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OPTIMIZATION OF INTER NETWORK SHARING SCHEME FOR CELLULAR NETWORK USING GENETIC ALGORITHM

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ABSTRACT
The cost of wireless network highly depends on the power consumption for transmission. The power consumption increases as number of users increase . Nonlinear enhancement of cost with increase in power needs the attention and optimization.The base station sharing is identified as the most efficient solution to reduce energy consumption costs of cellular networks. In this project, a scheme has been proposed which is based on framework for the study of such cooperative solutions where different mobile network operators (MNOs) decide to switch OFF subsets of their base stations during off-peak hours and roam their traffic to the remaining stations**.**The genetic algorithm has been used in this project to identify the traffic threshold for switching off the base station depending on the data available. The fitness function consider the cost of power consumption and roming cost simultateously.The improvement with GA based optimization has given in the result section.
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KEYWORDS: Wireless communication, Network sharing ,Genetic Algorithm etc.

INTRODUCTION
The cellular radio equipment (base station) can communicate with mobiles as long as they are within range. Radio energy dissipates over distance, so the mobiles must be within the operating range of the base station. Like the early mobile radio system, the base station communicates with mobiles via a channel. The channel is made of two frequencies, one for transmitting to the base station and one to receive information from the base station. The cellular concept employs variable low-power levels, which allow cells to be sized according to the subscriber density and demand of a given area. As the population grows, cells can be added to accommodate that growth. Frequencies used in one cell cluster can be reused in other cells. Conversations can be handed off from cell to cell to maintain constant phone service as the user moves between cells. A typical cell communication architecture is shown in the fig 1

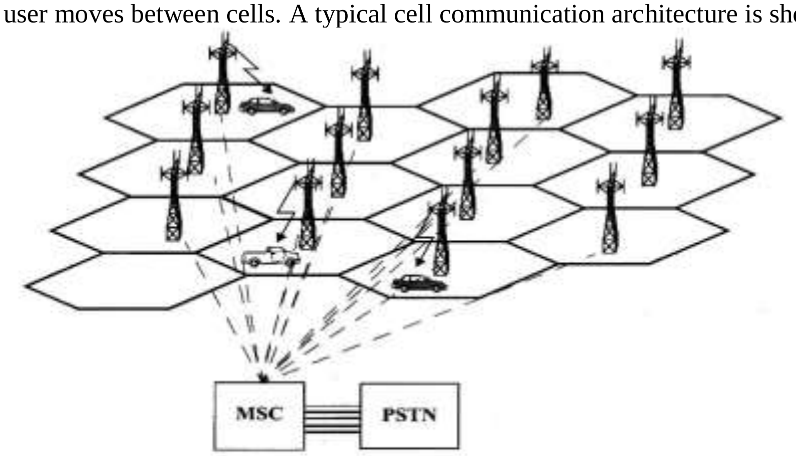

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Fig. 1celleular mobile network

By reducing the radius of an area by 50 percent, service providers could increase the number of potential customers in an area fourfold.Systems based on areas with a one-kilometer radius would have one hundred times more channels than systems with areas 10 kilometers in radius.As the user increase ,power incerese hence the cost of the transmission

increases . Commercial considerations, rather than regulatory mandates, appear to be driving the increasing trend for MNOs to adopt a variety of infrastructure models. Examples of mobile network sharing can be found in both mature and developing markets, with 3G providing an added impetus to assess the commercial and regulatory viability of network sharing.Network sharing may take many forms, ranging from passive sharing of cell sites and masts to sharing of radio access networks (RANs) and other active elements such as network roaming and the core.
In this paper we have our focus on the base station sharing. Base station sharing is possible as long as each operator maintains control over logical Node B so that it will be able to operate the frequencies assigned to the carrier, fully independent from the partner operator and retains control over active base station equipment such as the TRXs that control reception/transmission over radio channels. The important aspect of optimization has been achived using GA algorithm. A breief description of GA has been given here.

GENETIC ALGORITHM

Genetic algorithm is an iterative stochastic optimizer that works on the concept of the survival of the fittest, in motivated by Darwin, and uses methods based on the principle of natural genetics and natural selection to construct search and optimization scheme procedures that best satisfies a predefined goal. Genetic algorithms search about the solution space of a function through the use of simulated evolution, i.e., the Survival of the fittest strategy. The fittest individuals of any population who tend to reproduce and survive to the next generation, so improving a successive generation. Inferior individuals can, by chance, survive and also reproduce. Genetic algorithm has been show to solve linear and nonlinear problem by exploring all regions of the state space exponentially exploiting promising areas through mutation, crossover, and selection operation applied to individuals in the population. Genetic algorithms use principles of natural evolution. And there are five important features of (GA) as follow:

The important parameters of GA are:

- Selection
- Reproduction
- Crossover
- Mutation
- Stopping criteria

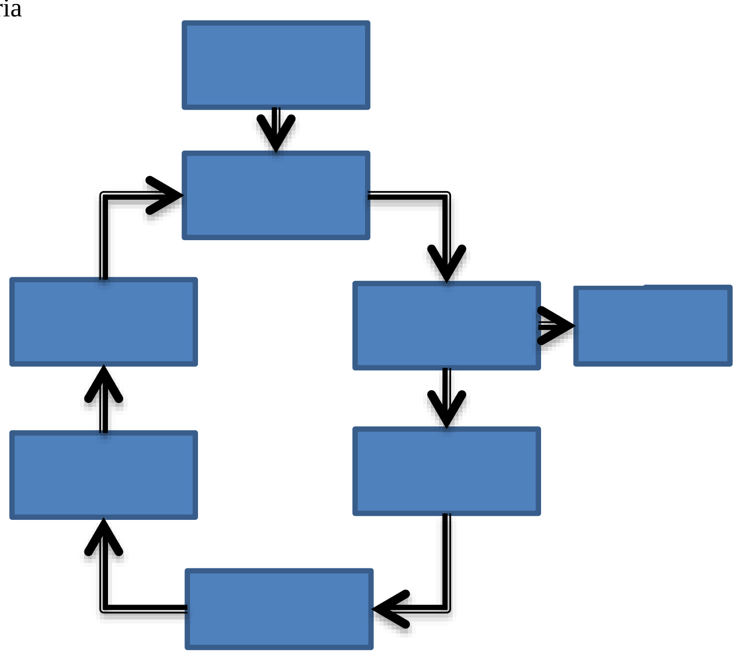

Fig. 2 Flowchart of Genetic Algorithm

The gentic algorithm in this project is used to minimize the cost of operation by network sharing for 3 MNO based operation. The methodology of simulation has described below for more clearity.

METHODOLOGY

Mobile network sharing is on the increase, driven mostly by the need to reduce the high cost of network infrastructure. In thuis paper, 3 MNOs are considard that are serving the same area. A typical scheme of the network is shown in the fig 3 .

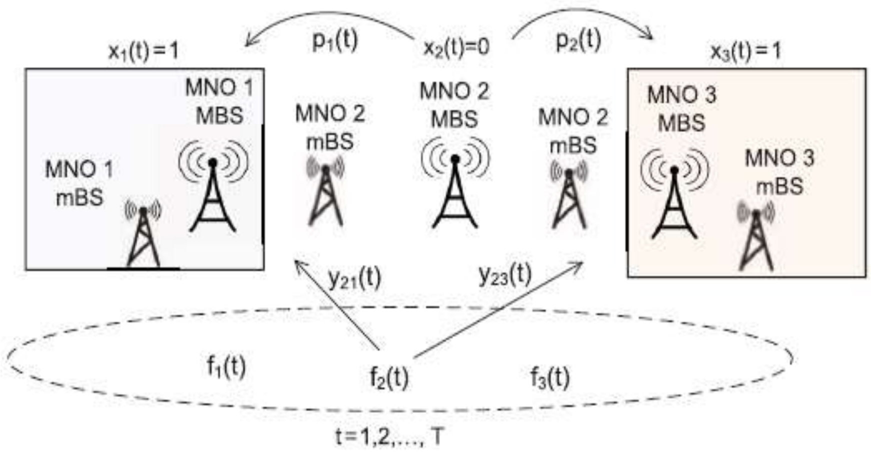

Fig. 3 Typical scheme of three MNOs that serve the same area. [1]

The x(t) shows base station is in switched off or switch on condition and yij(t) shows roamed traffic of BS 'MNO i' to 'MNO j'.fi(t) is traffic of operator Iand p(t) is payment by one operator to another for roaming services.MBS and mBS are macro and micro base stations.The power consumption is a function of the load of the BS. In the literature it is usually referred as a linear function of the transmitted RF power of the antennaThe minimum transmit power per user according to SINR criteria is given by :

$$P_u = P_0 - g_u - g_n + l_{n,u} + \psi_u + 10 \cdot \log10(M_u) \qquad (1)$$

Where,
P_0= receiver sensitivity
g_u= antenna gain of user u
g_n= antenna gain of BS n
$l_{n,u}$= path loss between base station and user u
ψ_u= shadow component
M_u= no of resource blocks assigned to user u
The Base station power consumption is a function of number of served users. The simulation result of the RF power output for 200 user are shown in the figure below.

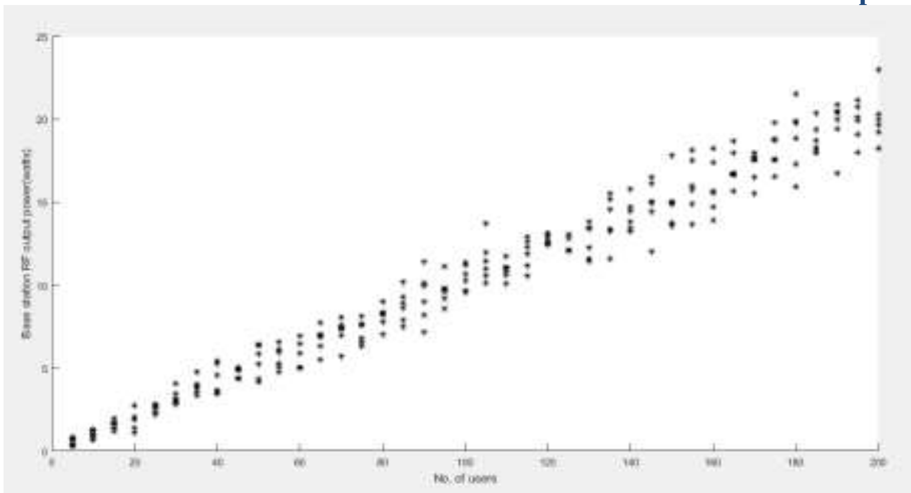

Fig. 4 The results were drawn from 3 experiments where up to 200 users were randomly placed in a radius of 3 km from the BS.

The total RF out power of BS n ∈ Ni at time t is given by:

$$P_n(t) = \sum_{u=1}^{u_i^n(t)} P_n \qquad (2)$$

As a next step, we incorporate this linear equation into the general bs power model, and correlate the power consumption of the BS with RF output power.

$$C_n^{RF} = \gamma_n P_n^{RF} + b_n \qquad (3)$$

Eeffect of base station technology on power consumption

$$C_n(U_i^n(t)) = \begin{cases} a_n \ldots\ldots U_i^n(t) + b_{n,} BS\ is\ on \\ 0, \qquad BS\ is\ OFF \end{cases} \qquad (4)$$

With the above equation and a typical pattern of the no. of user over a week has been taken for the simulation. The pattern of no. of user in a hour over a week has shown in the figure 5.

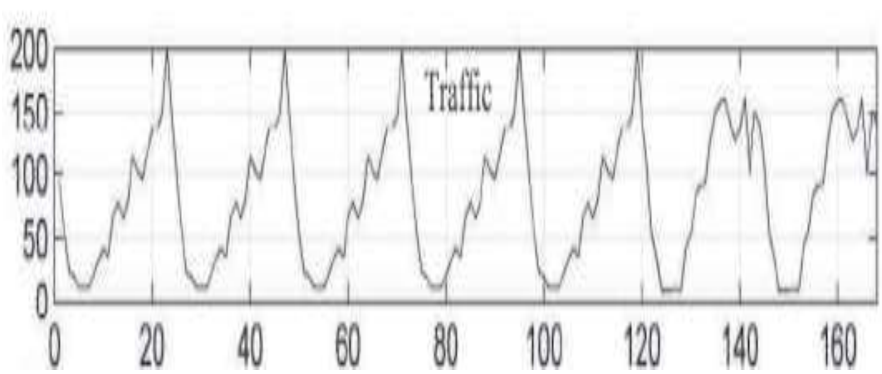

Fig. 5 Average user traffic for weekly traffic profile [2]

The patten as given in [2] is slightly changed for simulation and accordingly power consumption are assumed.The power consumption of the three base station are shown in the figure -6 .

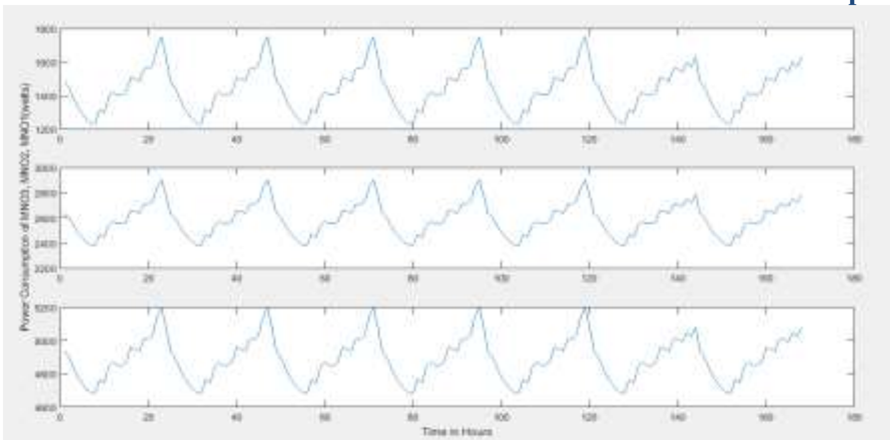

Fig. 6 Power consumption of MNOs without cooperation

RESULTS AND DISCUSSION

The energy saving is the prime objective to reduce the cost ,however the cost of roming also controls in this projects.

Table 2. The simulation parameters are given as below

MNO i	**i=1**	**i=2**	**i=3**
Maximum served users in area A	200	200	200
No. of MBSs	5	5	5
No. of mBSs	10	10	10
an for MBs in watt/user	3	3	3
bn for MBs in watt/user	200	400	800
an for mBs in watt/user	0.7	0.7	0.7
bn for mBs in watt/user	15	20	60

There is 4 different case has been considered in this paper,

1. MNO 1,2 and 3 are working together
2. MNO 1 and 2 are working together
3. MNO 1 and 3 are working together
4. MNO 2 and 3 are working together

Optimization of Energy and cost values has been done with minimization of Energy consumption .Derivation of the optimized values of energy and cost has been done using Genetic Algorithm technique. The fitness function is given as

$$out = w1 * cost\ for\ power\ consumption + w2 * roming\ cost$$

Here w1 and w2 is the normalization constant. The optimization curve of this problem is shown in the figure below.

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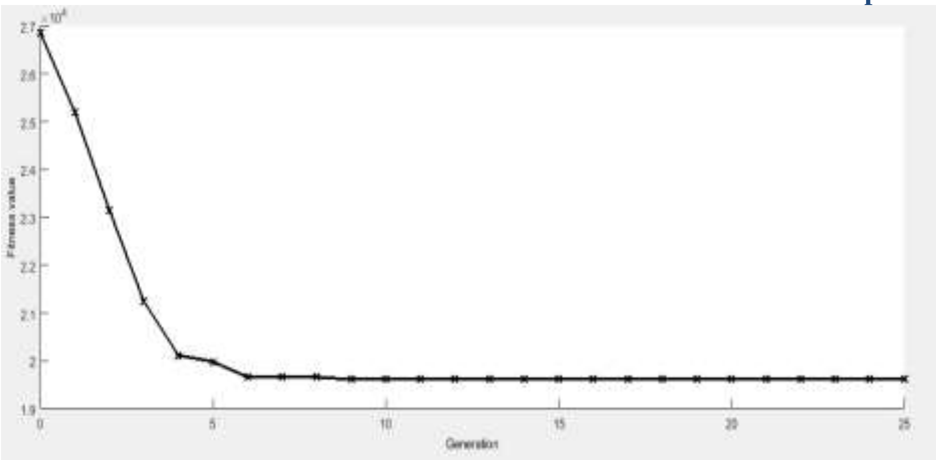

Fig. 7 Optimized values of Cost Function

The base station switing has been shown in the figure given below

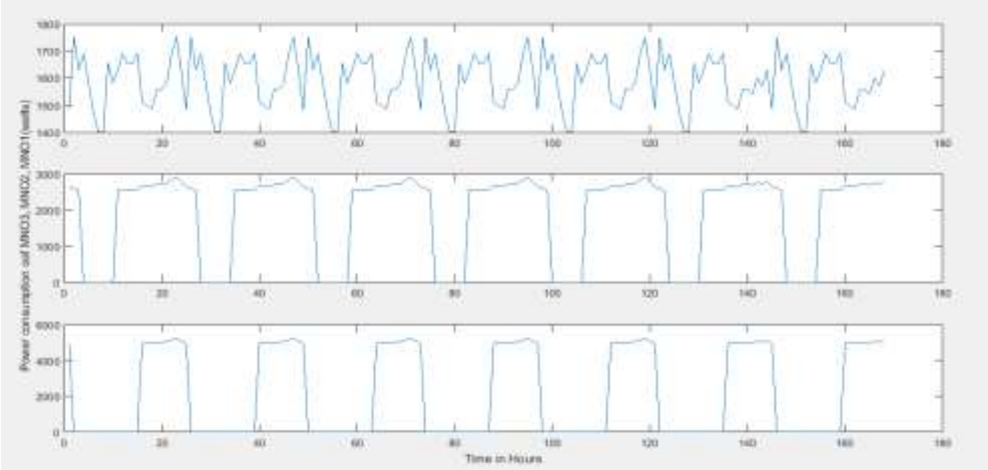

Fig. 8 Power consumption of MNOs during cooperation

The result of the coopration has been shown in table -2 . The net saving of the coopration becomes high in the case of the a low cost operation MNO is operating with higher capability of user.

Table 2. Savings achieved by cooperation

Coalition	MNO	Cost- No cooperation	Cost- Cooperation	Savings(%)
{1,2,3}	i=1	241	248	-2.9
	i=2	434	284	30
	i=3	821	622	24
	Total	1496	1254	22
{1,2}	i=1	241	246	-2.07
	i=2	434	232	46
	Total	675	478	29
{1,3}	i=1	241	246	-2.07
	i=3	821	522	24
	Total	1062	768	27
{2,3}	i=2	434	436	-0.46
	i=3	821	655	20
	Total	1255	1091	13

CONCLUSION

With the increasing volume of mobile data traffic, it is required to adopt such innovative solutions such as the inter-network sharing among different mobile network operators.In this paper, we have considerd 3 MNOs only. Energy savings of MNO1 is in negative means more energy has been exploited by MNO1.Over all energy savings made by MNO2 and MNO3 are more as compared to energy exploited by MNO1.Hence mutual cooperation between MNOs (Base station sharing) has resulted into overall savings.The optimization using GA has improve the significant saving of cost. This work has open a way to use the evolutionary optimization algorithm to identify the optimum sharing between MNOs. Further other optimization technique may be used for optimization.

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