Experimental Evaluation of Intersymbol Interference in Non-Far Region Transmission using 30-GHz Band Large Array Antennas

T. Ruckkwaen *, K. Araki, T. Tomura, J. Hirokawa, and M. Ando
Dept. of Electrical and Electronic Engineering, Tokyo Institute of Technology

The adoption of large array antennas for non-far region transmission has been investigated and the intersymbol interference (ISI) issue was identified (M. Zhang, K. Araki, J. Hirokawa, and M. Ando, IEEE Trans., vol. 63, no. 8, pp. 3432-3440, Aug. 2015.). The knowledge of ISI for the transmission distances is of interest. The direct measurement of ISI is, however, difficult. Incidentally, ISI can be obtained via S21. In this case, the full simulation of S21 at such large antenna size and high frequency is not feasible due to memory constraint. In addition, the direct measurement of S21 is troublesome and time-consuming because of cable length limitation and alignment problem. We propose the estimation of ISI, from near-field aperture distribution.

The ISI issue for this scenario is attributable to the time delay difference of symbol traveling from each antenna slot. The problem is severe as the antenna size becomes larger and transmission distance is closer. Furthermore, the uniformity of the antenna excitation significantly affects the ISI level. In this paper, we measure a prototype of a 64x32-slot array antenna using the near-field measurement system. Based on the near-field aperture distribution, S21, as well as ISI, can be estimated as the functions of transmission distance.

Figure 1(a) demonstrates the problem configuration and Figure 1(b) shows the ISI results calculated using two methods:1) near-field aperture distribution (red-line), 2) directly measured S21 (black-dot) in an anechoic chamber. The ISI level from the two methods is acceptable. However, the deviation from the proposed method (red-line) is mainly caused by the misalignment between the antenna and a receiving probe. This is bound by the misalignment boundary (blue-line) which is calculated assuming that probe is equivalently shifted ±3 cm horizontally and ±1 cm vertically from the center of the array. The green-line shows the ISI for the ideally uniform excitation. The comparison between the red-line and the green-line indicates the effect of uniformity of the antenna excitation.

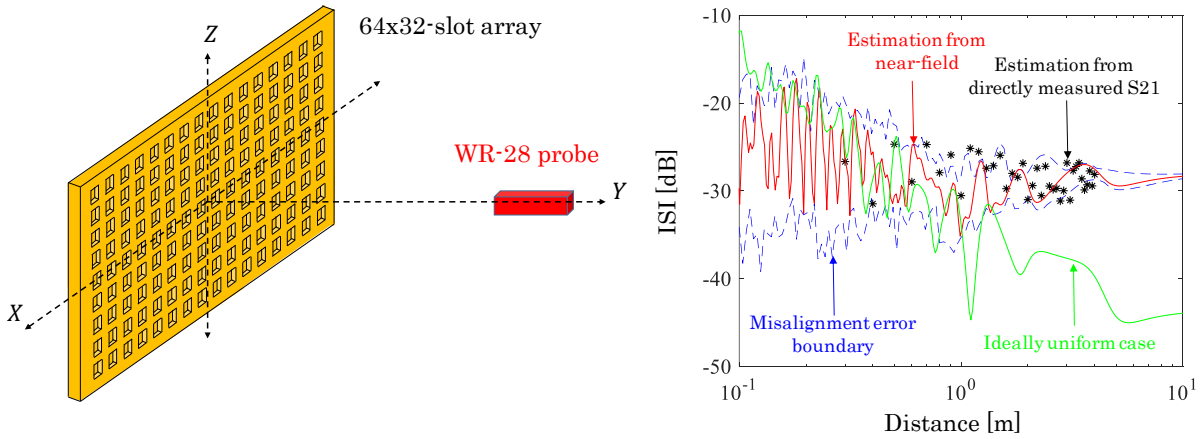

Figure 1 (a) Array antenna and receiving probe configuration (b) ISI results for various cases