TOWERS OF POWER

GSM Infrastructure and Development

IMSI & IMEI

IMSI

IMSI - International Mobile Subscriber Identifier

Unique number of the mobile subscriber.

MCC-MNC-MSIN

MCC= Mobile Country Code (e.g. 310 for USA) -

MNC = Mobile Network Code (e.g. 410 for AT&T),

MSIN = Sequential Serial Number

IMSI is stored on SIM CARD

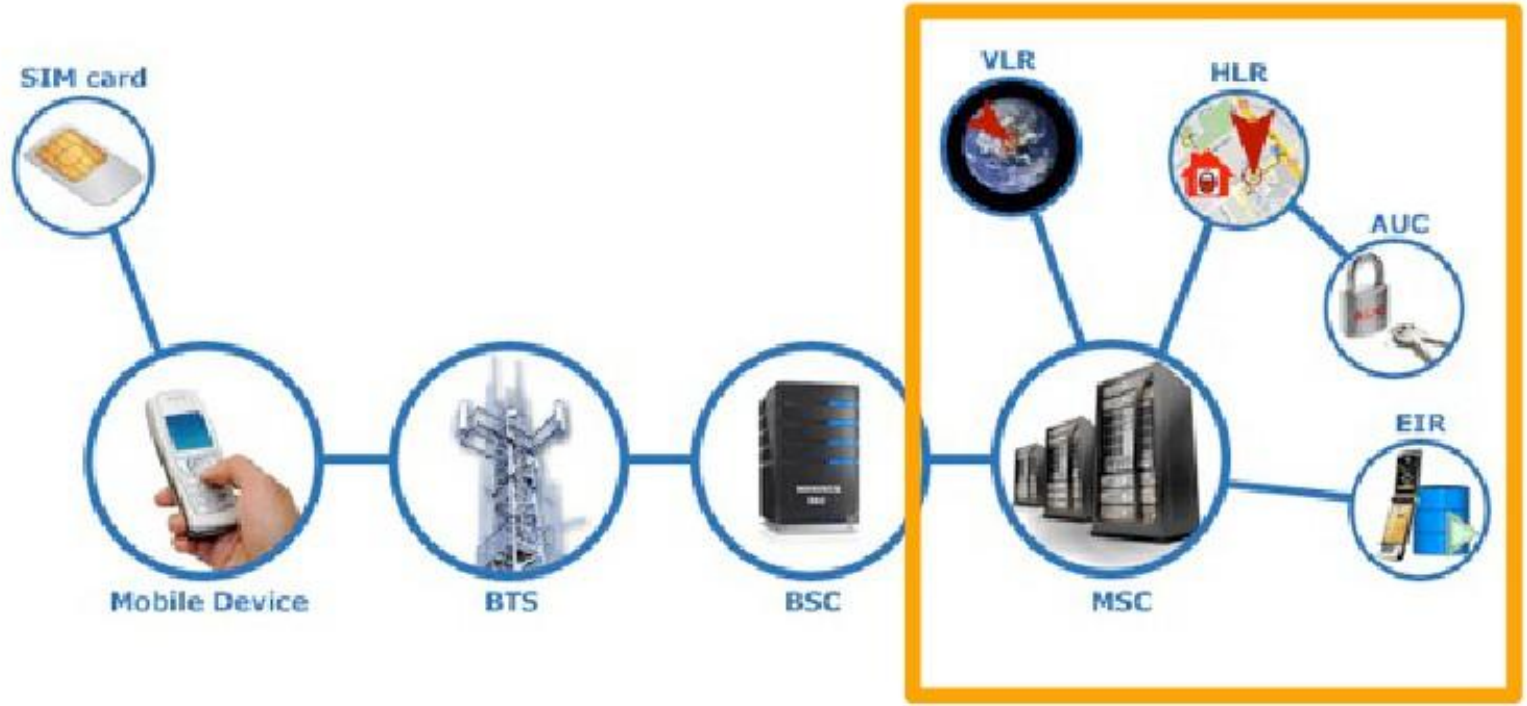
IMEI

International Mobile Station Equipment Identity

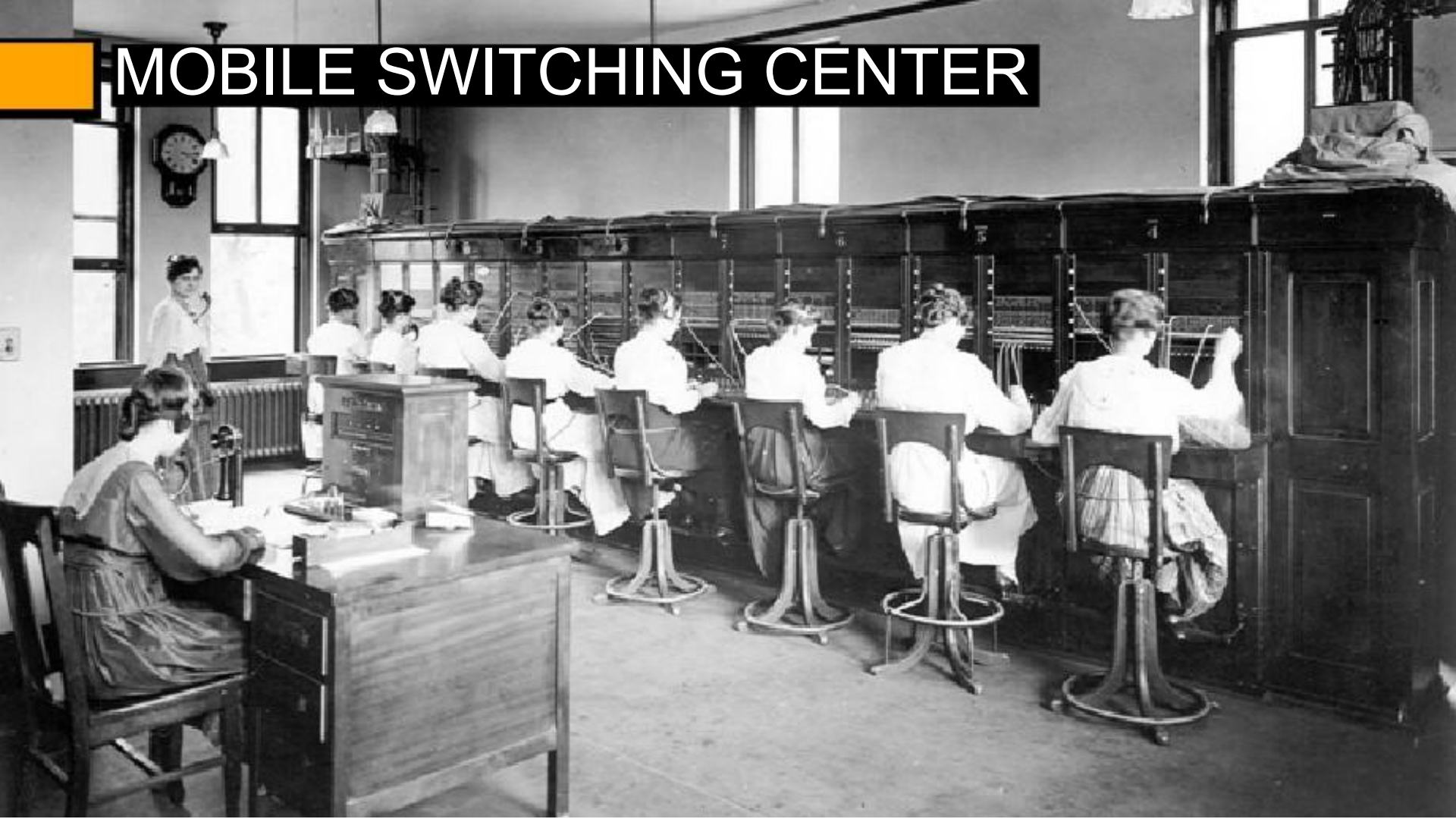
is a unique number, used to identify mobile phones.
Can be found printed inside the battery compartment of the phone.
Can also be displayed on-screen on most phones by entering
***#06#**

GSM SYSTEM ARCHITECTURE

NETWORK SUBSYSTEM

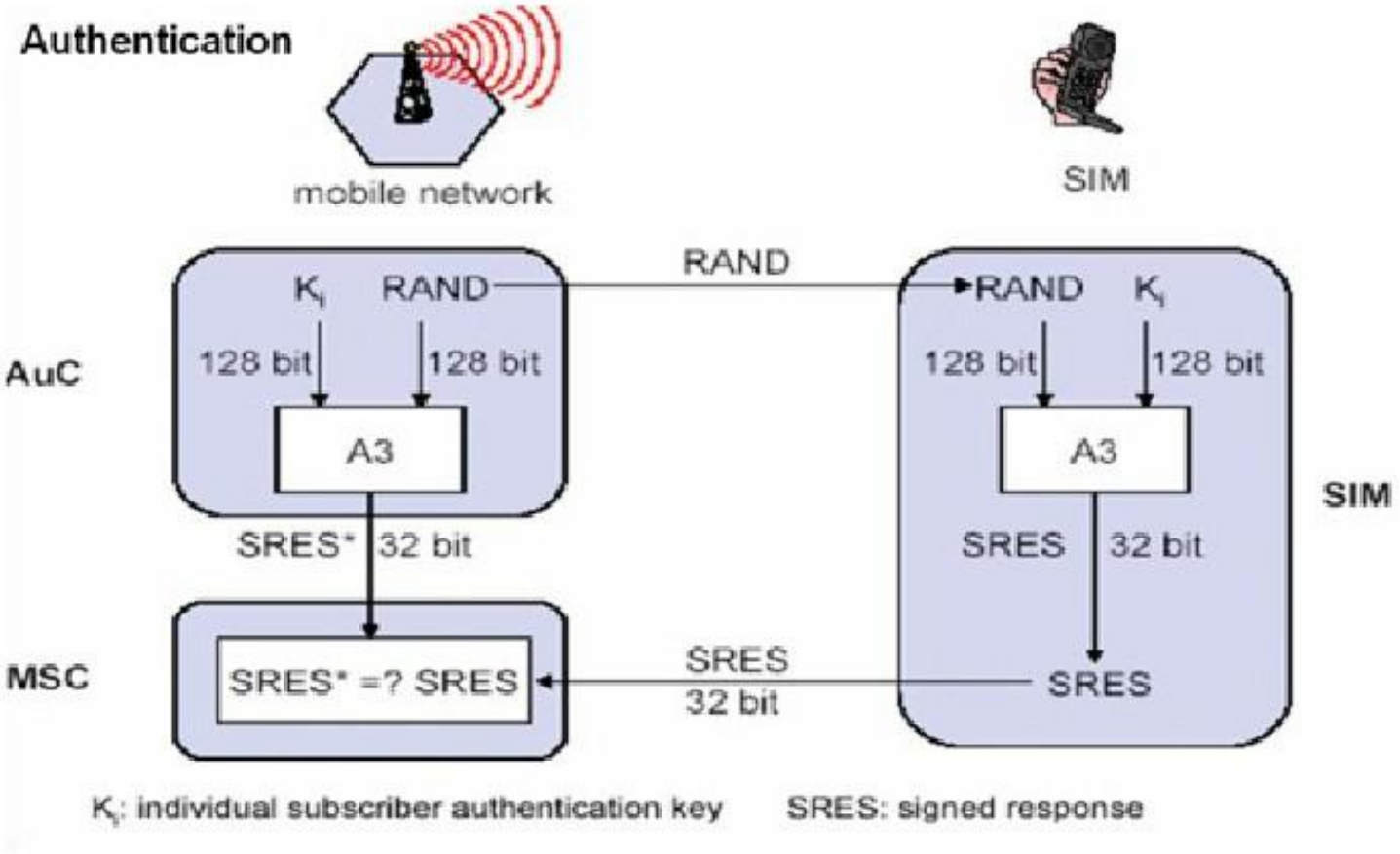


MOBILE SWITCHING CENTER



HOME LOOKUP REGISTRY

AUTHENTICATION CENTER (AUC)



VLR + EIR

Visitor Location Register:

- responsible for mobility management and handles local caller traffic
- each MSC has its own VLR

Equipment Identification Register:

- a database that contains the information about the identity of the mobile equipment (IMEI)
- Keeps track black listed phones

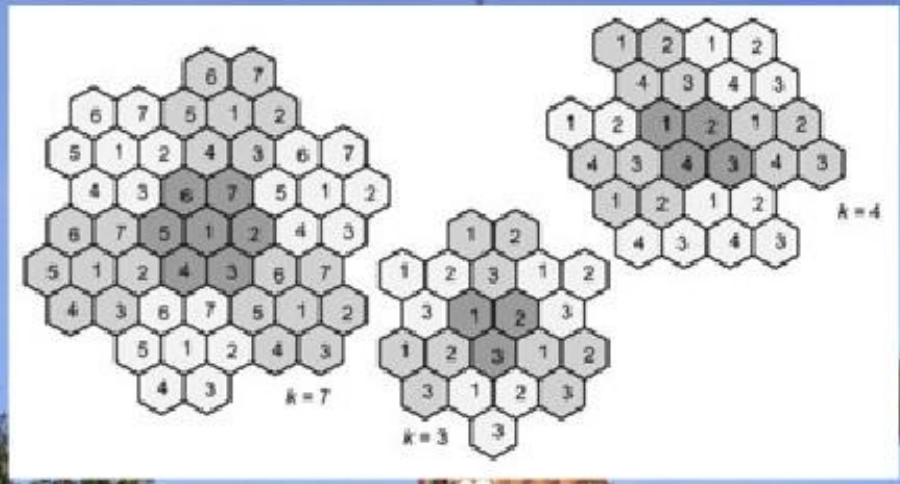
BASE STATION SUBSYSTEM

BASE STATION CONTROLLER

The intelligence of the BTS

BASE TRANSCEIVER STATION

The Tower of Power



Designed as cells in order for efficient **frequency reuse**

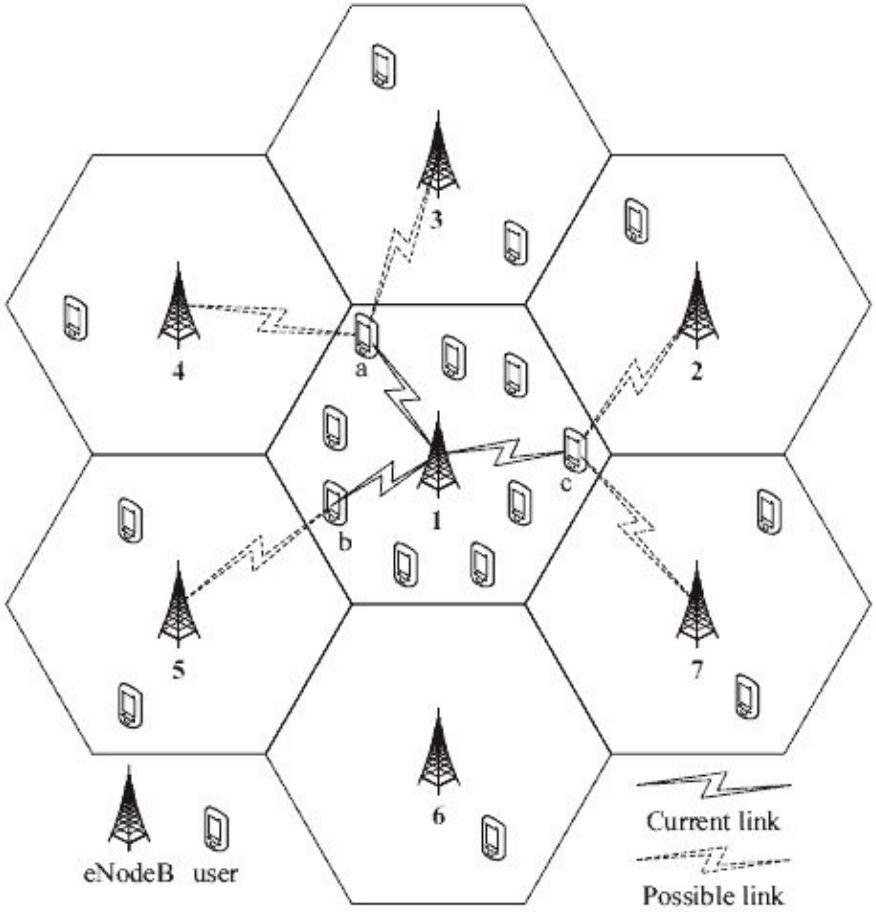
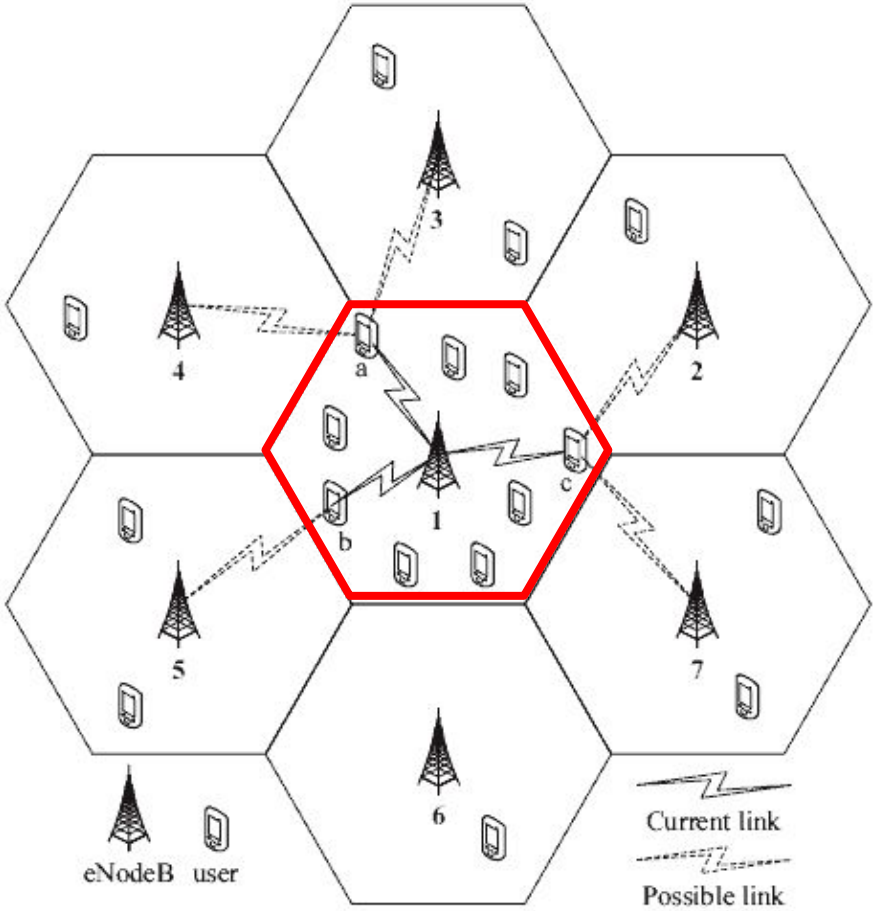


Figure 1: Network model.

ARFCN	Frequency (MHz)	
	Downlink	Uplink
128	869.2	824.2
129	869.4	824.4
130	869.6	824.6
131	869.8	824.8
132	870	825
133	870.2	825.2
134	870.4	825.4
135	870.6	825.6
136	870.8	825.8
137	871	826
138	871.2	826.2
139	871.4	826.4
140	871.6	826.6
141	871.8	826.8
142	872	827
143	872.2	827.2
144	872.4	827.4
145	872.6	827.6
146	872.8	827.8
147	873	828
148	873.2	828.2

ARFCN
http://niviuk.free.fr/gsm_arfcn.php



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134	870.4	825.4
135	870.6	825.6
136	870.8	825.8
137	871	826
138	871.2	826.2
139	871.4	826.4
140	871.6	826.6
141	871.8	826.8
142	872	827
143	872.2	827.2
144	872.4	827.4
145	872.6	827.6
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148	873.2	828.2

1

ARFCN

http://niviuk.free.fr/gsm_arfcn.php

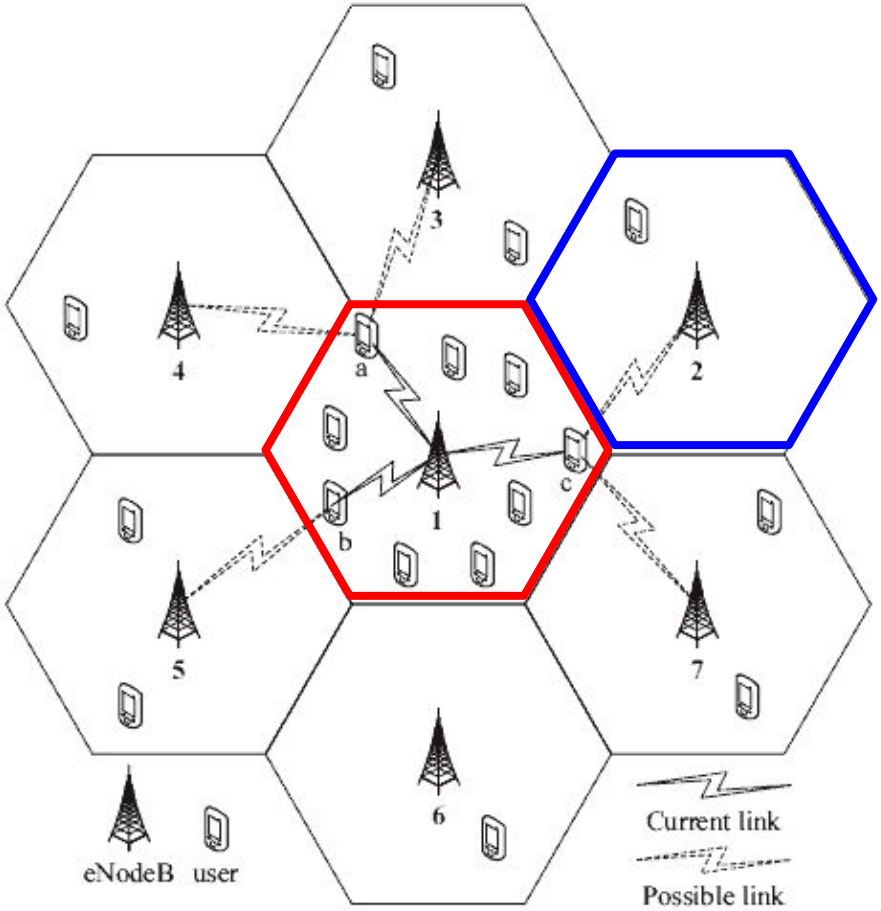

Figure 1: Network model.

ARFCN	Frequency (MHz) Downlink	Uplink	
128	869.2	824.2	1
129	869.4	824.4	
130	869.6	824.6	
131	869.8	824.8	2
132	870	825	
133	870.2	825.2	
134	870.4	825.4	
135	870.6	825.6	
136	870.8	825.8	
137	871	826	
138	871.2	826.2	
139	871.4	826.4	
140	871.6	826.6	
141	871.8	826.8	
142	872	827	
143	872.2	827.2	
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ARFCN

http://niviuk.free.fr/gsm_arfcn.php

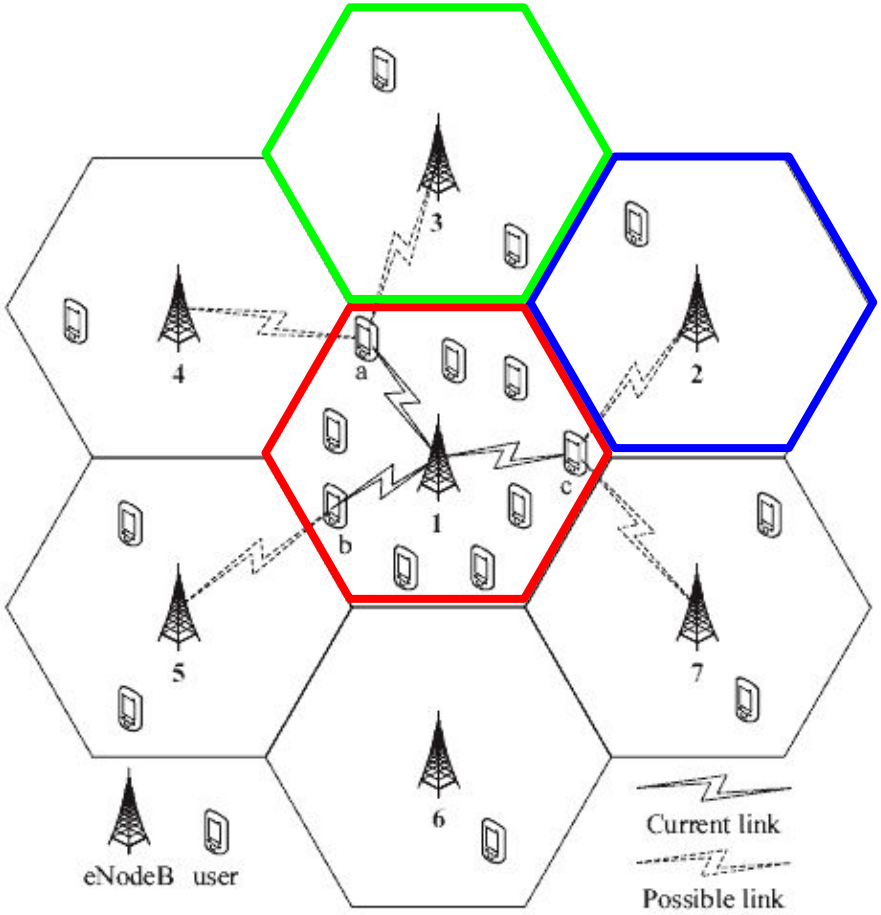

Figure 1: Network model.

ARFCN	Frequency (MHz) Downlink	Uplink	
128	869.2	824.2	1
129	869.4	824.4	
130	869.6	824.6	
131	869.8	824.8	2
132	870	825	
133	870.2	825.2	
134	870.4	825.4	3
135	870.6	825.6	
136	870.8	825.8	
137	871	826	
138	871.2	826.2	
139	871.4	826.4	
140	871.6	826.6	
141	871.8	826.8	
142	872	827	
143	872.2	827.2	
144	872.4	827.4	
145	872.6	827.6	
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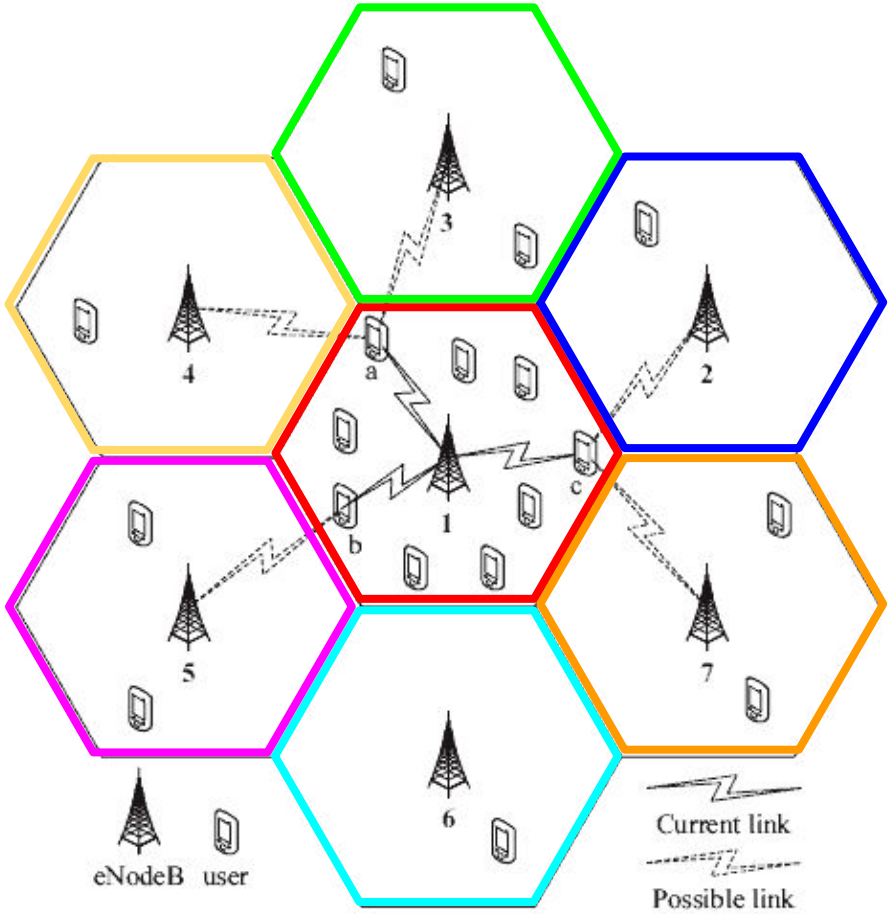
147	873	828	
148	873.2	828.2	

ARFCN

http://niviuk.free.fr/gsm_arfcn.php



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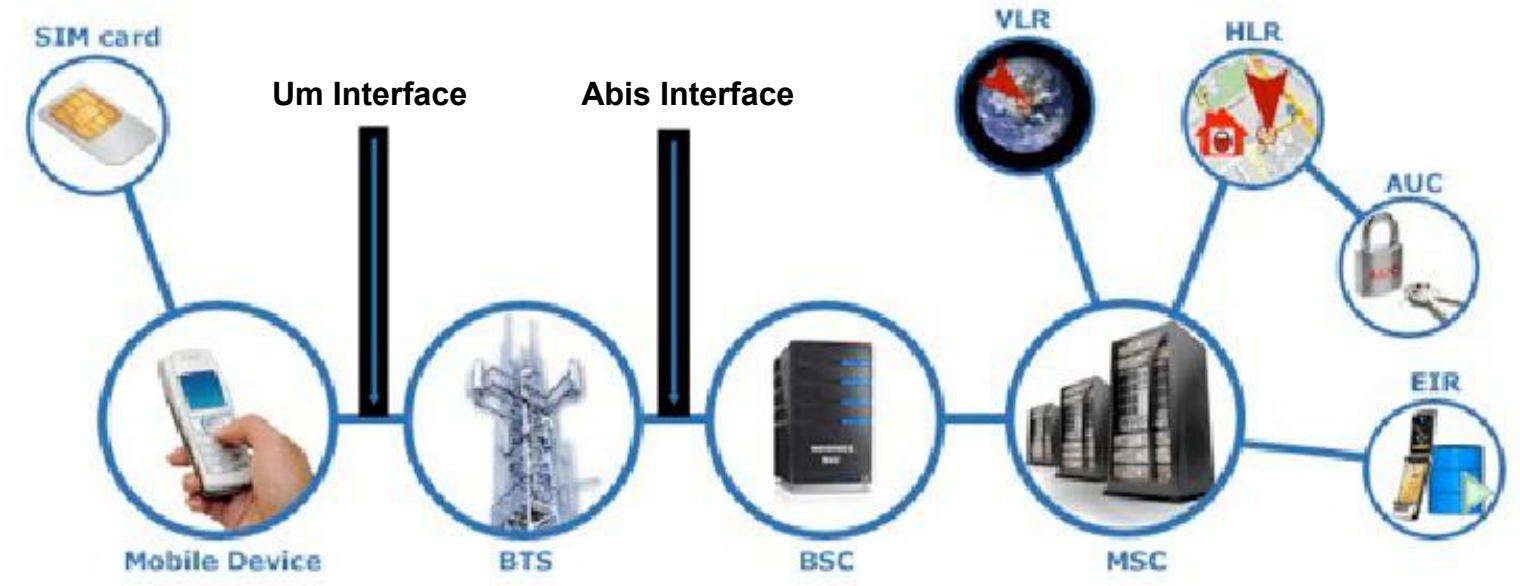
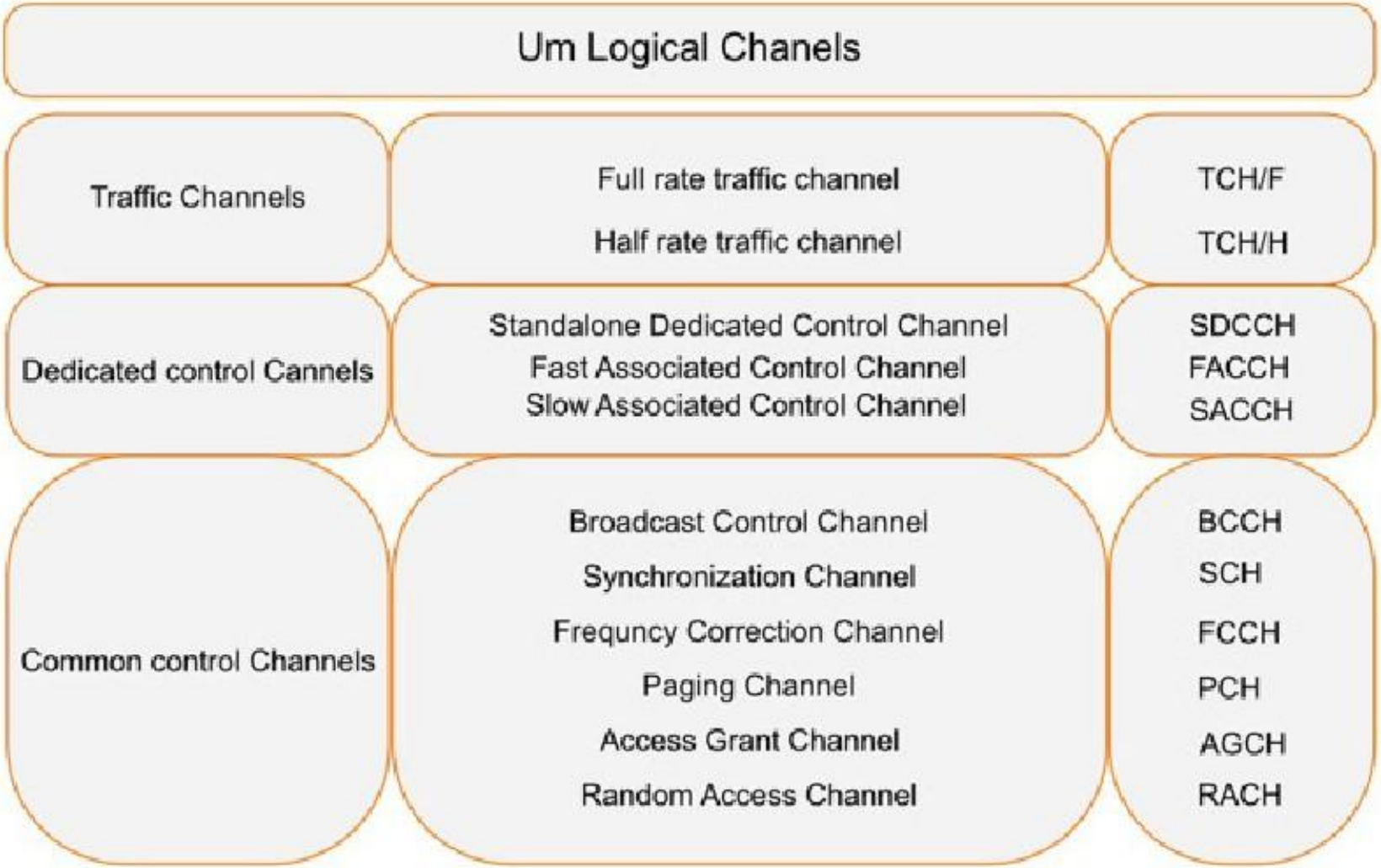
132	870	825	
133	870.2	825.2	
134	870.4	825.4	3
135	870.6	825.6	
136	870.8	825.8	
137	871	826	4
138	871.2	826.2	
139	871.4	826.4	
140	871.6	826.6	5
141	871.8	826.8	
142	872	827	
143	872.2	827.2	6
144	872.4	827.4	
145	872.6	827.6	
146	872.8	827.8	7
147	873	828	
148	873.2	828.2	

ARFCN

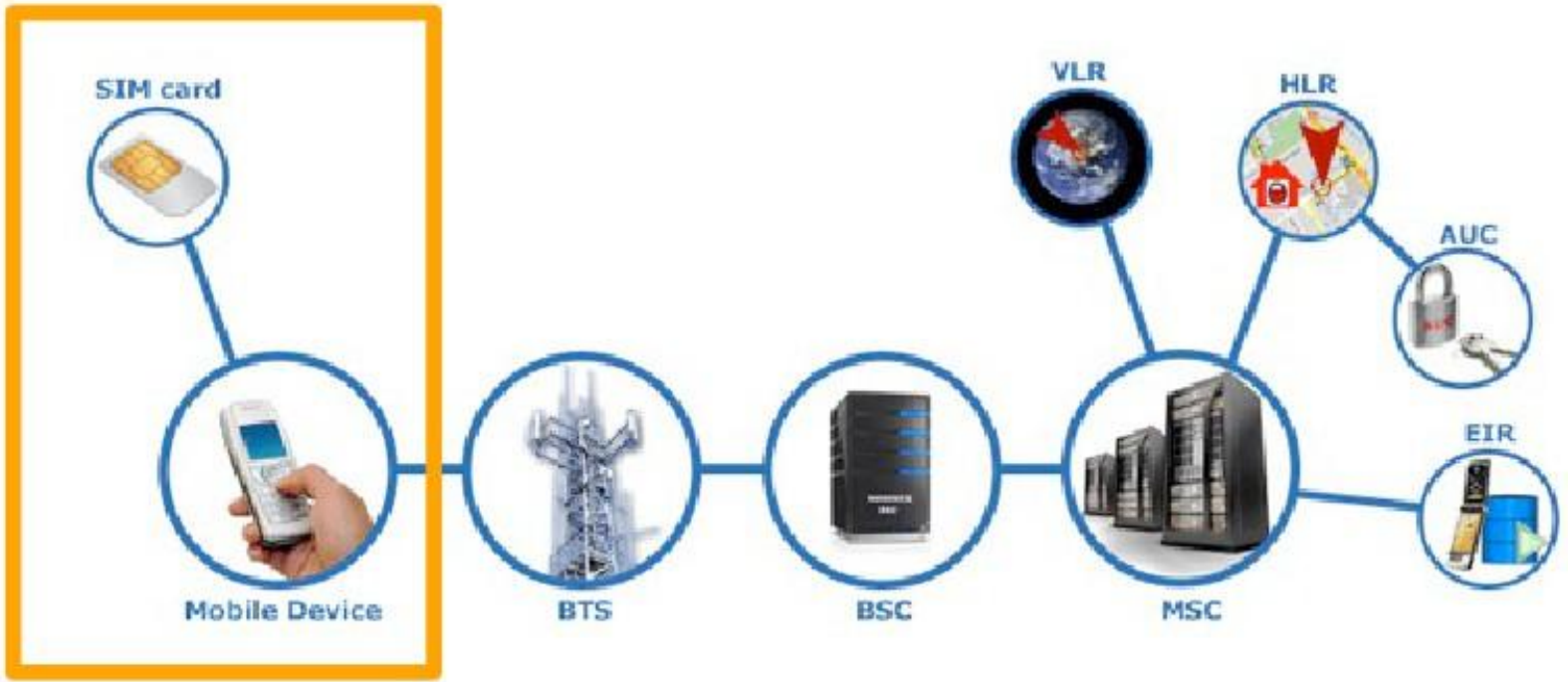
http://niviuk.free.fr/gsm_arfcn.php

INTERFACING

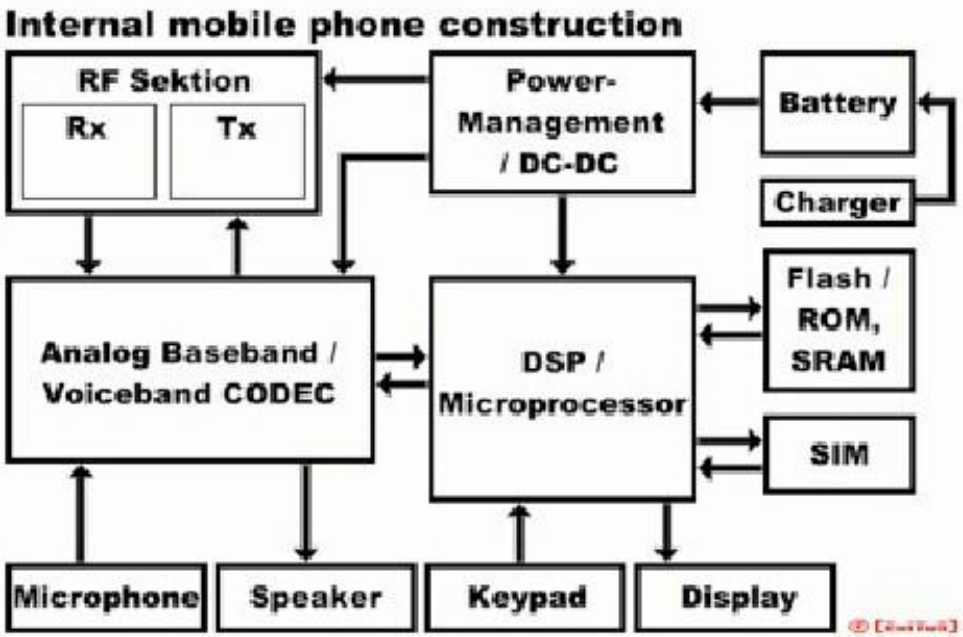



Um Logical Chanels
Traffic Channels
Full rate traffic channel
Half rate traffic channel
TCH/F
TCH/H
Dedicated control Cannels
Standalone Dedicated Control Channel
Fast Associated Control Channel
Slow Associated Control Channel
SDCCH
FACCH
SACCH
Common control Channels
Broadcast Control Channel
Synchronization Channel
Frequncy Correction Channel
Paging Channel
Access Grant Channel
Random Access Channel
BCCH
SCH
FCCH
PCH
AGCH
RACH

MOBILE STATION SYSTEM



MOBILE DEVICE

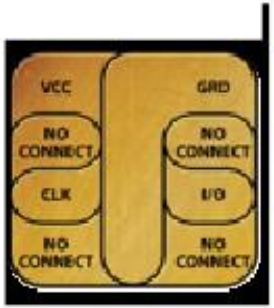


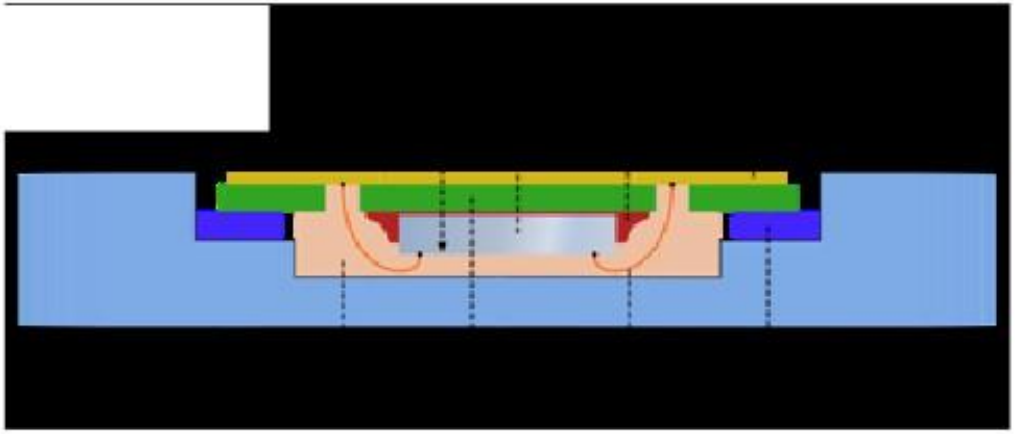
SUBSCRIBER IDENTITY MODULE

International Mobile Subscriber Identifier (IMSI)
Unique number of the mobile subscriber.

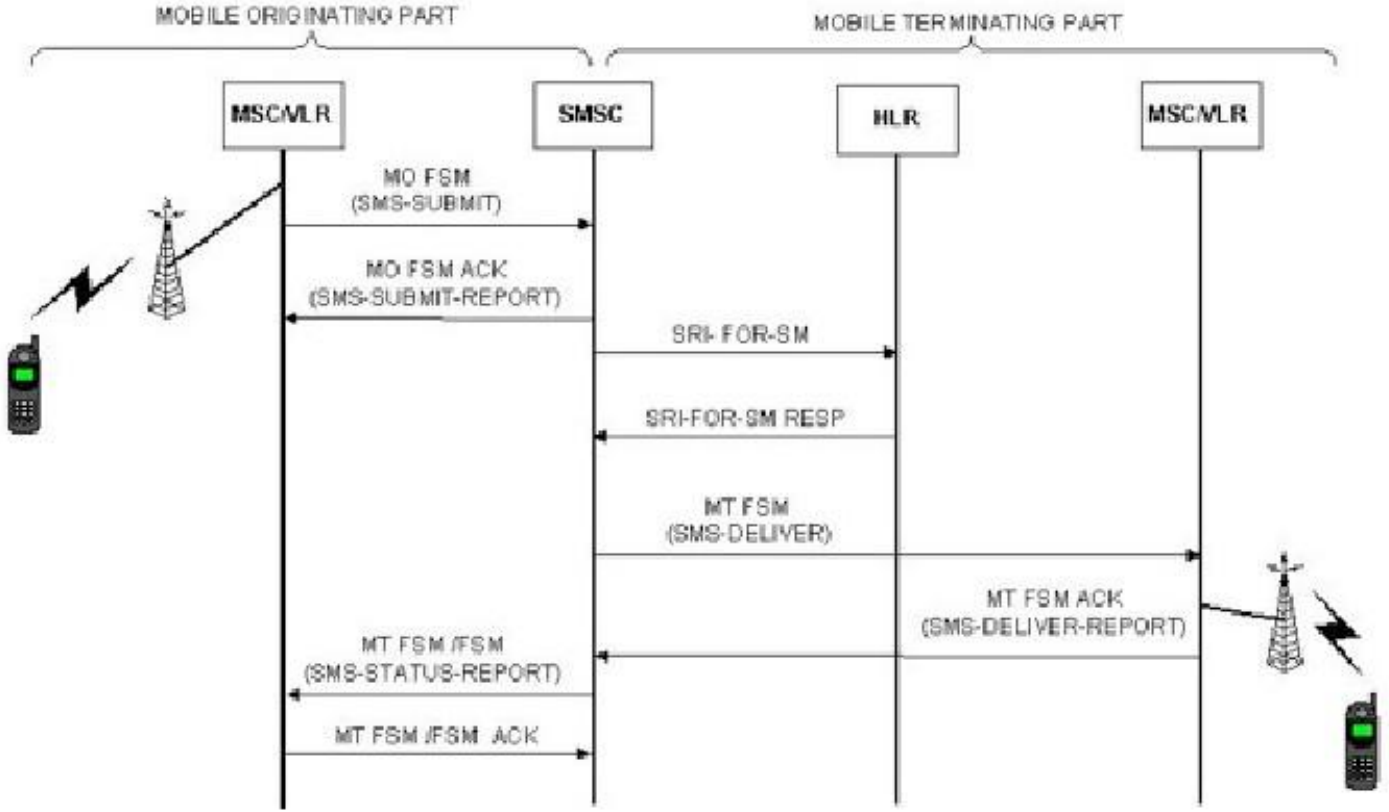
MCC + MNC + MSIN
Mobile Country Code + Mobile Network Code + Mobile Subscriber Id Number

International Mobile Equipment Identifier (IMEI) - a number stored on the hardware devices describing it - unique to each phone - like a serial number



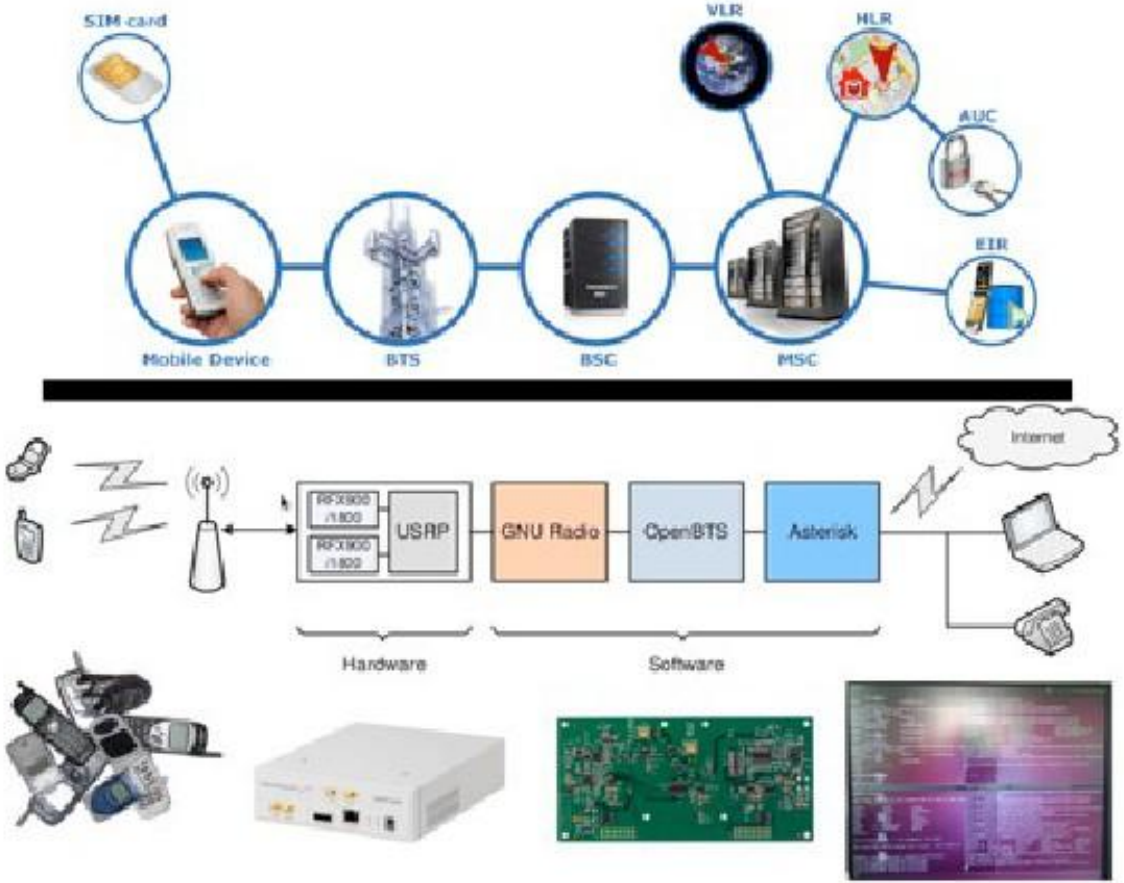


OTHER NETWORK COMPONENTS



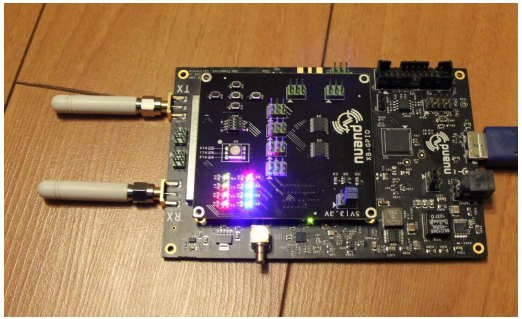
From http://learntelecom.com/sms-in-gsm-network/

OPEN SOURCE BTSs



Software Defined Radios

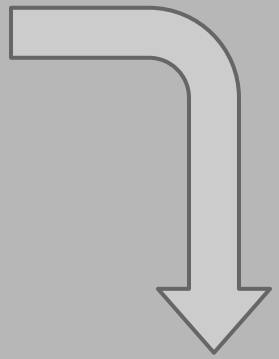
Software-defined radio (SDR)



Software-defined radio (**SDR**) is a radio communication system where components that have been typically implemented in hardware (e.g. mixers, filters, amplifiers,modulators/ demodulators, etc.) are instead implemented by means of software on a personal computer or embedded system.

Some examples are: Ettus USRP, Blade RF, LimeSDR, RTL-SDR

GSM in Software



Software based **BTS** (Base Transceiver station) forward call traffic through to an operator's mobile switching center.

This software delivers calls via SIP to a VOIP soft switch (such as FreeSWITCH or yate) or PBX (such as Asterisk) forming a self-contained cellular network in a single computer system.

Software based Cellular uses a software-defined radio transceiver with no specialized GSM hardware.

Open Source Cellular Options

OpenBTS

Range NETWORKS

Original

Open Source

GSM

osmocom

sysmocom

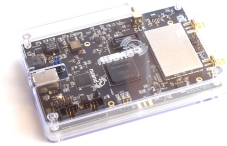
systems for mobile communications GmbH

fairwaves

3G Support

Rhizomatica

yate BTS



BladeRF

4G Support

OpenCellular

ENDAGA

facebook

$1000 ?

TELECOM INFRA PROJECT

Open Source Cellular Software

+

wiki.rhizomatica.org

Hardware

BSC

Base Station Controller

BTS

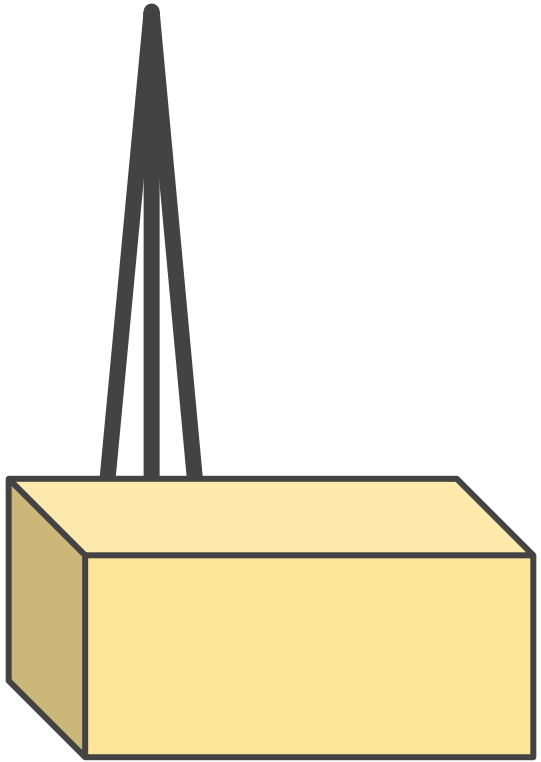
Base Transceiver Station

Antennas

Omni-Directional

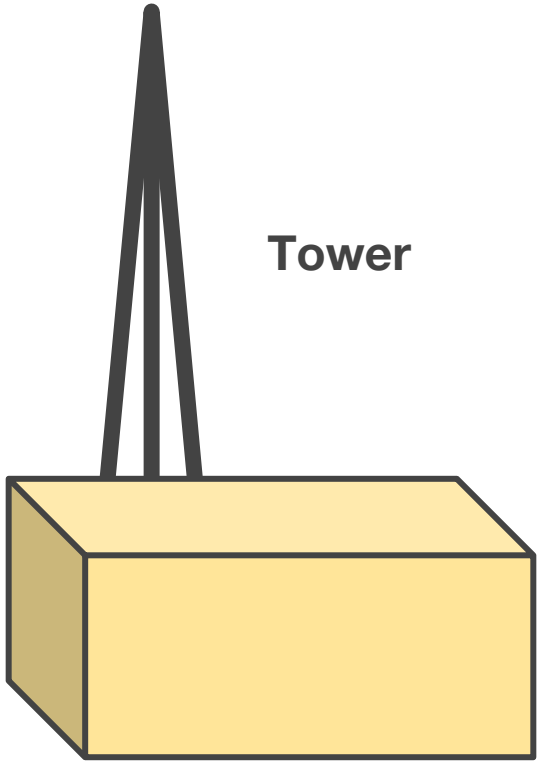
nuRAN™ WIRELESS
Reaching Everyone, Everywhere

Community Cellular

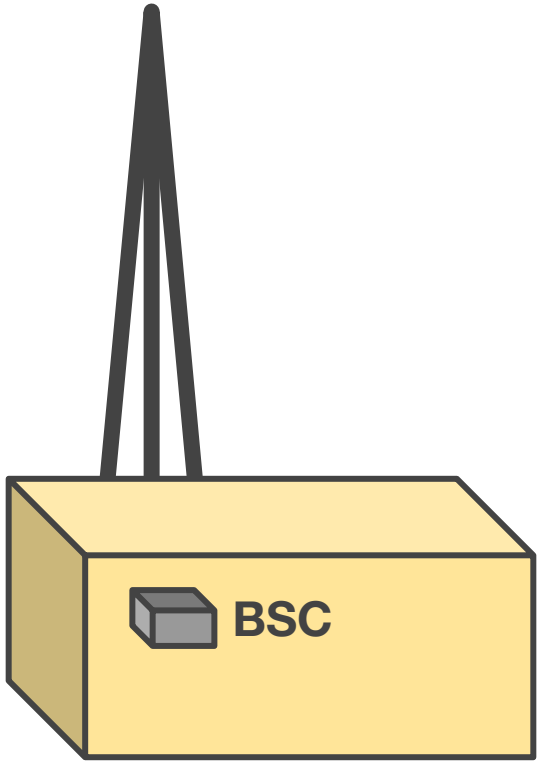


Communal
Radio
Station

Community Cellular



Community Cellular



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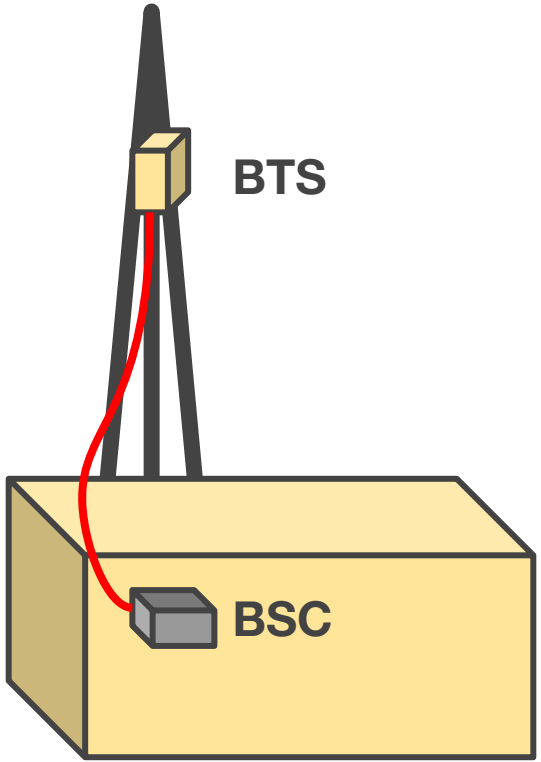
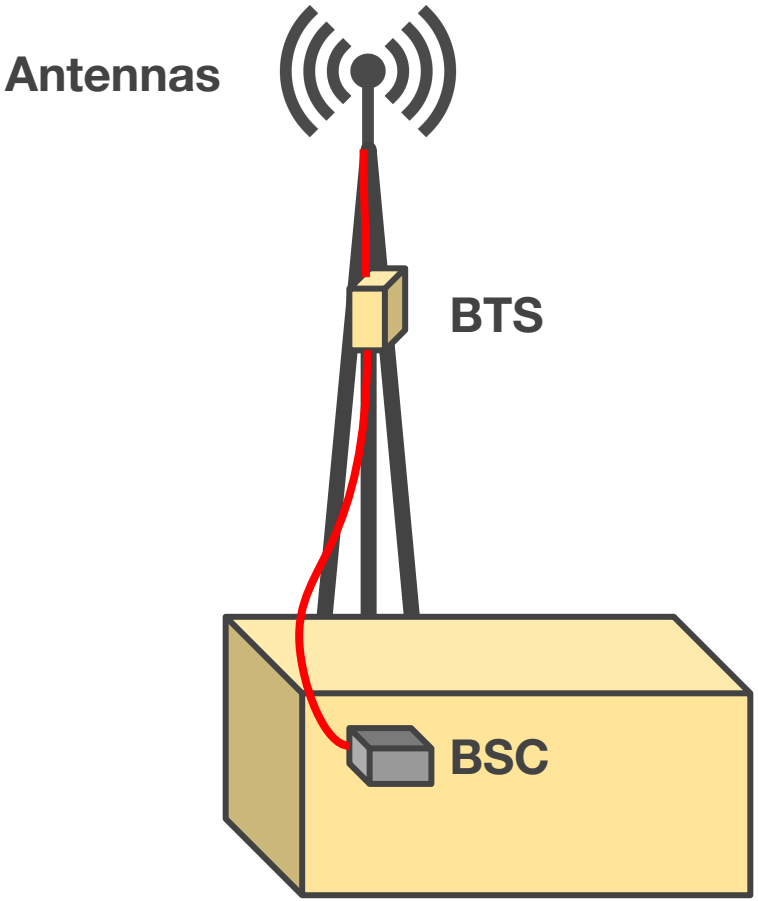
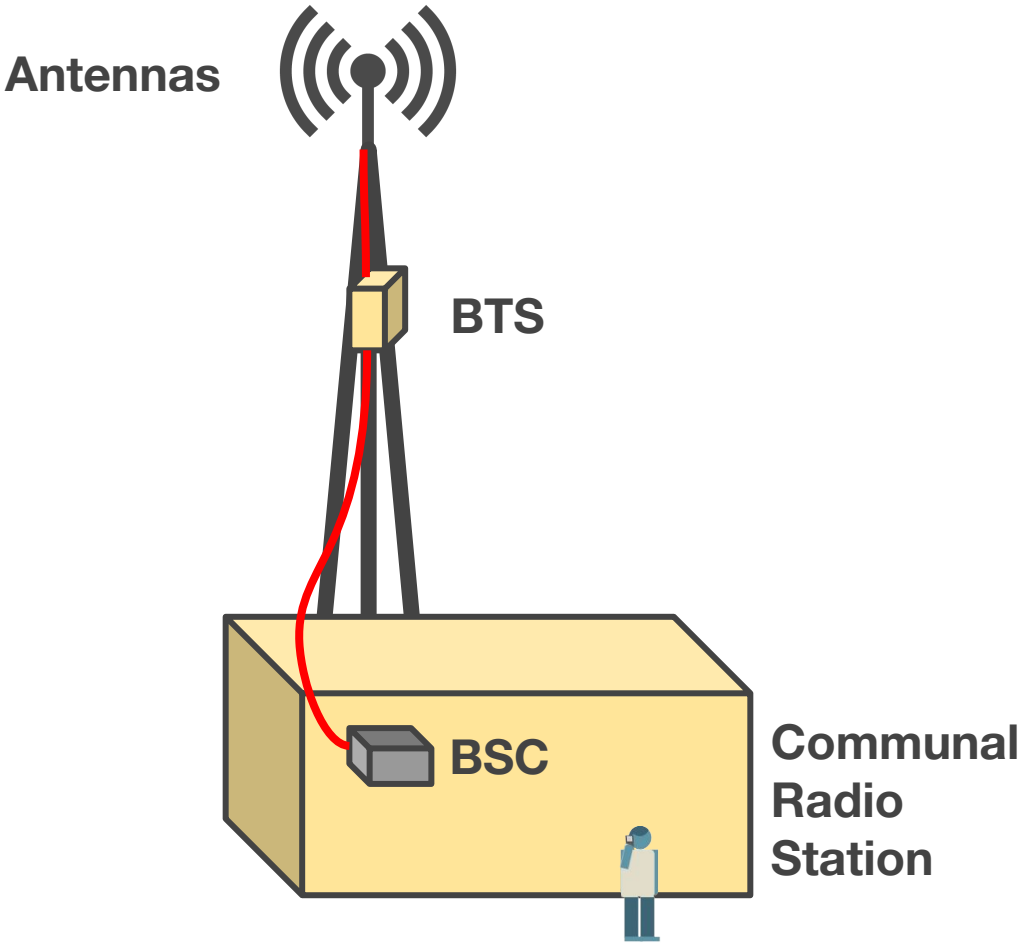
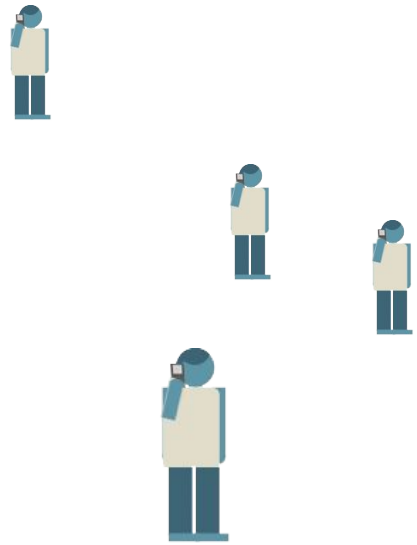




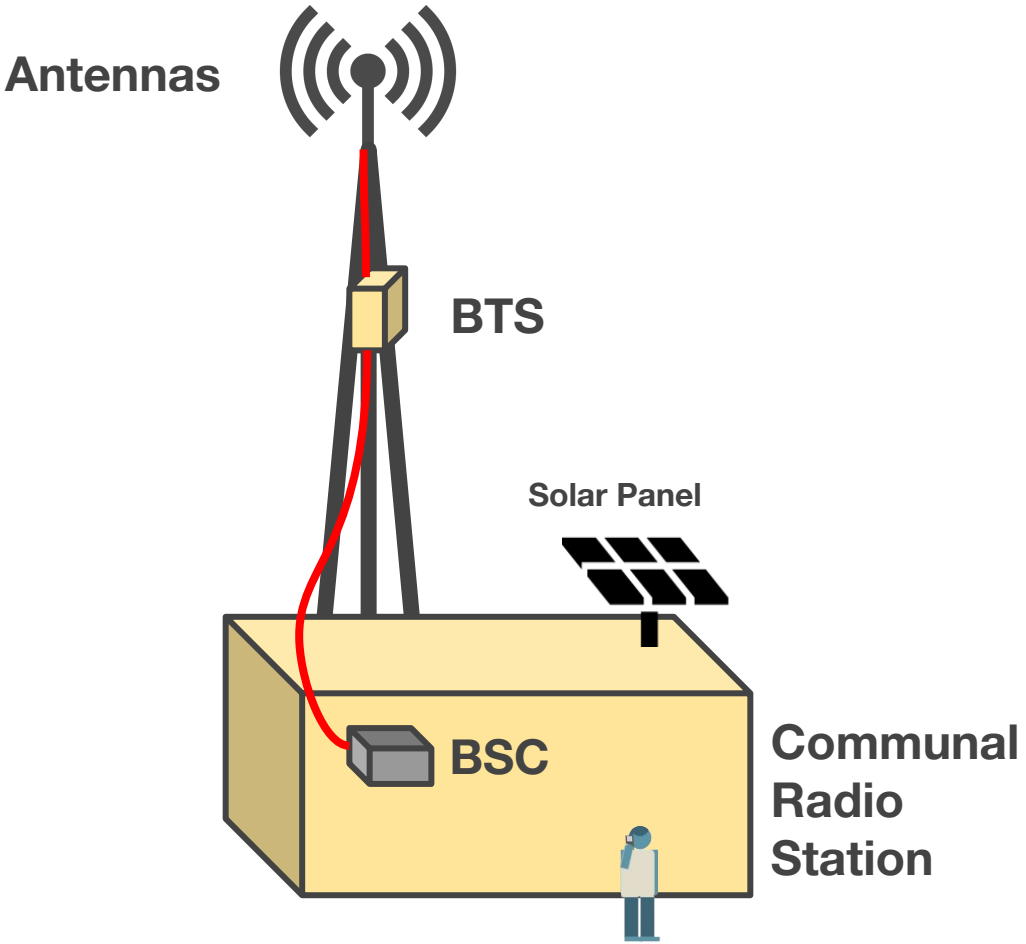
Community Cellular

Community Cellular

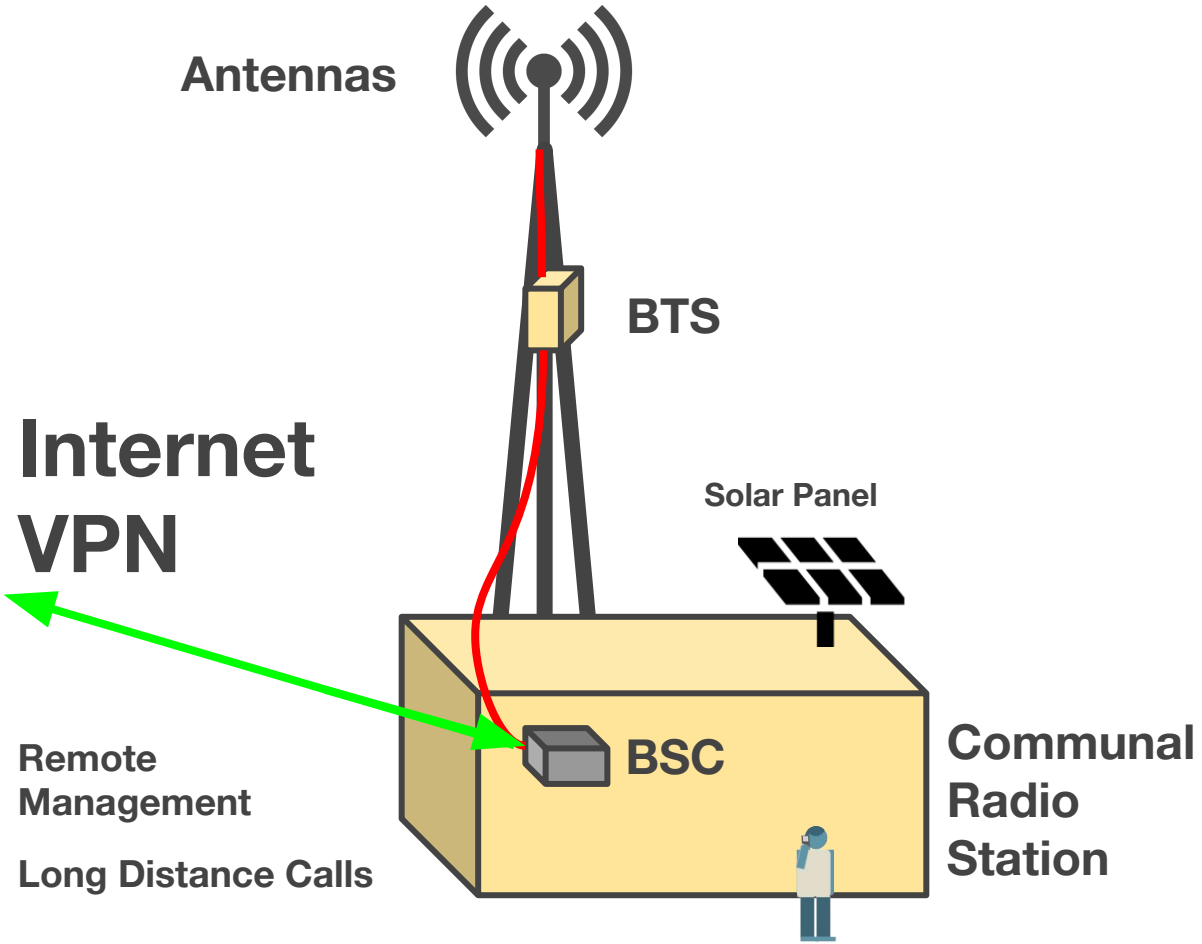




Community Cellular



Community Cellular



Nuran LiteCell 1.0 BTS

$4800

- **2 TRX**
- **Power consumption: 52 Watts**
- **Rating: IP67**
- **Up to 30 concurrent calls (half rate)**

Band	Reception	Transmission
850	824-850 MHz	869-895 MHz
900	880-915 MHz	925-960 MHz
1800	1710-1785 MHz	1805-1880 MHz
1900	1850-1910 MHz	1930-1990 MHz

http://nuranwireless.com/wp-content/uploads/2015/02/NuRAN-GSM-LiteCell-web.pdf

Nuran LiteCell 1.5 BTS

Nuran LiteCell 1.5 BTS

Nuran LiteCell 1.5 BTS

Nuran LiteCell 1.5
BTS

Power
24V

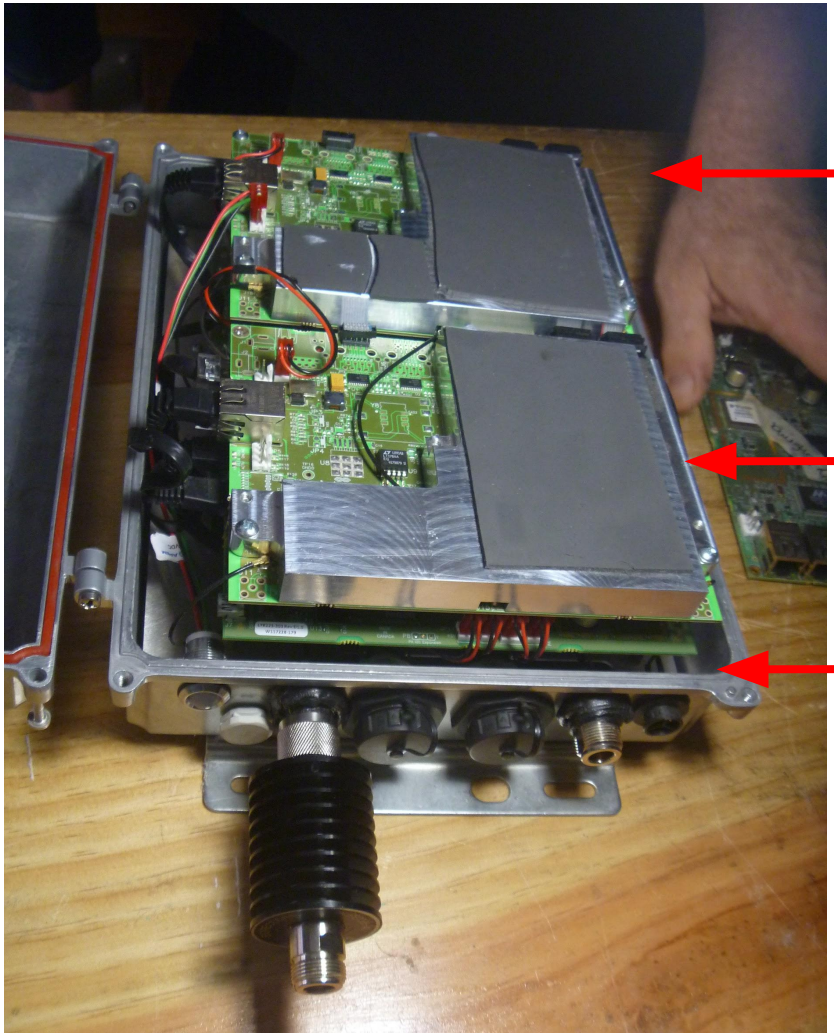
Nuran LiteCell 1.5 BTS

GPS (Timing)

fairwaves

UmSITE-TM3

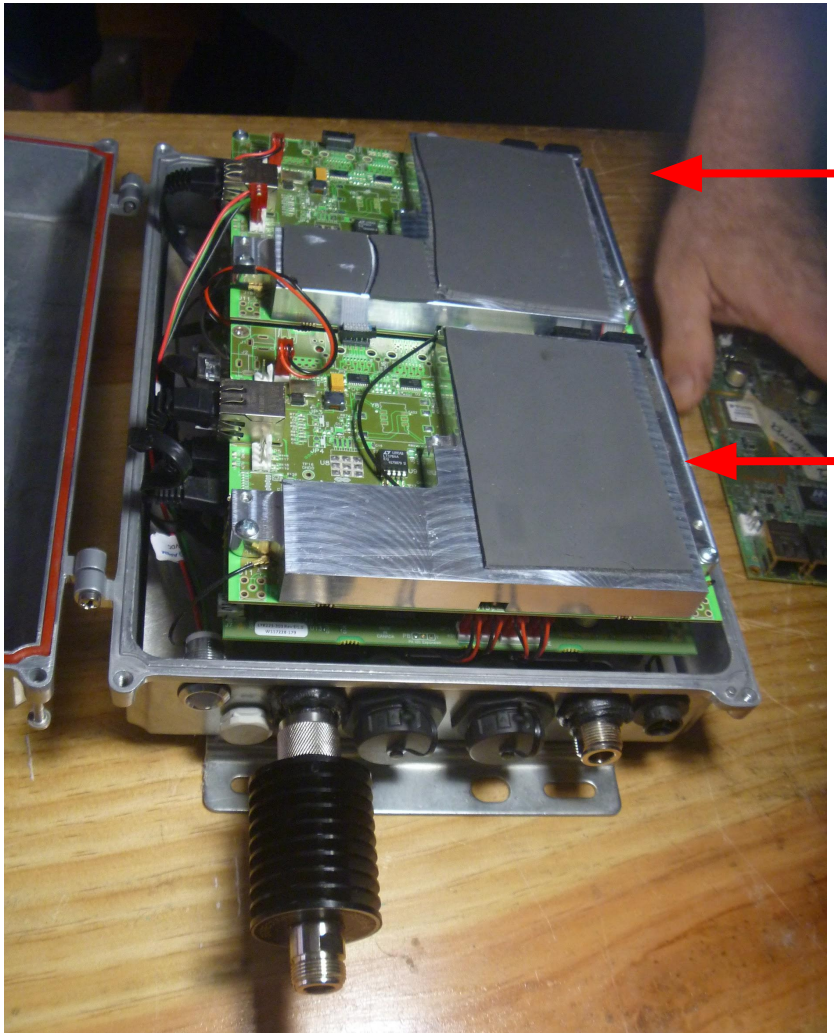
$4000



TRX 1

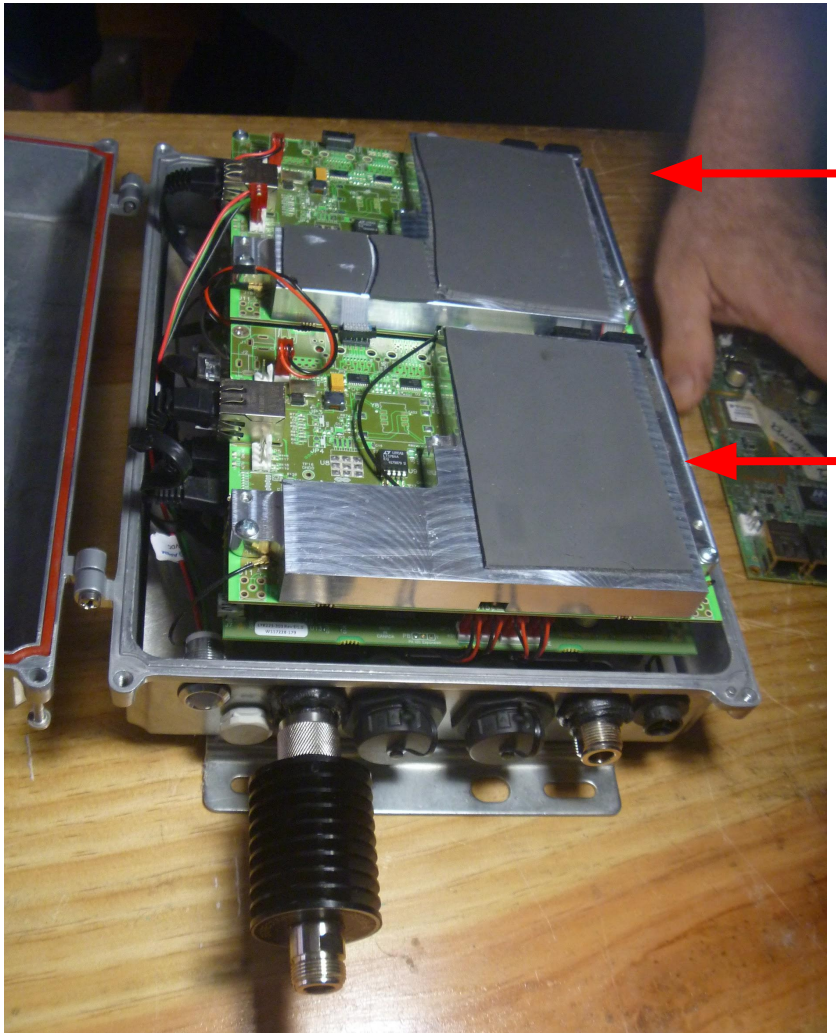
TRX 2

Controller
- Linux



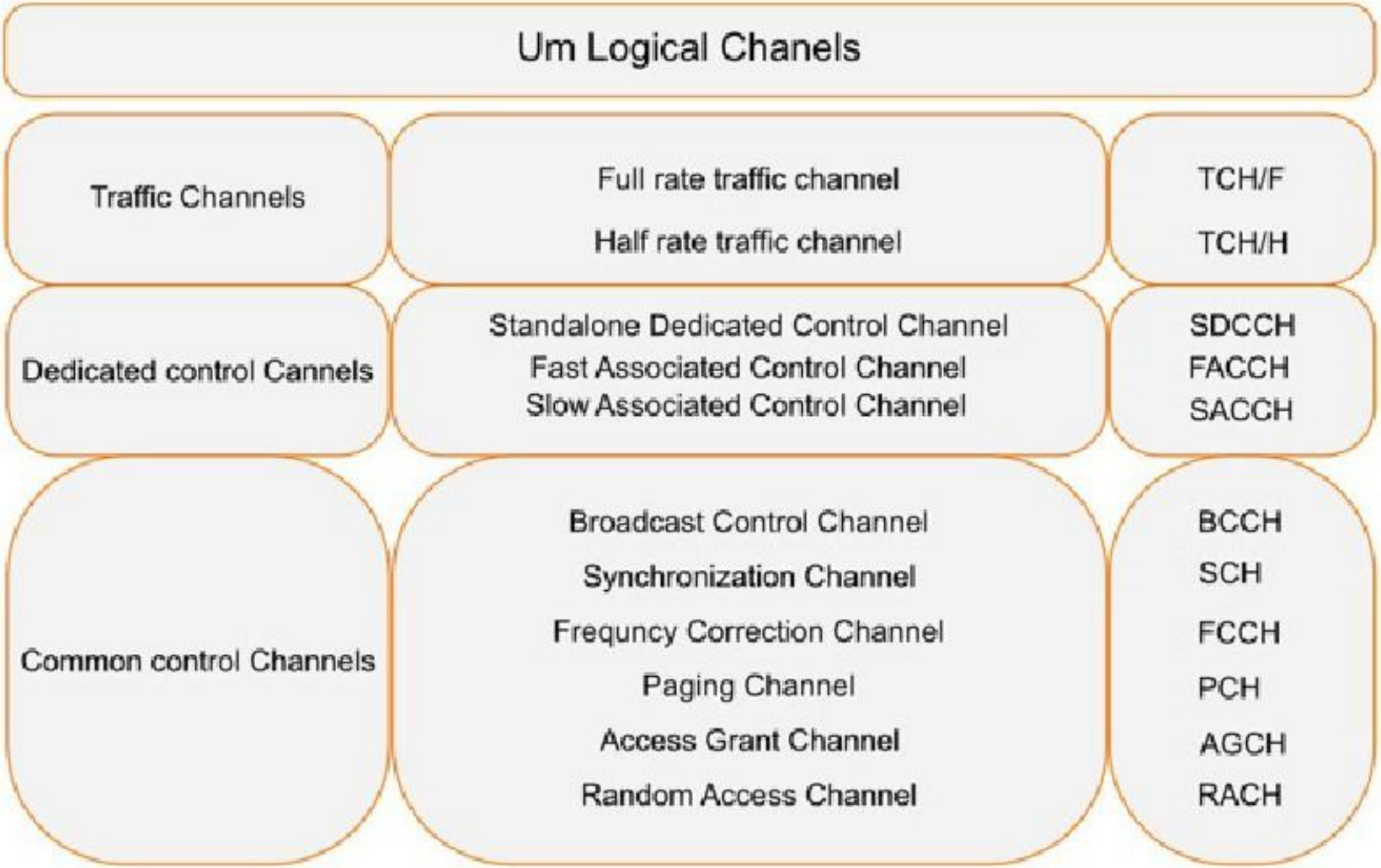
TRX 1
8 Channels

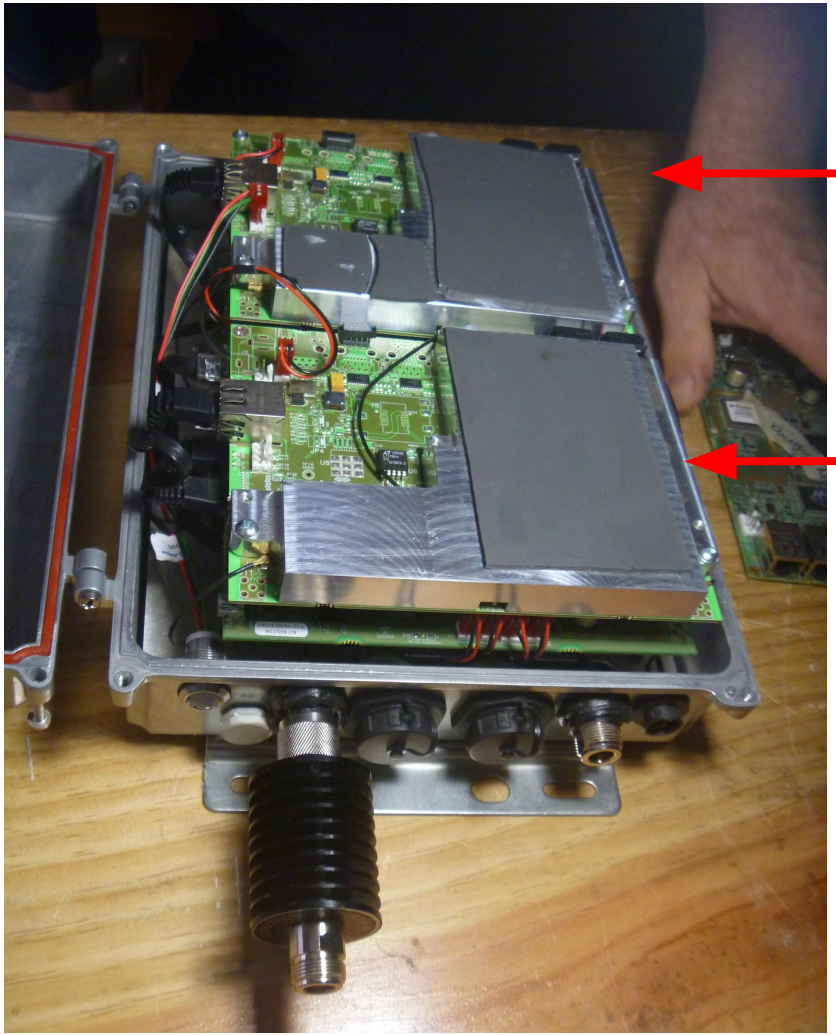
TRX 2
8 Channels



TRX 1
8 Channels
- **1 control**

TRX 2
8 Channels


Um Logical Chanels
Traffic Channels
Full rate traffic channel
Half rate traffic channel
TCH/F
TCH/H
Dedicated control Cannels
Standalone Dedicated Control Channel
Fast Associated Control Channel
Slow Associated Control Channel
SDCCH
FACCH
SACCH
Common control Channels
Broadcast Control Channel
Synchronization Channel
Frequncy Correction Channel
Paging Channel
Access Grant Channel
Random Access Channel
BCCH
SCH
FCCH
PCH
AGCH
RACH



TRX 1

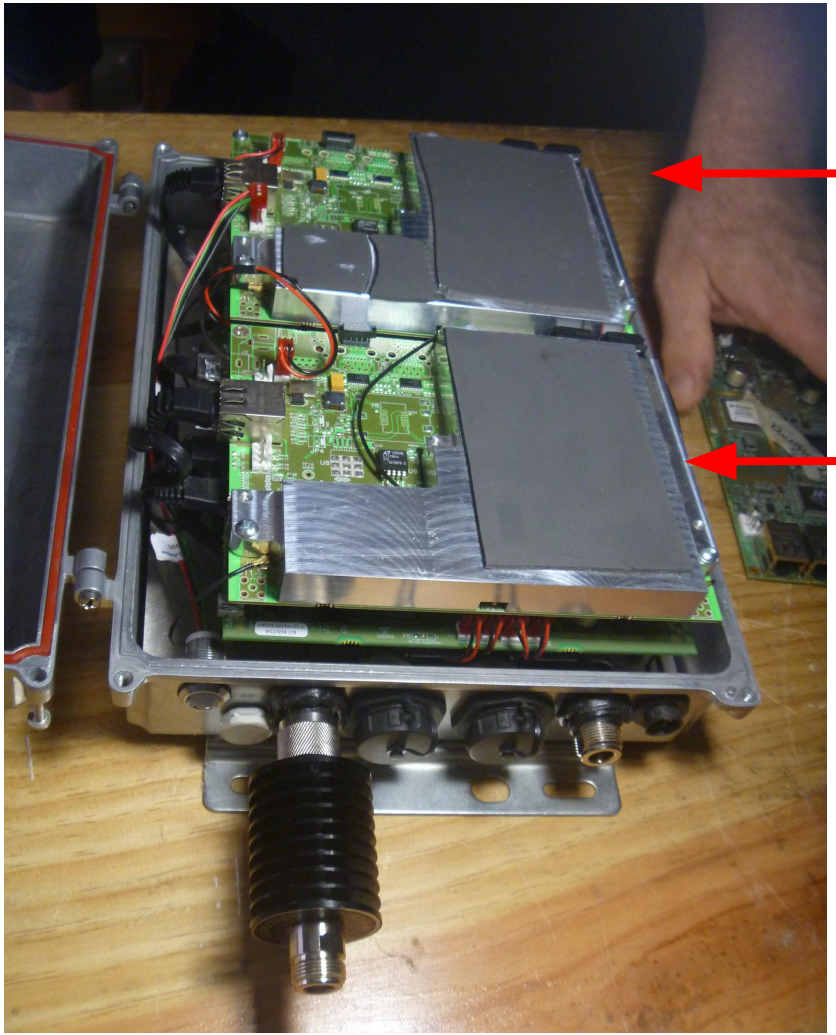
8 Channels

- **1 control**
- **7 Full Rate “Call” TCH/F**

TRX 2

8 Channels

- **8 Full Rate “Call” TCH/F**



TRX 1

8 Channels

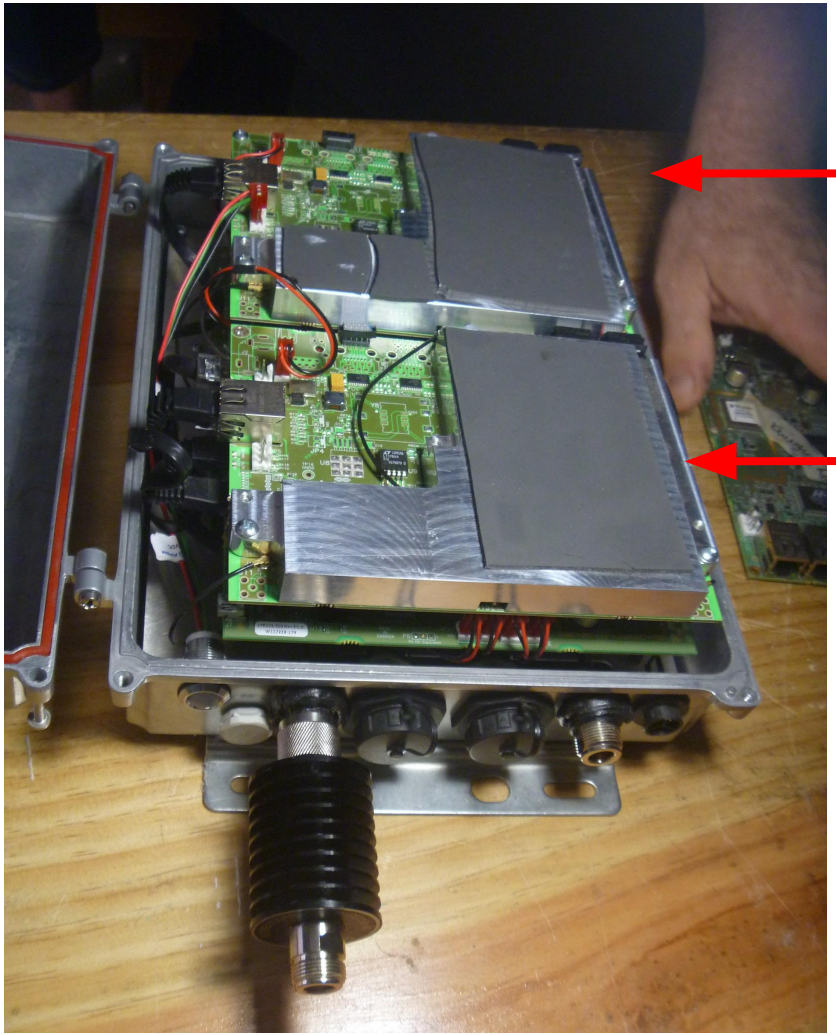
- **1 control**
- **7 Full Rate “Call” TCH/F**

TRX 2

8 Channels

- **8 Full Rate “Call” TCH/F**

15 Full Rate Calls



TRX 1

8 Channels

- **1 control**
- **14 Half Rate “Call” TCH/H**

TRX 2

8 Channels

- **16 Half Rate “Call” TCH/H**

30 Half Rate Calls

Omni Directional
Antennas
1 BTS

Sector/Patch Antennas
3 BTS

Omni-directional dipole

2.2dBi gain

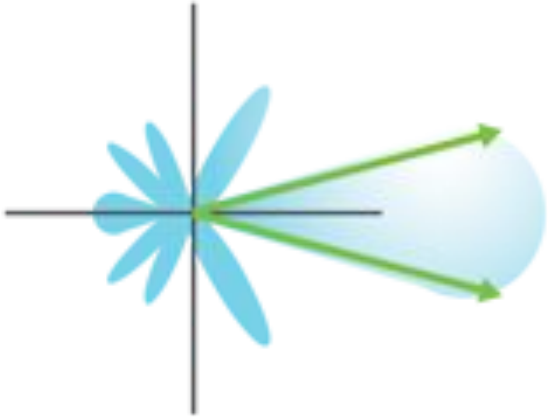
Example: Light Bulb

Omni-directional dipole

2.2dBi gain

Example: Light Bulb

High gain directional



6dBi gain

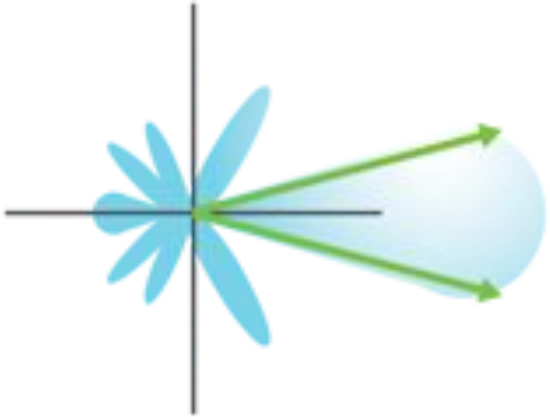
Example: Flashlight

Omni-directional dipole

2.2dBi gain

Example: Light Bulb

High gain directional



6dBi gain

Example: Flashlight

Multi-sector array with high gain directional

6dBi gain per sector

Example: Multiple Flashlights

TESSCO TECHNOLOGIES®

Advanced Search

Welcome Edwin Reed-Sanchez
#2604350
Log Out

PRODUCTS SYSTEMS MARKETS WHY TESSCO SUPPORT

Account Worksheet

Products >Antennas & Filter Products

Antennas & Filter Products

Everything you need for indoor and outdoor RF applications, including antennas, filter products, and mobile amplifiers.

- Filter Products
- In-Building Antennas
- Microwave Antennas
- Mobile Amplifiers
- Mobile Antennas, Mounts & Accessories
- Outdoor Base Station Antennas

Ventev / TerraWave - 824-960 MHz 6 dBi Omni Stick Antenna with N Jack

TESSCO SKU : 392017 **Mfg Part #:** T09060O10006 **Qty/UOM :** 1 EACH **UPC:** 888063920172

Ventev's TerraWave 824-960 MHz 6 dBi omni-directional stick antenna with N Jack is designed for applications in the 900 MHz frequency, including, radio frequency identification (RFID) applications, cellular systems, global system for mobile (GSM) communications, code-division multiple access systems (CDMA) applications, multipoint applications and wireless video links. The antenna's fiberglass radome withstands the harshest environmental conditions. Includes a heavy-duty L-bracket for mast or vertical surface mounting. Every TerraWave antenna is RoHS compliant, and is covered by Ventev's two-year TerraNet warranty program. For more information, contact a regional sales executive at 210-375-8482, 800-851-4965 or sales@terrawave.com, or visit www.terrawave.com.

List: $75.60

Your Price: $68.00

Qty: 1

Add

View Worksheet

Ventev / TerraWave - 800-2500 MHz 7/10dBi Patch Antenna

TESSCO SKU : 322000 **Mfg Part #:** M4070100P11206 **Qty/UOM :** 1 EACH **UPC:** 888063220005

TerraWave M4070100P11206 is a patch antenna operating in the 800 - 2500 MHz frequency range. The dual band patch antenna features 7 dBi gain in 800 - 960 MHz or 10 dBi in frequency range 1710 - 2500 MHz. Maximum power input 50 watts. The antenna is terminated with an N Plug (female) connector. A 12 inch jumper is included along with antenna mounting hardware.

This patch antenna is ideal for outdoor voice and data wireless application.

List: $67.38

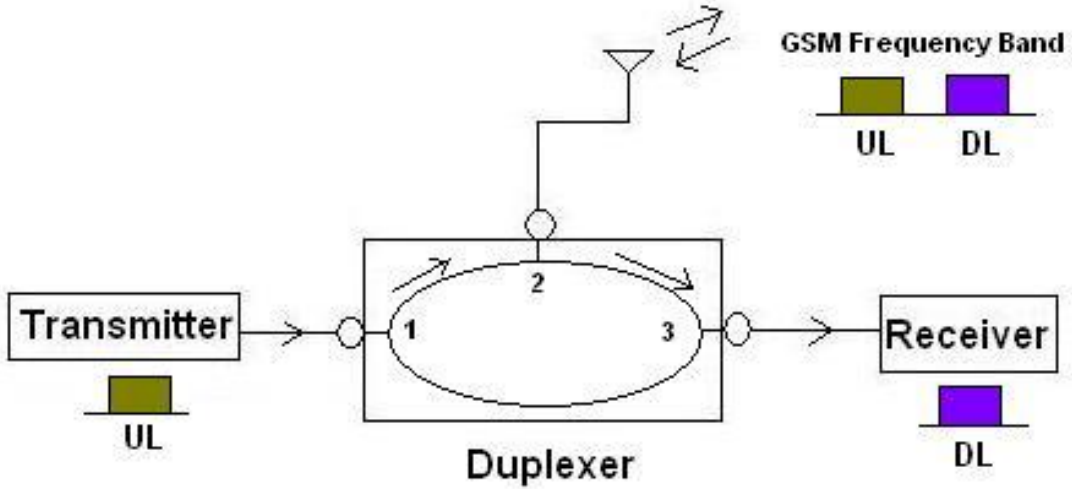
Your Price: $58.20

Qty: 1

Add

View Worksheet

DUPLEXER


GSM Frequency Band
UL
DL
Transmitter
UL
1
2
3
Duplexer
Receiver
DL


COMMON
MICRODATA TELECOM
1710-1880
1920-2170

Open Source Cellular Software

+

OsmoTRX

OpenBSC

OsmoNITB

RAI - Rhizomatica Administration Interface

RCCN - Rhizomatica Community Cellular Network

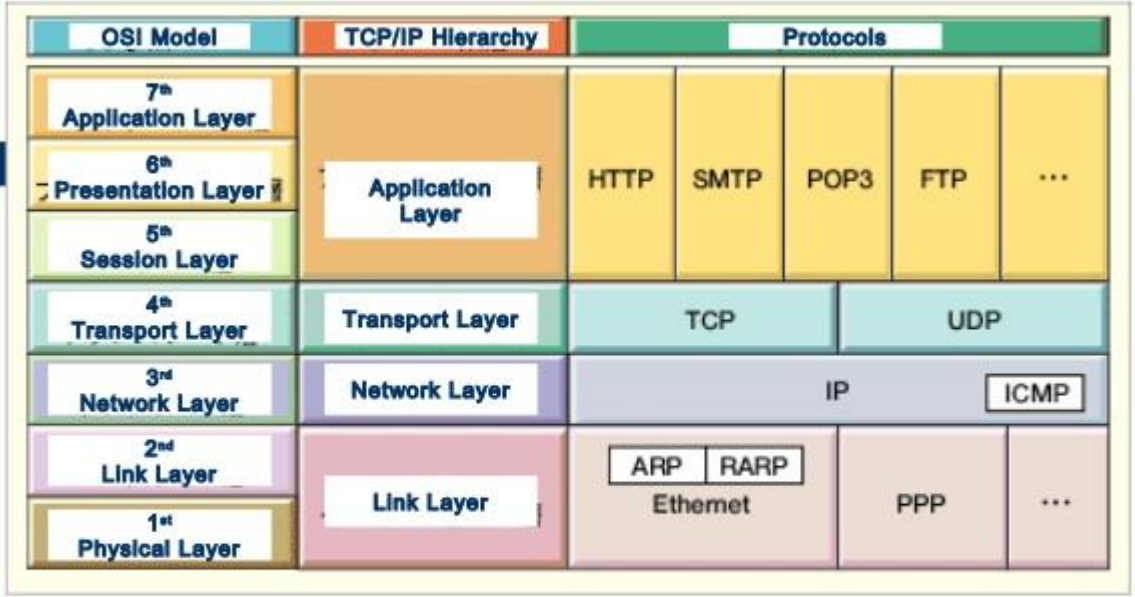
Freeswitch (Call Routing)

Kannel (Text Messages)

osmocom

Harald Welte

Comparing TCP/IP with OSI



Link Layer : includes device driver and network interface card
Network Layer : handles the movement of packets, i.e. Routing
Transport Layer : provides a reliable flow of data between two hosts
Application Layer : handles the details of the particular application

OsmoTRX

https://osmocom.org/projects/osmotrx/wiki/OsmoTRX

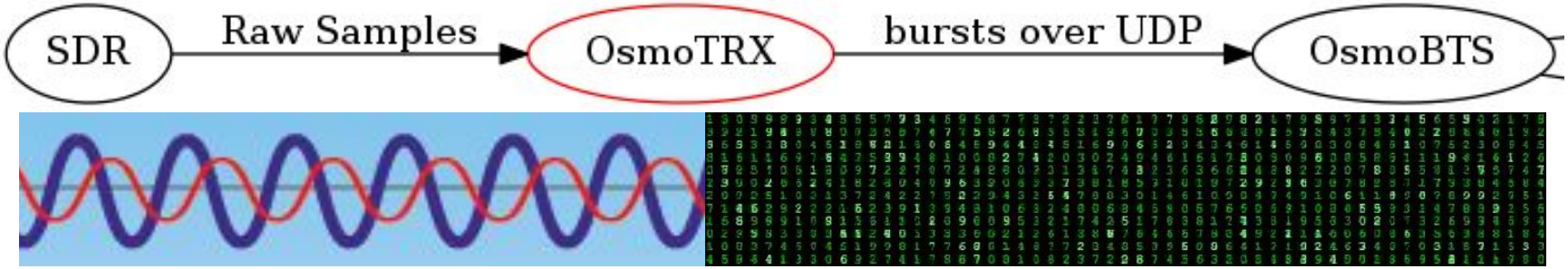
OsmoTRX

OsmoTRX is a software-defined radio transceiver that implements the Layer 1 physical layer of a BTS comprising the following 3GPP specifications:

- **TS 05.01 "Physical layer on the radio path"**
- **TS 05.02 "Multiplexing and Multiple Access on the Radio Path"**
- **TS 05.04 "Modulation"**
- **TS 05.10 "Radio subsystem synchronization"**

https://osmocom.org/projects/osmotrx/wiki/OsmoTRX

OsmoTRX



OpenBSC

https://osmocom.org/projects/openbsc/wiki/OpenBSC

OpenBSC

BSC (Base Station Controller) software that connects A-bis protocol, and implemented according to GSM technical Specification

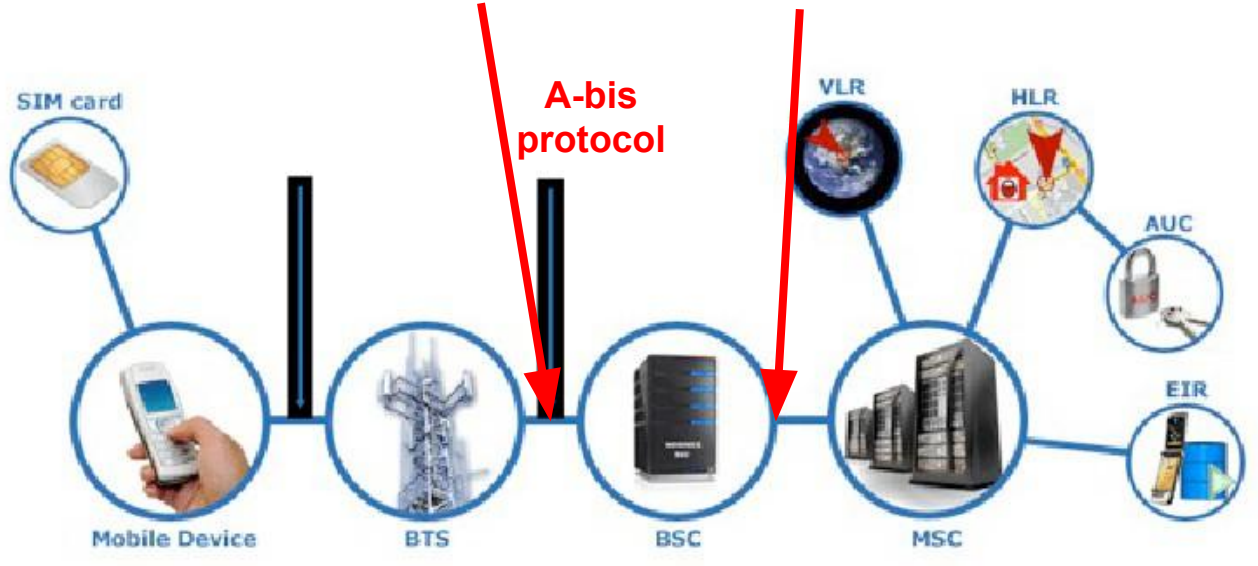
OpenBSC

BSC (Base Station Controller) software that connects A-bis protocol, and implemented according to GSM technical Specification

OsmoBSC Mode

OpenBSC

OsmoBSC Mode



OpenBSC

BSC (Base Station Controller) software that connects A-bis protocol, and implemented according to GSM technical Specification

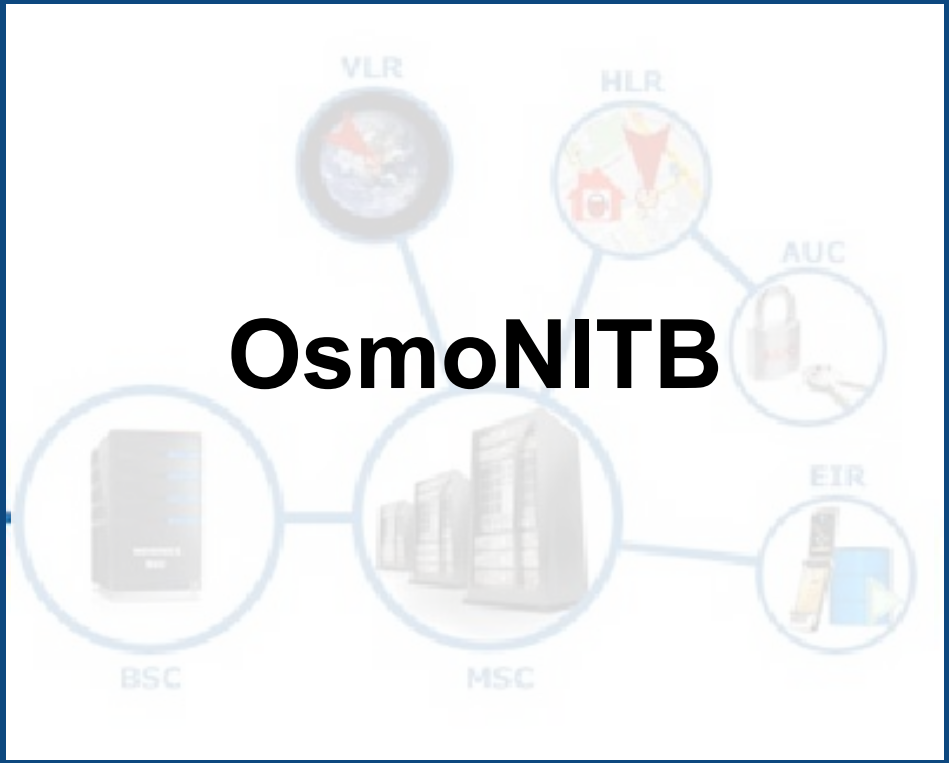
OsmoNITB Mode

BSC

Base Station Controller

BSC

Base Station Controller



OsmoNITB

BSC

Base Station Controller

RAI

RCCN
python

Freeswitch
PBX

SIP

Kannel
SMS

Linux
Call
Router

Osmo NITB

Open BSC

Osmo TRX

BTS

BSC

Base Station Controller

RAI

RCCN
python

Freeswitch
PBX

SIP

Kannel
SMS

Linux Call Router

Osmo NITB

Open BSC

Osmo TRX

BTS

Linux Call Router makes it possible to connect telephones to a Linux box.

BSC

Base Station Controller

RAI

RCCN
python

Kannel
SMS

Freeswitch PBX

SIP

Linux Call Router

Osmo NITB

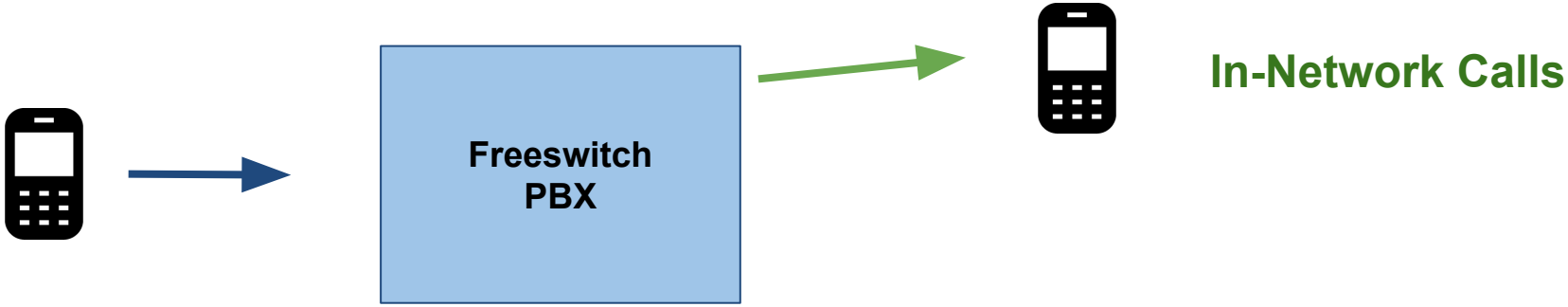
Open BSC

Osmo TRX

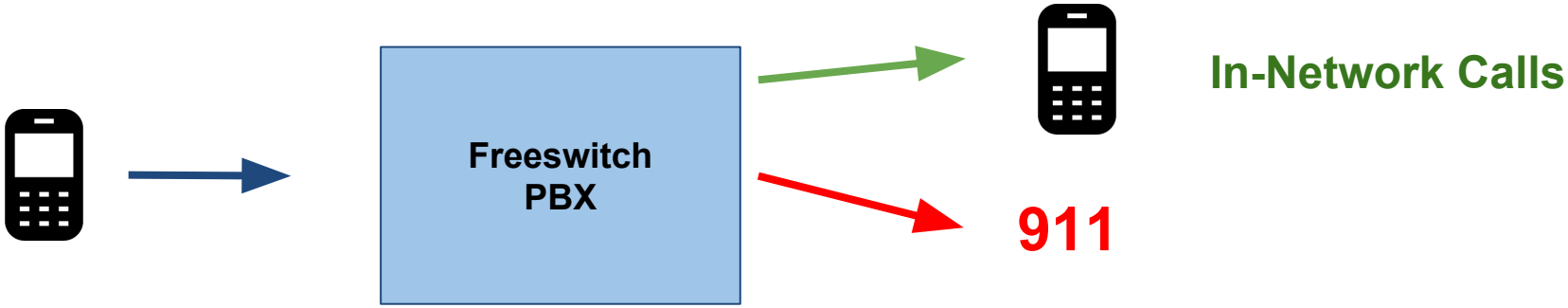
BTS

FreeSWITCH is a scalable open source cross-platform telephony platform designed to route and interconnect communication protocols.

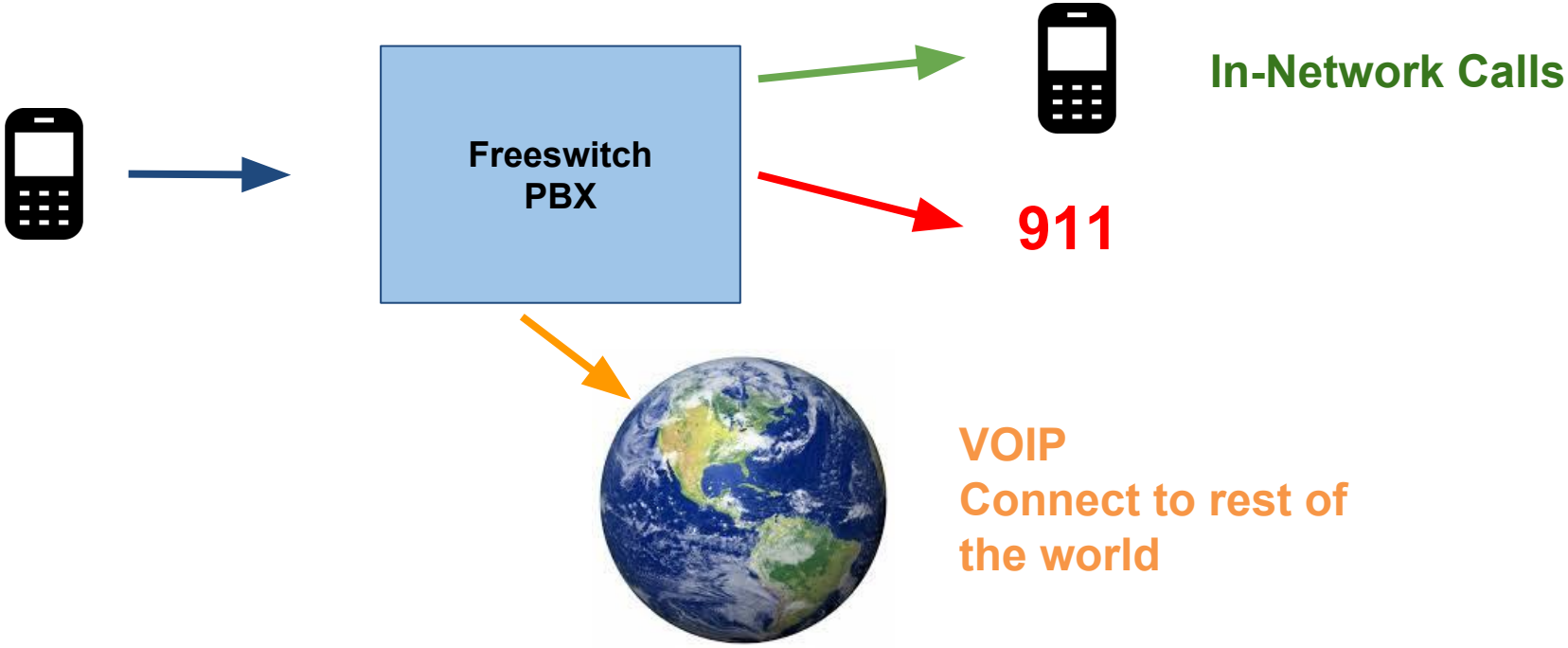
FreeSWITCH



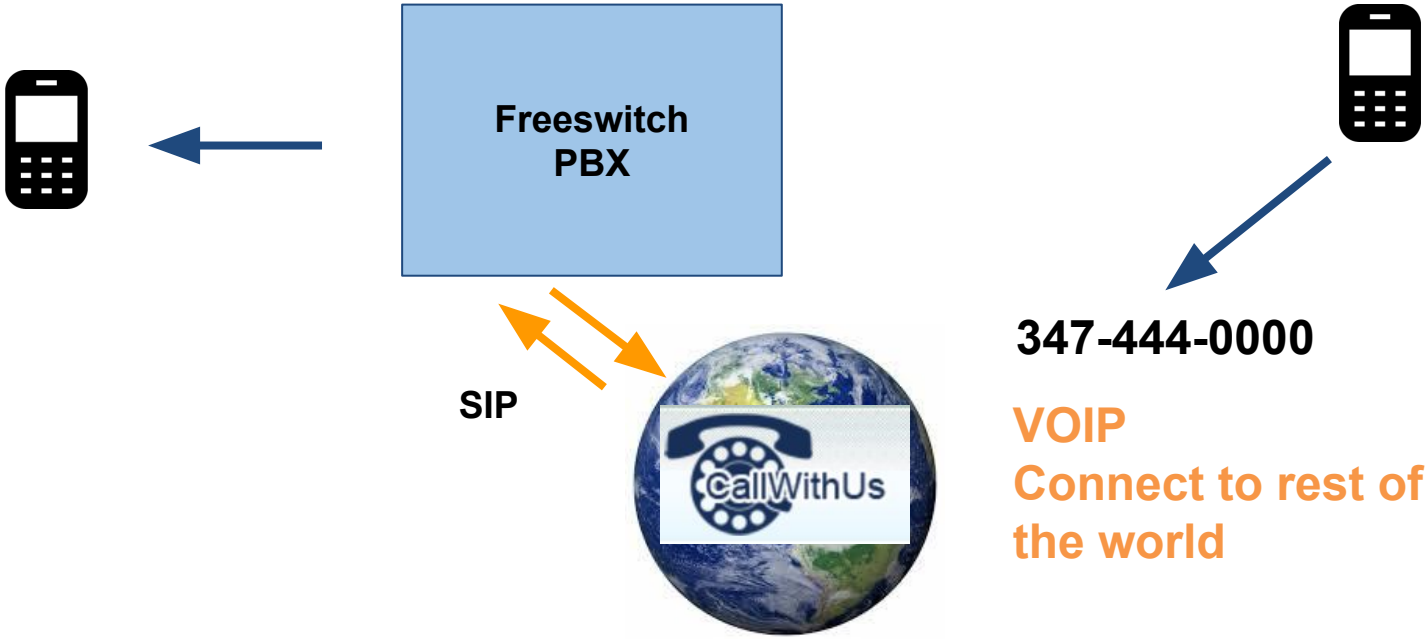
FreeSWITCH



FreeSWITCH


Freeswitch
PBX
In-Network Calls
911
VOIP
Connect to rest of
the world

FreeSWITCH


Freeswitch
PBX
SIP
CallWithUs
347-444-0000
VOIP
Connect to rest of
the world

BSC

Base Station Controller

RAI

RCCN

python

Freeswitch PBX

SIP

Kannel SMS

Linux Call Router

Osmo NITB

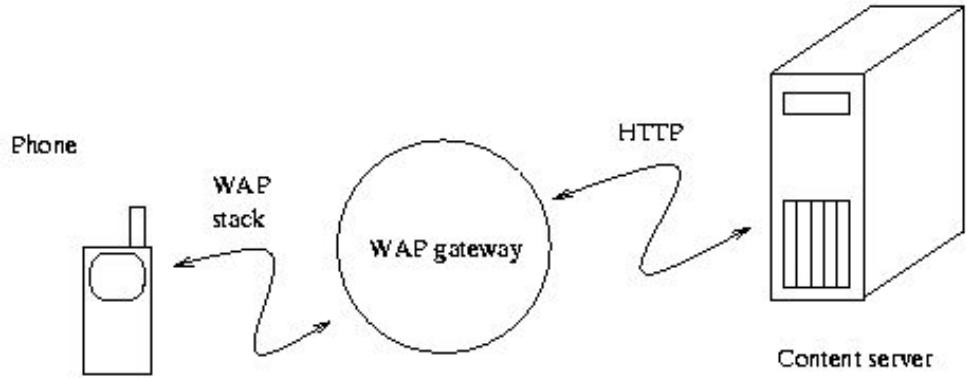
Open BSC

Osmo TRX

BTS

Kannel

Kannel is a WAP and SMS gateway.
WAP (Wireless Application Protocol) gateway talks to the phone using the WAP protocol stack, and translates the requests it receives to normal HTTP.



BSC

Base Station Controller

RCCN
python

Freeswitch PBX

SIP

Kannel SMS

Linux Call Router

Osmo NITB

Open BSC

Osmo TRX

BTS

RHIZOMATICA

RCCN
is a **python package** with the glue code that makes all the software components work together. It exposes a REST api, the RAPI.

Rhizomatica / rccn

Watch 8 | Star 11 | Fork 5

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Pulse | Graphs

Branch: master | rccn / rccn / | Create new file | Upload files | Find file | History

Keith Make in inbound loop work and add some more audio feedback — Latest commit 9154c98 17 days ago

..		
extensions	Moved/deleted stuff, now it's only the content of /var/rhizomatica	3 years ago
log	Renamed git_placeholder to .gitignore (to keep the empty directory)	3 years ago
modules	Add a filter to drop some autogenerated SMS	17 days ago
__init__.py	Moved/deleted stuff, now it's only the content of /var/rhizomatica	3 years ago
config.py	Riak IP Address is configurable	6 months ago
config_values.py.example	Added sms notification for when credit is added to a user.	2 years ago
context.py	Make in inbound loop work and add some more audio feedback	17 days ago
dialplan.py	Stop Unauthorised MS from calling DID number to get on system	17 days ago
install.py	Fix decimal() into to_decimal() in install.py	2 years ago
populate_distributed_db.py	Add riak_ip_address to populate_dist db	a month ago
push.py	More info on d_hlr anomalies	5 months ago
rapi.py	Add IMEI stuff to rapi	6 months ago
rccn.py	Stop Unauthorised MS from calling DID number to get on system	17 days ago
rhs.py	debugging rhs	2 years ago
rip.py	Fix RIP cron job, exclude msisdn==10000	2 years ago
rrc.py	more roaming stuff	7 months ago
rsc.py	Some help to track down monthly deactivation problems	10 months ago
wi.py	Add some scripts for D_HLR management	5 months ago

BSC
Base Station Controller

RAI

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python

Freeswitch
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SIP

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Linux
Call
Router

Osmo NITB

Open
BSC

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TRX

BTS

RHIZOMATICA

RAI

is a php package that uses the REST api and exposes an http administrative interface, allowing admins to register uses, manage payments, broadcast text messages and access the live system statistics.

BSC

Base Station Controller

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python

Freeswitch PBX

SIP

Kannel SMS

Linux Call Router

Osmo NITB

Open BSC

Osmo TRX

BSC

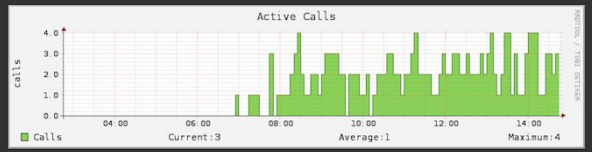
Base Station Controller

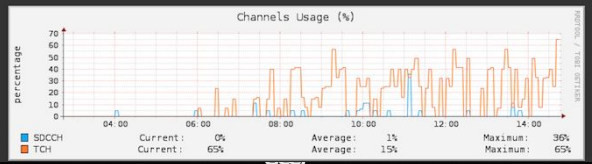
Freeswitch PBX

RAI - Administration Interface

Subscribers | Resellers | Credits | SMSs | CDRs | Rates

Last 12 Hours | Daily | Weekly | Monthly | Year



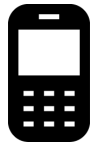


Osmo TRX

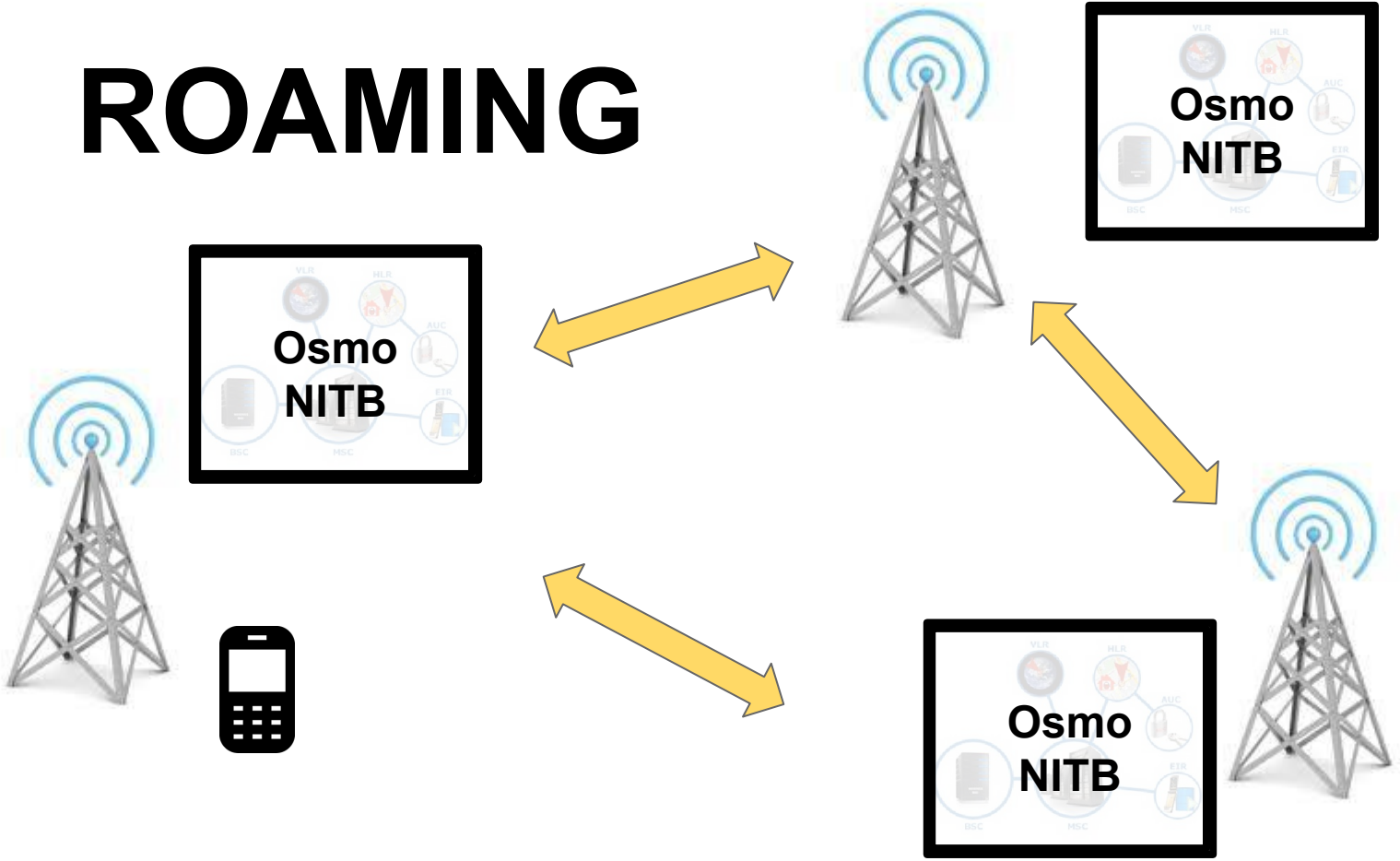
ROAMING

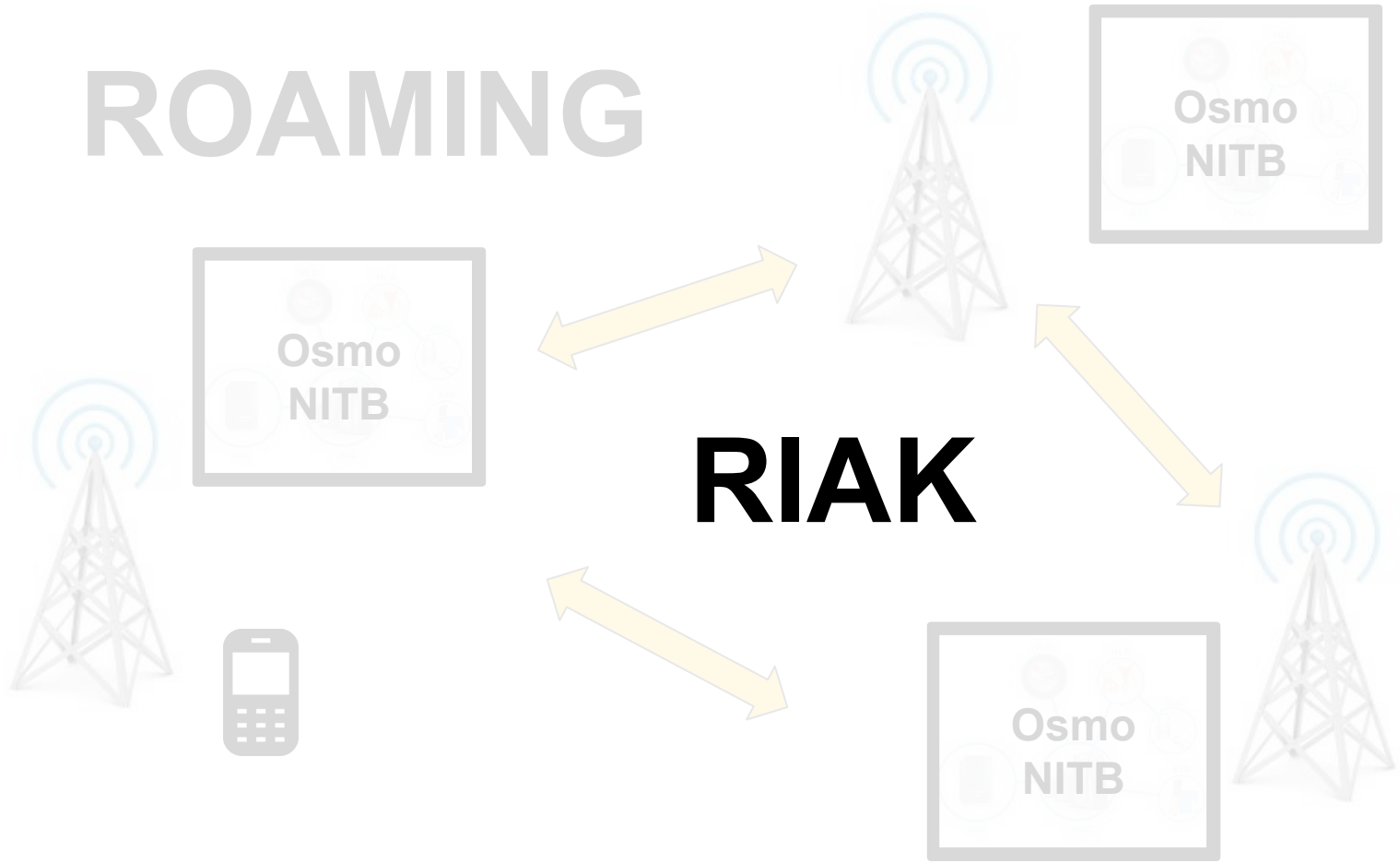
ROAMING

ROAMING



ROAMING



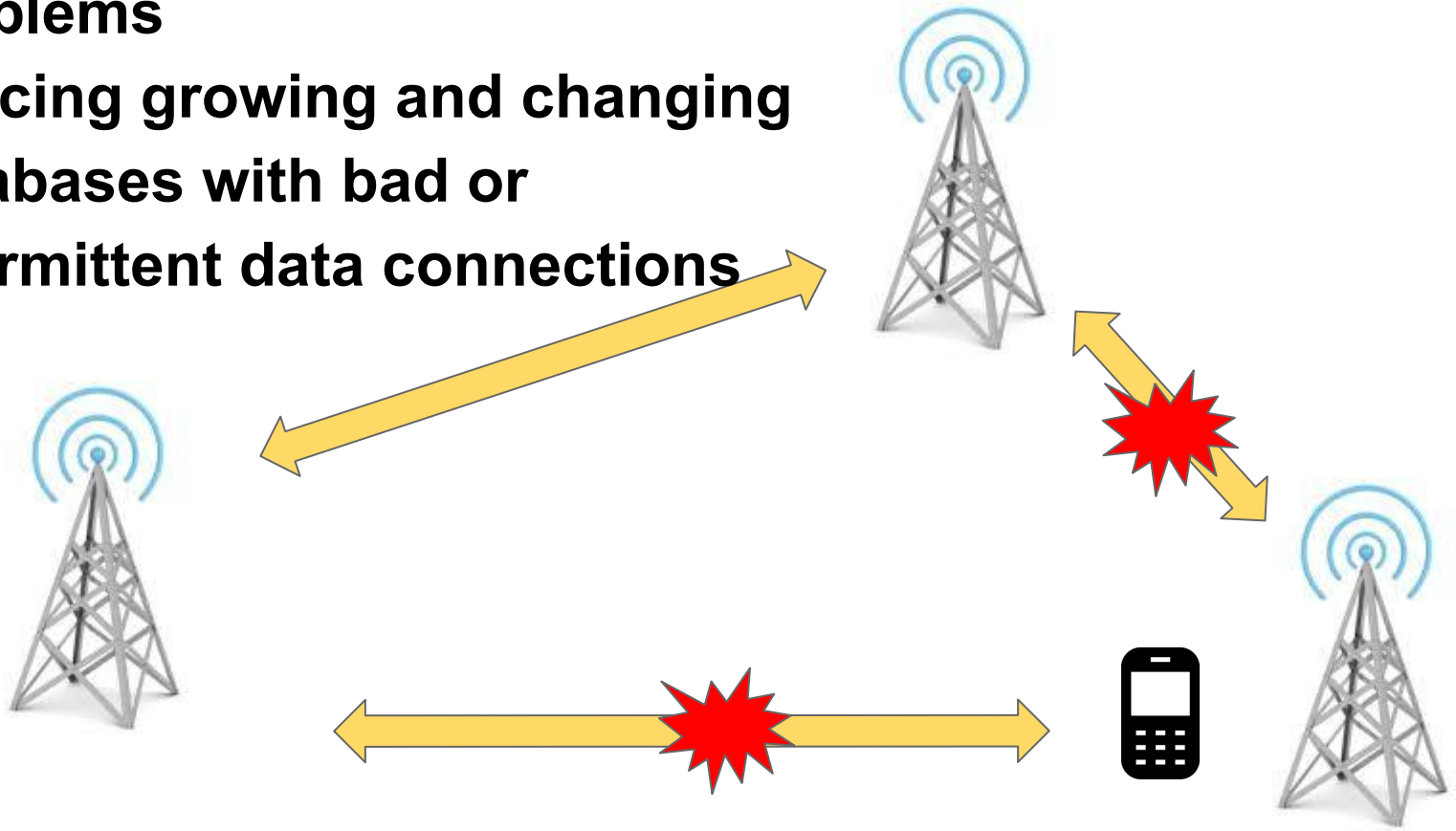

ROAMING
Osmo
NITB
Osmo
NITB
RIAK
Osmo
NITB

RIAK

Distributed NoSQL Database
Riak KV is a distributed NoSQL database that is highly available, scalable and easy to operate. It automatically distributes data across the cluster to ensure fast performance and fault-tolerance.

Problems

Syncing growing and changing databases with bad or intermittent data connections



BSC

Base Station Controller

RAI

RCCN
python

Freeswitch
PBX

SIP

Kannel
SMS

Linux
Call
Router

Osmo
NITB

Open
BSC

RIAK

Osmo
TRX

Installation

BSC

Base Station Controller

Installing Ubuntu

1. Download Ubuntu 12.04.5 Server 64bit
2. Make Bootable Flash Drive with Ubuntu 12.04.5 - Startup disk creator.
3. Copy this rhizomatica.seed to the preseed directory folder inside the bootable flash drive. - https://github.com/Rhizomatica/puppet
4. Replace the ubuntu-server.seed file with the rhizomatica.seed. AKA delete the ubuntu-server.seed and rename the rhizomatica.seed file to ubuntu-server.seed
5. Attach the Bootable Flash to the BSC with a monitor mouse and keyboard. Follow the installation instructions.

(Virtual Private Network)

Public IP
186.245.124.111

Cloud Server

Public IP
186.245.124.111

Cloud Server

VPN Server
10.99.0.1

BSC1

Public IP
186.245.124.111

DigitalOcean

Cloud Server

VPN Server
10.99.0.1

Public IP
186.245.124.111

Cloud Server

VPN Server
10.99.0.1

BSC1
VPN Client
10.99.0.2

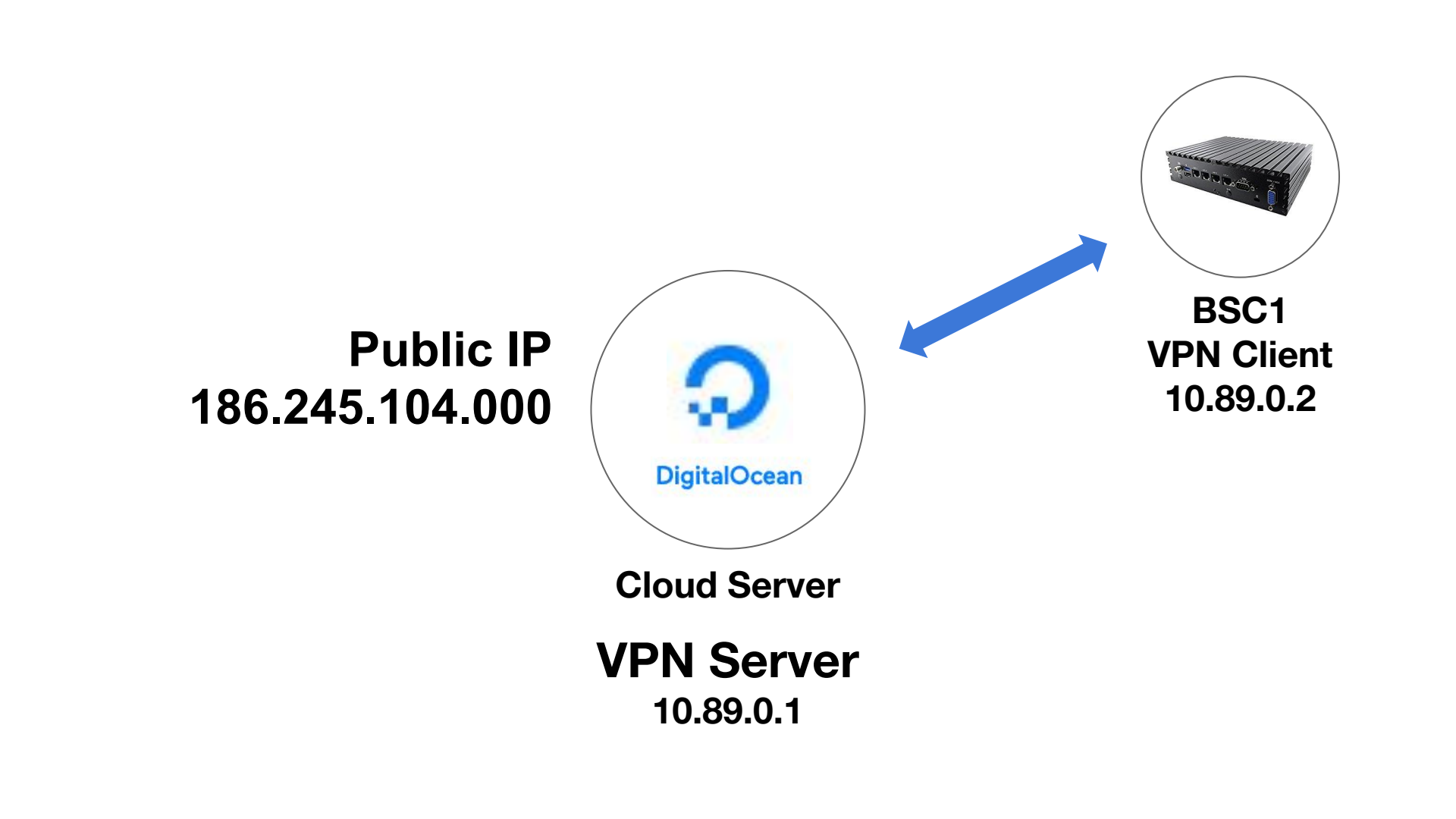
BSC1
VPN Client
10.99.0.2

Public IP
186.245.124.111

DigitalOcean

Cloud Server

VPN Server
10.99.0.1


Public IP
186.245.104.000
DigitalOcean
Cloud Server
VPN Server
10.89.0.1
BSC1
VPN Client
10.89.0.2

Public IP
186.245.124.111

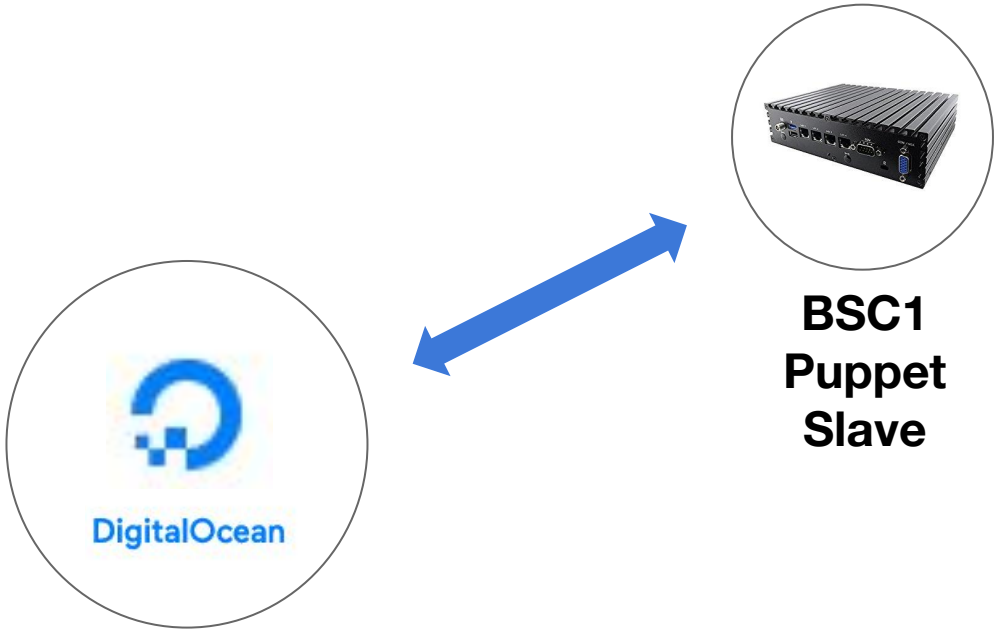
Cloud Server

VPN Server
10.99.0.1

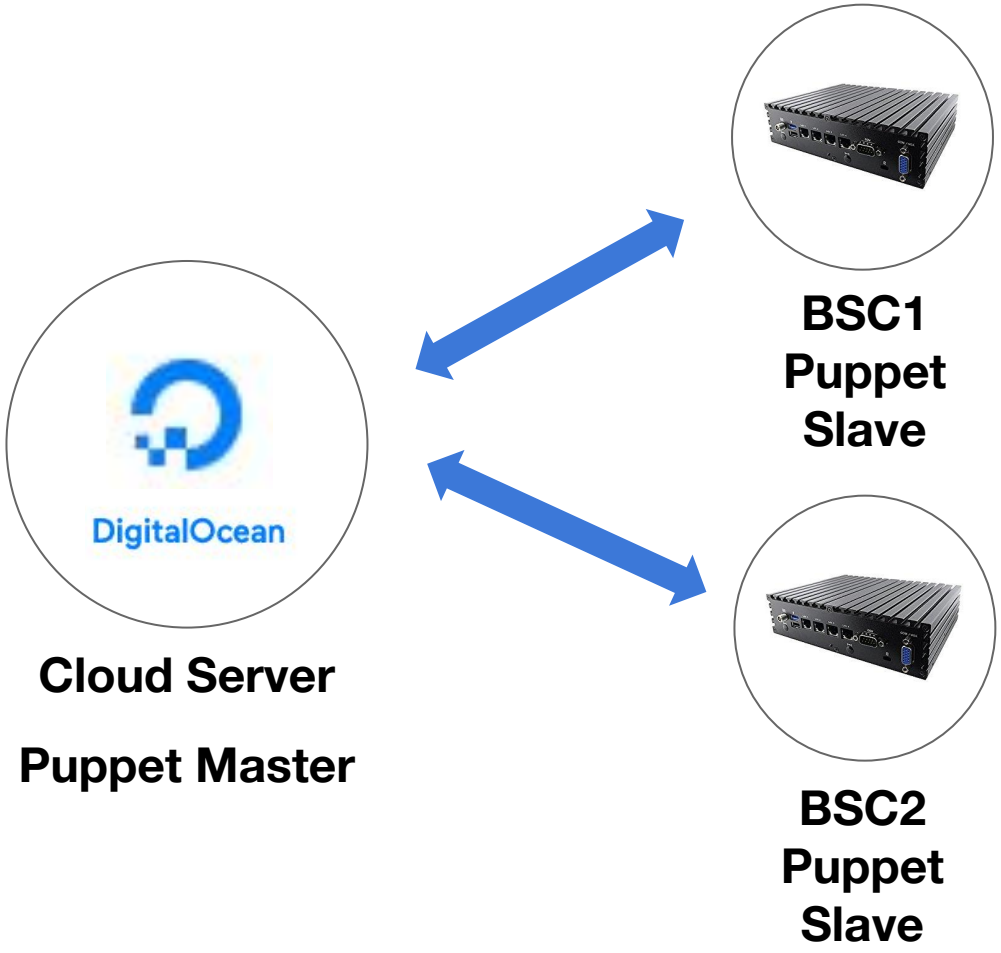
BSC1
VPN Client
10.99.0.2

Puppet provides way of delivering operating software, updates and configurations to several remote servers

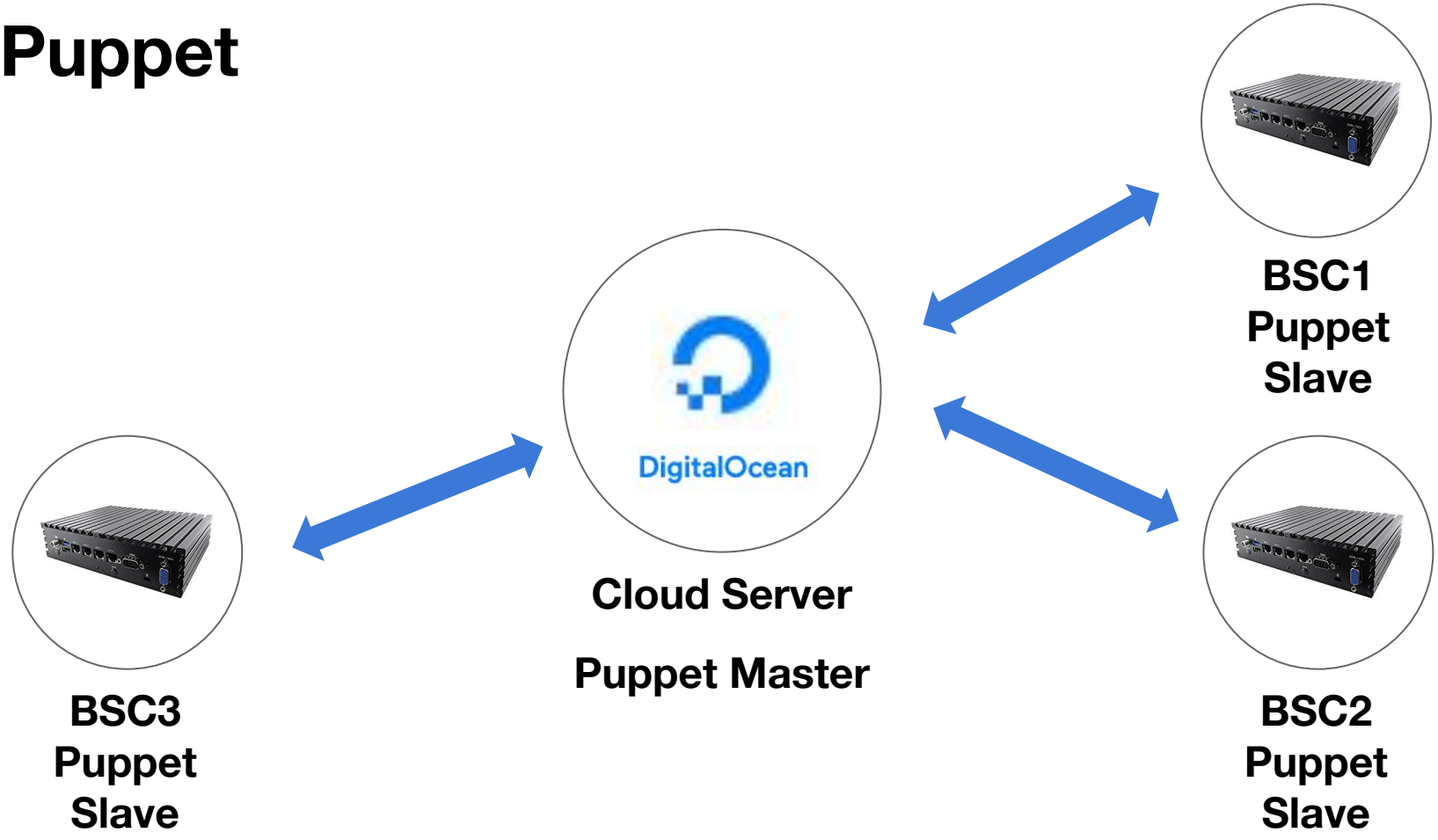
Puppet


DigitalOcean
BSC1
Puppet
Slave
Cloud Server
Puppet Master

Puppet


DigitalOcean
Cloud Server
Puppet Master
BSC1
Puppet
Slave
BSC2
Puppet
Slave

Puppet


DigitalOcean
BSC1
Puppet
Slave
Cloud Server
Puppet Master
BSC3
Puppet
Slave
BSC2
Puppet
Slave

Puppet

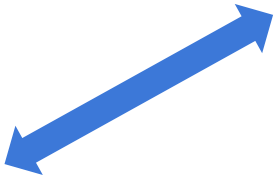
Use Rhizomatica Puppet Recipe
To install GSM System

`Full instructions:`

`https://github.com/Rhizomatica/puppet`

Cloud Server

Puppet Master



BSC1
Puppet
Slave

BSC

Base Station Controller

RAI

RCCN
python

Freeswitch
PBX

SIP

Kannel
SMS

Linux
Call
Router

Osmo
NITB

Open
BSC

RIAK

Osmo
TRX

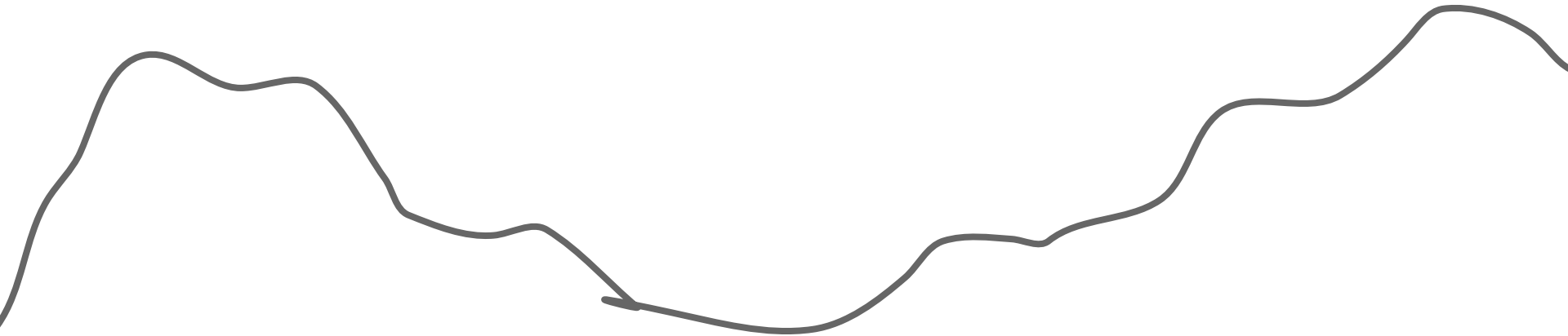
After running puppet several times you should have a working system, although there will be several fixes that need to be completed.

SETUP BTS SCRIPT

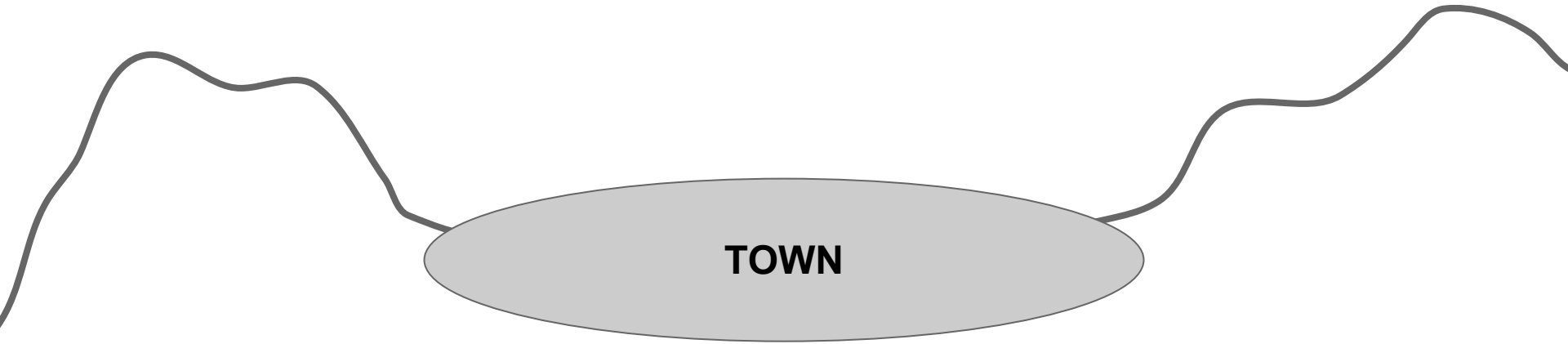
Use Fabric to install:
setup-bts.py

BTS
Base Transceiver Station

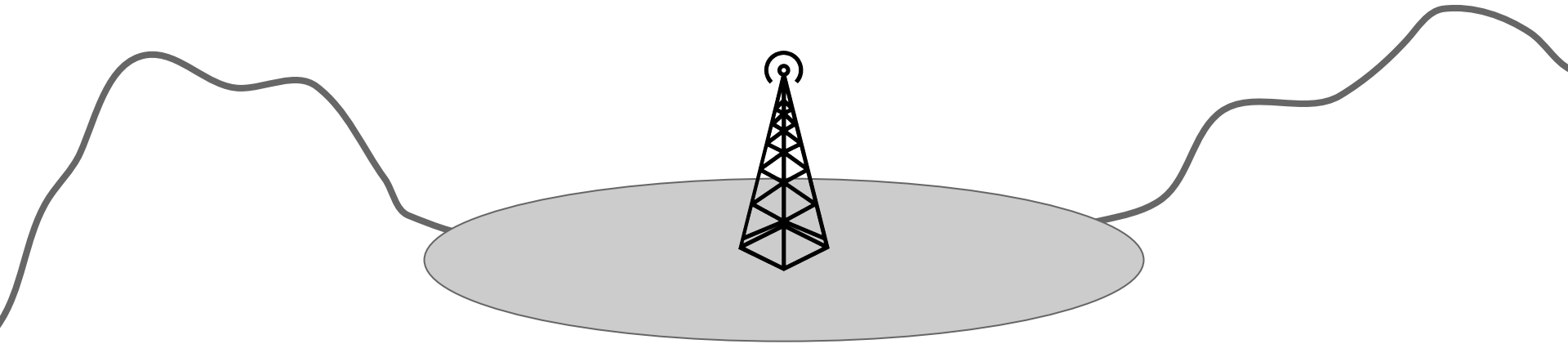
Site Location

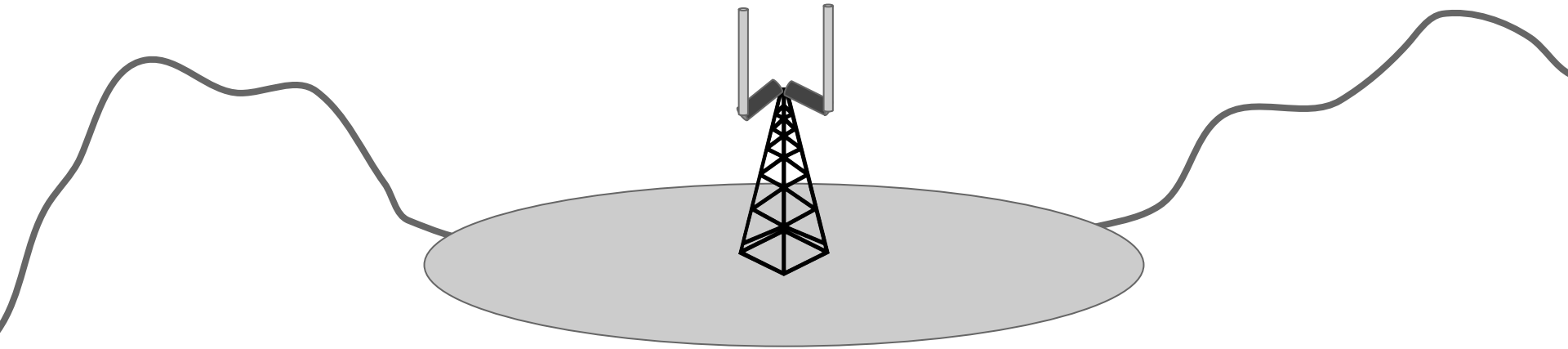


Site Location



Site Location





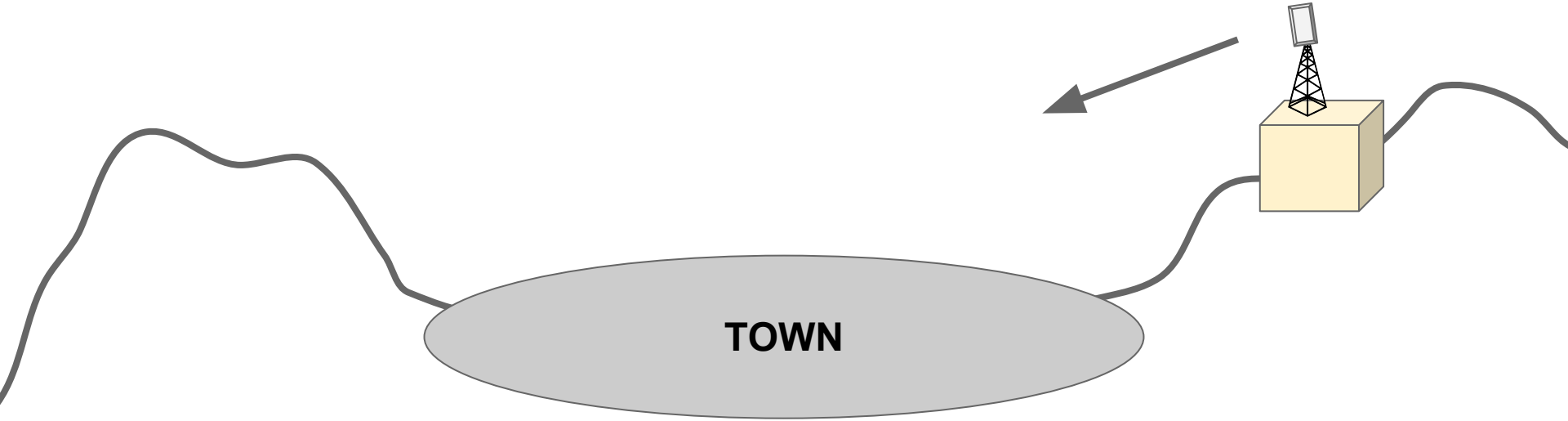
Site Location

Omni Directional Antenna

(antennas at least 6 feet apart)

Site Location

Patch Antennas



Site Location

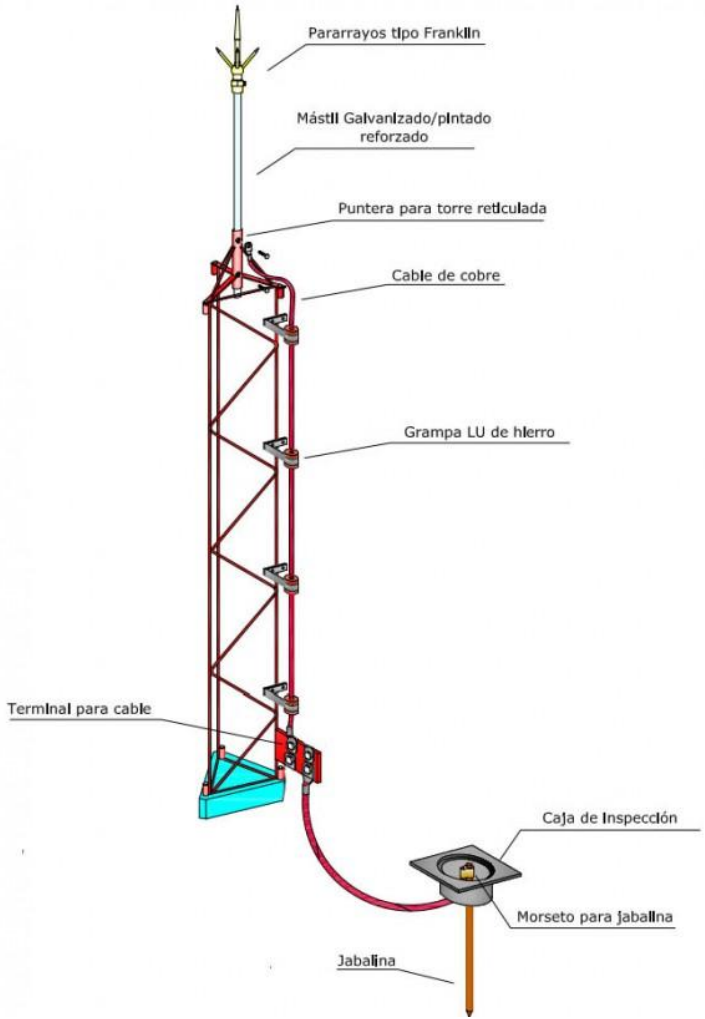
Patch Antennas

TOWN

Tower
Lighting Protection

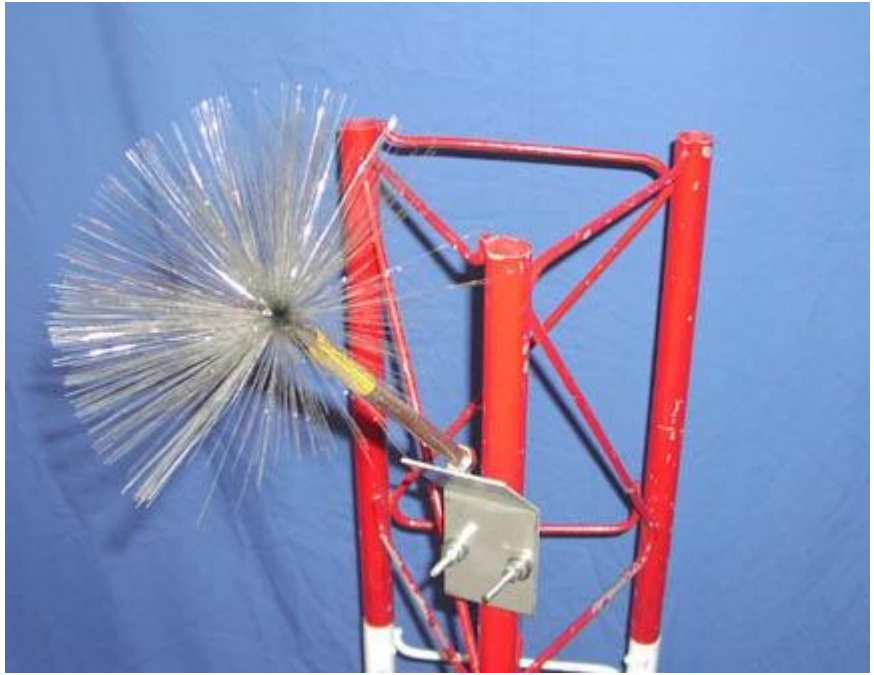
Lightning Protection

- Grounding



Lightning Protection

- Lightning Dissipator



Climbing Gear


MAMMUT


EXOFIT

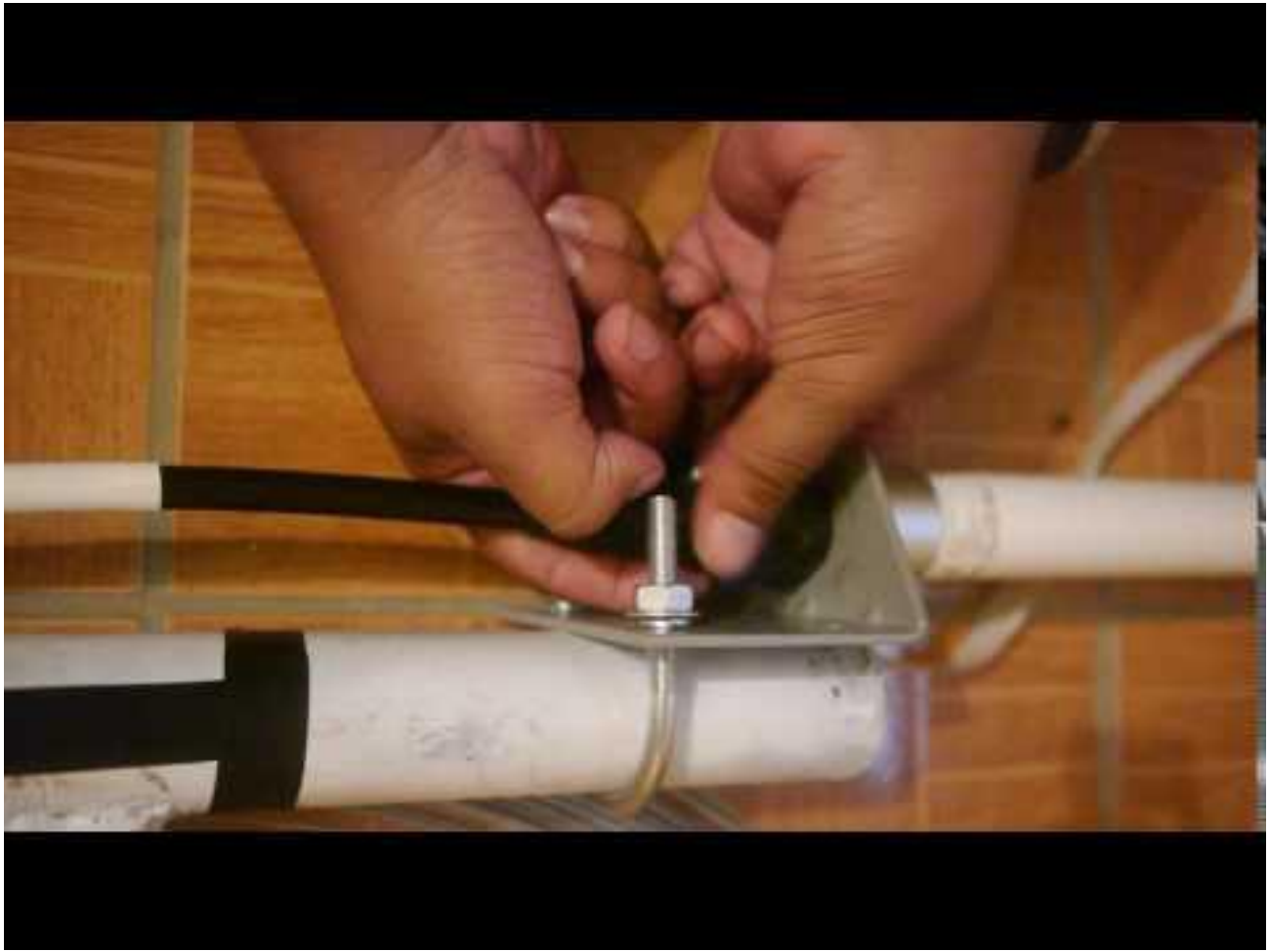
Waterproof Connections


Scotch
HEAVY-DUTY GRADE
Vinyl Electrical Tape
Super 88
• Thicker for heavy-duty use
• Withstands harsh conditions
• Super strong adhesion
3M


COAX-SEAL
The Original Connector Sealant
Seals connections from moisture & corrosion
WRAP
MOLD
HAND MOLDABLE PLASTIC
48 in.
COAX-SEAL
"The Original Connector Sealant"
SEALS COAX FITTINGS FROM MOISTURE AND CORROSION
PROVEN IN COMMERCIAL USE
4 ROLLS - ½" WIDE X 12' LONG (48 ft.)
NON-IRRITATING

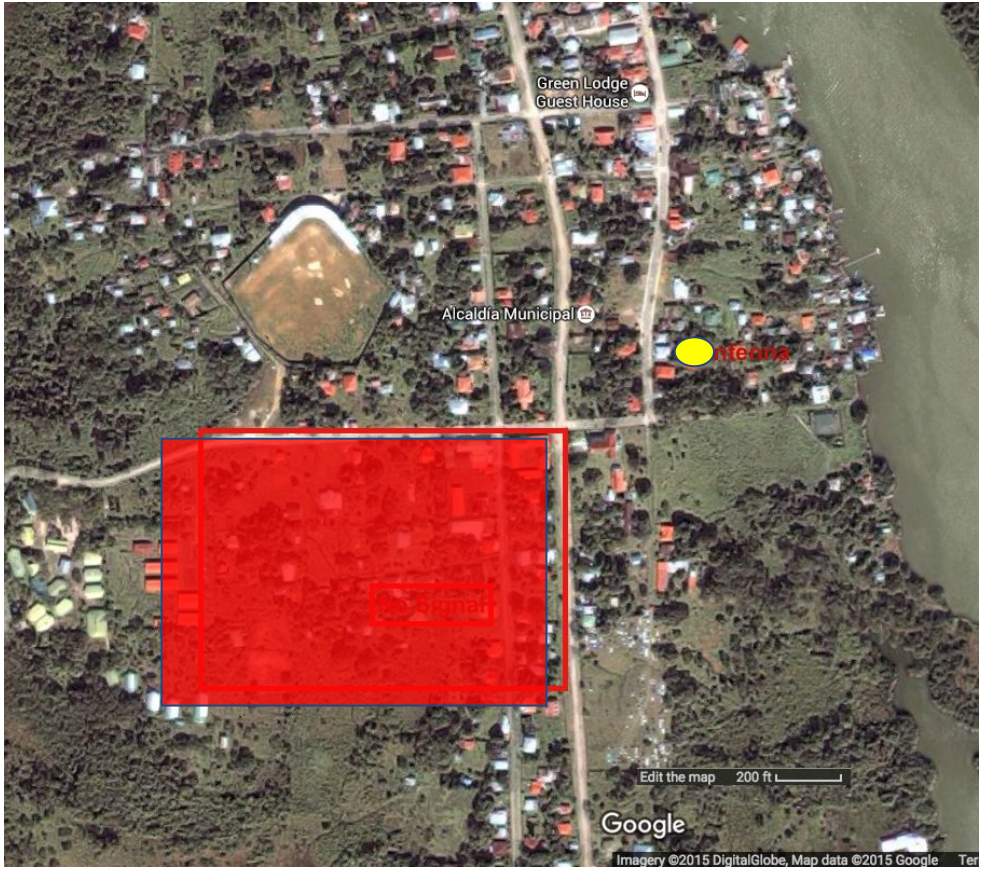
Tape > Coax Seal > Tape

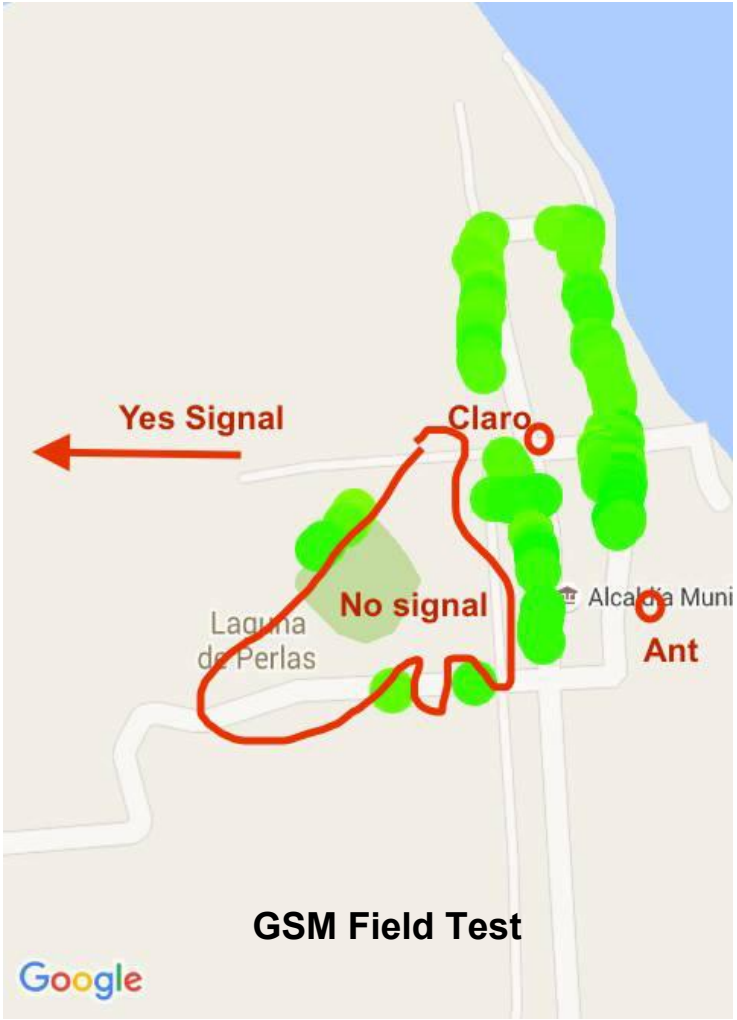
Tower Installation Prep




GPS

RF Troubleshooting


Green Lodge
Guest House
Alcaldia Municipal
Antenna
Signal
Edit the map
200 ft
Google
Imagery ©2015 DigitalGlobe, Map data ©2015 Google


Yes Signal
Claro
No signal
Laguna
de Perlas
Alcaldía Muni
Ant
GSM Field Test
Google


RF IN/OUT 50Ω
912.089
-96.5
RF Explorer
Handheld Spectrum Analyzer
RETURN
MENU
ENTER
BATTERY
ON
OFF
USB 2.0

BSC

Base Station Controller

BSC

Base Station Controller

BSC

Base Station Controller

Installing Ubuntu

1. Download Ubuntu 12.04.5 Server 64bit
2. Make Bootable Flash Drive with Ubuntu 12.04.5 - Startup disk creator.
3. Copy this rhizomatica.seed to the preseed directory folder inside the bootable flash drive. - https://github.com/Rhizomatica/puppet
4. Replace the ubuntu-server.seed file with the rhizomatica.seed. AKA delete the ubuntu-server.seed and rename the rhizomatica.seed file to ubuntu-server.seed
5. Attach the Bootable Flash to the BSC with a monitor mouse and keyboard. Follow the installation instructions.

BSC

Base Station Controller

BTS

Base Transceiver Station