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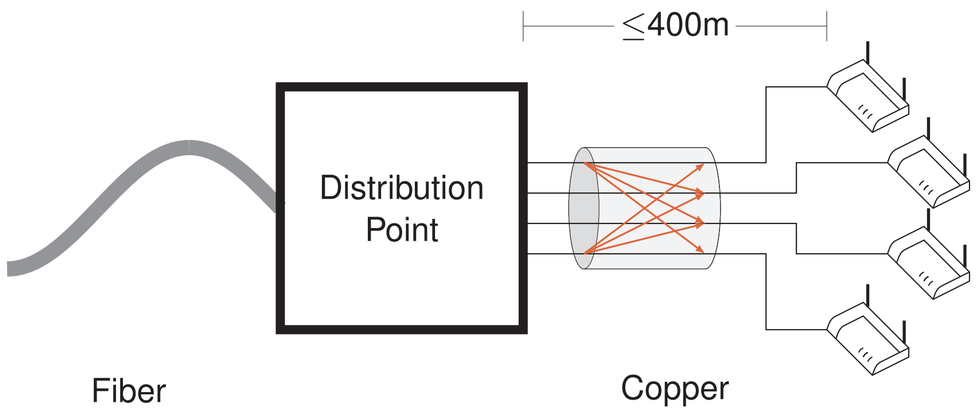
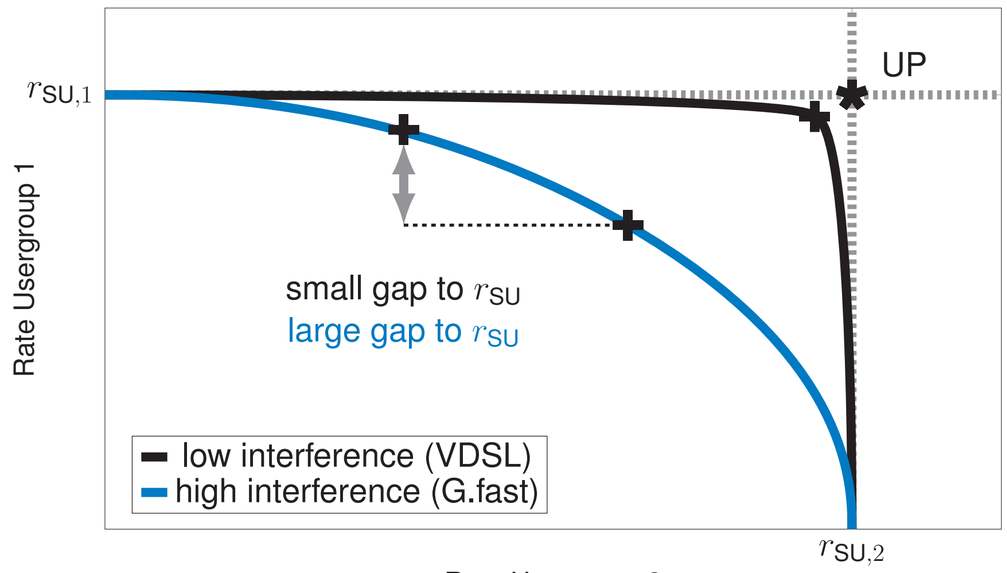
Precoding for Enhanced User Experience in G.fast DSL[1]

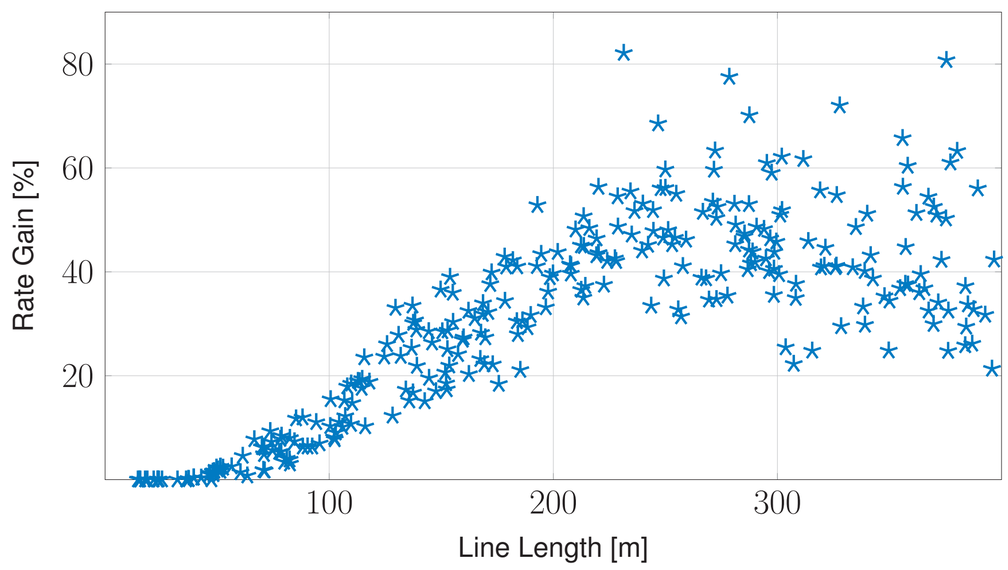


Frequencies up to $212\,\text{MHz} \Rightarrow$ Intereference increases significantly

$$\begin{aligned} &\max_{\boldsymbol{T}} \; f(\boldsymbol{T}) \\ \text{s.t: } &\operatorname{diag}\left(\boldsymbol{T}^{(n)}\boldsymbol{T}^{(n),\mathrm{H}}\right) \leq \boldsymbol{p}_{\mathsf{mask}}^{(n)} \quad \forall n \\ &\sum_{n=1}^{N} \operatorname{diag}\left(\boldsymbol{T}^{(n)}\boldsymbol{T}^{(n),\mathrm{H}}\right) \leq \boldsymbol{p}_{\mathsf{sum}} \\ &\boldsymbol{r}^{(n)} \leq \boldsymbol{p}_{\mathsf{bmax}}^{(n)} \quad \forall n \end{aligned}$$

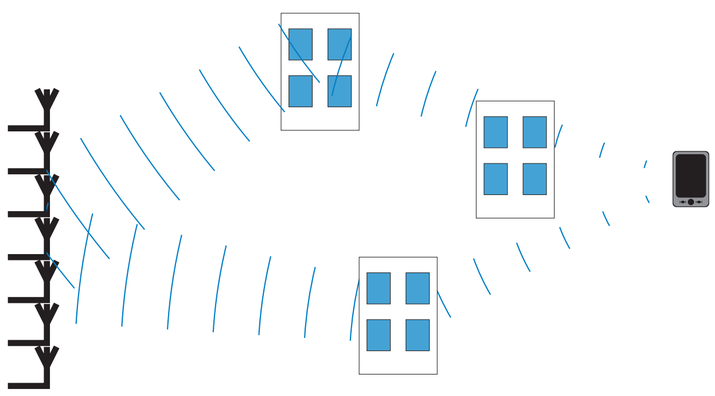
NEW: Objective should be chosen according to the user demands!





[1] In cooperation with Intel Connected Home Division

CSI Acquisition based on Machine Learning - Leveraging Massiveness in 5G Systems[2]

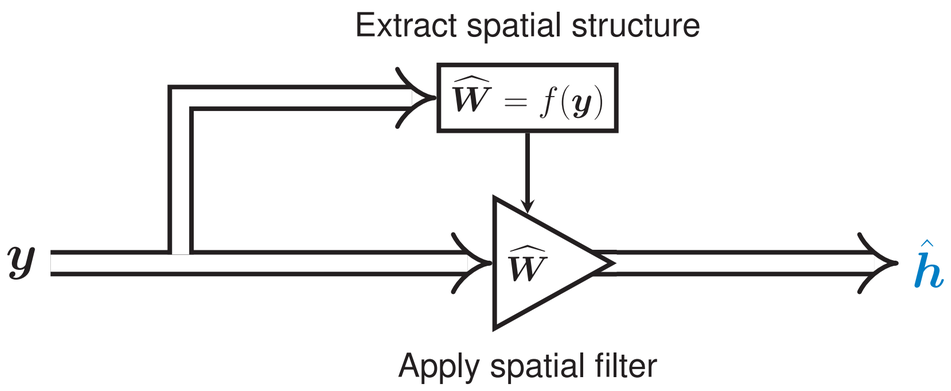


$$\boldsymbol{y} = \boldsymbol{h} + \boldsymbol{z}$$

We want to exploit structure of the channel to reduce the noise in the observation $\boldsymbol{y}$.

Problem: The channel structure is unknown!

Optimal Estimator for unknown structure



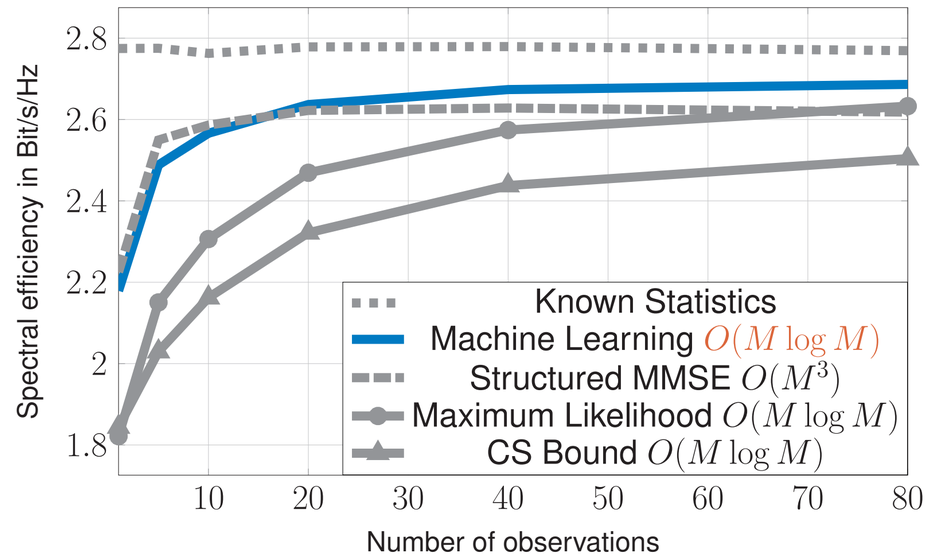
$$\widehat{\boldsymbol{W}}(\boldsymbol{y}) = \frac{\mathrm{E}_{\boldsymbol{\delta}}\left[\exp\left(\frac{T}{\sigma^2}\boldsymbol{y}^{\mathrm{H}}\boldsymbol{W}_{\boldsymbol{\delta}}\boldsymbol{y} + T\log|\boldsymbol{I} - \boldsymbol{W}_{\boldsymbol{\delta}}|\right)\boldsymbol{W}_{\boldsymbol{\delta}}\right]}{\mathrm{E}_{\boldsymbol{\delta}}\left[\exp\left(\frac{T}{\sigma^2}\boldsymbol{y}^{\mathrm{H}}\boldsymbol{W}_{\boldsymbol{\delta}}\boldsymbol{y}\right) + T\log|\boldsymbol{I} - \boldsymbol{W}_{\boldsymbol{\delta}}|\right)}$$

The function that extracts the spatial structure is complex and depends on the physical channel model (distribution of hyperparameters $\boldsymbol{\delta}$)

To get an accurate $O(M \log M)$ approximation of $\widehat{\boldsymbol{W}}$ we

- exploit properties of the array geometry
- apply machine learning in the form of neural networks

Results for the 3GPP spatial channel model



[2] Funded by the DFG