Robustness of Communication Networks in Complex Environments -

A simulations using agent-based modelling

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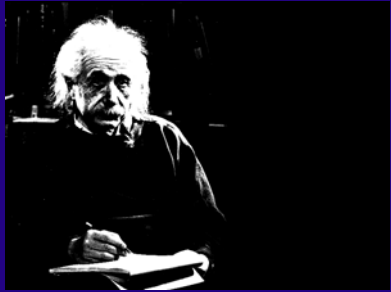

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Problem

- Communication which relies on direct line of sight is very difficult to achieve in complex environments

- This work takes a blue sky approach to consider methods that may overcome this problem
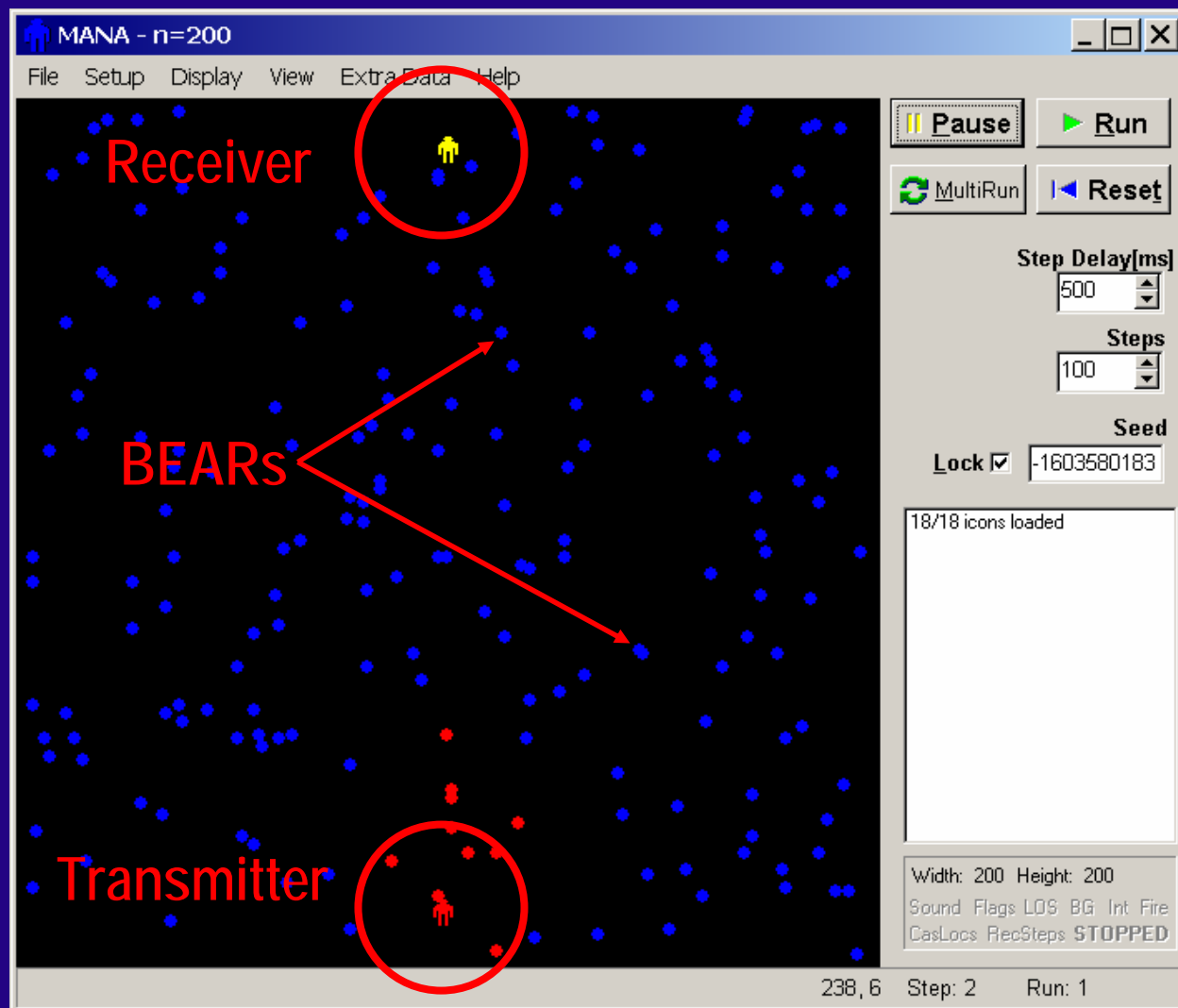
Communication in Complex Terrain

"You see, wire telegraph is a kind of a very, very long cat. You pull his tail in New York and his head is meowing in Los Angeles. Do you understand this? And radio operates exactly the same way: you send signals here, they receive them there. The only difference is that there is no cat."
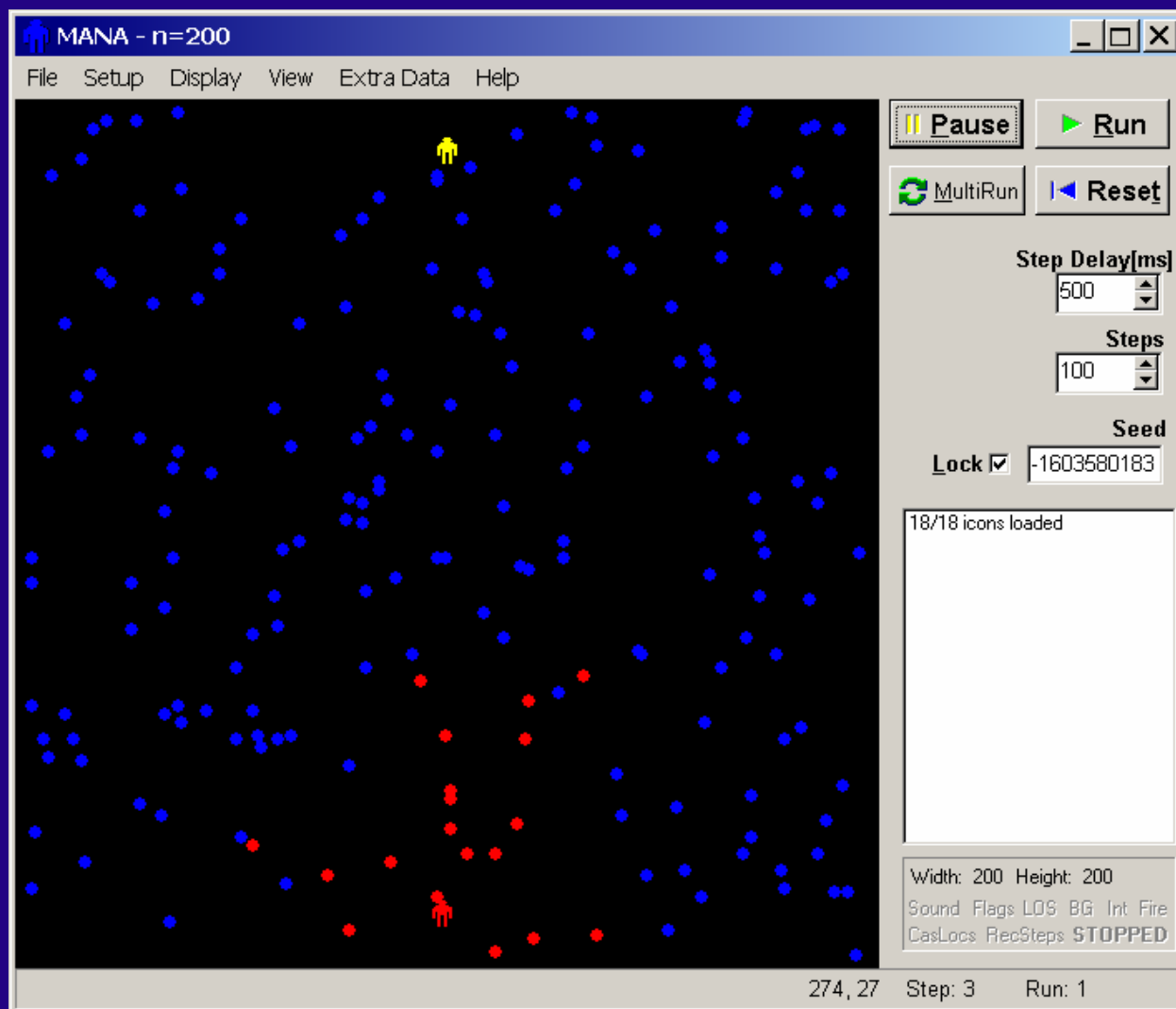
Model

- The Army has named this communications method the BEAR

- Ballistic Expendable Air-delivered Retransmitter

- An extension of work on disease transmission

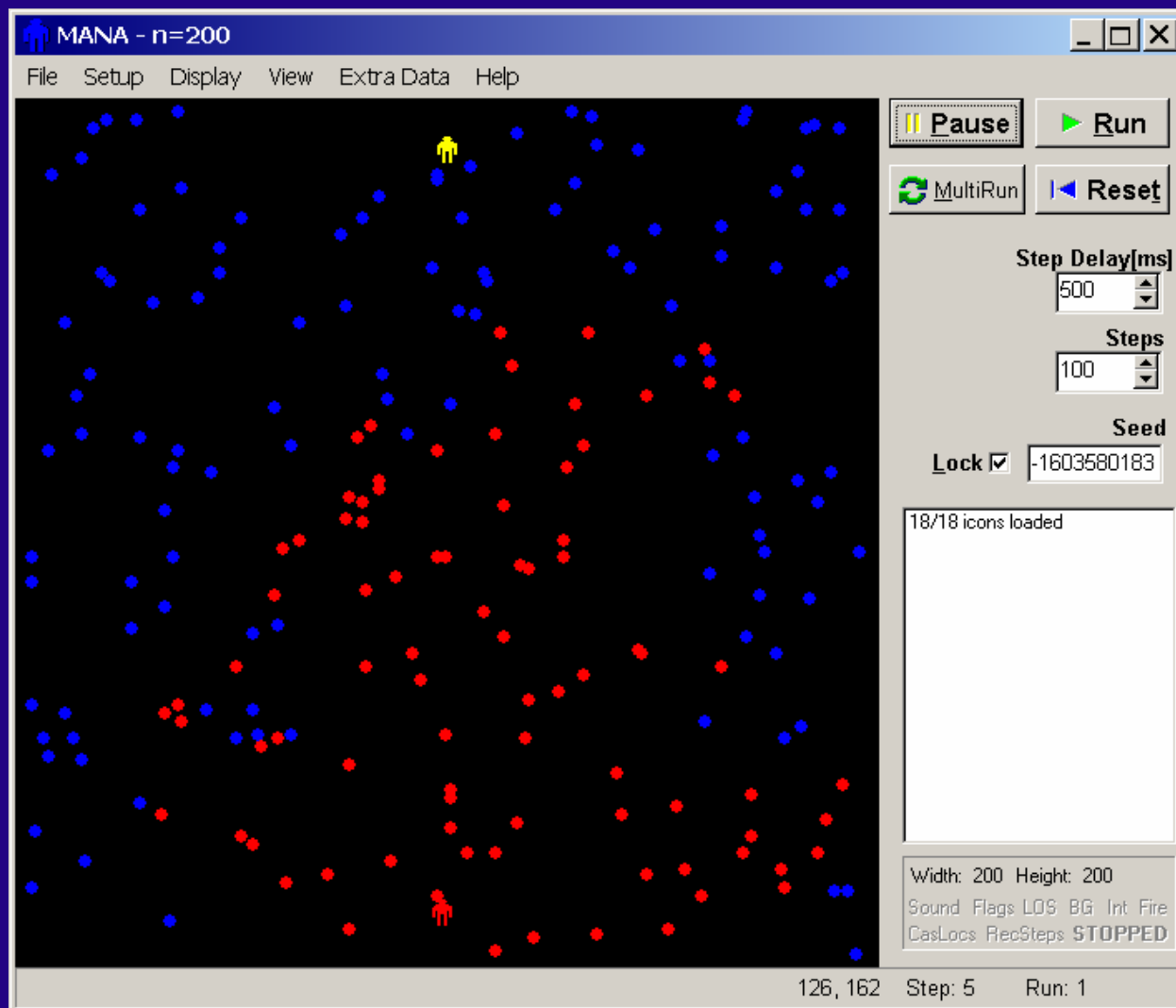- Uses an agent-based distillation MANA
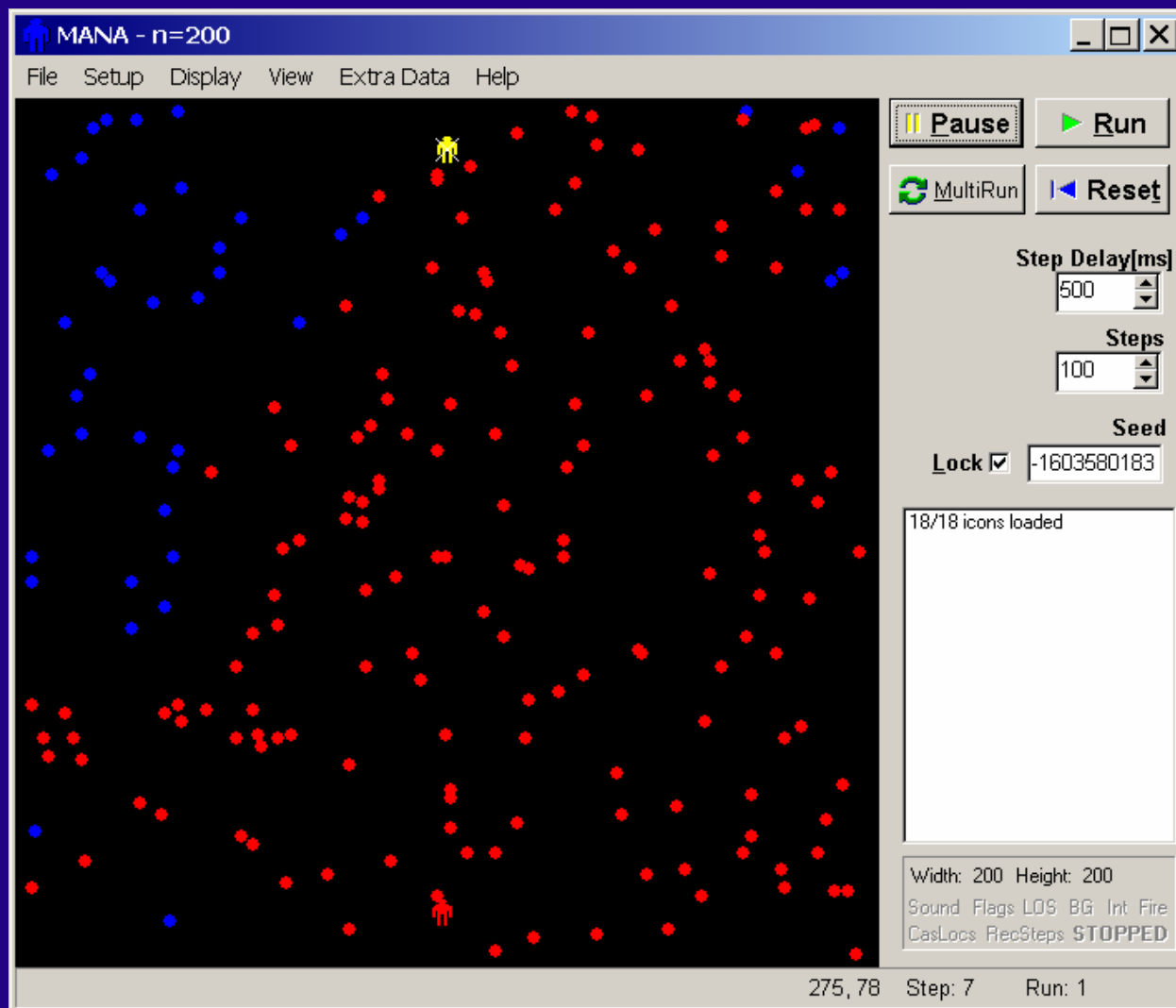
Communication in Open Terrain
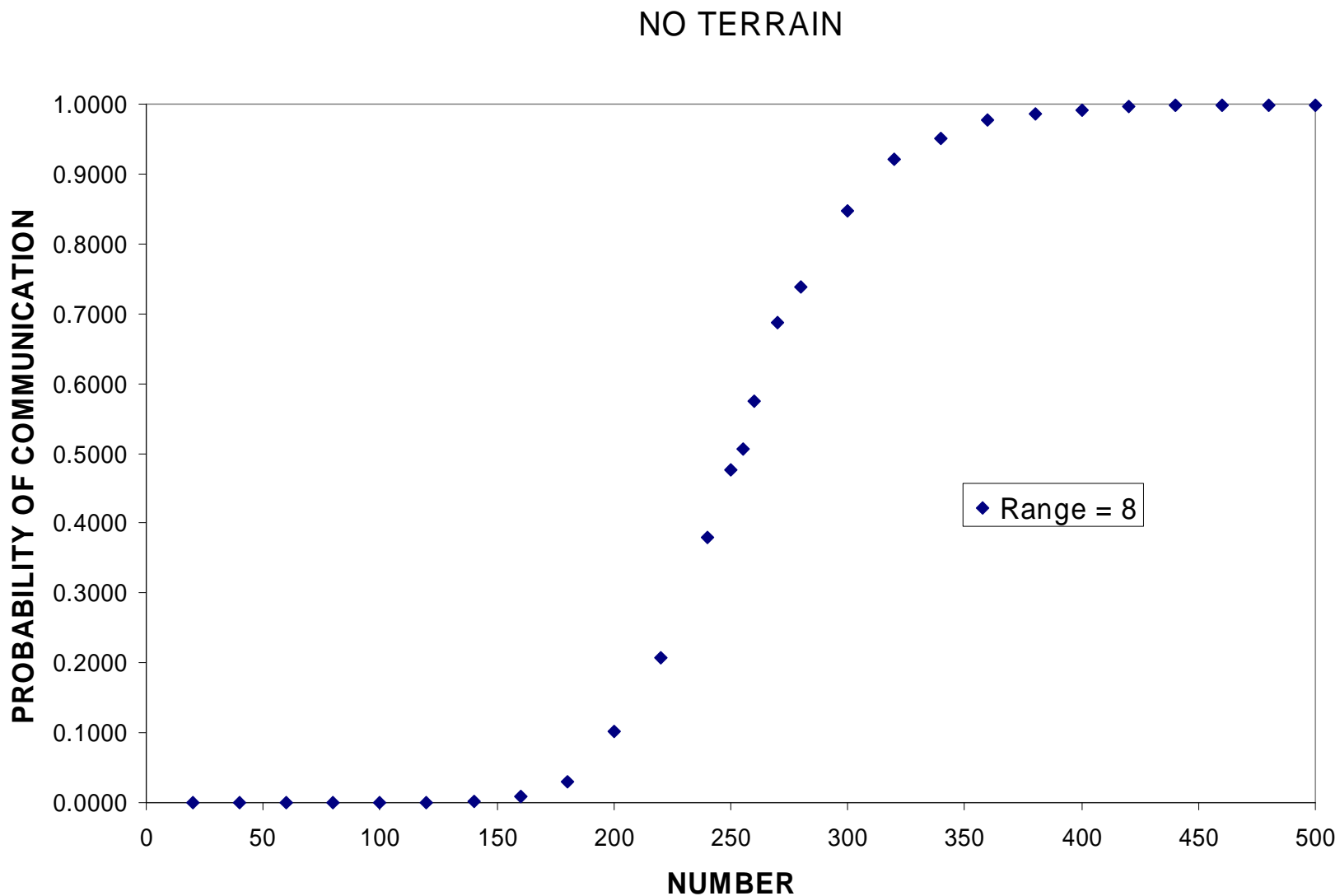
Communication in Open Terrain

Communication in Open Terrain
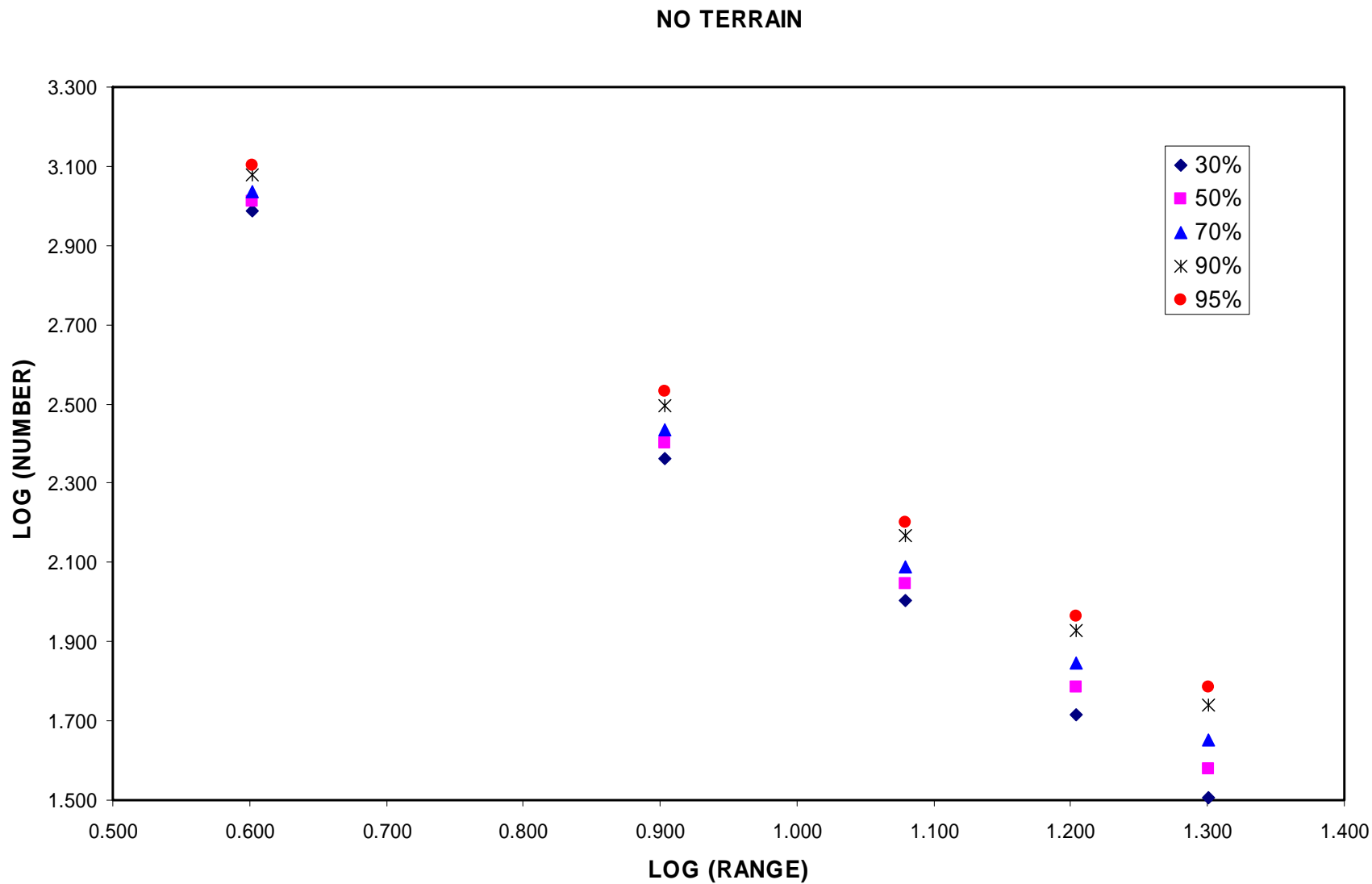
Communication in Open Terrain

Probability of Successful Communication
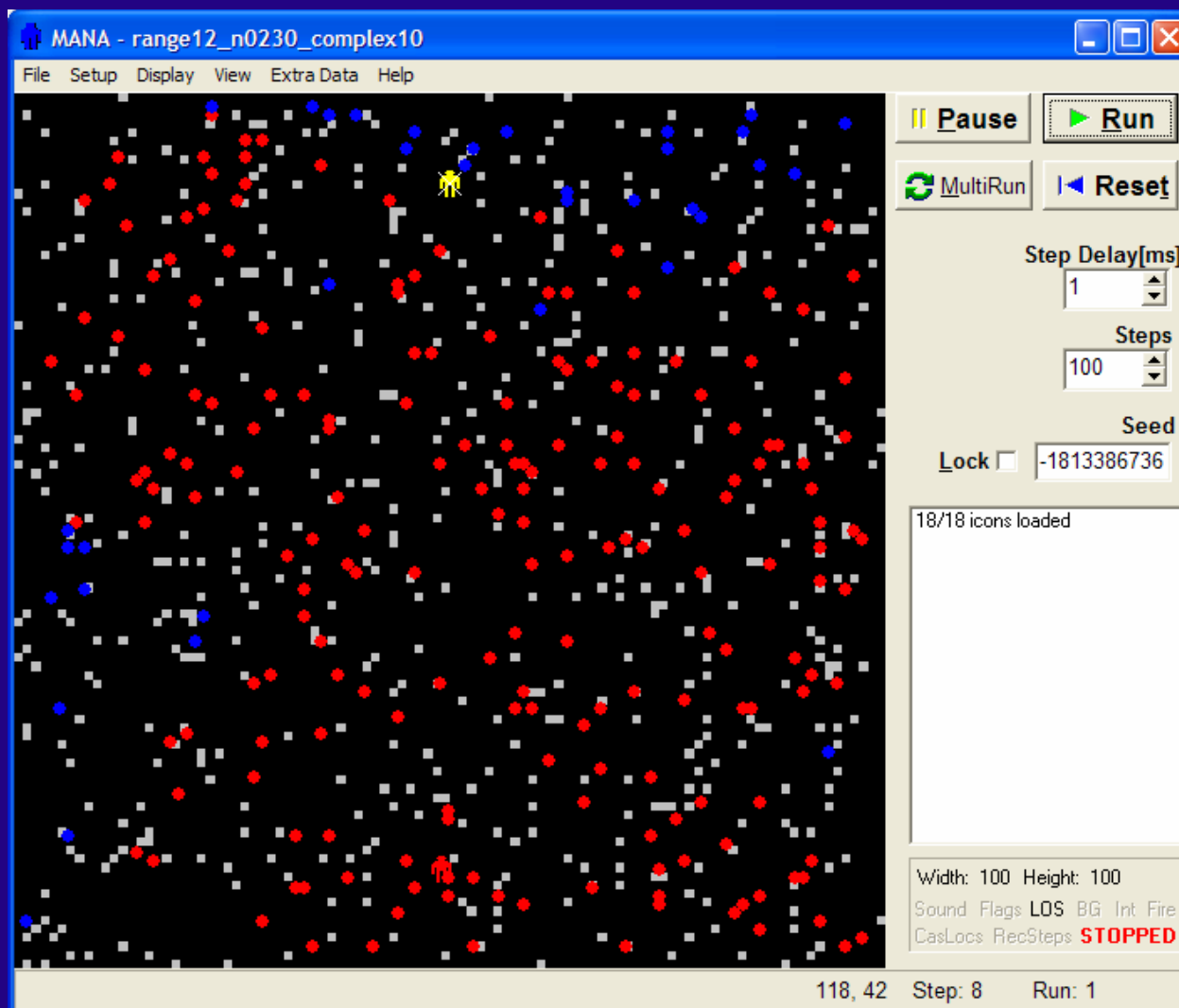
NO TERRAIN

Range = 8

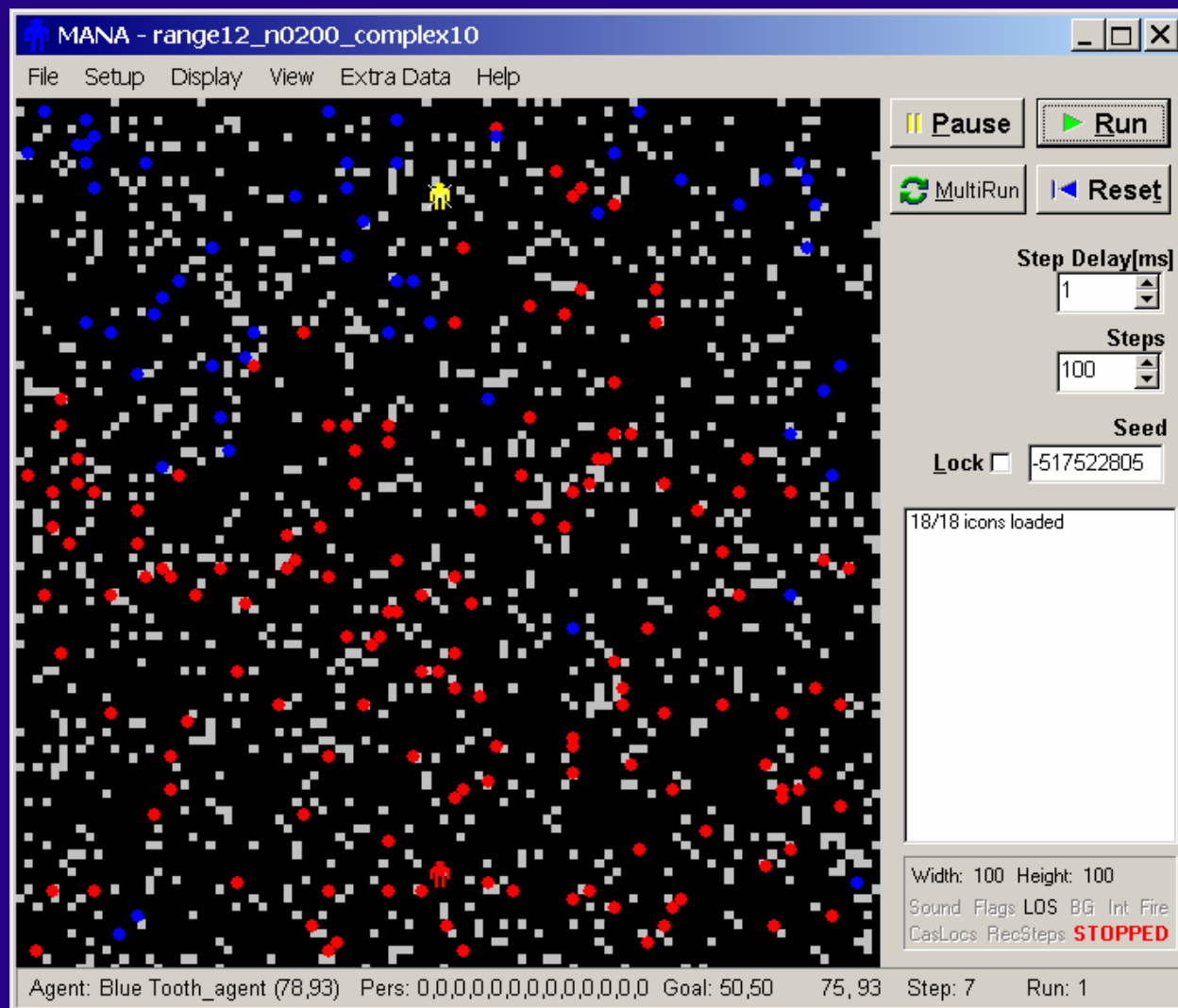# Results with No Terrain

NO TERRAIN

Terrain

- We now introduce "Terrain" to block signal

- Terrain is represented by blocks in the grid through which a signal cannot be passed

- Terrain is randomly generated

- We examine how the relationship between range of the BEARs and number required varies as environment complexity is increased
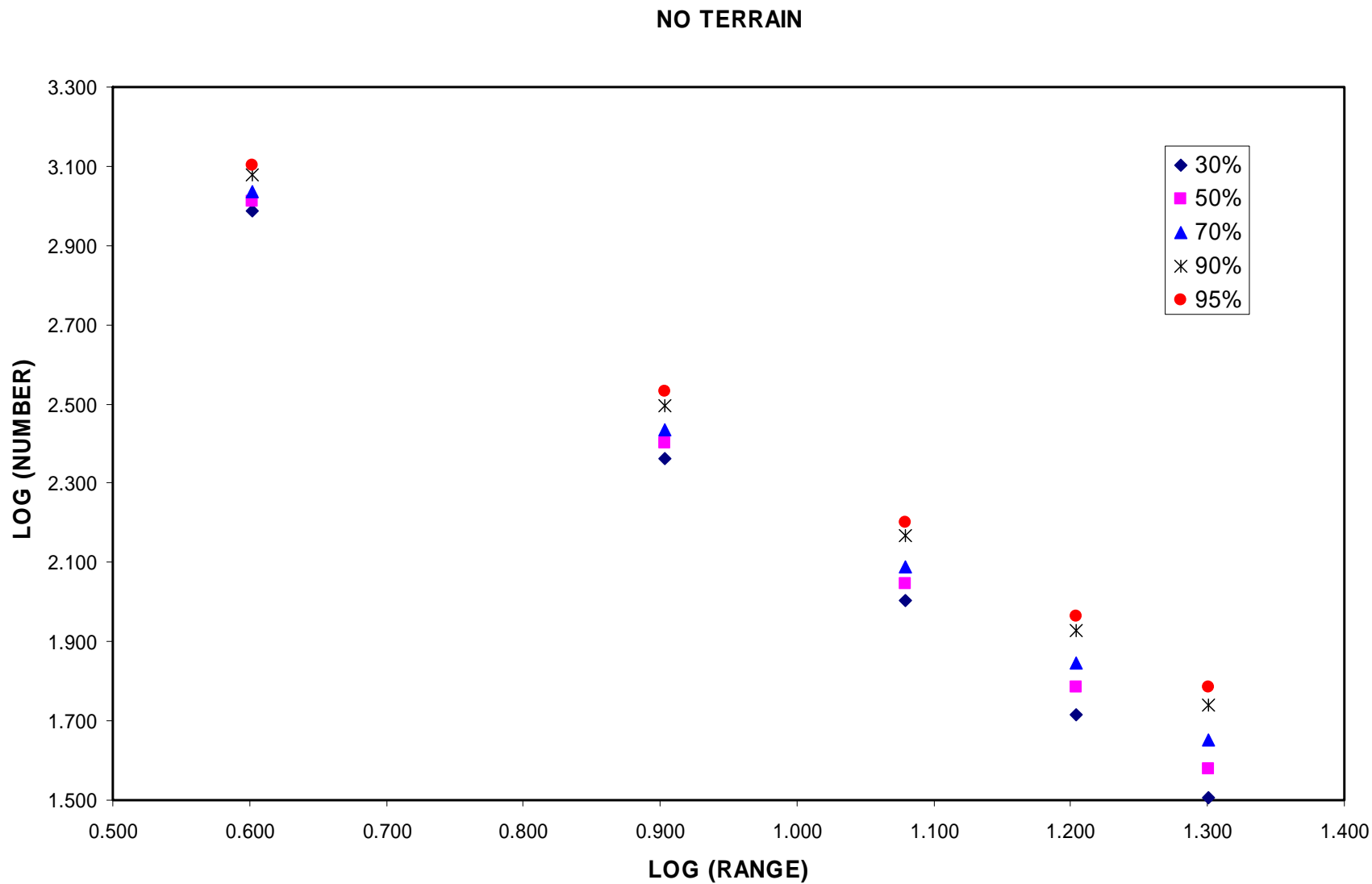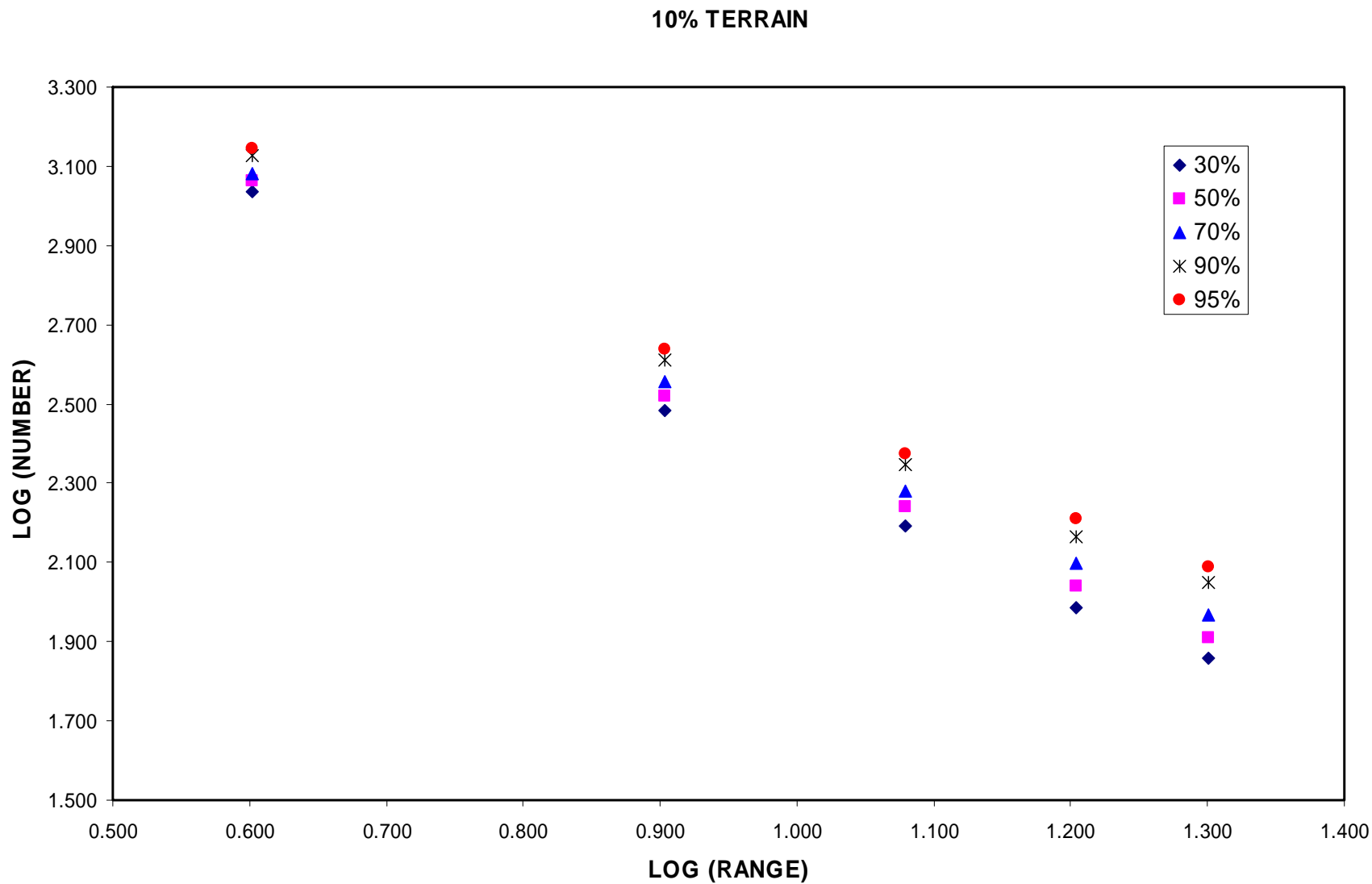
Communication in Complex Terrain

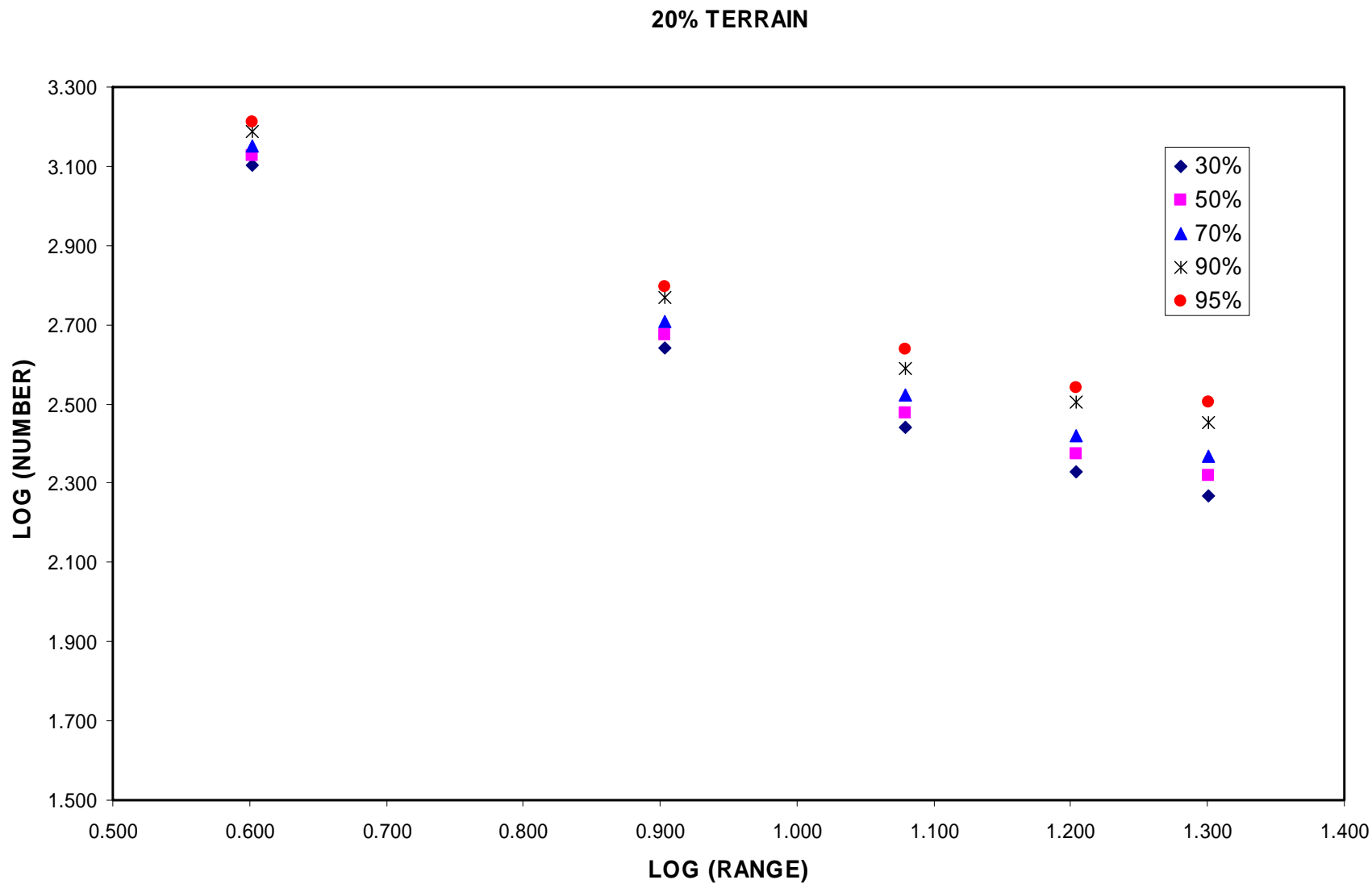# Communication in Very Complex Terrain

Results with No Terrain

NO TERRAIN

Results with 10% Impassable Terrain

10% TERRAIN

Results with 20% Impassable Terrain

20% TERRAIN

Communication in Complex Terrain

- Insights

    - There is a trade-off between range of retransmitters and number of retransmitters

    - The relationship is a simple power law when there is no terrain

    - Number of re-transmitters required drops off more slowly with increasing range than a power law when terrain is present

    - A larger number of shorter range retransmitters is more robust

QUESTIONS?