A Study on Resource Granularity of vEPC Optimal Resource Assignment

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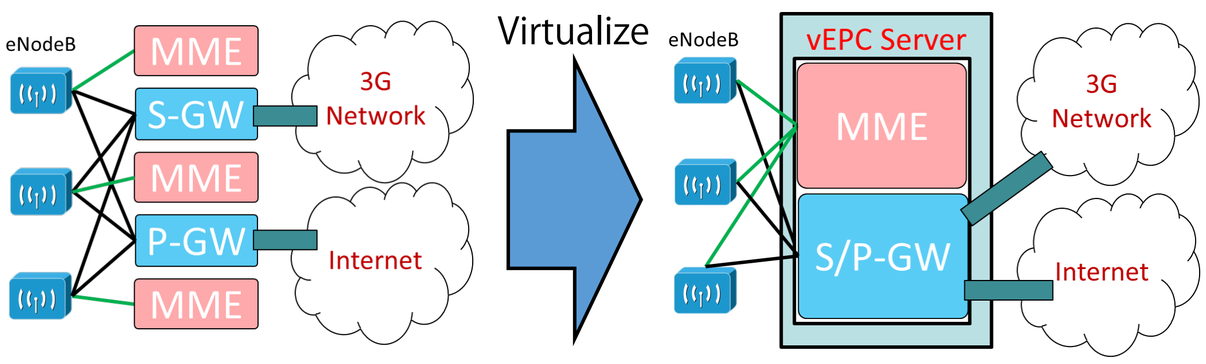
Background

◆ Rise of M2M communications
- Autonomous car, AR etc.
- Strict allowable delay (~10msec)

◆ vEPC(Virtualized Evolved Packet Core)
- Deploy functions of EPC entities as VNFs
- Lower costs and more flexible deployment



◆ Problem of conventional vEPC network
- M2M devices and smartphones share the same MME resource → Congestion on MME
- M2M allowable delay may not be satisfied

◆ vEPC-ORA method [1] : Our proposal
- Optimize VM resource assignment of MME and S/P-GW in a single vEPC server
- vEPC server is modeled as a VM pool of n_{VM} VM resources
- Distinguish M2M communications and smartphone communications

Minimize M2M blocking rate on MME

$$S^* \in \underset{n_{MME}, n_{GW}}{\arg\min} \; Br_m$$

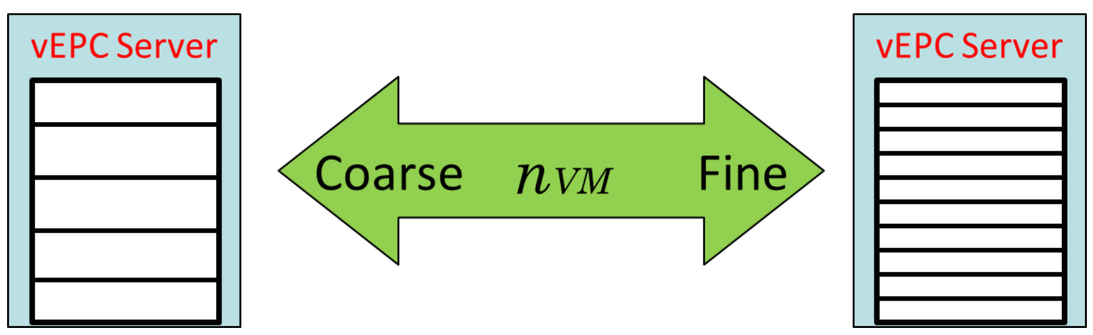
$$s.t. \;\; n_{MME} + n_{GW} = n_{VM}, \;\; n_{GW} \geqq \frac{\Lambda + D}{2\mu_{GW}}$$

Mean packet processing time on S/P-GW is below M2M allowable delay

[1] K. Tanabe, H. Nakayama, T. Hayashi, and K. Yamaoka, "An optimal resource assignment for C/D-plane virtualized mobile core networks," in Proc. IEEE ICC2017, May 2017.

However...

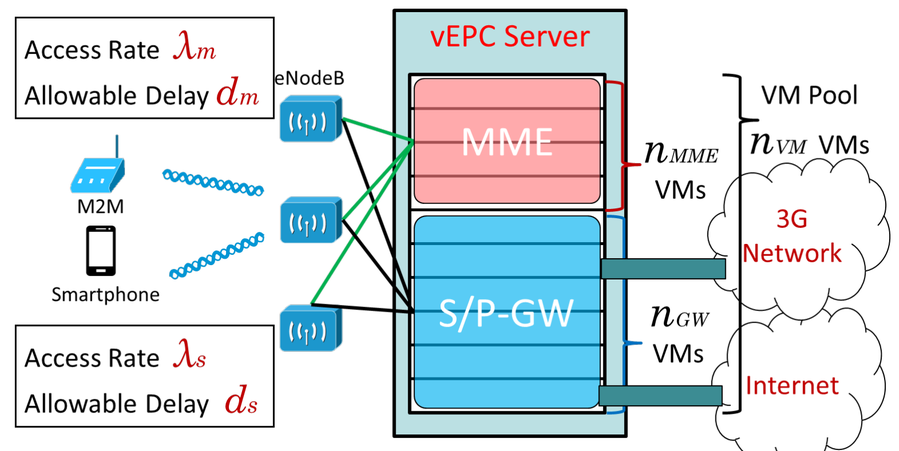
- Exponential time is required for calculation of optimal resource assignment S*
- Calculation time depends on granularity of VM pool n_{VM}



We study → Effect of resource granularity on vEPC-ORA method

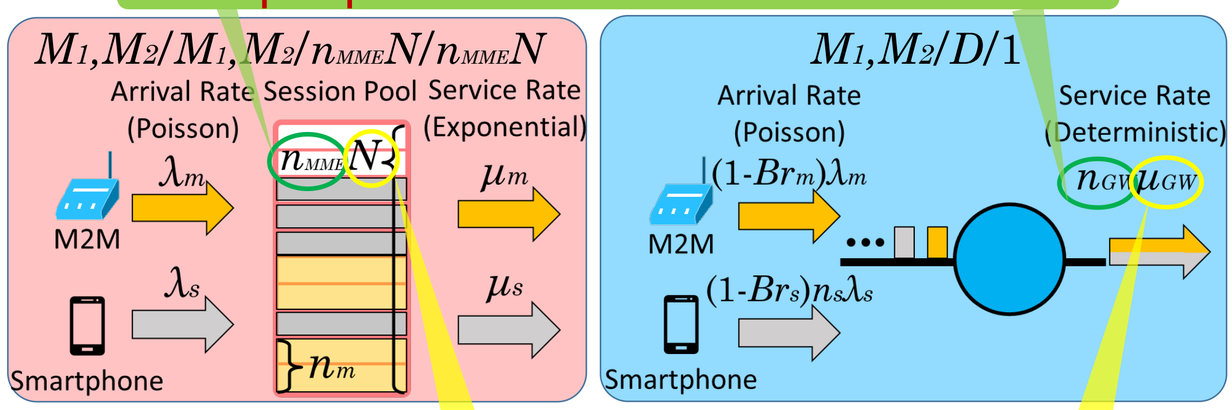
Network Model

◆ vEPC server: VM pool of n_{VM} VM resources



◆ Queueing model of MME and S/P-GW

In proportion to # of VM resources



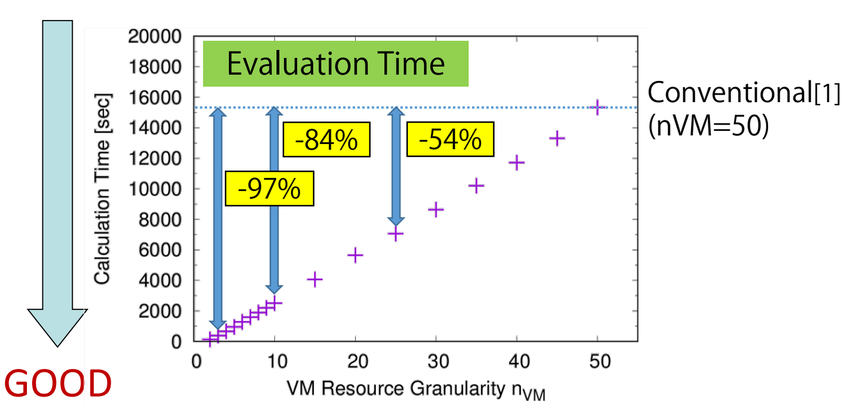
In inverse proportion to resource granularity n_{VM}

Numerical Analysis

◆ Parameter Settings

{M2M, Smartphone} Access Rate λ_m, λ_s	50 [/sec]
{M2M, Smartphone} Session Holding Time μ_m, μ_s	{1, 60} [sec]
{M2M, Smartphone} Allowable Delay d_m, d_s	{1, 10} [msec]
# of Session Resources per M2M Session n_m	10 (=$\lfloor d_s/d_m \rfloor$)
# of User Data Packets per Smartphone Session n_s	500
Total # of Session Resource per MME VM $n_{VM}N$	12500
Total Processing Rate per S/P-GW VM $n_{VM}\mu_{GW}$	75000 [pps]

◆ Evaluation Results
- n_{VM} = 2, 3, ..., 9, 10, 15, 20, ..., 45, 50
- Calculated by dual socket Intel Xeon E5-2640v2



vEPC-ORA method derives the optimal resource assignment in a practical calculation time