# EPIDEMIC BROADCAST

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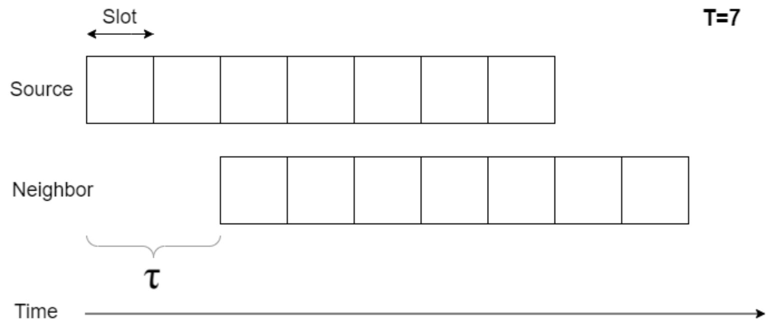
# Modeling




**Parameters**

- Radius $R$
- Number of Slots $T$
- Number of Copies $m$
- Number of Users $N$

**Performance Indexes**

- Broadcast Time
- Number of Collisions
- Percentage of Covered Users: $\frac{N_c}{N-1}$

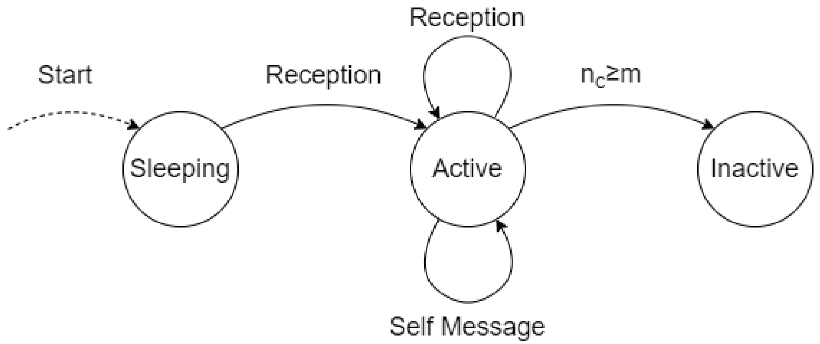
**General Assumptions**

- Communications are slotted
- Message transmission last one slot
- No transmission delay
- Collided messages will be dropped
- Trickle Relaying policy
- Time Windows misaligned for a factor of τ
- Users’ positions and τ are uniformly distributed

# Implementation

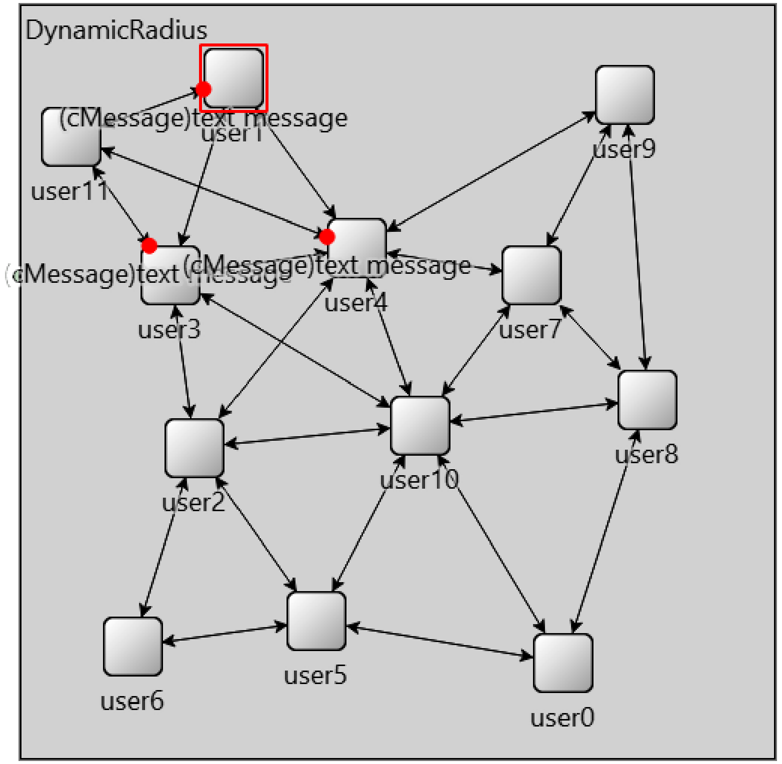
**Users memory**
- Messages received (without collisions)
- Timestamp receptions
- Collisions counter

**User Module Behavior**




**Type of messages received**
- Self message: if $n_c < m$ the user relays the messages, else it deactivate itself.
- External message: the message is stored in the memory at $slot_i = \frac{simTime}{t} mod\ T$, if the slot is empty.

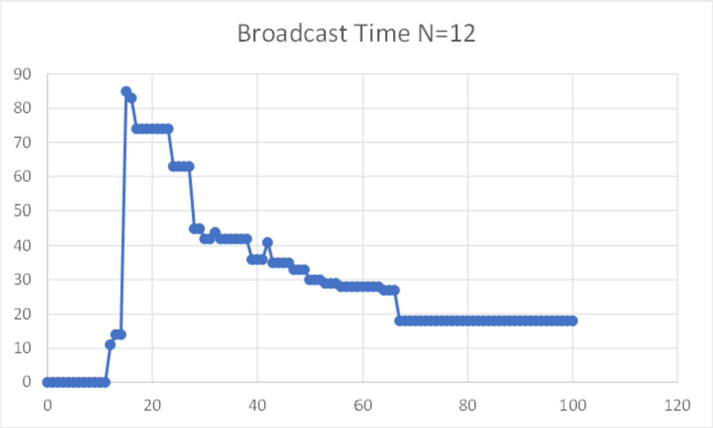
**Network generation**
- Dynamic Radius
- Dynamic Positions

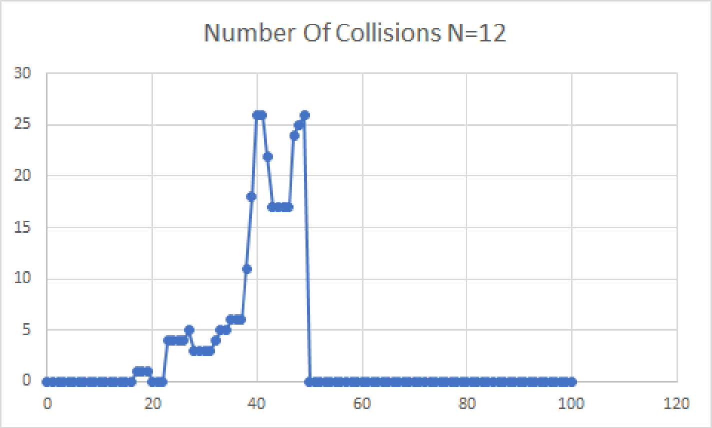


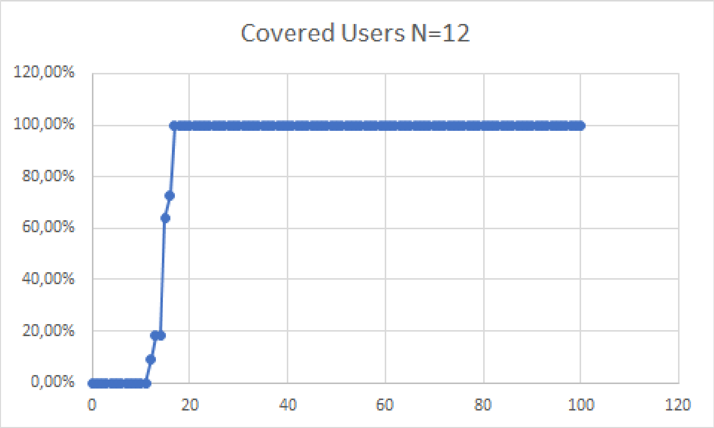
# Study on R (1)

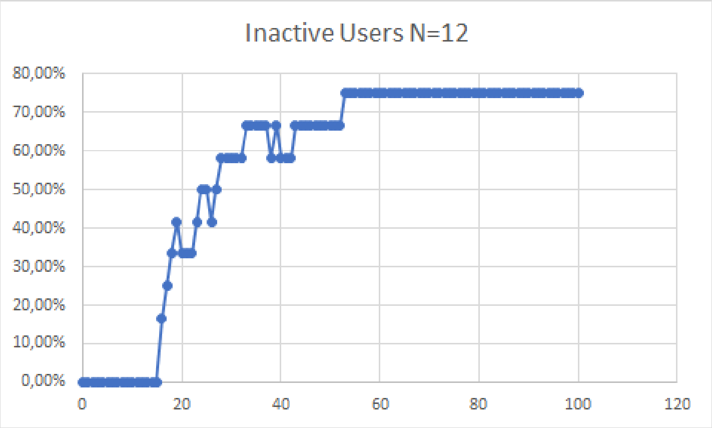
$$x_R = \frac{R}{d} \qquad x_R \in [0\%, 100\%]$$

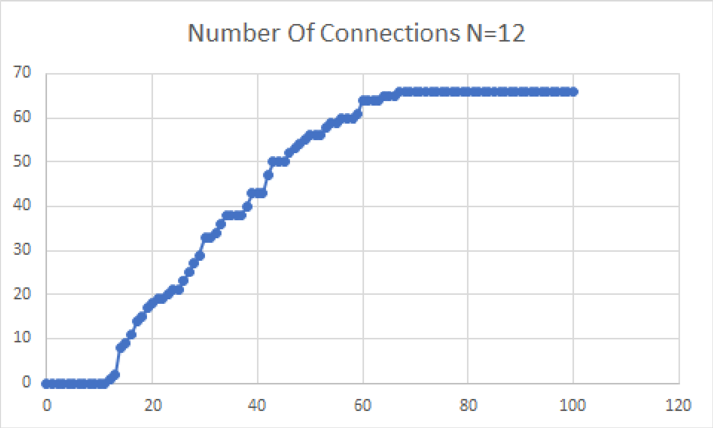
$R$ = [0,986]  $T$ = 10  $m$ = 3  $N$ = 12 ➞ $x_R \in [20\%, 70\%]$



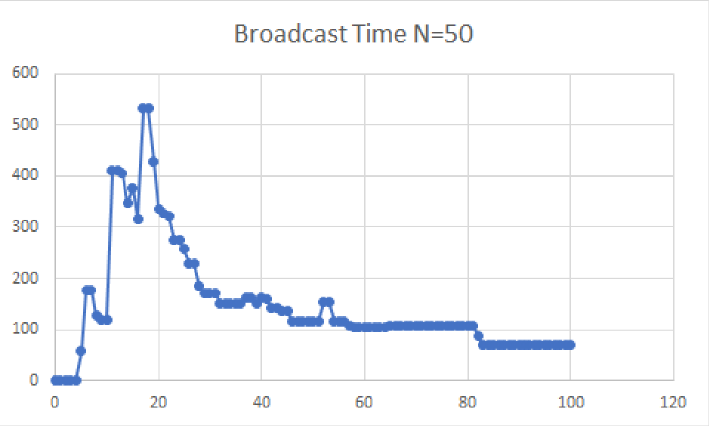



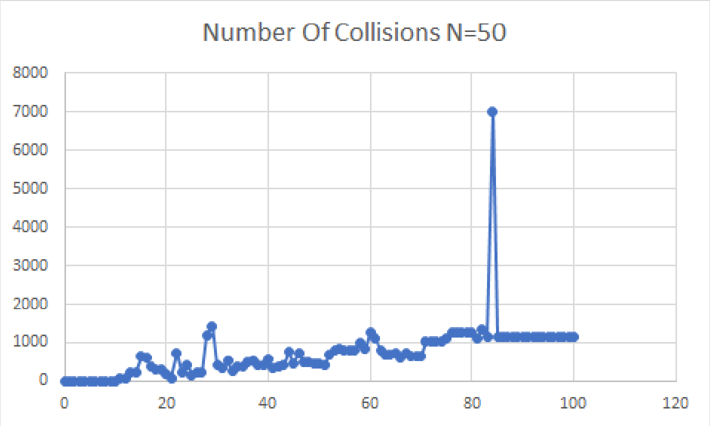



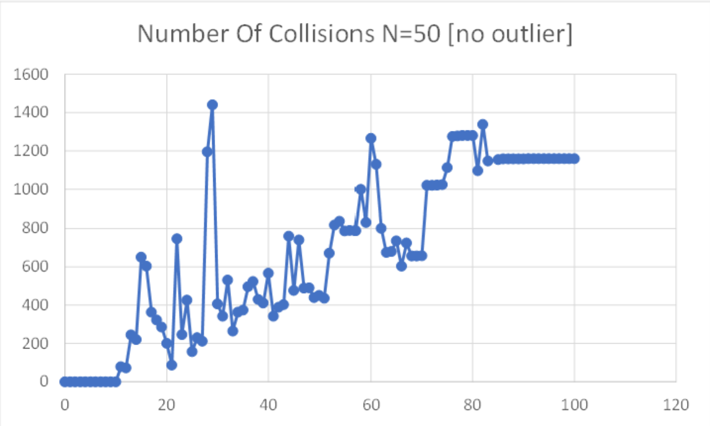
# Study on R (2)

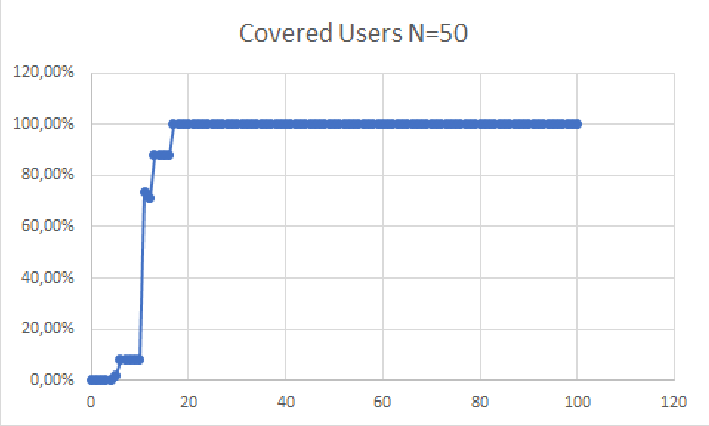
$$x_R = \frac{R}{d} \qquad x_R \in [0\%, 100\%]$$

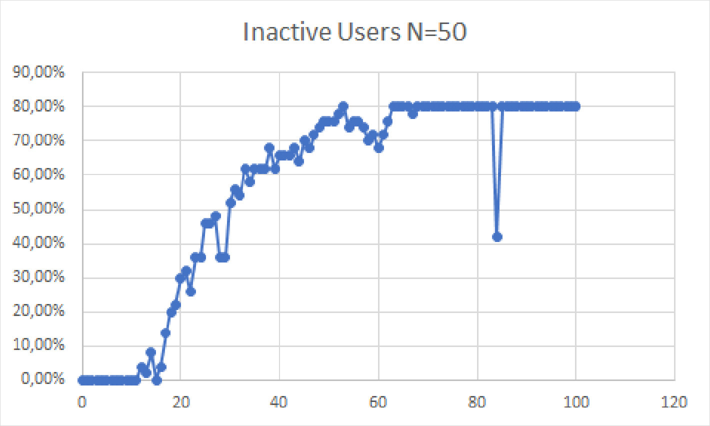
$R$ = [0,1118]  $T$ = 35  $m$ = 10  $N$ = 50 → $x_R \in [20\%, 70\%]$

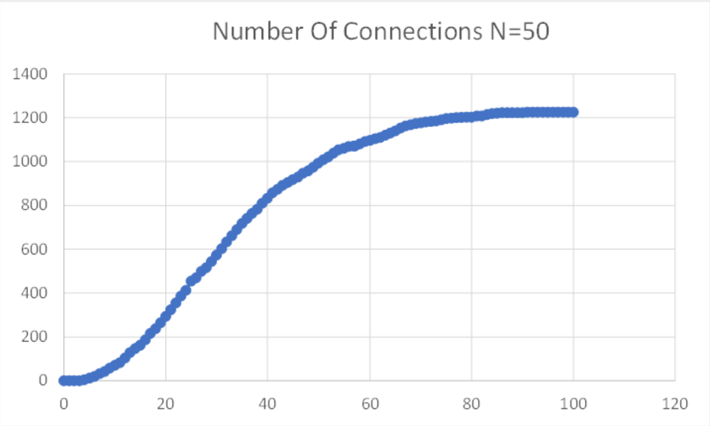


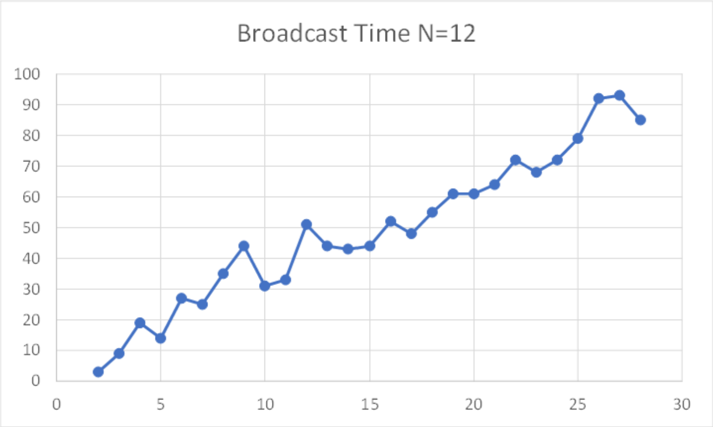



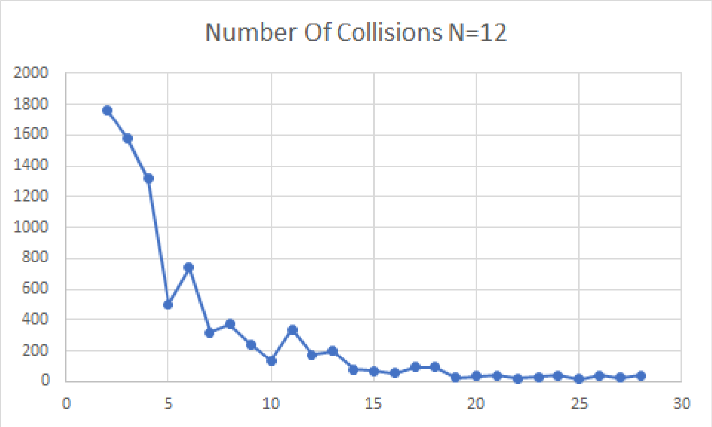



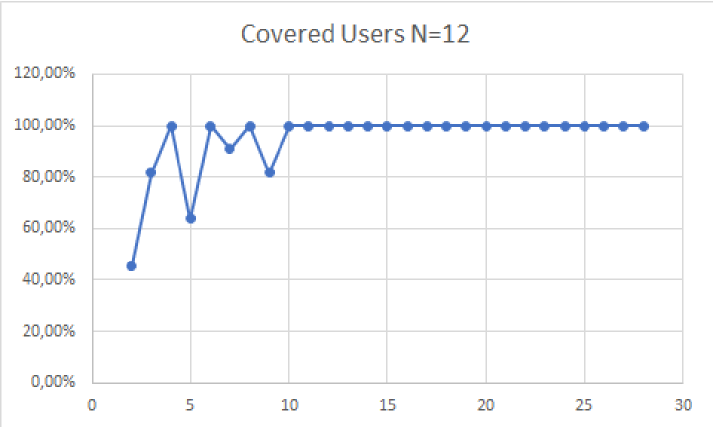
# Study on T (1)

$$x_T = \frac{T}{D} \qquad x_T \geq 0$$

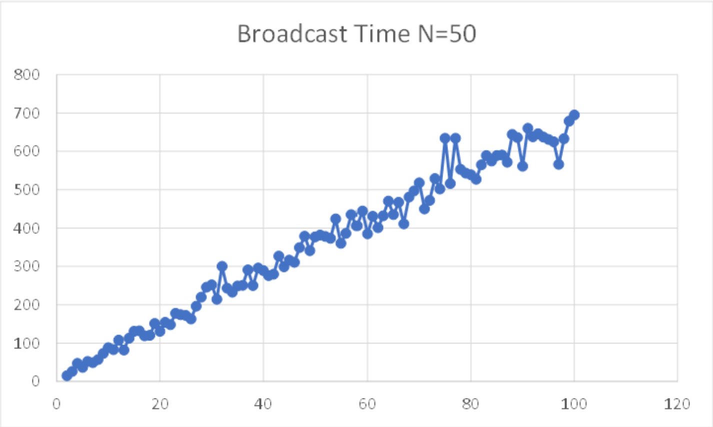
*R* = *425*  *T* = [2,28]  *m* = 12  *N* = 12 → $x_T \in [35,67]$

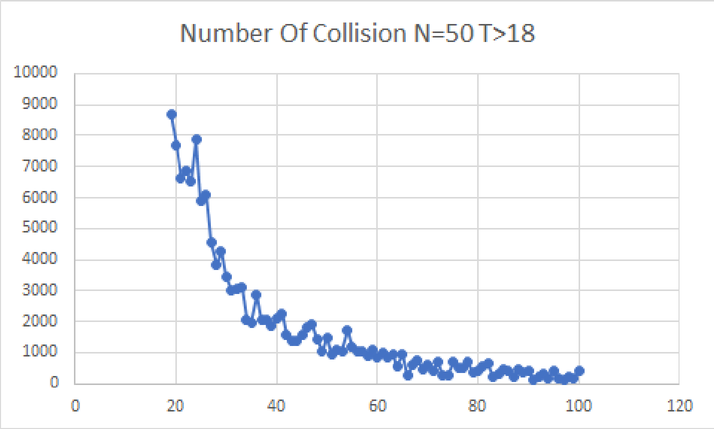


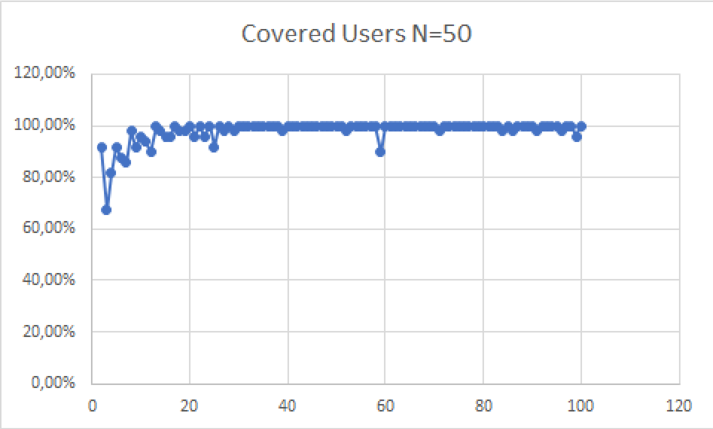




*R* = *250*  *T* = [2,100]  *m* = 50  *N* = 50 → $x_T \in [40,80]$



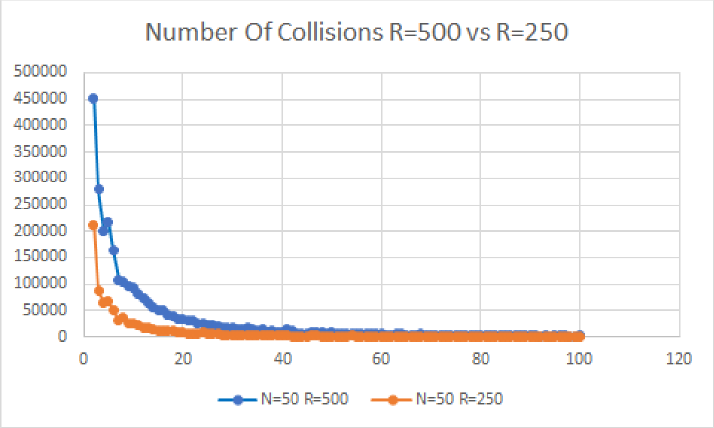



# Study on T (2)

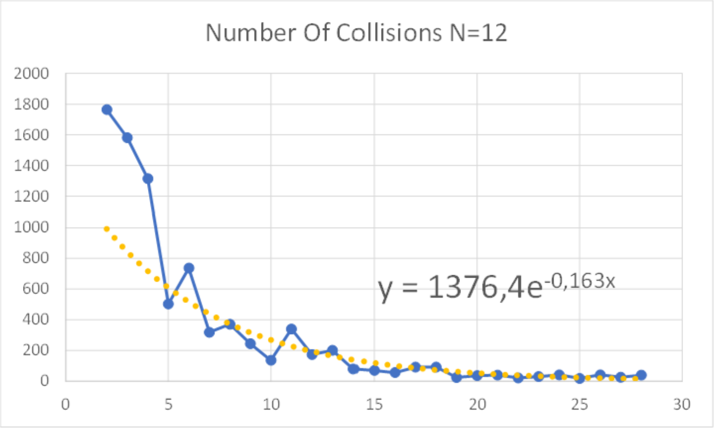
$$x_T = \frac{T}{D} \qquad x_T \geq 0$$

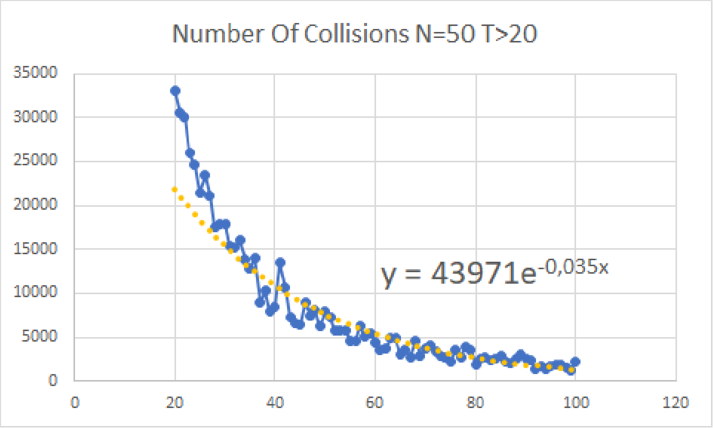
*R = 500* *T* = [2,100] *m* = 50 *N* = 50

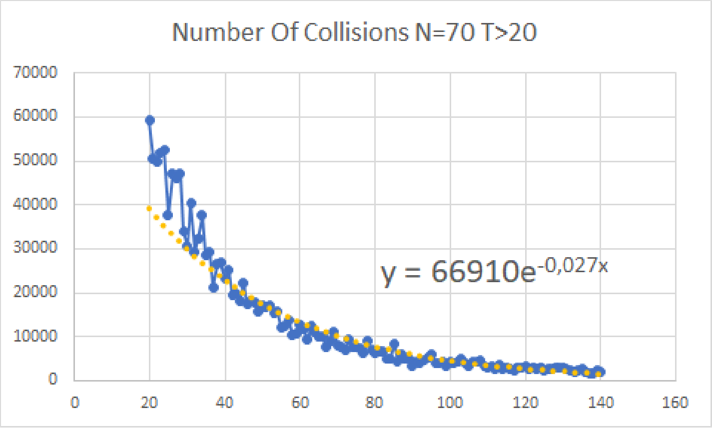



- The translation is mainly influenced by the **radius**.
- increasing ***N***, the velocity at which collisions tend to 0 decreases.

Comparison with increasing of *N*:



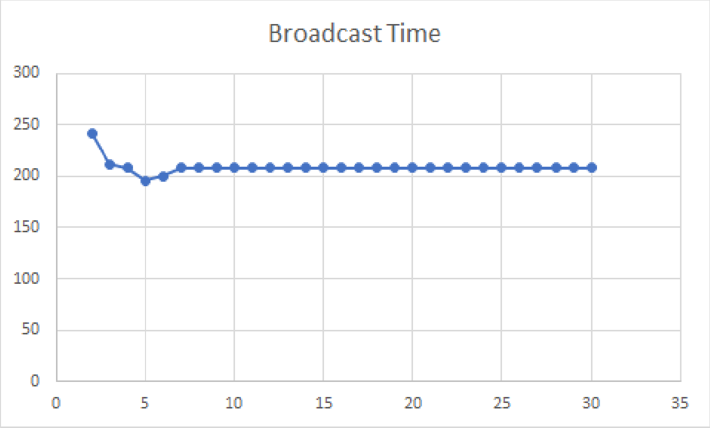



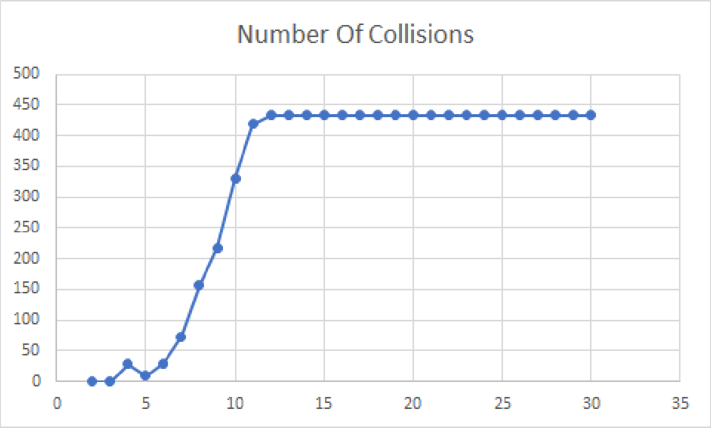



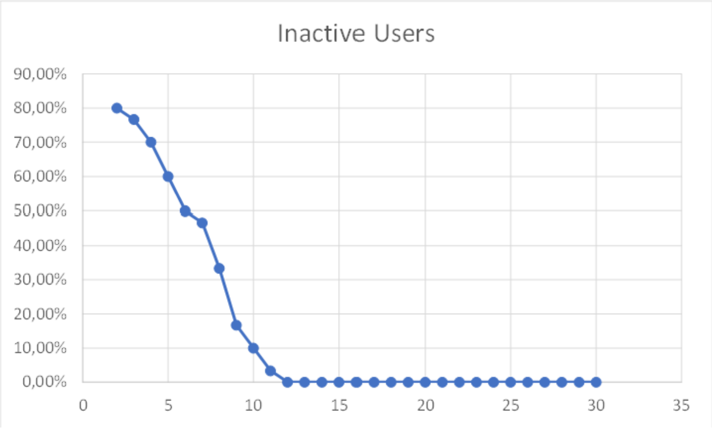
# Study on m

$$x_m = \frac{m}{\min\{N_n, N\}} \qquad N_n = DR^2\pi$$

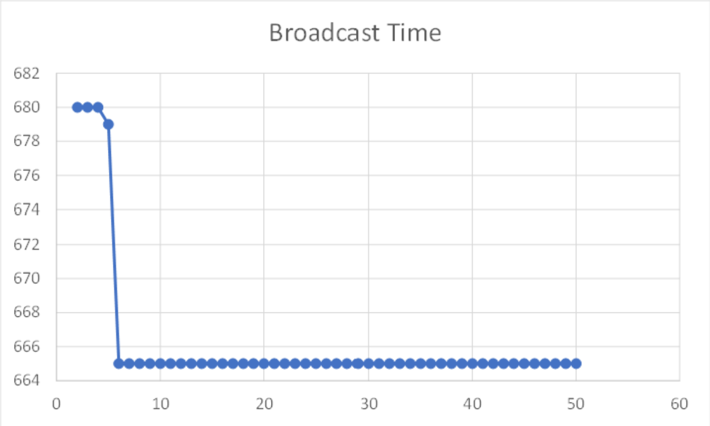
*R* = 300 *T* = 30 *m* = [2,T] *N* = 30 (Coverage 100%) → $x_m \in [23\%, 71\%]$

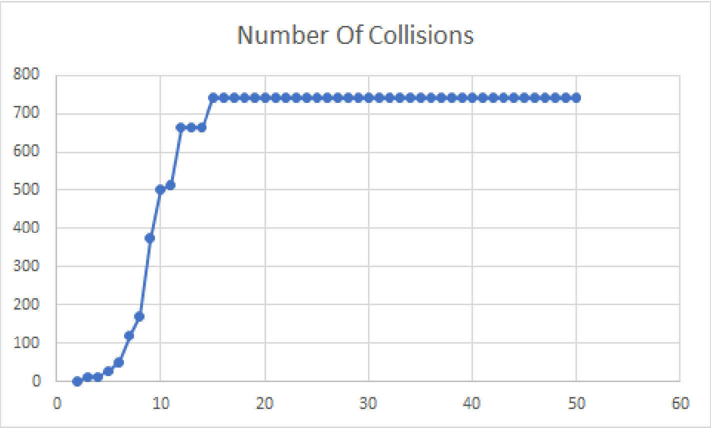


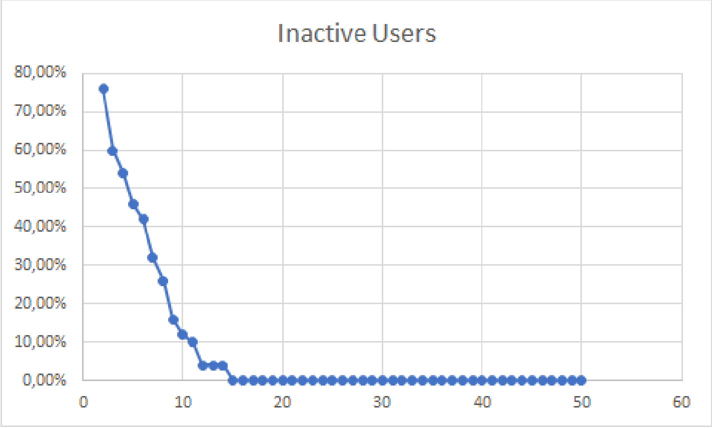




*R* = 200 *T* = 50 *m* = [2,T] *N* = 50 (Coverage 100%) → $x_m \in [46\%, 115\%]$



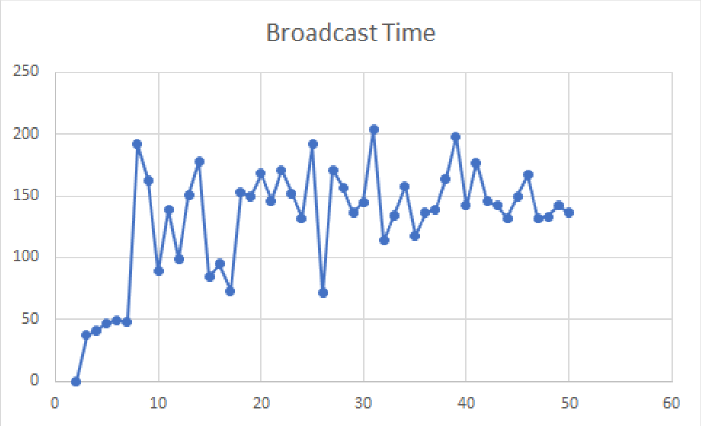



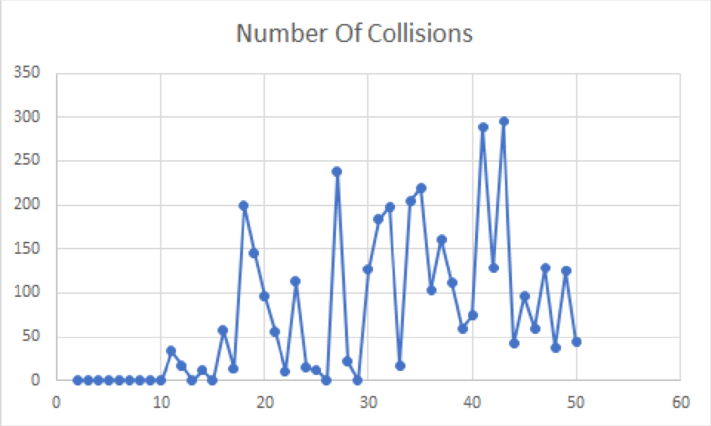



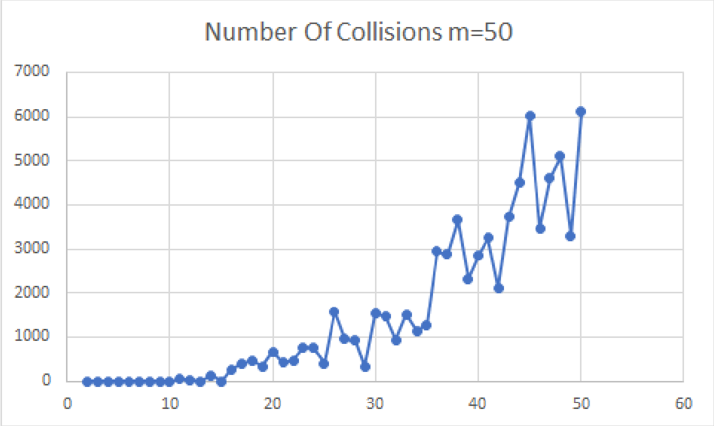
# Study on N

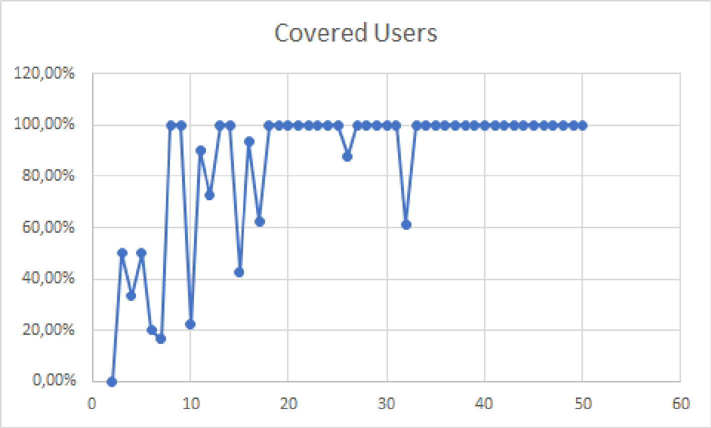
$$D = \frac{N}{A} \qquad A = floorplan\ area$$

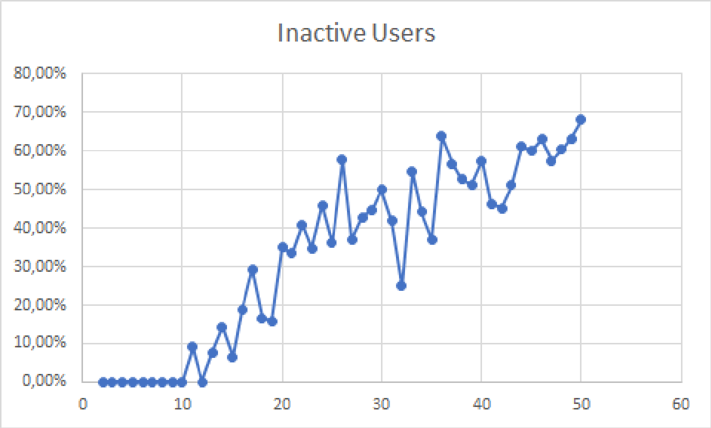
$R = 300 \quad T = \frac{N_{max}}{2} \quad m = \frac{T}{4} \quad N = [2,50] \rightarrow D \in [\frac{2}{5}; 1]$

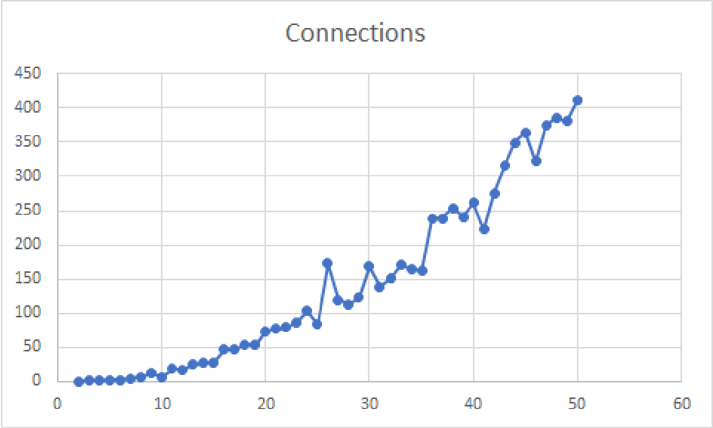


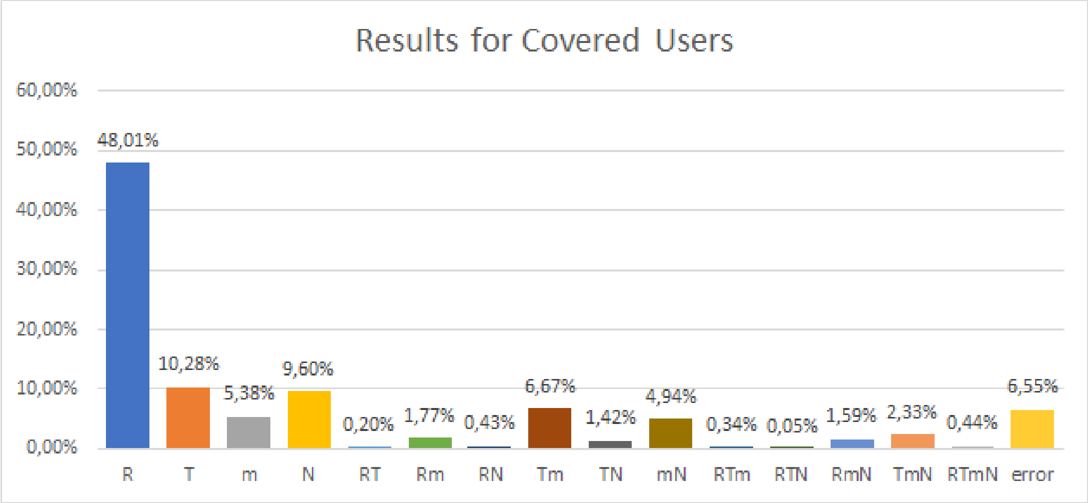



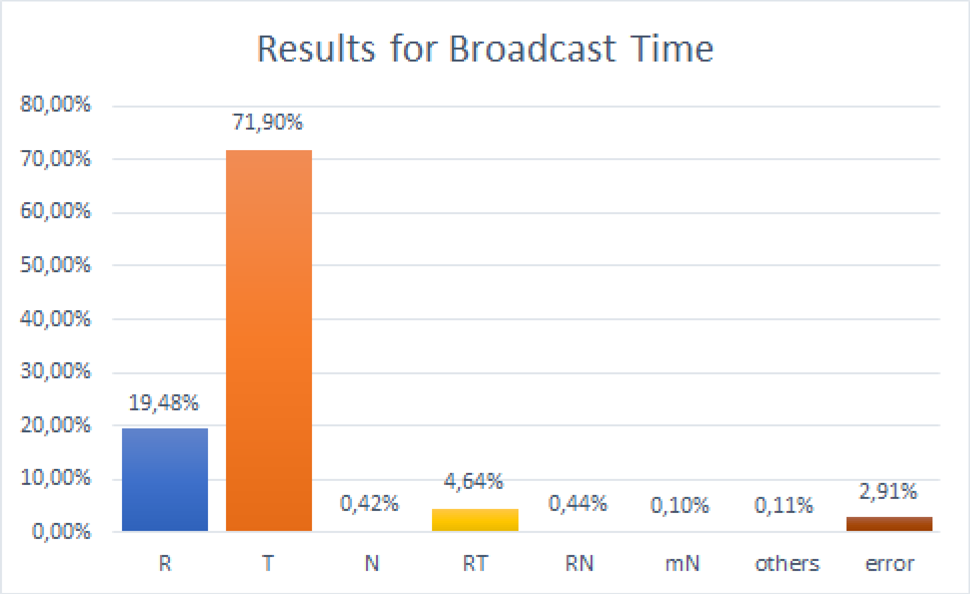



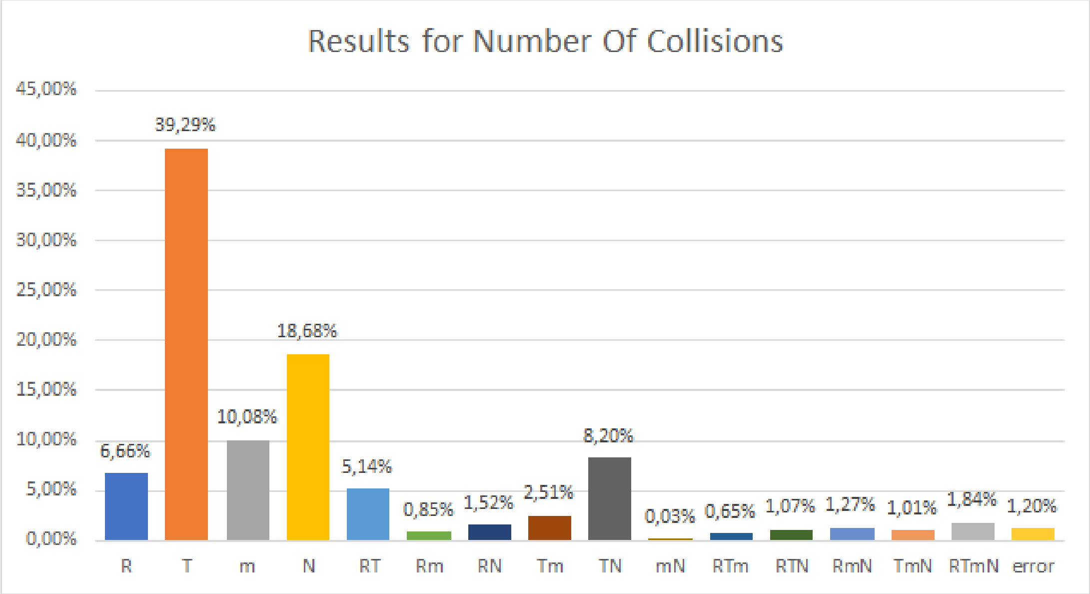
# $2^k r$ Factorial Analysis

**Broadcast Time** and **Collisions**
R = {300, 650}
T = {6, 20}
m = {3, 6}
N = {12, 30}

**Covered Users**
R = {650, 800}
T = {10, 20}
m = {4, 9}
N = {200, 300}



# Conclusions

From the results obtained in the measurements can be stated that the **choice of the parameters**, which influences the broadcast working, has to be weighted respect to the **requirements wanted**.

**Main trade-off**
- Broadcast time
- Number of Collisions

Strong dependency between **connections** and **collisions**, the increasing of connections:
- Allows to reach a better coverage.
- Can cause an higher value of collisions, which can imply a lower coverage.

***T*** allows to:
- keep down the number of collisions
- increase the number of deactivated users.

**Stability Intervals**
- $x_R \in [20\%, 70\%]$
- $D \in [\frac{2}{5}, 1]$

For a **low consumption network**, it is important the parameter ***m***:
- too low m can early block the network, due to the massive deactivation of the users.
- too high can cause a low number of deactivations, so a waste of resources.