Localized minimum-energy broadcasting in ad-hoc networks

INFOCOM 2003

Outline

- Introduction
- Relative Neighborhood Graph
- Localized Protocol
- Performance Evaluation
- Conclusion

Introduction

- We consider nodes that have the capacity to modify the area of coverage with its transmission.

  1.Control of emitted transmission power consumption

  2.Increase lifetime of the network

  3.Maintain the connectively of the network

Introduction

- All existing solution are globalized , meaning the each node need global network information.

=> Topology change must be propagated throughout the network for any globalized , cause communication overhead for ad-hoc network

Introduction

- We propose a localized protocol where each node only knowledge of its 1-hop or 2-hops neighbor and distance to them.

1. Topology control oriented protocol
2. Broadcast oriented protocol

Introduction

- Topology control oriented protocol

  All nodes can be a source of a broadcast and able to reach all nodes of the network using pre-assigned transmission radii at each node

- Broadcast oriented protocol

  Consider the broadcast process from a given source node

  source node adds new nodes at a time according to a cost evaluation

Relative Neighborhood Graph

- Definition of RNG:

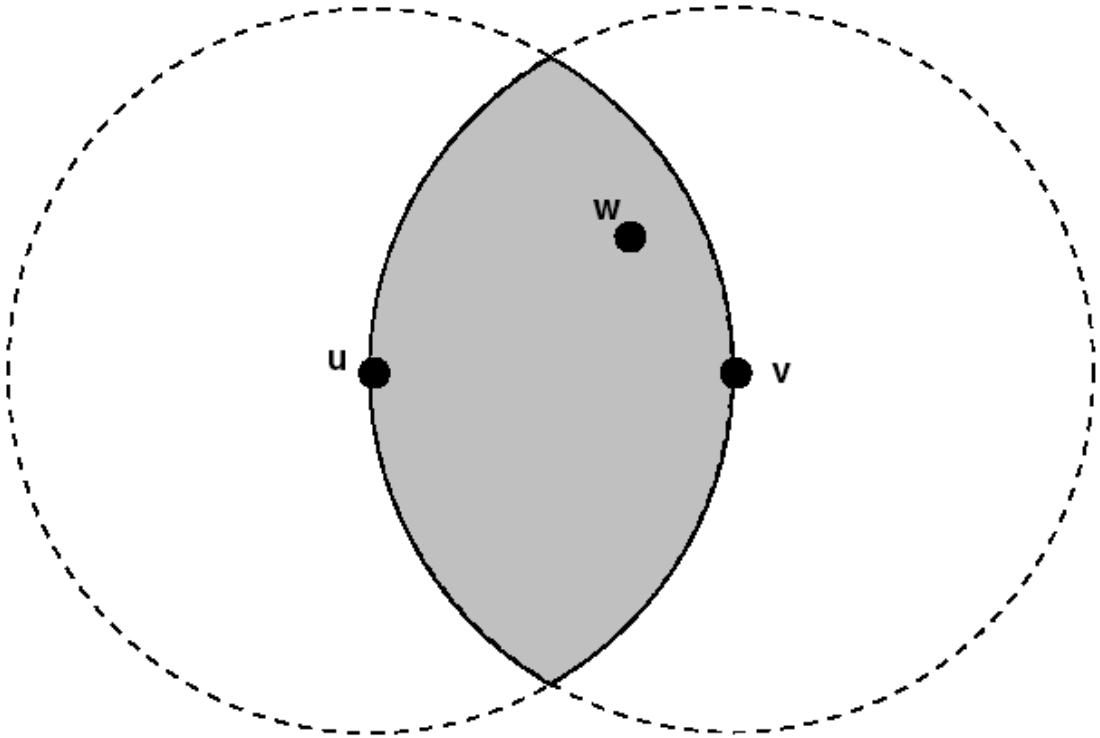
  A edge (u,v) exist between vertices u and v if the distance between them , d(u,v) is less than or equal to the distance between every other vertex w.

  . RNG is a connected graph

  . RNG is a planar graph

$$\forall w \neq u,v:\ d(u,v) \leq max\ (d(u,w),\ d(v,w)).$$

Relative Neighborhood Graph



Relative Neighborhood Graph

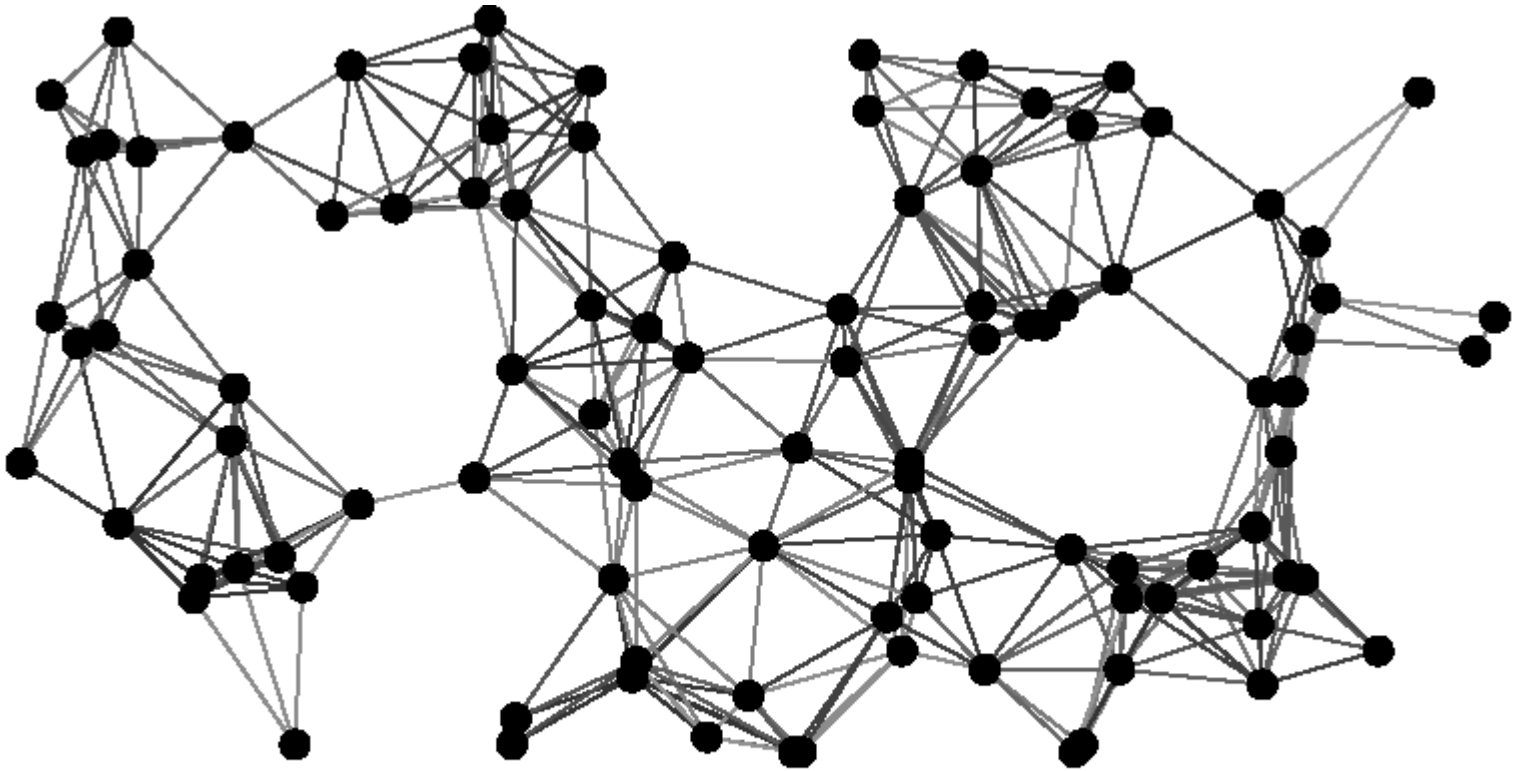


Fig. 2. A graph with average degree 8.

Relative Neighborhood Graph

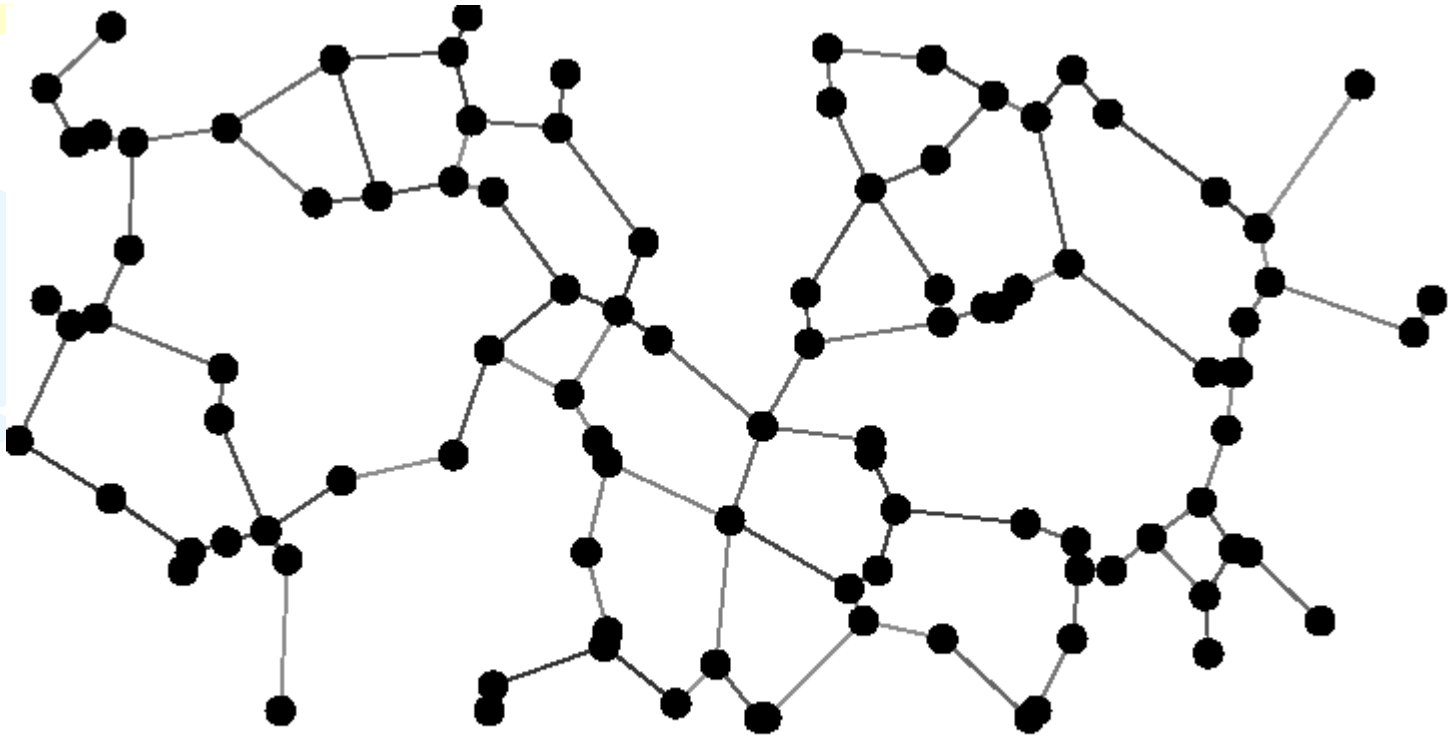


Fig. 6. Relative neighborhood graph for graph in Fig. 2.

Localized Protocol

- RTCP(RNG Topology Control Protocol)

  .Each node maintain a neighborhood list with neighbor locations that allows to determine whether or not an edge is in RNG

  .We need only 1-hop information

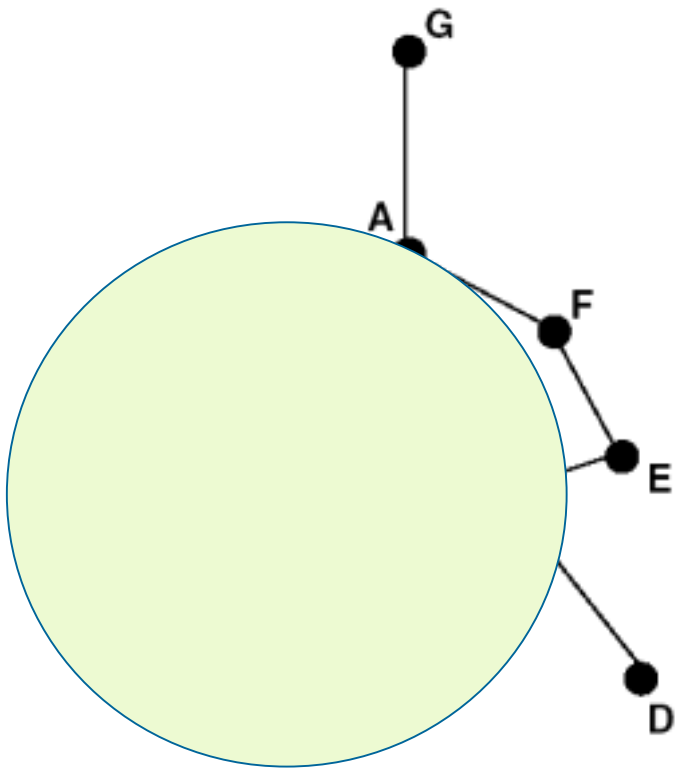
  .Each node sends in its HELLO message the list of its neighbors with distance

  = > The connectivity of RNG assure that all nodes receive the message for any choice of the source node. (Maintain Connectivity)

Localized Protocol

- RBOP(RNG Broadcast Oriented Protocol)
  =>Provides an efficient energy saving

- S emits its message with the range d(S,A) and A,B,C receive message
- A adjust its range to d(A,G)
- C receives message from S, C resend the message with range d(C,D)



Localized Protocol

- F elimination E for this broadcast message, The set of remaining neighbor for F contain only A.
- F and G eliminate A from their respect neighborhood and terminate the protocol

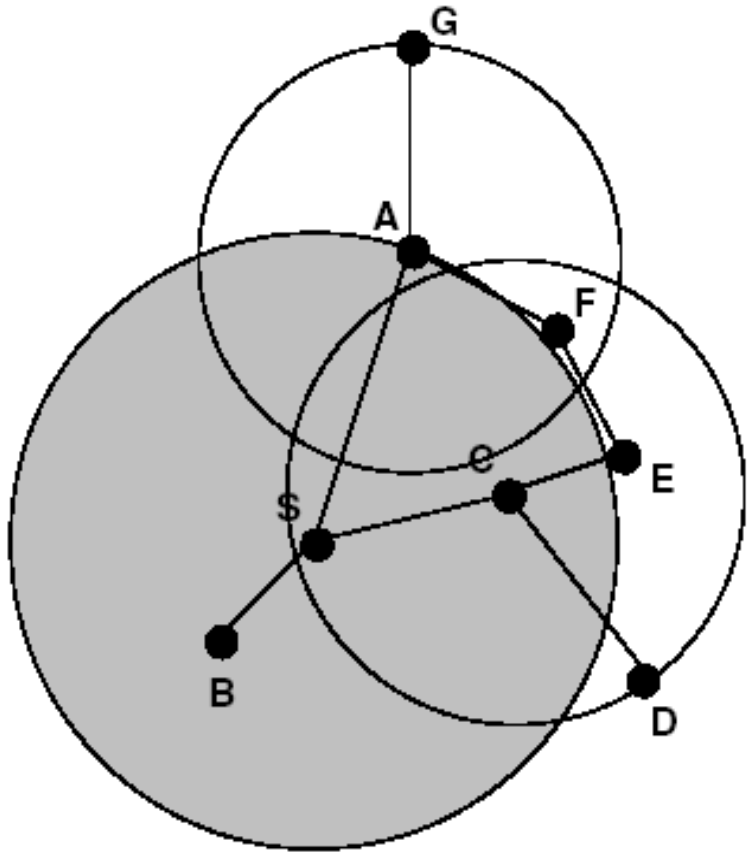


Fig. 8. Broadcast from S with neighbor elimination.

Performance Evaluation

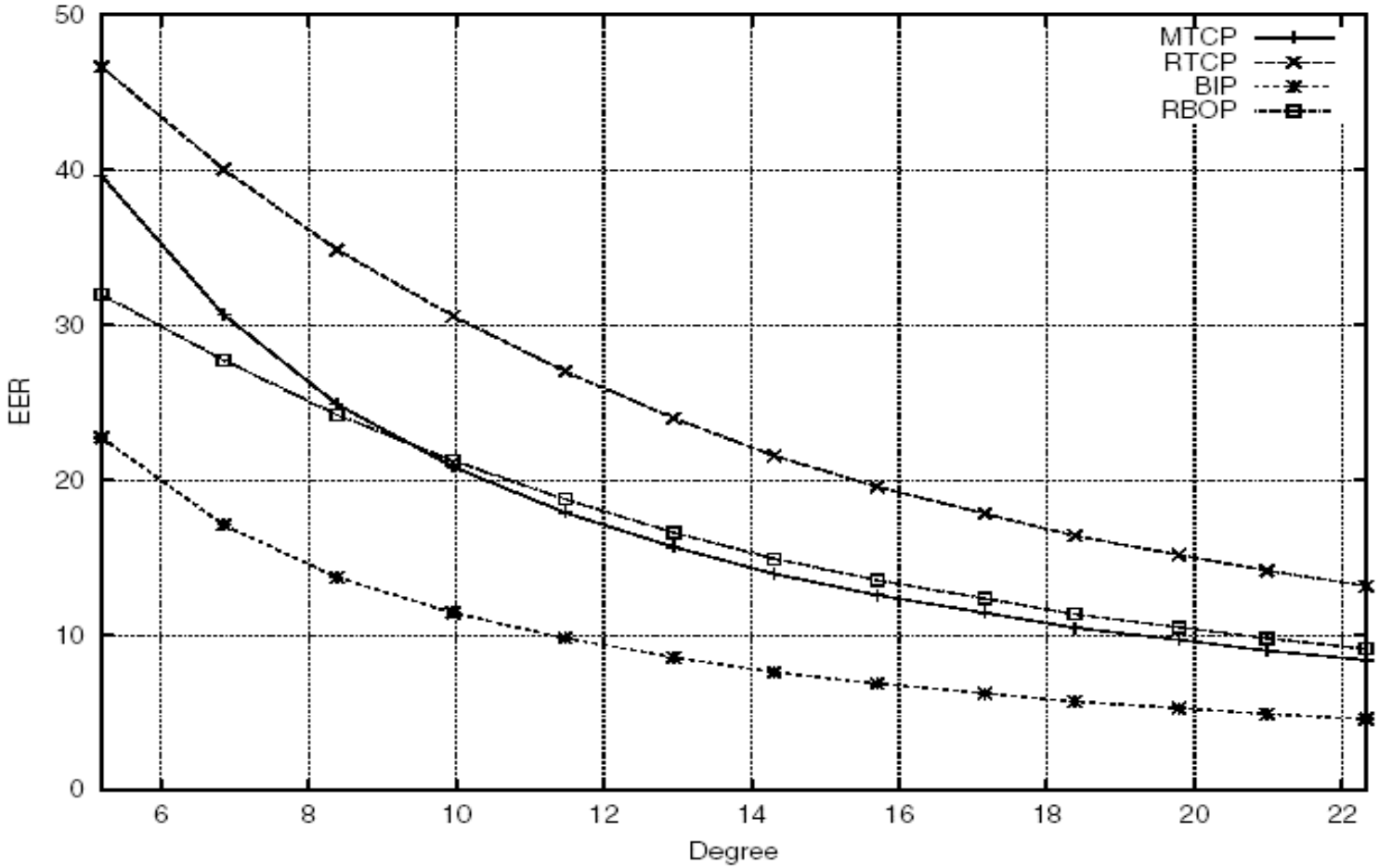
- 1. $E = \{(u, v) \in V^2 \mid d(u, v) \leq R\}.$
- 2. $E_r = \{(u, v) \in V^2 \mid d(u, v) \leq r(u)\}.$ (with $0 \leq r(u) \leq R$)
- 3. $E(u) = r(u)^{\alpha}$
- 4. $$E(u) = \begin{cases} r(u)^{\alpha} + c & \text{if } r(u) \neq 0, \\ 0 & \text{otherwise.} \end{cases}$$
- 5. $$E_{total} = \sum_{u \in V} E(u)$$

Performance Evaluation

- 6. $E_{flooding} = n \times (R^{\alpha} + c).$

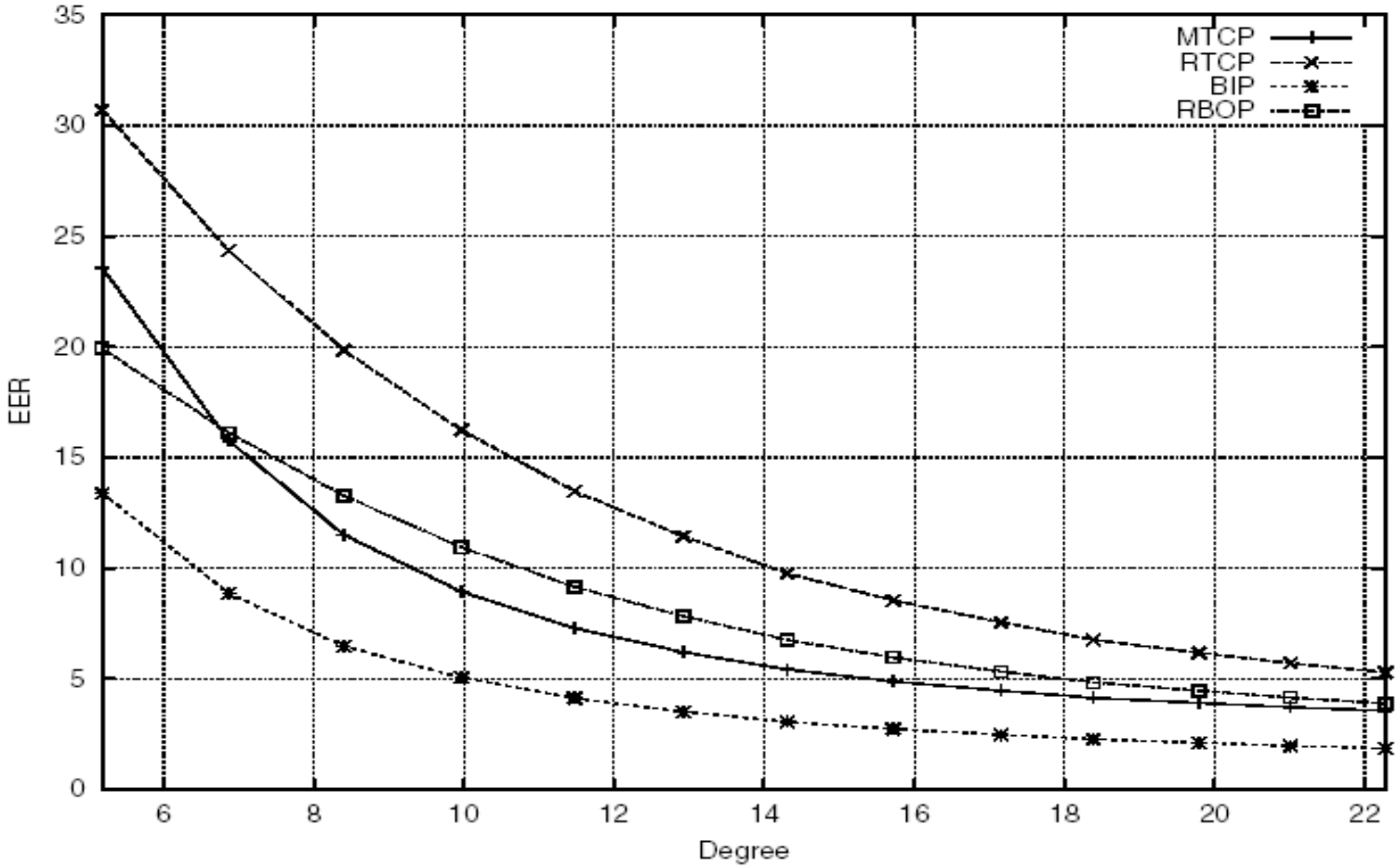
- 7. $EER = \frac{E_{total}}{E_{flooding}} \times 100.$

Performance Evaluation



(a) $\alpha = 2 \quad c = 0$

Performance Evaluation



(b) $\alpha = 4 \quad c = 10^8$

Conclusion

- The value r(u) in RBOP is actually the minimum possible transmission radius which required to maintain connectively of the broadcast process