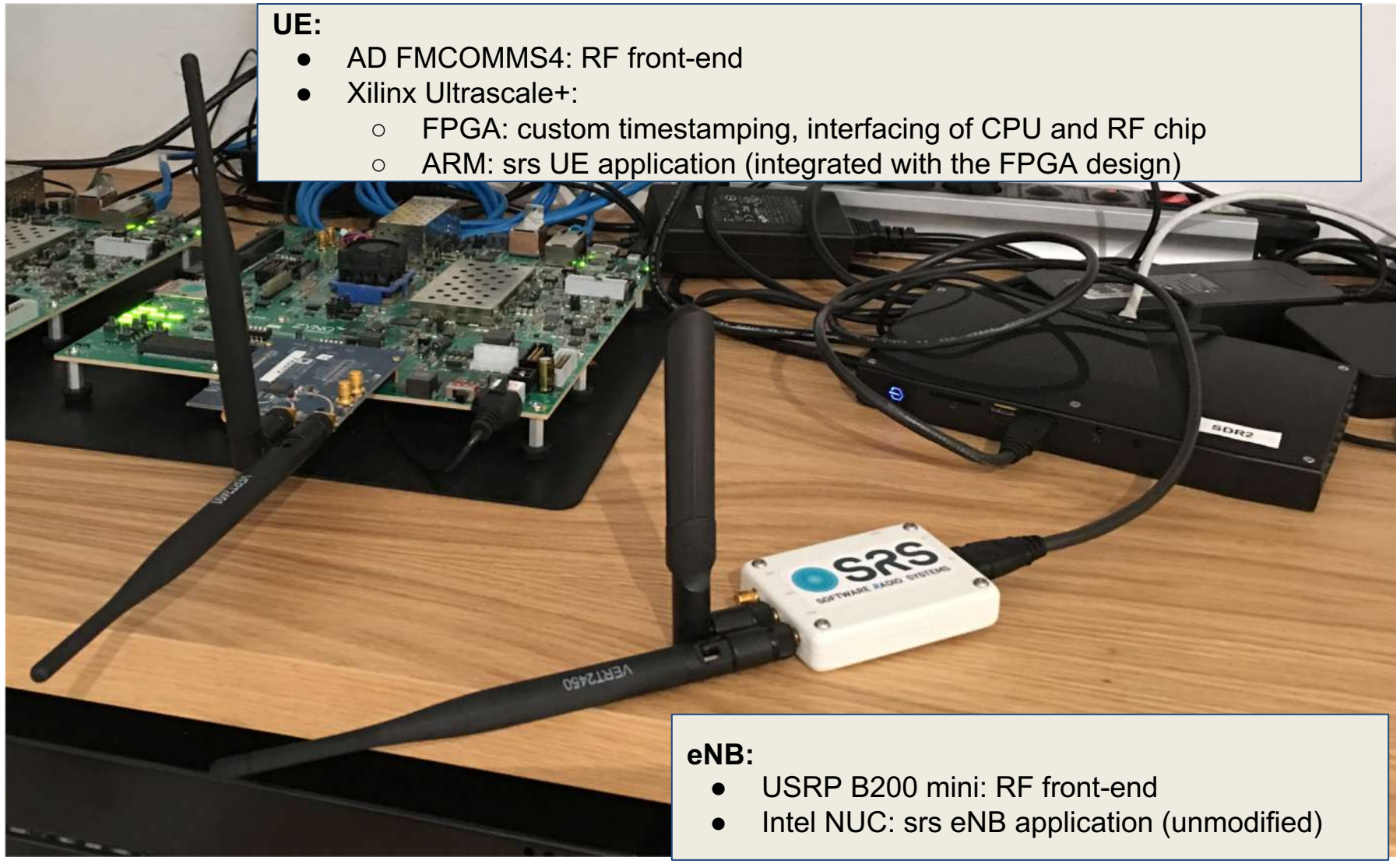

UE:

- AD FMCOMMS4: RF front-end
- Xilinx Ultrascale+:
  - FPGA: custom timestamping, interfacing of CPU and RF chip
  - ARM: srs UE application (integrated with the FPGA design)

eNB:

- USRP B200 mini: RF front-end
- Intel NUC: srs eNB application (unmodified)

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3:30 PM