SUPPLEMENT MATERIAL

A. The proof of Theorem 1

Proof. For the situation $|S_l'| \geq 2$, we have the first derivation of end device n's utility is

$$\frac{R_l}{\sum_{i\in S_l} x_i} - \frac{R_l x_n}{(\sum_{i\in S_l} x_i)^2} - L_n \tag{13}$$

where $L_n = \tau\sigma \cdot (c_n^{cmp} + c_n^{com})$. We set (13) equals zero and derive

$$(|S_l'|-1)R_l = \sum_{i\in S_l} x_i \sum_{i\in S_l} L_i. \tag{14}$$

Due to the equation (14) is from setting the first derivation equals zero, the strategy x_n is a Nash strategy, namely

$$\sum_{i\in S_l} x_i^{ne} = \frac{(|S_l'|-1)R_l}{\sum_{i\in S_l} L_i}. \tag{15}$$

Combining equation (13), (15) and summing $S_l' \backslash \{n\}$ give

$$\sum_{i\in S_l'\backslash\{n\}} x_i^{ne} = \frac{(|S_l'|-1)^2 R_l L_n}{(\sum_{i\in S_l'} L_i)^2}. \tag{16}$$

For the end device $n \in S_l'$, since $x_i = 0$, $i \in S_l \backslash S_l'$, we have $L_n \sum_{i\in S_l\backslash\{n\}} x_i^{ne} = L_n \sum_{i\in S_l'\backslash\{n\}} x_i^{ne}$. From the equation (5), $R_l > L_n \cdot \sum_{i\in S_l\backslash\{n\}} x_i^{ne}$, then combining the equation (16), we have

$$L_n < \frac{\sum_{i\in S_l'} L_i}{|S_l'|-1}.$$

Furthermore, introducing (16) into equation (5), the end device's strategy become

$$\begin{aligned} x_n^{ne} &= \sqrt{\frac{R_l \cdot \sum_{i\in S_l\backslash\{n\}} x_i}{L_n}} - \sum_{i\in S_l\backslash\{n\}} x_i \\ &= \frac{R_l(|S_l'|-1)}{\sum_{i\in S_l'} L_i} - \frac{L_n R_l(|S_l'|-1)^2}{(\sum_{i\in S_l'} L_i)^2} \\ &= \frac{R_l(|S_l'|-1)}{\sum_{i\in S_l'} L_i}\left(1 - \frac{L_n(|S_l'|-1)}{\sum_{i\in S_l'} L_i}\right) \end{aligned}$$

In summary, the best strategy of end device n is

$$x_n^{ne} = \begin{cases} 0, \quad n \notin S_l' \\ \frac{R_l(|S_l'|-1)}{\sum_{i\in S_l'} L_i}\left(1 - \frac{L_n(|S_l'|-1)}{\sum_{i\in S_l'} L_i}\right), \quad n \in S_l' \end{cases}$$

$\square$