Resource Allocation and Energy Efficiency in Cellular Networks In Comparison with How to Raise a Happy and Good Child?

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Science Storytellers, I used to think many times that how my research would be useful to the society if not immediately at least in near future. Because of this, I am working in such a domain of theoretical analysis and optimisation in cellular networks. But, now, I have got a platform to express my research in a very simplistic way that even a person who knows very little English would understand. This story is based on my two papers that were published last year.

We are all using our mobile phones these days. On an average, there would be at least two mobile phones with the data connectivity nowadays and that will increase tenfold in near future. I am writing this story related to mobile phone communication in a different way.

As in the formal engineer's way, let's begin the story with a phrase "Let's assume". Assume what? Yeah, that's the question now?

Please note that the technical explanations are in normal font and the analogy that I made is written in *Italics.*

Let's assume and make some analogy

Our *child* as our mobile phones, technically mobile users,

Parents & relatives as the high power mobile towers, technically macro base stations,

Teachers & Well-wishers as small power mobile towers, technically small cell base stations,

Society as the environment that the children are growing in, technically the channel, and

Friends as other mobile phones, technically other mobile users.

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A beautiful creation of God is human being. A human is born to grow, love, interact, learn, achieve, give, get, enjoy and finally live their own life. In all the stages of life, there will be somebody or there will be some reasons for a human to achieve their self needs.

What's the role of parents and relatives, teachers and well-wishers and society in the life of our children? (or)

What's the role of high-power macro base stations, low-power small cell base stations, and the channel for a mobile user?

Both are same, right? Let's clarify what's the need of all

A child is born and raised by the parents and sometimes with the support of relatives. The same applies to the mobile user who gets it connected to high-power macro base station traditionally.

But, parents and relatives alone cannot completely help a child to grow into a complete human, either man or woman. The children require a teacher to teach them good and bad and a well-wisher to cheer them up when they are down. In the same way, the traditional high-power macro base station gives some basic form of coverage to the mobile user by spending high energy like parents keep a watch on their kids all the time. Now, these low-power small cell base stations will drag some of the children from the parents towards them by offering some additional incentives. In this case, these mobile users will get high speed as the children will learn from the teachers and develop with the help of their encouragement.

Apart from these, the society plays a major main role in the child's life. This society has the power to change all the good persons (parents, relatives, teacher, well-wisher) around the child to appear as selfish and bad people. In the same way, the nature of the channel has the tendency to make some of the base station's signal as interference, produce high distortions, attenuations, and path loss.

What if only Parent or only Teacher cares about their child?

What if the mobile user is connected to only one base station?

In either case, the child will have insecure feelings for at least one. Either in home the child will be searching for a good teacher or in school the child will be looking for a good parent. The child would try to manage but would not be happy and efficient.

The mobile user will be satisfied with the speed that it gets from one of the base station either it is macro or small cell but the speed will not be up to the mark.

What if both of them are same (parent and teacher) or both of them spend the same time with the child?

What if the mobile user is connected to both the base stations?

If parent and teacher are same to a child or if they both spend exactly same time, then either he will get enough attention in both the places but same kind of information will be passed to the child making him feel bored or the child will be confused while listening.

If both the base stations are connected at the same time, then the mobile user's coverage will increase (Coordinated MultiPoint Transmission (CoMP) - Joint Transmission).

What if both of them spend time individually with the child?

What if both the base stations allocate separate time to mobile user?

Yeah, this might be an interesting case to look into. There is a quality of time spent bya teacher and the same quality of time spent by the parent that adds up and makes the child efficient in learning aspects of life as well as the vocational knowledge.

If both the base stations are connected to the mobile user individually, then the mobile's speed will be increased (dual connectivity).

What is my contribution in this?

There will be some points where with less energy we can give maximum care and knowledge to the child. *One of my research publications was the proposal of those energy efficient points with the optimum time that both the teacher and the parent can spend with the child. The most interesting results that I got were, for one child this technique will increase the efficiency, but if you consider more number of children, then the overall efficiency of the group of children will decrease.*

Two or more base stations connected to a single mobile user will increase its coverage and throughput. But, if there are more mobile users in the system, then the overall system throughput decreases. We proposed time allocation for CoMP users and base station sleeping patterns for achieving energy efficiency.

There should be an optimal time that the parent and teacher should spend with the child. Even in the presence of many children, every child will get to spend time with them. So, the efficiency of understanding personal aspects as well as outdoor knowledge will increase. So, this case will perform better than the case (B).

The optimal time allocation to a mobile user by the base stations in dual connected mode is proposed and thereby proving this is performing better than the CoMP.

And what's the future has for us?

Last but not the least, in future, not only parents, relatives, teachers, but FRIENDS will also be a part in transforming a child into a human. The constructive friendship will make them to learn among themselves and grow by their own with the presence of their parents/teachers that will help the child to understand the society effectively.

This is nothing but the device-to-device communication where the base stations make these mobile users to learn about the channel and instruct the mobile users to communicate with the other mobile user.