Figure 1: A Chain of Sampling

$f(x)$ $f_{\mathcal{N}}(x)$ $f_{\mathcal{S}}(x)$ $f_k(x)$

$\mathcal{D}$ $\mathcal{D}_{\mathcal{N}}$ $\mathcal{D}_{\mathcal{S}}$ $\mathcal{D}_k$

Join FL Training → Client Sampling → Local Update →

Infinite data   All Clients   Sampled Clients   A Client

x^* $x_{\mathcal{N}}^*$ $x_{\mathcal{S}}^*$ x_k^*

THE IDEAL WORLD

$\mathbb{E}[f_{\mathcal{N}}(x)] = f(x)$ $\mathbb{E}[f_{\mathcal{S}}(x)] = f_{\mathcal{N}}(x)$ $\mathbb{E}[f_k(x)] = f_{\mathcal{S}}(x)$

$\mathbb{V}[f_{\mathcal{N}}(x) - f(x)] = \sigma_{\mathcal{N}}^2$ $\mathbb{V}[f_{\mathcal{S}}(x) - f_{\mathcal{N}}(x)] = \sigma_{\mathcal{S}}^2$ $\mathbb{V}[f_k(x) - f_{\mathcal{S}}(x)] = \sigma_k^2$

Figure 2: A Gap from $x_{\mathcal{S}}^*$ to $x_{\mathcal{N}}^*$

Client Drift

$$x^* \neq x_{\mathcal{N}}^* \neq x_{\mathcal{S}}^* \neq \bar{x} = \frac{1}{|\mathcal{S}|} \sum x_k^* \neq x_k^*$$

Period Drift