LoRaWAN Demo

Davide Magrin

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1 Network Topology

1.1 Variable number of EDs

1.2 One GW

1.3 Various propagation options

1.4 Confirmed / Unconfirmed traffic

2 Baseline example

2.1 A simple UL only network with 200 devices

Each device will send one packet, at a random time during the simulation.
./waf --run "complete-network-example" | tail -n 15

PHY
---
TOT: 200
SUCC: 200
INT: 0
NMR: 0
US: 0
GWTX: 0

MAC Confirmed
-------------
Successes: 0 0 0 0 0 0 0 0
Failures: 0 0 0 0 0 0 0 0
Delays: 0 0
Totals: 0

gnuplot -p -e "set term png; set output 'eds1.png'; \
plot 'endDevices.dat' with points palette"
2.2 More devices!

```bash
./waf --run "complete-network-example --nDevices=1000" | tail -n 15
```

<table>
<thead>
<tr>
<th>PHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOT: 1000</td>
</tr>
<tr>
<td>SUCC: 899</td>
</tr>
<tr>
<td>INT: 91</td>
</tr>
<tr>
<td>NMR: 10</td>
</tr>
<tr>
<td>US: 0</td>
</tr>
<tr>
<td>GWTX: 0</td>
</tr>
</tbody>
</table>

MAC Confirmed
-------------
Successes: 0 0 0 0 0 0 0 0
Failures: 0 0 0 0 0 0 0 0
Delays: 0 0
Totals: 0
3 Impact of channel model

Previously, we used a 'gentle' propagation model. With buildings and shadowing, instead...

```bash
./waf --run "complete-network-example --addBuildings=True" | tail -n 15
```

<table>
<thead>
<tr>
<th>PHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOT: 200</td>
</tr>
<tr>
<td>SUCC: 81</td>
</tr>
<tr>
<td>INT: 3</td>
</tr>
<tr>
<td>NMR: 0</td>
</tr>
<tr>
<td>US: 116</td>
</tr>
<tr>
<td>GWTX: 0</td>
</tr>
</tbody>
</table>

MAC Confirmed

------------
Successes: 0 0 0 0 0 0 0 0
Failures: 0 0 0 0 0 0 0 0
Delays: 0 0
Totals: 0

![Diagram]
4 Unconfirmed / Confirmed

When EDs require confirmation, the GW will need to reply with an ACK.

```bash
./waf --run "complete-network-example --MType=Confirmed" | tail -n 15
```

PHY
---
TOT: 259
SUCC: 203
INT: 1
NMR: 0
US: 0
GWTX: 55

MAC Confirmed
-------------
Successes: 157 32 7 3 1 0 0 0
Failures: 0 0 0 0 0 0 0 0
Delays: 30.0995 31.4437
Totals: 259

With too many devices, we get congestion!

```bash
./waf --run "complete-network-example --MType=Confirmed --nDevices=600" | tail -n 15
```

PHY
---
TOT: 1246
SUCC: 630
INT: 51
NMR: 7
US: 0
GWTX: 558

MAC Confirmed
-------------
Successes: 336 109 61 32 26 13 11 7
Failures: 0 0 0 0 0 0 0 5
Delays: 110.524 112.697
Totals: 1246