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Christos Bouras, Computer Engineering and Informatics Department, University of Patras, Patras, Greece
Vasileios Kokkinos, Computer Engineering and Informatics Department, University of Patras, Patras, Greece
Evangelos Michos, Computer Engineering and Informatics Department, University of Patras, Patras, Greece

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5G NR, Association, BS, Decoupling, DL, HetNet, MCS, UC, UE, UL

DOI: 10.4018/IJWNBT.2020070103

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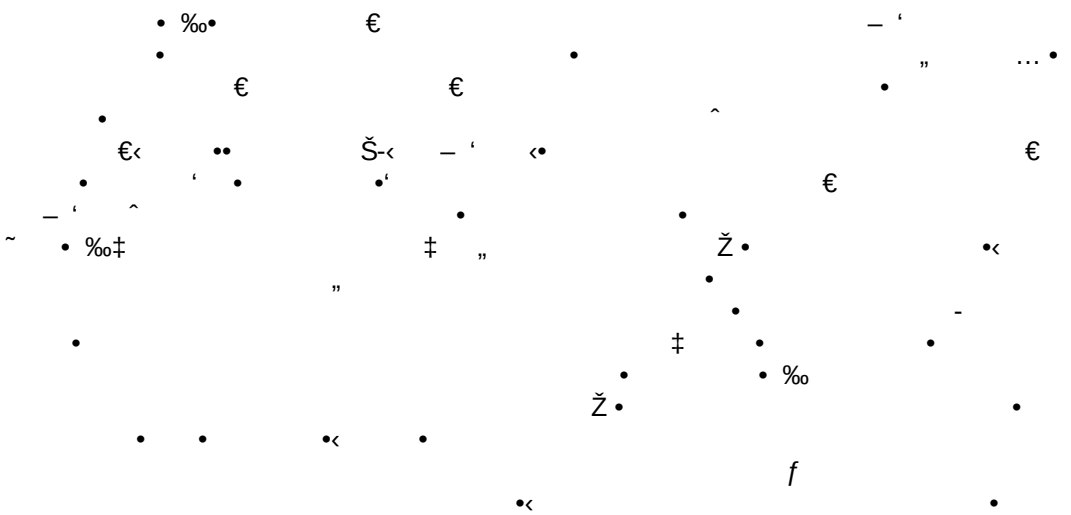

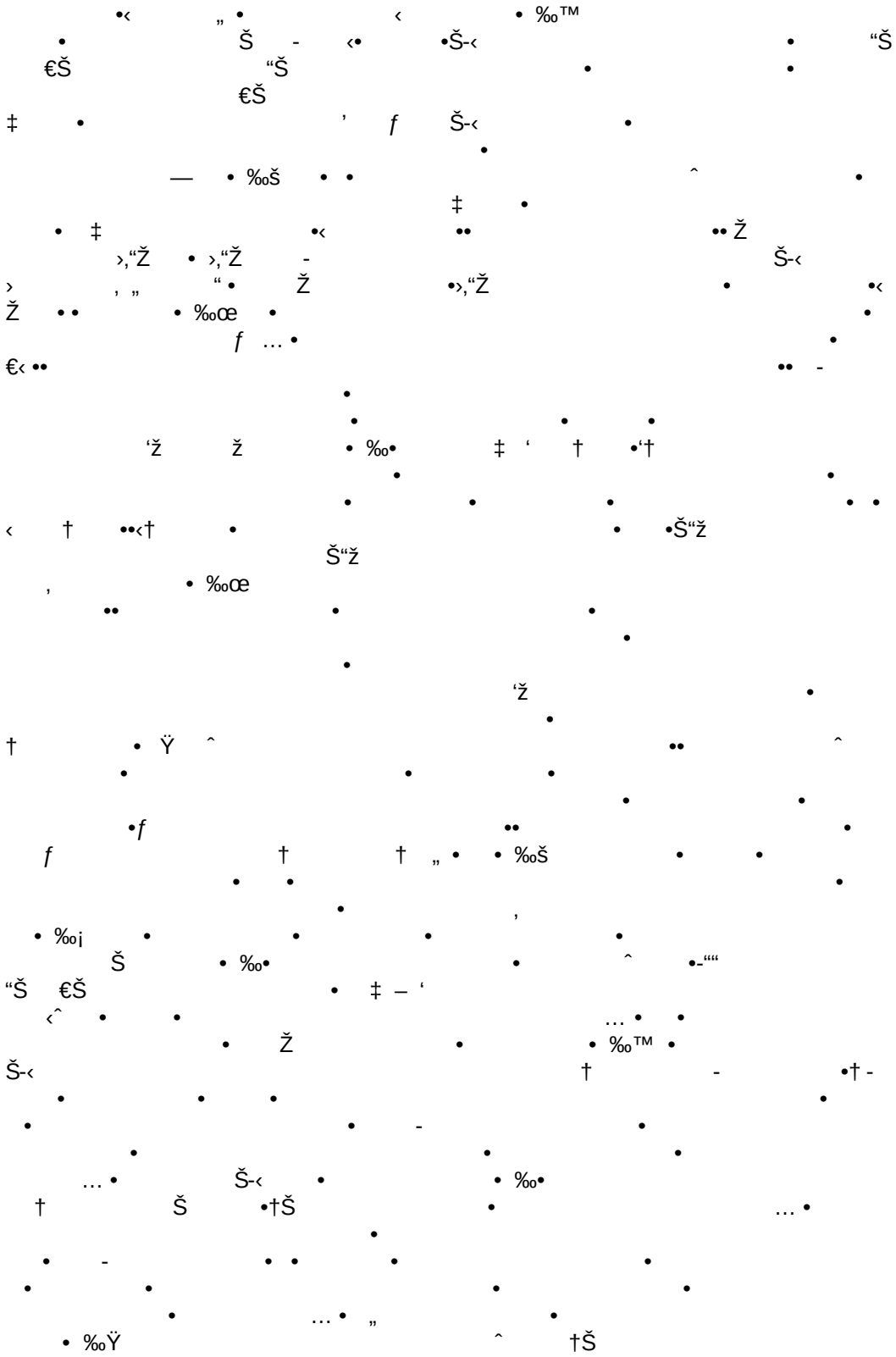

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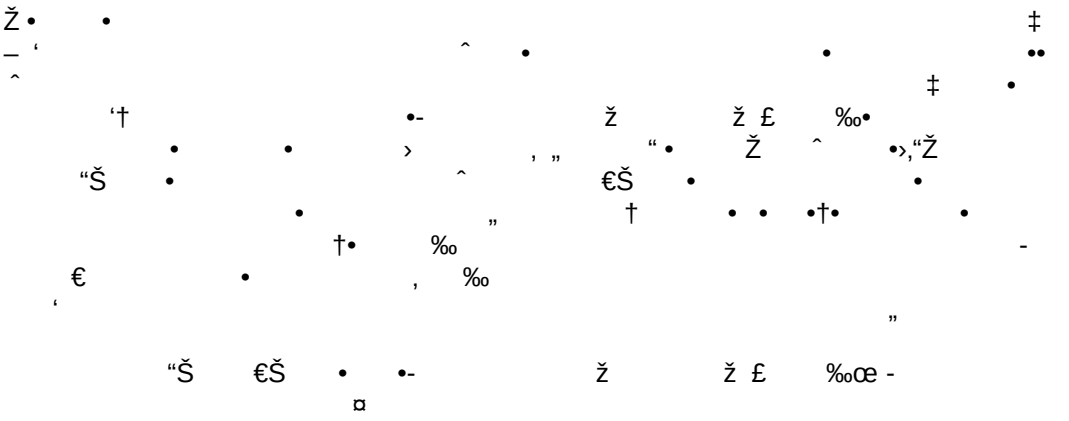
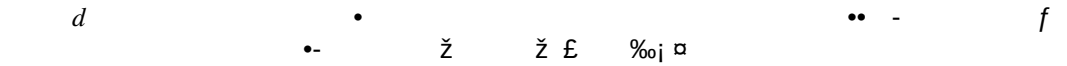
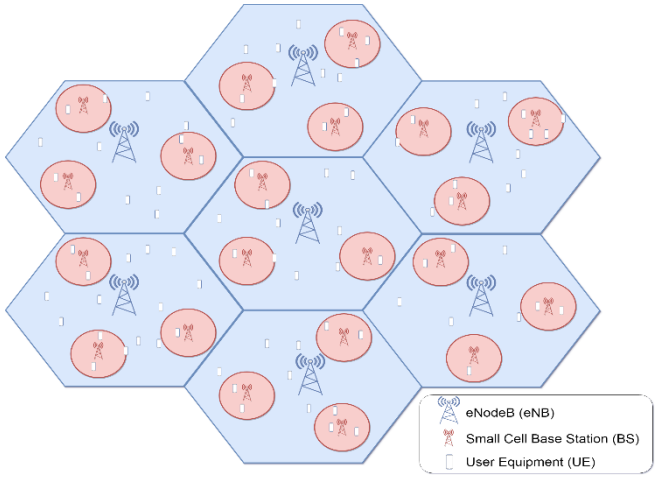


$$PL_{macro} = 128.1 + 37.6 \cdot \log_{10}\left(d\right)$$



$$PL_{small} = 140.7 + 36.7 \cdot \log_{10}\left(d\right)$$

Figure 1. The UC model scenario



$$G^{UL} = G^{DL} = 10^{-PL/10}$$ •¡

$$rb_{j,i} = \left\lceil \frac{th_j}{B_{RB} \cdot \log_2\left(1 + SINR_{j,i}\right)} \right\rceil$$ •™

$$SINR_{i,j}^{DL} = \frac{P_i^{rad} \cdot G_{i,j}}{N_0 \Delta f + \sum_{i'} P_{i'}^{rad} \cdot G_{i',j}}$$ •‡

, $\sum_{i'} P_{i'}^{rad} \cdot G_{i',j}$ •
•• ^ i^{th} •• •• „ • j^{th} €‹
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• f
• Ž• — j^{th} €‹ • i^{th} •• •
†• „ • • ‘† $R_{j,i}^{DL}$ f
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$$R_{j,i}^{DL} = \left|r\right| \cdot \sum_{r \in RB} W_{RB} \cdot cr_{SINR} \cdot \left(1 - BLER_{SINR}\right)$$ •œ

$\left|r\right|$ †• f W_{RB} †•f
cr_{SINR} Ž• $BLER_{SINR}$ • ‘†
•‹†
, €Š • ›,“Ž $SINR_{j,i}^{UL}$ • ‘† i^{th} ••
j^{th} €‹ • ‰• ¤

$$SINR_{j,i}^{UL} = \frac{P_j^{rad} \cdot G_{j,i}}{N_0 \Delta f + \sum_{j'} P_i^{rad} \cdot G_{j',i}}$$ •š

P_j^{rad} €‹f $G_{j,i}$ €‹ •• N_0
Δf “Š $\sum_{j'} P_i^{rad} \cdot G_{j',i}$ •
^ j^{th} €‹
•• $R_{j,i}^{UL}$ f €Š • ¤

$$R_{j,i}^{UL} = W_s \cdot \left|N_s^{UL}\right| \cdot cr_{SINR} \cdot \left(1 - BLER_{SINR}\right)$$ ••

W_s N_s^{UL}
€Š • cr_{SINR} f
$BLER_{SINR}$ •‹† • ‘† €Š •
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•š ¤

$$SINR_{(dB)}^{DL} = 10 \cdot \log_{10}\left(SINR_{i,j}^{DL}\right)$$ •Ÿ

$$SINR_{(dB)}^{UL} = 10 \cdot \log_{10}\left(SINR_{j,i}^{UL}\right)$$ •‰

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Algorithm 1. Association algorithm for the DL network

```
function association_DL_mode(r_user,BS, SINR^DL_BS,user)
    for each macrocell BS
        for each CQI = 1:15
            for each UE
                calculate user data rates(CQI);
            end
            calculate average data rates(CQI) for macrocell area;
        end
        calculate optimal average data rates(CQI) for macrocell area;
        select MCS based on average CQI;
        for each UE
            select UE with min(r_user,BS);
            select optimal BS by finding max(SINR^DL_BS,user);
            if RBs of this BS are enough
                link UE - BS;
                calculate user data rates(CQI);
                update available RBs of this BS;
            else
                try next best BS by finding new max(SINR^DL_BS,user);
            end if
        end for
    end for
end
```

Algorithm 2. Association algorithm for the UL network

```
function association_UL_mode(r_user,BS, SINR^UL_user,BS)
    for each macrocell BS
        for each CQI = 1:15
            for each UE
                calculate user data rates(CQI);
            end
            calculate average data rates(CQI) for macrocell area;
        end
        calculate optimal average data rates(CQI) for macrocell area;
        select MCS based on average CQI;
        for each UE
            select UE with min(r_user,BS);
            select optimal BS by finding max(SINR^UL_user,BS);
            if RBs of this BS are enough
                link BS - UE;
                calculate user data rates(CQI);
                update available RBs of this BS;
            else
                try next best BS by finding new max(SINR^UL_user,BS);
            end if
        end for
    end for
end
```

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Figure 2. MATLAB deployment scenario for the case of 100 UEs

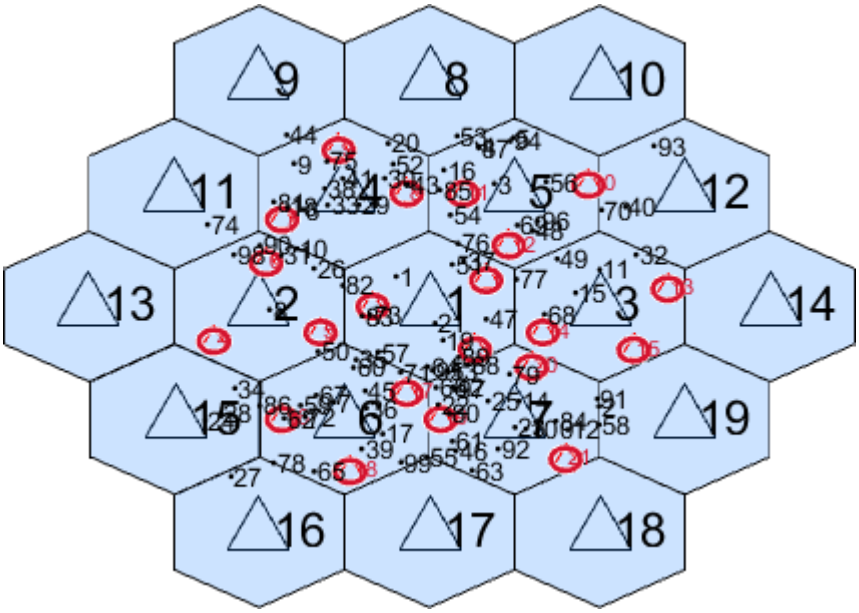

Table 1. Simulation parameters from the deployment scenarios

Parameter	FR1 Scenario	FR2 Scenario
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€‹ -	›	›
Ž •• $P_{i,max}^{rad}$	¡ —	¡ —
• •• $P_{i,max}^{rad}$	‰ —	‰ —
€‹ $P_{j,max}^{rad}$	—	—

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Figure 3. [DL] Macro cell-small cell connections for FR1/FR2 scenarios

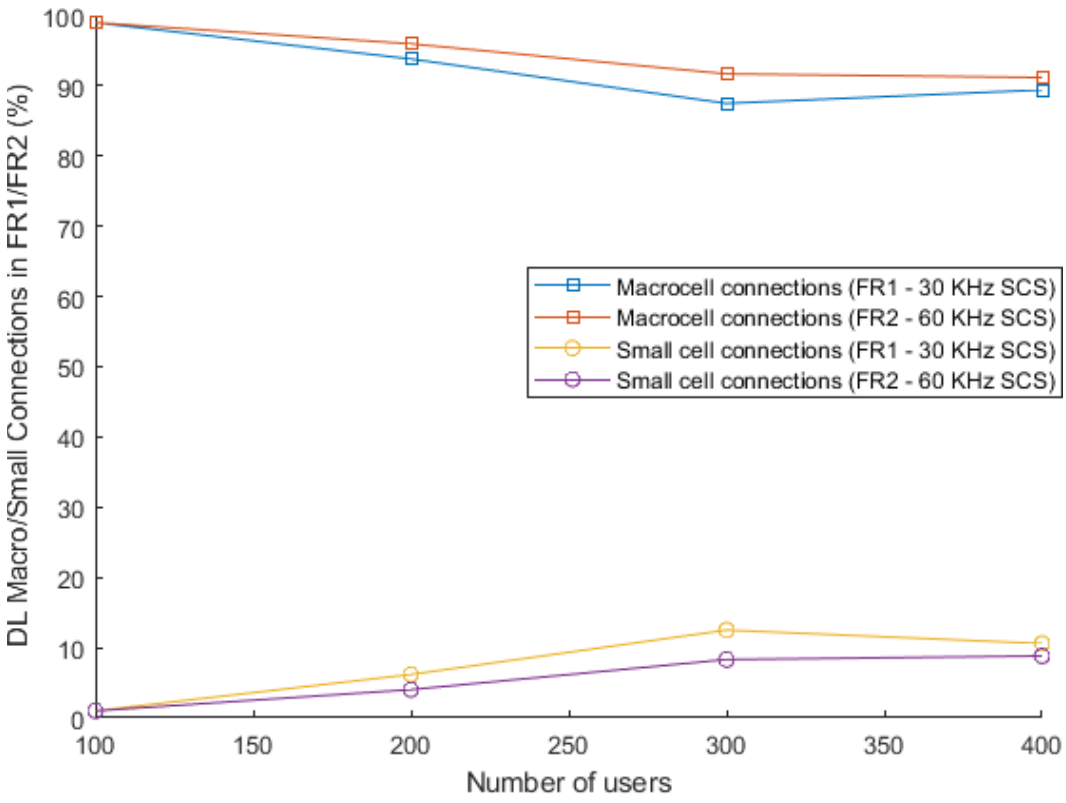


Figure 4. [UL] Macro cell-small cell connections for FR1/FR2 scenarios

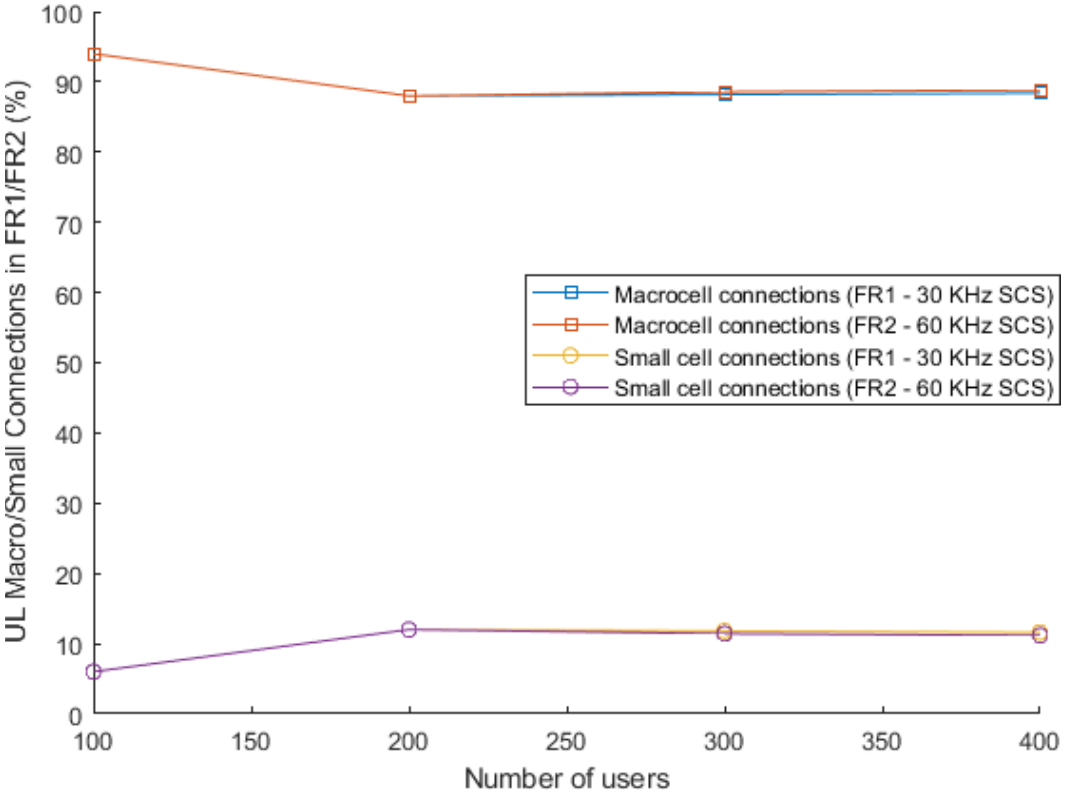


Figure 5. [DL] Average data rates for FR1/FR2 scenarios

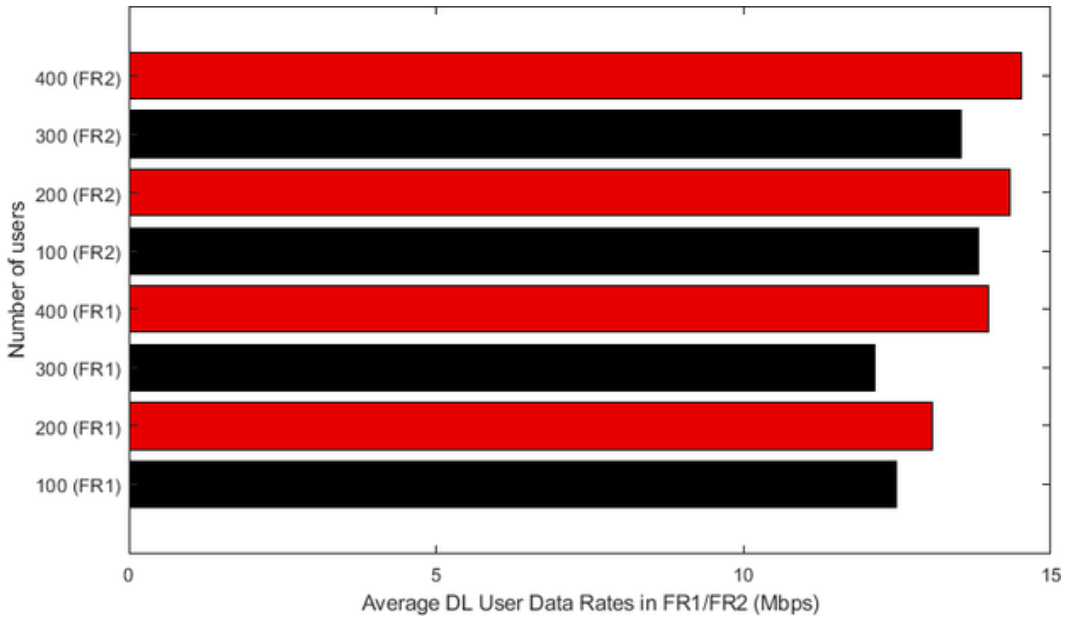


Figure 6. [UL] Average data rates for FR1/FR2 scenarios

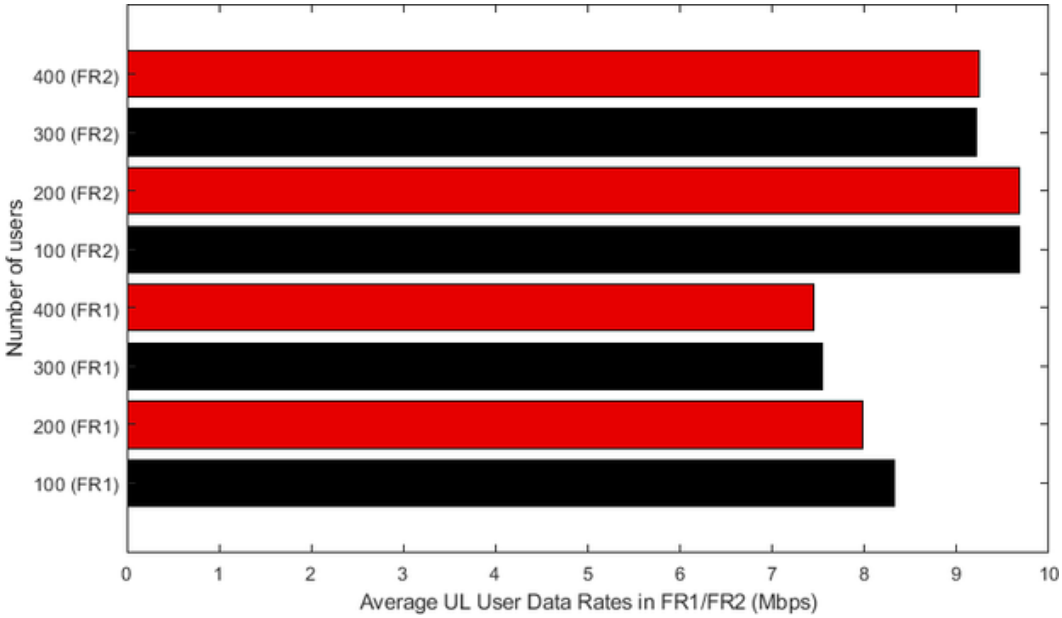
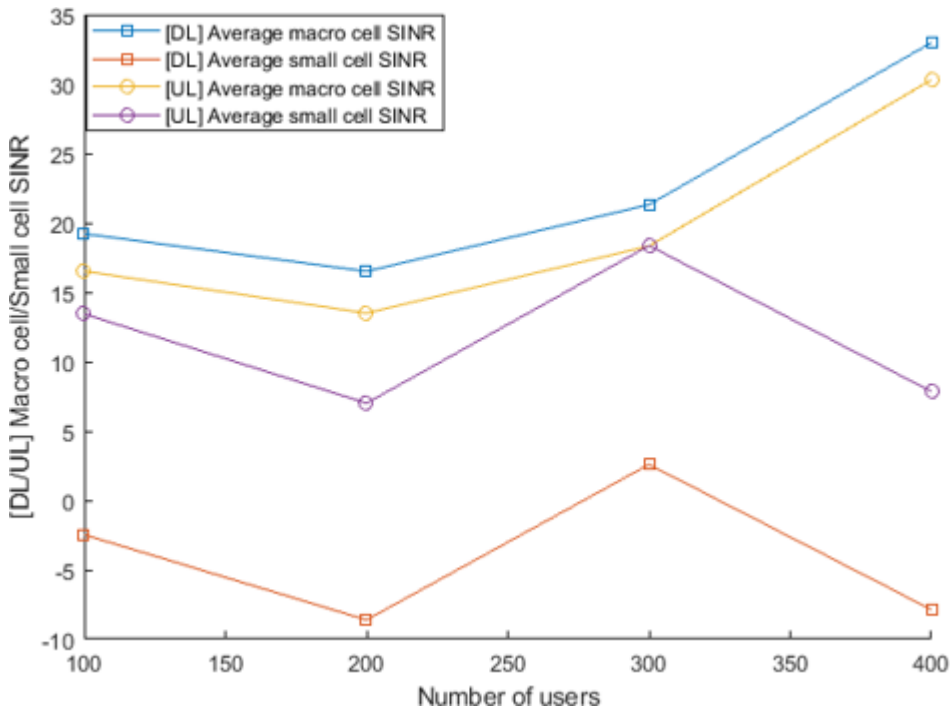


Figure 7. Macro cell and small cell average SINR in DL and UL



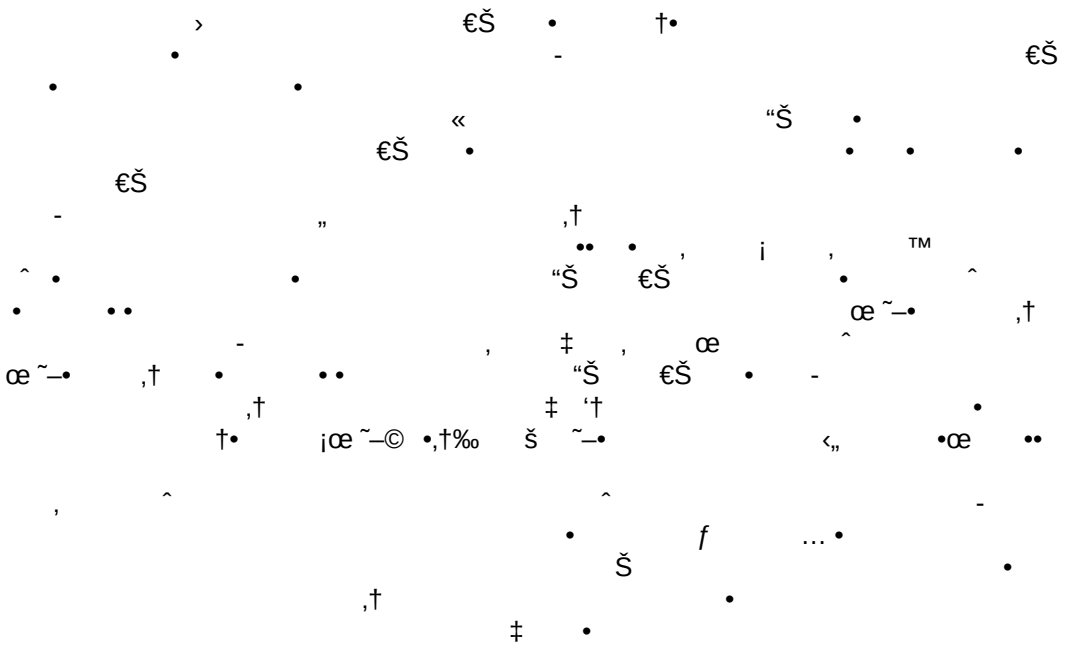


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Table 2. Simulation parameters from the deployment scenarios

Users	100	200	300	400
FR1 Setting (SCS 30 KHz)				
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FR2 Setting (SCS 60 KHz)				
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Christos Bouras is a Professor at the University of Patras, Department of Computer Engineering and Informatics. Also, he is a scientific advisor of Research Unit 6 in Computer Technology Institute and Press - Diophantus, Patras, Greece. His research interests include the analysis of performance of networking and computer systems, computer networks and protocols, mobile and wireless communications, telematics and new services, QoS and Pricing for networks and services, e-learning, networked virtual environments and WWW issues. He has extended professional experience in the design and the analysis of networks, protocols, telematics, and new services. He has published more than 400 papers in various well-known refereed books, conferences and journals. He is a co-author of 9 books in Greek and the editor of one in English. He has been member of editorial board for international journals and PC member and referee in various international journals and conferences. He has participated in R&D projects.

Vasileios Kokkinos obtained his diploma from the Physics Department of the University of Patras in October 2003. Next, he was accepted in the postgraduate program "Electronics and Information Processing" in the same department and in March 2006 he obtained his master's degree. In 2010 he received his PhD on Power Control in Mobile Telecommunication Networks from the Computer Engineering and Informatics Department. His research interests include data networks, next generation mobile telecommunications networks, multicast routing, radio resource management and wireless networks measurement and verification. He has published several research papers in various well-known refereed conferences and scientific journals.

Evangelos Michos was born in 1995 in Athens, Greece. He entered the Department of Information and Communication System Engineering at University of Patras in 2013 and is currently an undergraduate student. He has obtained the Michigan Certificate of Proficiency in English and the Diplome D' Etudes en Langue Francaise B2. His interests involve web development and next generation mobile telecommunications networks. He has published two research papers in various well-known refereed conferences.