Ex de MAC

- $d = 20$ m
- $L[dB] = k_0 + k_1 \cdot \log(d)$; $k_0 = 60$ dB ; $k_1 = 43{,}3$
- $P_0 = 0$ dBm
- $R_T = 5d \cdot \sqrt{2}$; $R_S = 5 \cdot d \cdot \sqrt{2}$
- 5 channels disjoints (see figure)
- QoS App $\Rightarrow$ $T_q \leq 32$ ms $\Rightarrow$ SO $\rightarrow$ 1 $\Rightarrow$ $T_q = 30{,}72$ ms
  $= 960 \cdot 2^{-1} \cdot T_S$
- No ReTx
- $\neq$ GTS
- $\gamma \rightarrow \infty$
- packet size = 20 Bytes ; 10 Bytes payload

Question 1 :

- $P_S^{trame} \geq 30\%$
  - $P_{succ} \cdot P_{mac}$
    - $L_0 = 1$ $\delta = 0$ $d_{node-sink} \leq R_T$

$\Rightarrow P_{mac} \geq 30\% \Rightarrow$ figure $\Rightarrow N_{PAN} \leq 39$

- $d_{node-node} \leq R_S$
  - No ReTx
  - 20 Bytes
  - $\gamma \rightarrow \infty$

Provided that we guarantee

- connectivity $\Rightarrow d_{sink-node} \leq R_T$
- no HTP $\Rightarrow d_{node-node} \leq R_S$

$\Rightarrow P_S^{frame} \geq 30\% \Leftrightarrow N_{PAN} \leq 39$

Suppose $\Rightarrow$ equally split the number of nodes among coordinators/PANs

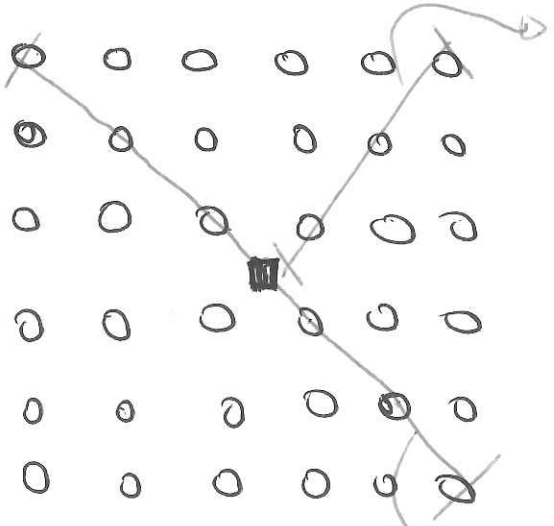
$N_{TOT} = 164$

2 coord $\Rightarrow N_{PAN} = 82 \Rightarrow$ not ok

3 " $\Rightarrow$ " $= 69 \Rightarrow$ " "

4 " $\Rightarrow N_{PAN} = 36 \Rightarrow$ (ok)

$\Rightarrow$ check connectivity



$d_{sink-node}$ (worst-case) $= 2,5 \cdot d\sqrt{2}$

" $< R_T \Rightarrow$ (ok)

$\Rightarrow R_{COV} = 1$

- check HTP $\Rightarrow d_{node-node} = 5 \cdot d\sqrt{2} = R_S \Rightarrow$ (ok)

- 4 coord. ⇒ 4 channels needed ⇒ ok

⇒ $P_{mac} \overset{\uparrow}{=} P_S^{frame} = P_{mac}(BO=1, N_{PAN}=36, \text{no GTS}) \approx 0,35$

$P_{coll}=1$

$$S_{PAN} = \frac{10 \cdot 8 \cdot P_{mac} \cdot N_{PAN}}{T_q} = \frac{10 \cdot 8 \cdot 0,35 \cdot 36 \text{ [bit]}}{32 \cdot 20 \cdot 10^{-3} \text{ [s]}}$$

$$= \boxed{32,8 \text{ kbit/s}}$$

$$S_{total} = 4 \cdot S_{PAN} = 131,2 \text{ kbit/s}$$

- no GTS
- $P_S^{frame} \geq 40\% \Rightarrow P_{mac} \geq 40\% \overset{\text{figure}}{\Rightarrow} N_{PAN} \leq 21$
- 8 links → (ok) → $N_{PAN}=18$ but not square area
⇒ 2 sink ⇒ $N_{PAN}=16$

$P_{mac}(N_{PAN}=16, BO=1, N_{GTS}=0) = 0,45$ ⇒ (ok)

but 5 channels disabled ⇒ noise

⇒ check if $\frac{S}{I} \geq 1,3$ dB

↳ Inter-PAN interf.

$d_U = 1,5 \cdot 8 \sqrt{2} \cdot d = 42,42\ m$

$d_I = d \cdot \sqrt{(6,5)^2 + (2,5)^2} = 139\ m$

$C\,[dBW] = \phi\,[dBW] - 60 - 18,37 \cdot \log(d_U) =$

$= -105\ dBW$

$I_1[dBW] = \phi \cdot [dBW] - 60 - 18,37 \cdot \log(d_I) =$

$= -125,4\ dBW$

$$\frac{C}{I} = \frac{C}{16 \cdot I_1} = \frac{10^{-105/10}\ [mW]}{16 \cdot 10^{-125/10}\ [mW]} = 4,2 = 8,5\,dB > \underset{dB}{13}$$

$$S_{PAN} = \frac{10 \cdot 8 \cdot 0,05 \cdot 16}{T_q} = 18,5\ kbit/s$$

$$S_{total} = S_{PAN} \cdot 9 = 168,5\ kbit/s$$

↑ S at the cost of more coordinators.

- AP channel 6 $\Rightarrow P_0^{802.11} = 20\,dBW$
- 802.15.4 net. channel 16

$P_{int}^{11,15} = 24,52\%$

check $\frac{C}{I} \geq 1,3\,dB$?

$d_W = 1,5\sqrt{2} \cdot d$

$d_I = 4 \cdot \sqrt{2} \cdot d$

$C = -135\,dB$

$d_W = 1,5 \cdot \sqrt{2}\, d$

$$I = \frac{P_0^{802.15} \cdot P_{int}}{L} = \frac{10^{20/10} \cdot [mW] \cdot 0,2452}{10^{122,13/10}} = 1,5 \cdot 10^{-14}$$

$[W] = -108\ dBW$ $(-138\ dB)$

$L[dB] = k_0 + k_1 \cdot \log(d_I) = 122,13\,dB$

$\frac{C}{I}[dB] = \underbrace{-135\,dBW + 138\,dBW}_{3\,dB} = 3\,dB > 1,3\,dB$

OK