
Robustness of Communication Networks in Complex Environments - A simulations using agent-based modelling

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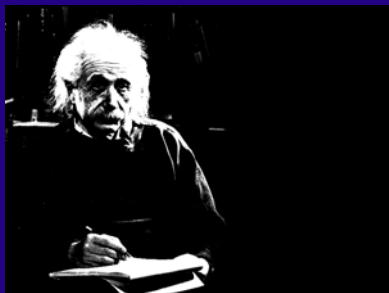
Land Warfare Development Centre, Australian Army

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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



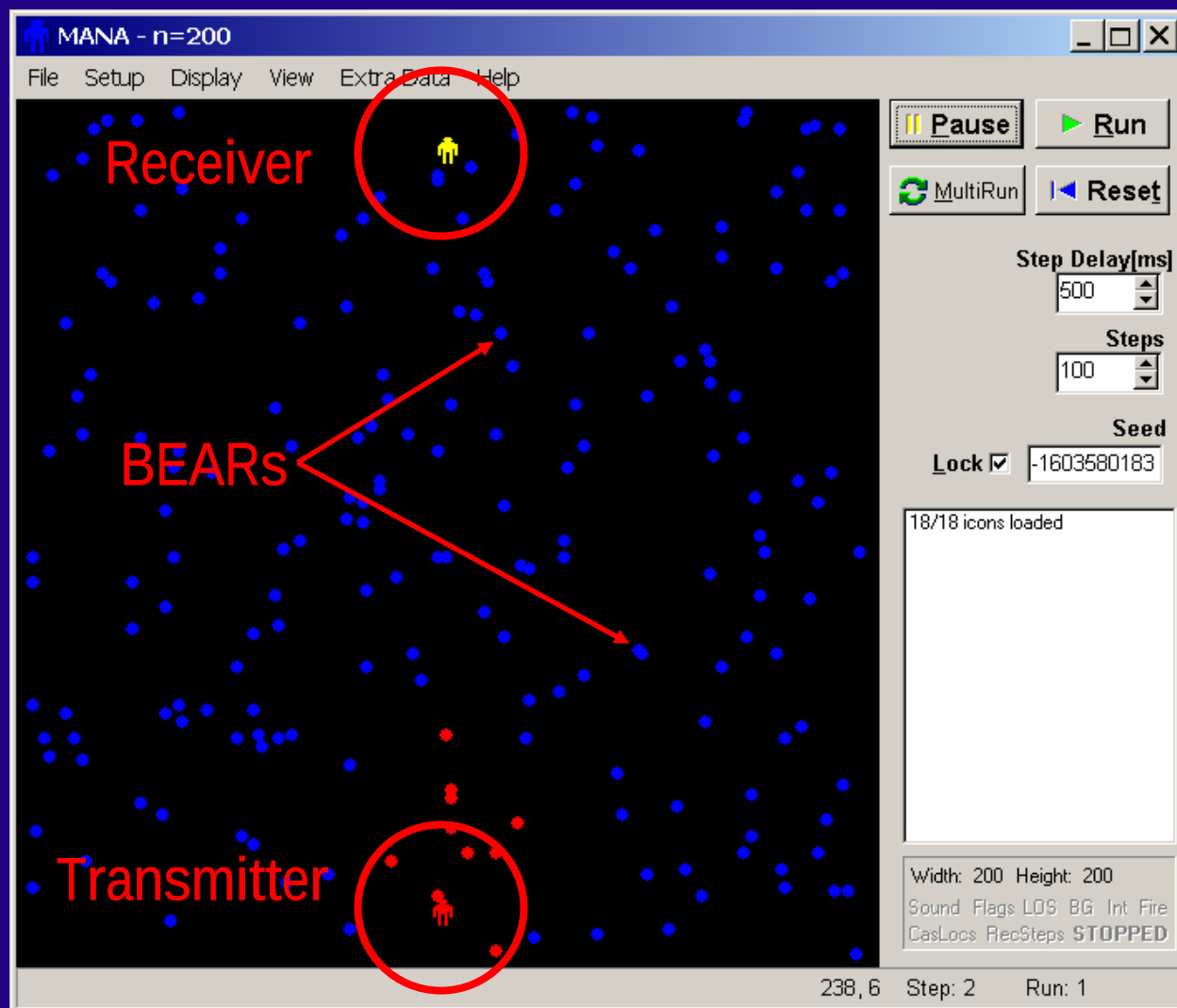
“You see, wire telegraph is a kind of a very, very long cat. You pull his tail in New York and his head is meowing in Los Angeles. Do you understand this? And radio operates exactly the same way: you send signals here, they receive them there. The only difference is that there is no cat.”



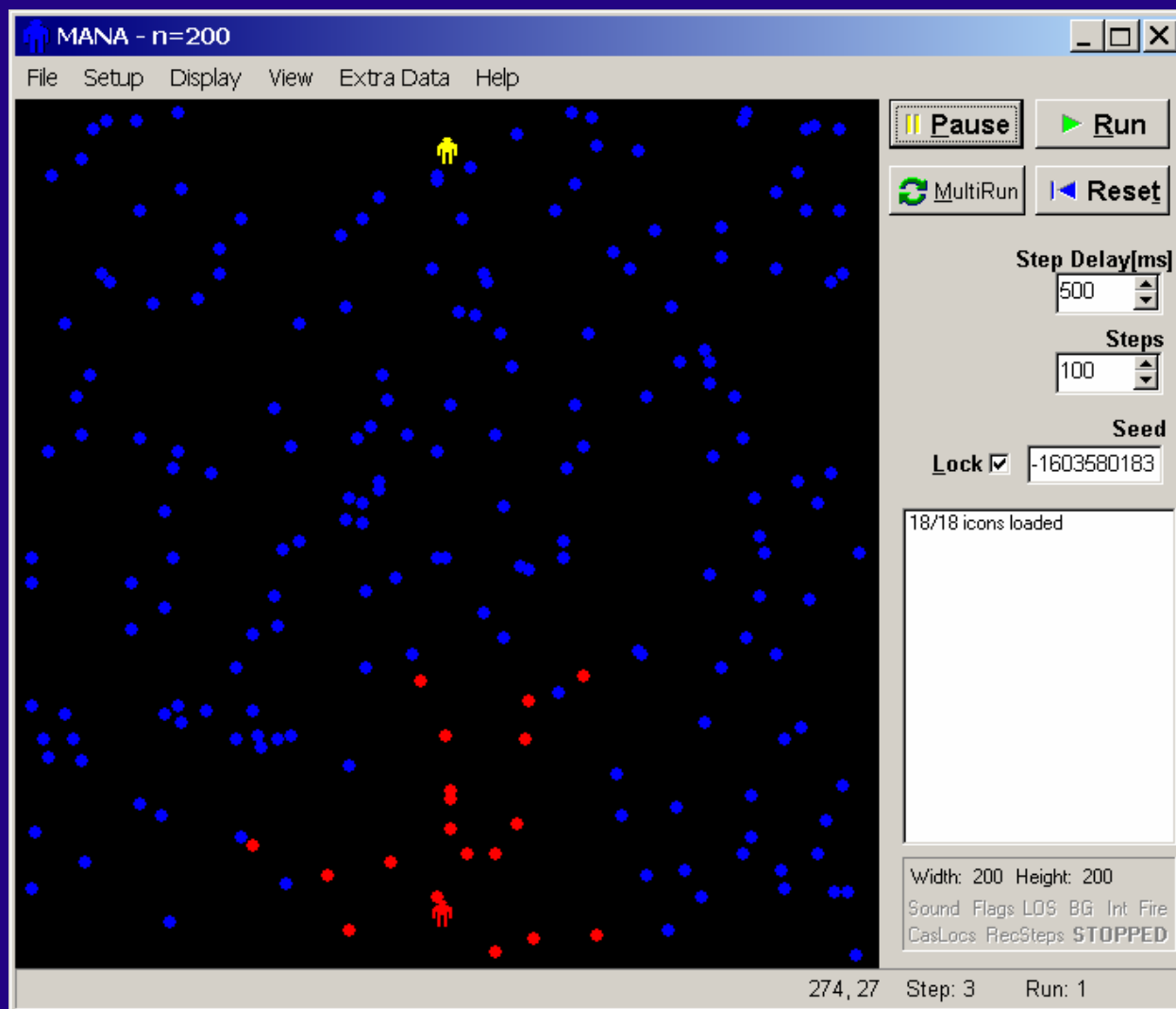
Model

- 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

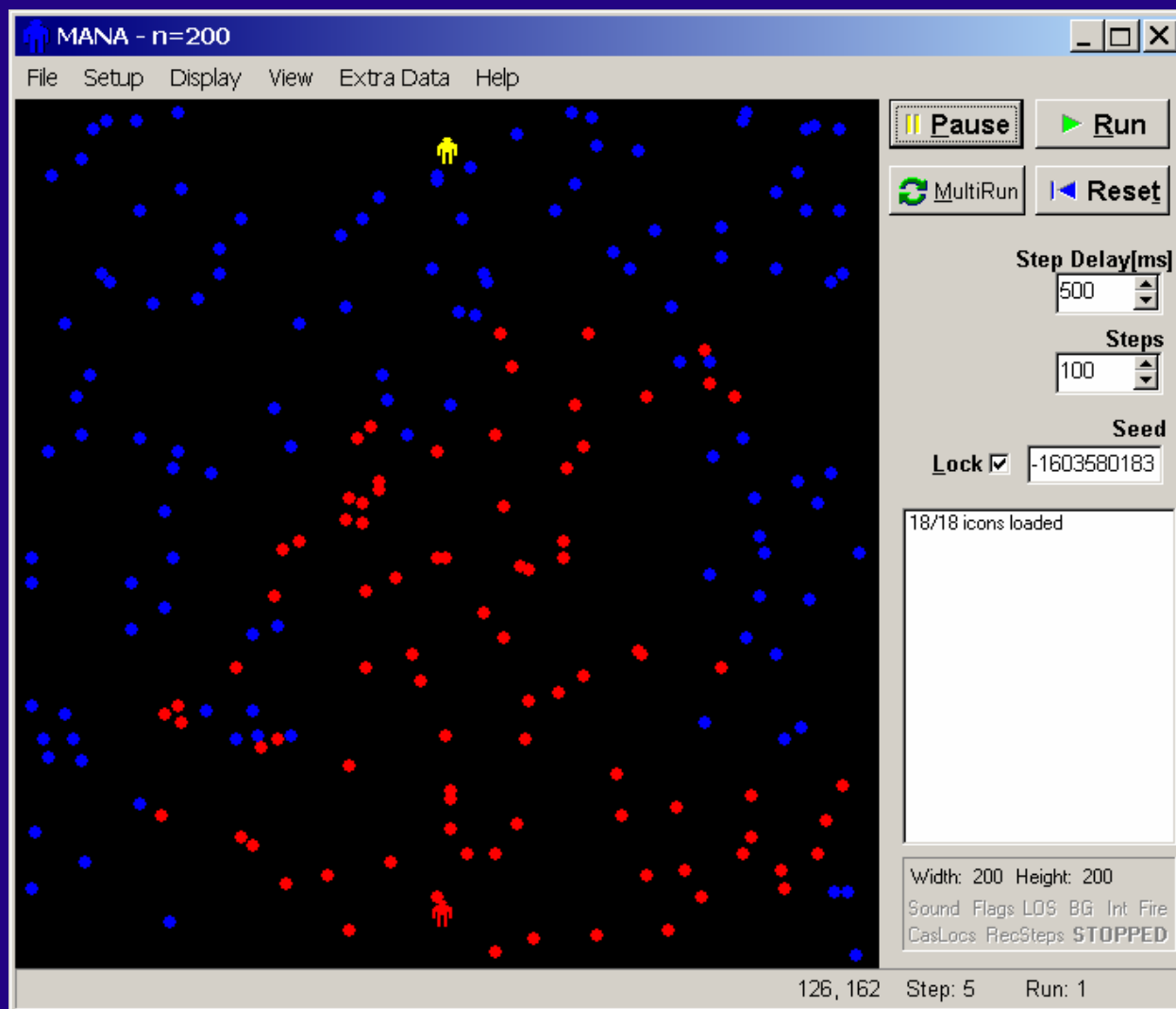
Communication in Open Terrain



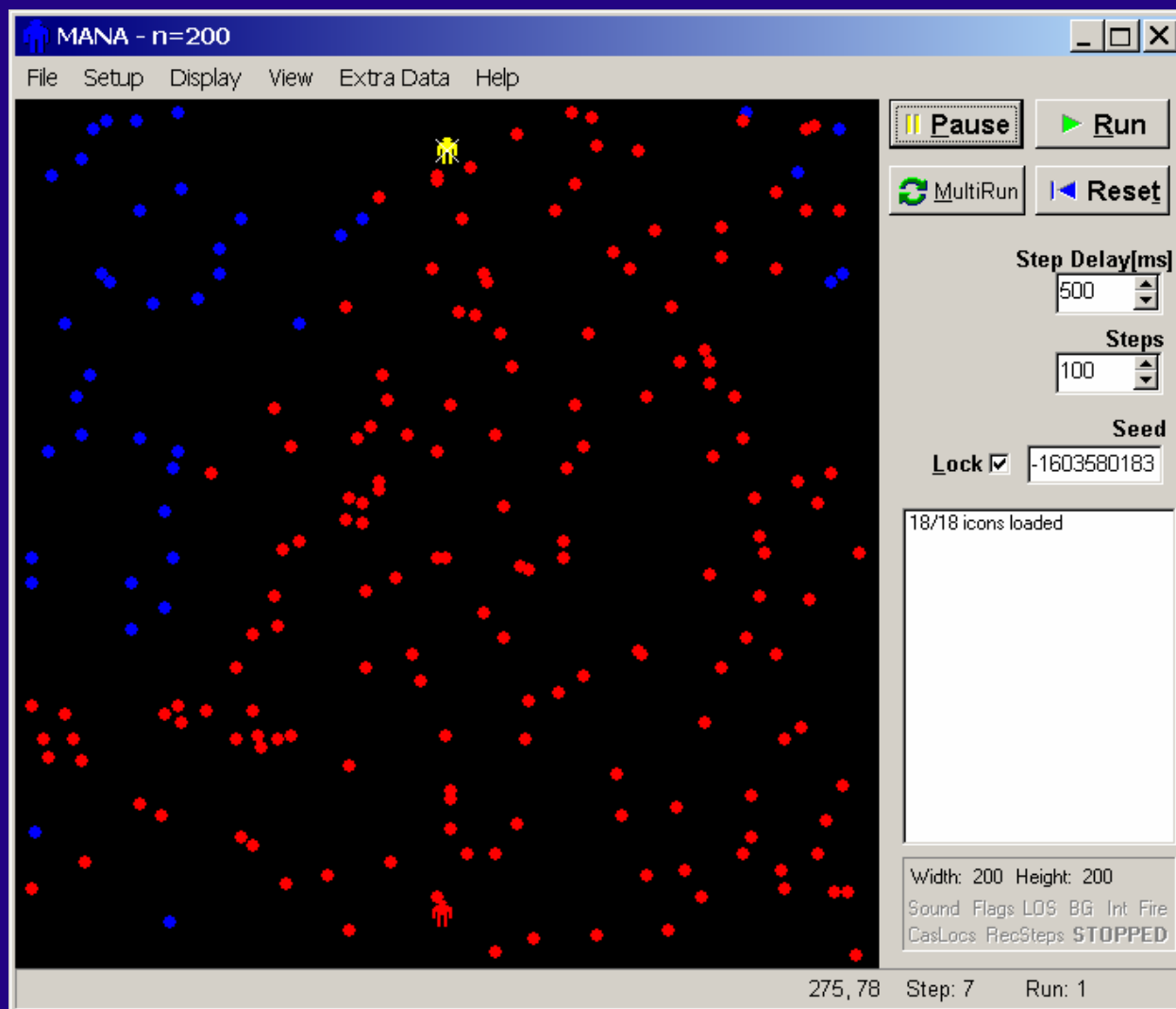
Communication in Open Terrain



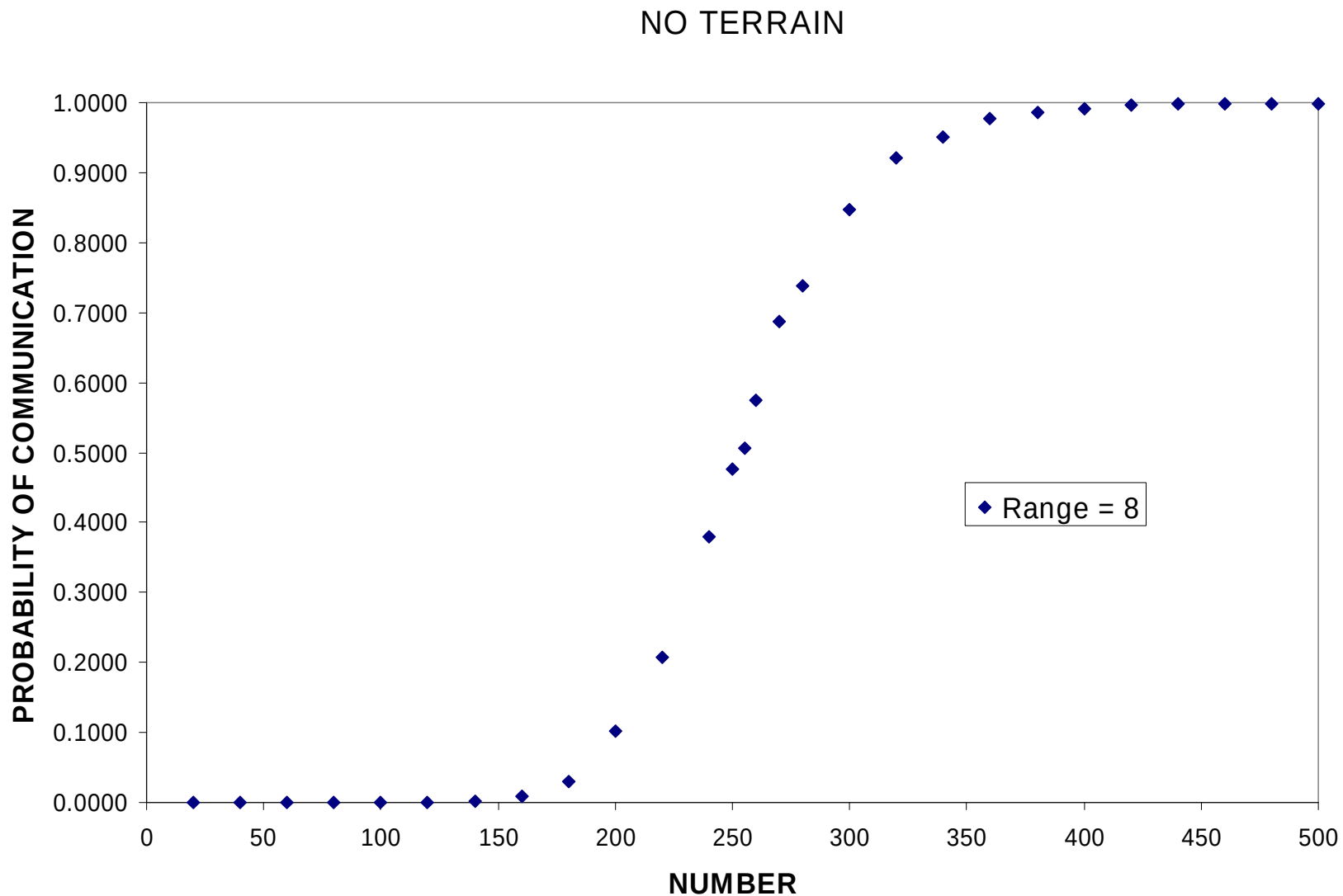
Communication in Open Terrain



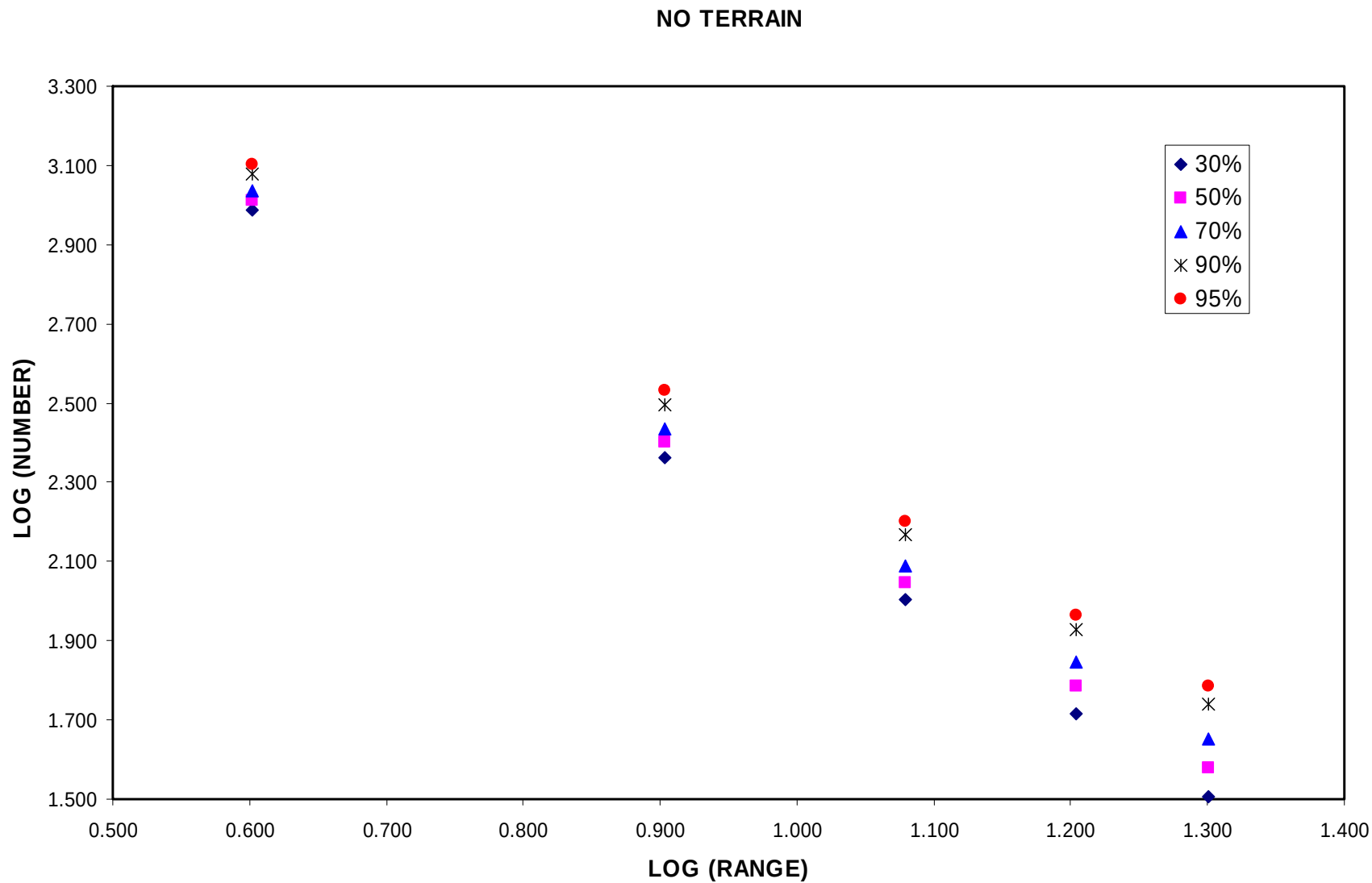
Communication in Open Terrain



Probability of Successful Communication



Results with No Terrain

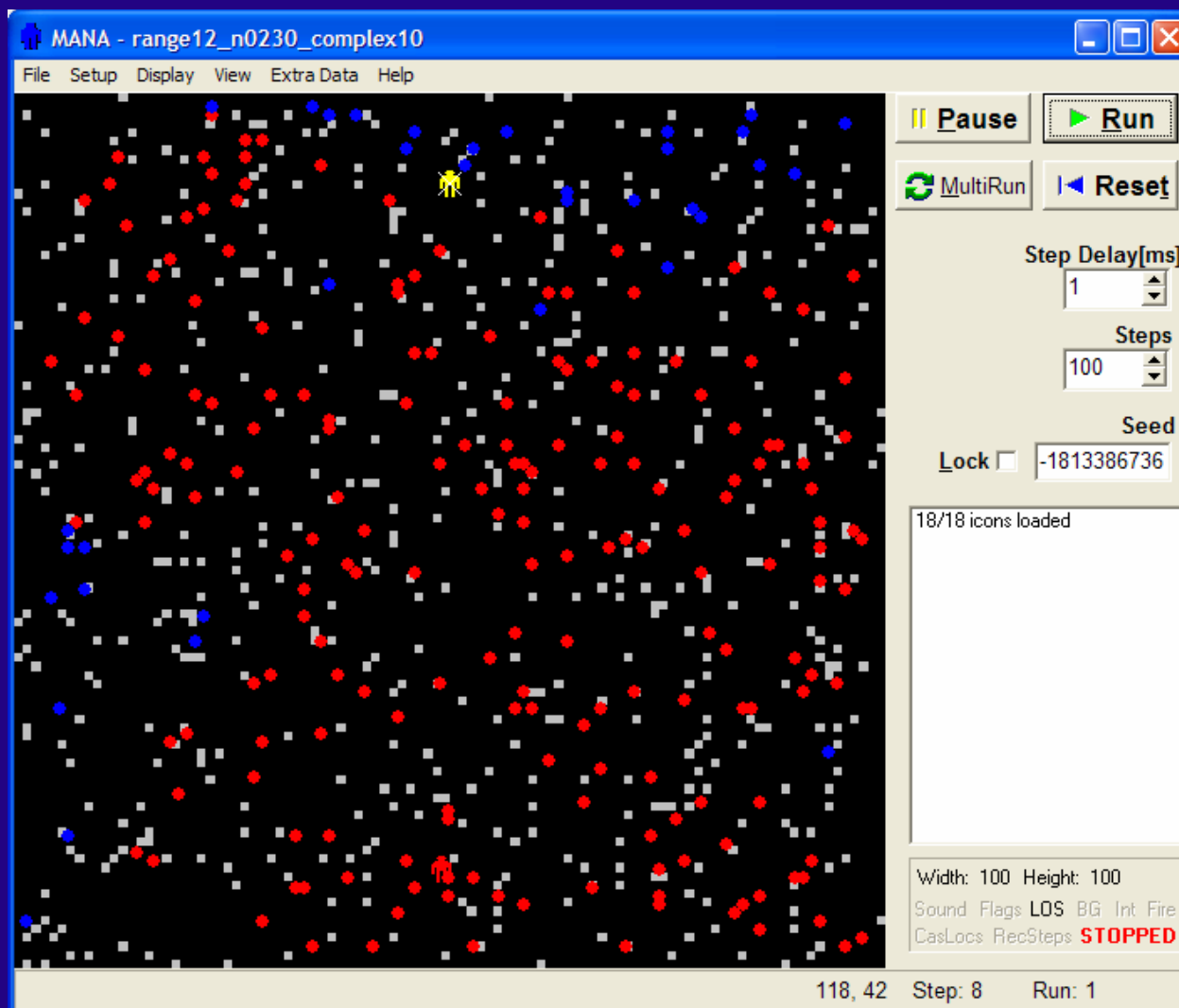




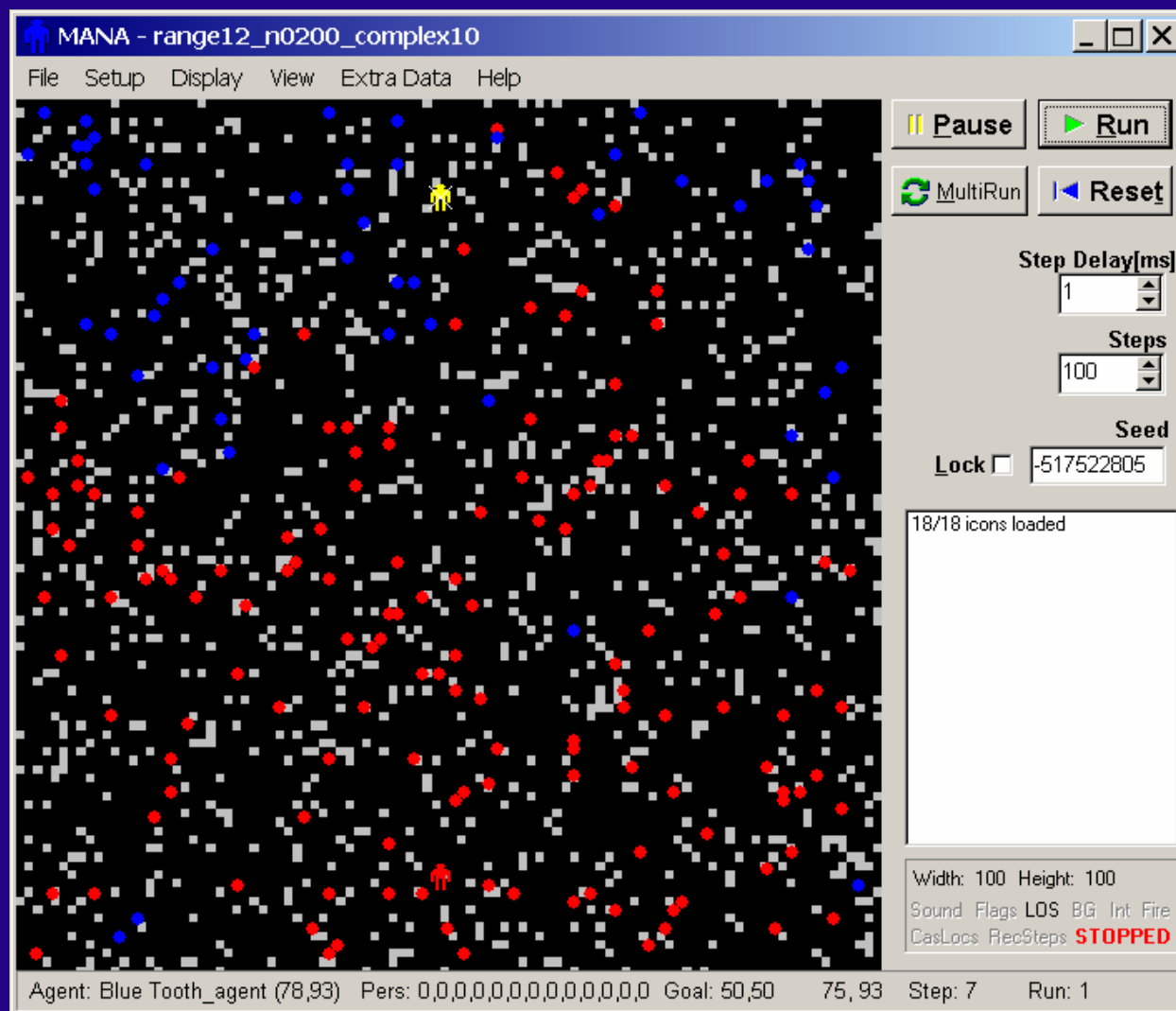
Terrain

- 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

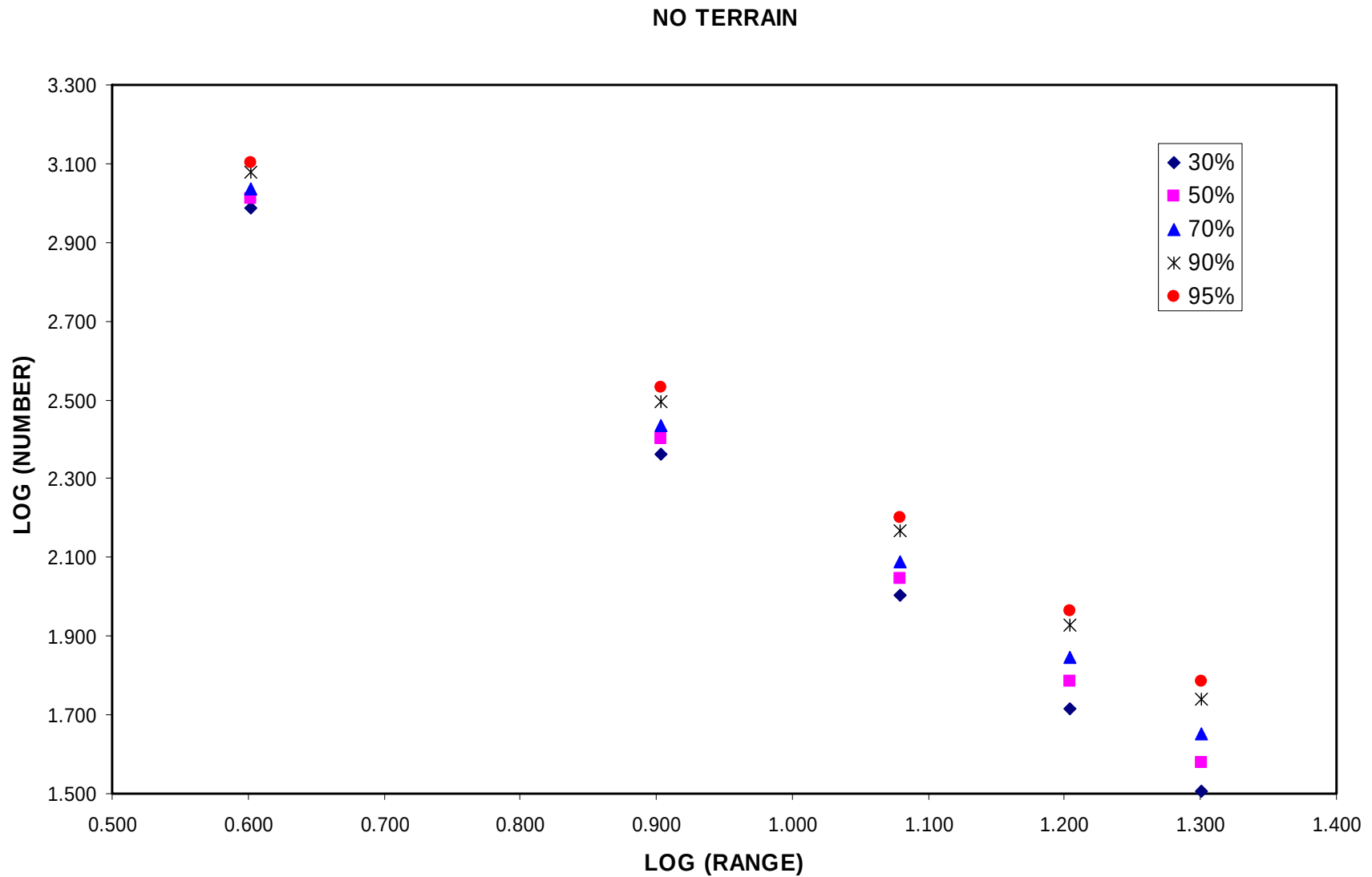
Communication in Complex Terrain



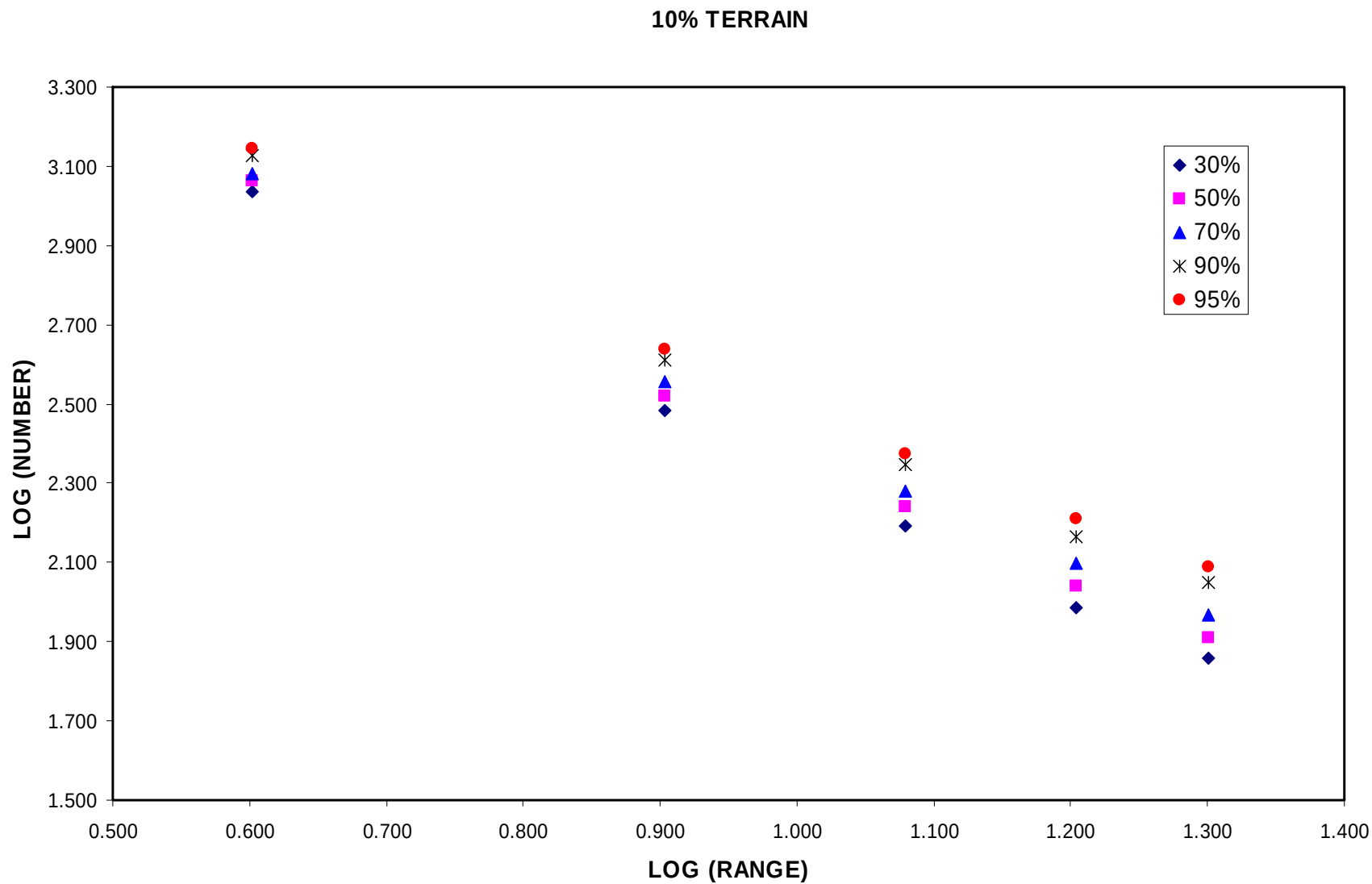
Communication in Very Complex Terrain



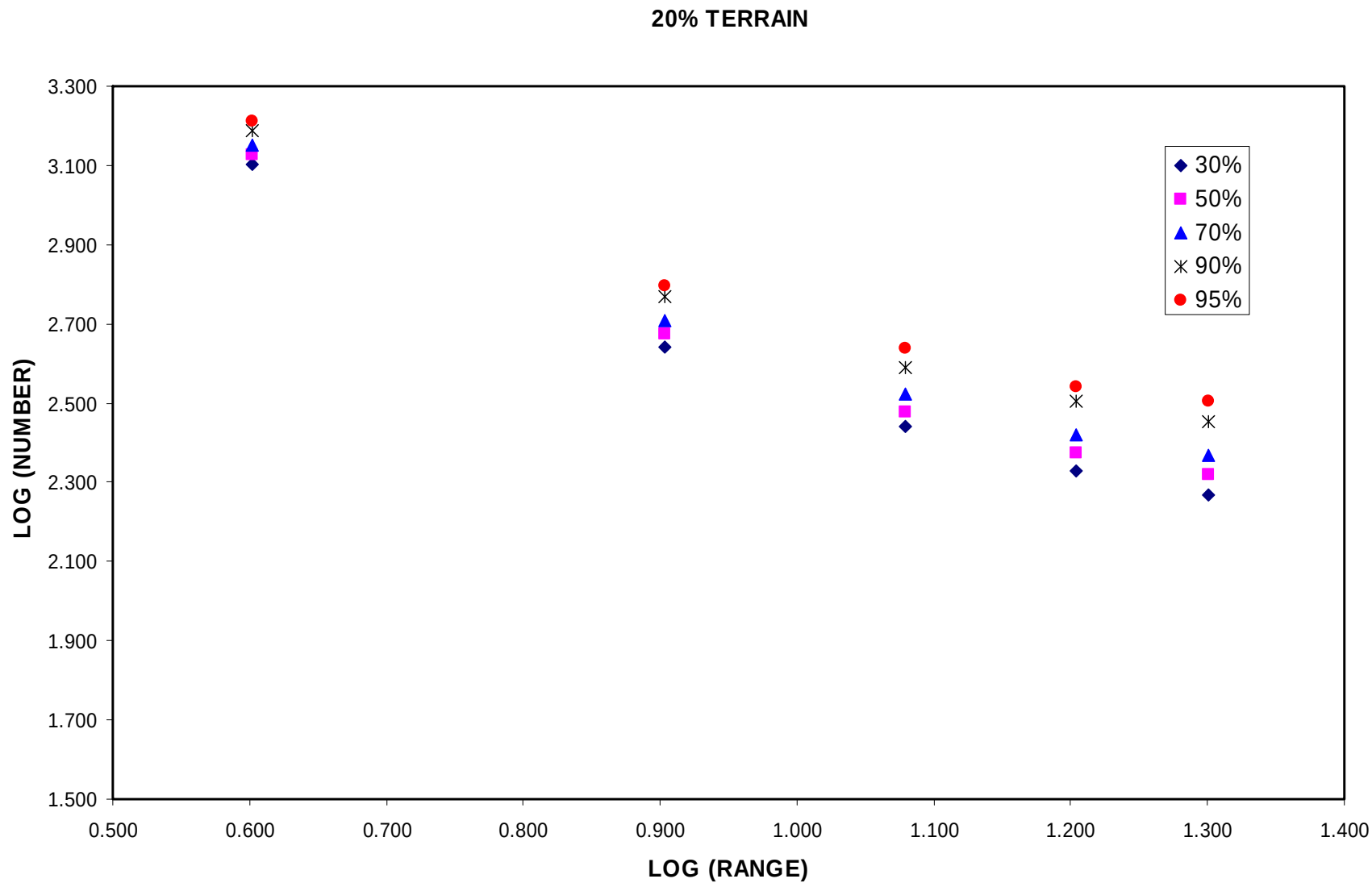
Results with No Terrain



Results with 10% Impassable Terrain



Results with 20% Impassable 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?