# Gossiping with interference in radio ring networks

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## 1 Introduction

In this paper, we study the problem of gossiping with interference constraint in radio ring networks. Gossiping (or total exchange information) is a protocol where each node in the network has a message and wants to distribute its own message to every other node in the network. The gossiping problem consists in finding the minimum running time (makespan) of a gossiping protocol and efficient algorithms that attain this makespan.

**Transmission model** A radio network consists of communication devices equipped with an half duplex interface. The network is assumed to be synchronous and the time is slotted into *rounds*. The half-duplex hypothesis implies that a node can transmit or receive at most one message during a round. The network is modeled as a digraph, where the vertices represent the nodes and the arcs represent the possible communications. The messages are transmitted through the communication over the arcs and we will denote a call such a transmission.

**Interference model** We use a binary asymmetric model of interference based on the distance in the communication digraph like the ones used in [1, 2, 5]. Let $d(u, v)$ denote the distance, that is the length of a shortest directed path, from $u$ to $v$ in $G$ and $d_I$ be a non negative integer. We assume that when a node $u$ transmits, all nodes $v$ such that $d(u, v) \leq d_I$ are subject to the interference from $u$'s transmission. So two calls $(u, v)$ and $(u', v')$ do not interfere if $d(u, v') > d_I$ and $d(u', v) > d_I$.

This problem has been studied in [4] where approximation results are given (see also the survey [3]). Here we focus on the case where the transmisson network is a ring network $C_n$ on $n$ nodes with the interference distance $d_I = 1$. We presented some partial results at `JCDCG^G 2013`, and we have now solved completely the gossiping problem by giving the minimum running time (makespan). We show lower bounds and then give gossiping algorithms which meet these lower bounds and so are optimal.

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## 2 Main Result

It appears that the determination of the minimum gossiping time needs various tools. The optimal time depends on the congruence of $n$ modulo 12. Our results are summarized in the following theorem.

**Theorem 1** *The minimum number of rounds $R$ needed to achieve a gossiping in a ring network $C_n$ ($n \geq 3$), with the interference model $d_I = 1$ is :*

$$\begin{cases} 2n-3 & \text{if } n \equiv 0 (mod\, 12) \\ 2n-2 & \text{if } n \equiv 4, 8 (mod\, 12) \\ 2n-1 & \text{if } n \text{ is odd, except when } n = 3 \text{ for which } R = 3, \text{ and } n = 5 \text{ for which } R = 10 \\ 2n+1 & \text{if } n \equiv 2, 6, 10 (mod\, 12) \text{ except for } n = 6 \text{ for which } R = 12 \end{cases}$$

## References


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