May 1998 doc.: IEEE 802.11-98/192r1

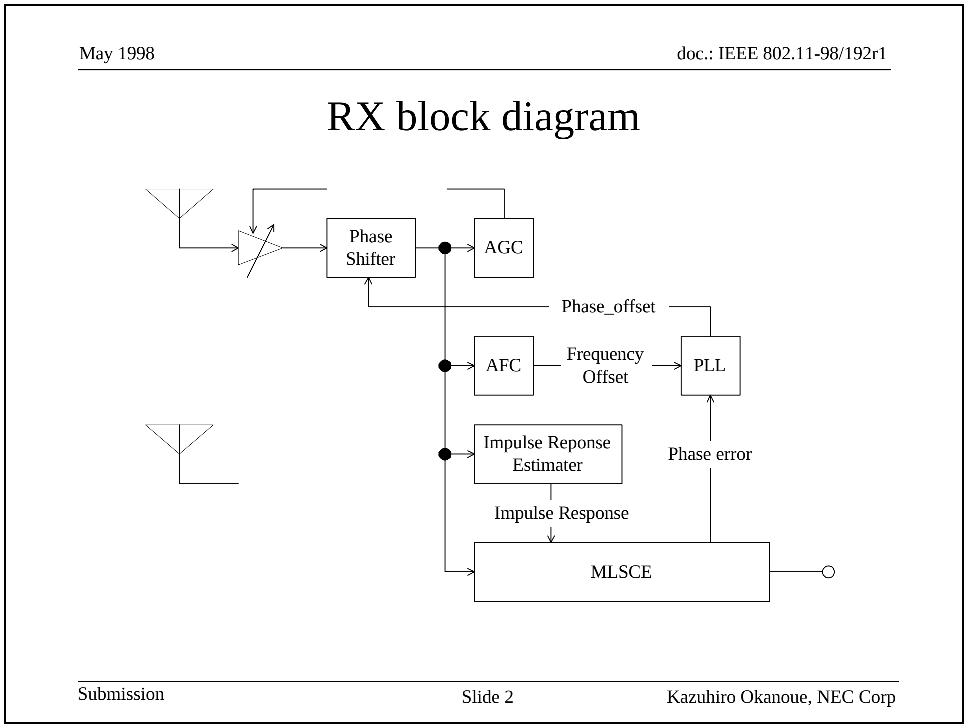
O-QPSK Implementation Considerations

May, 4 1998
Kazuhiro OKANOUE
NEC Corp.

Submission Slide 1 Kazuhiro Okanoue, NEC Corp

Abstract

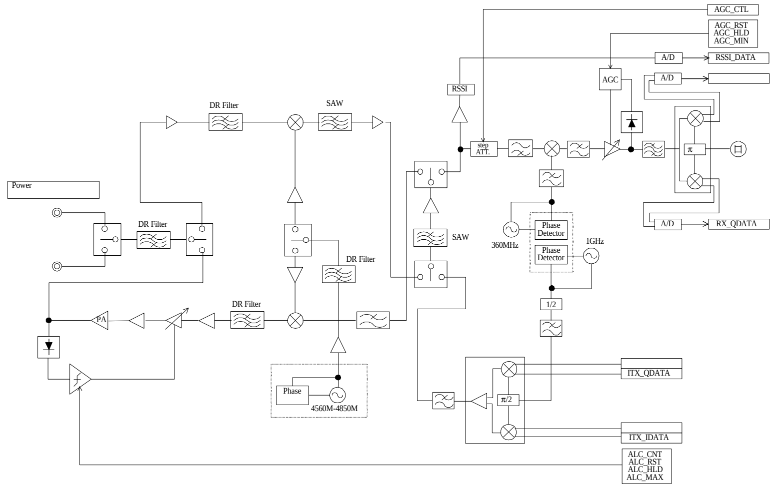
This document mainly describes implementation of O-QPSK modulation scheme proposed to TGa. This document includes 1) tentative system architecture, including RF chain, 2) required A/D converter accuracy, 3) CCA mechanism, 4) equalizer structure, 5) carrier loop structure and 6) equalizer initialization. The contents in the document are only one of the examples for implementation and will not be included into standardization documents.



This slide shows a tentative receiver architecture. A diversity reception is an optional. First of all, received signals are fed into an AGC system and adjusted their input level. Then a frequency offset in the received signals is estimated by an AFC system. A PLL uses the estimated offset value from the AFC as its initial value. The estimated offset is also fed into a phase shifter to cancel frequency offset in the received signal. Then impulse response estimator estimates channel impulse response vector and supplies the estimated vector to an anti-multipath scheme such as an equalizer. The anti-multipath scheme outputs decision results and error signals to the PLL to adaptively cancel frequency offset in the received signals.

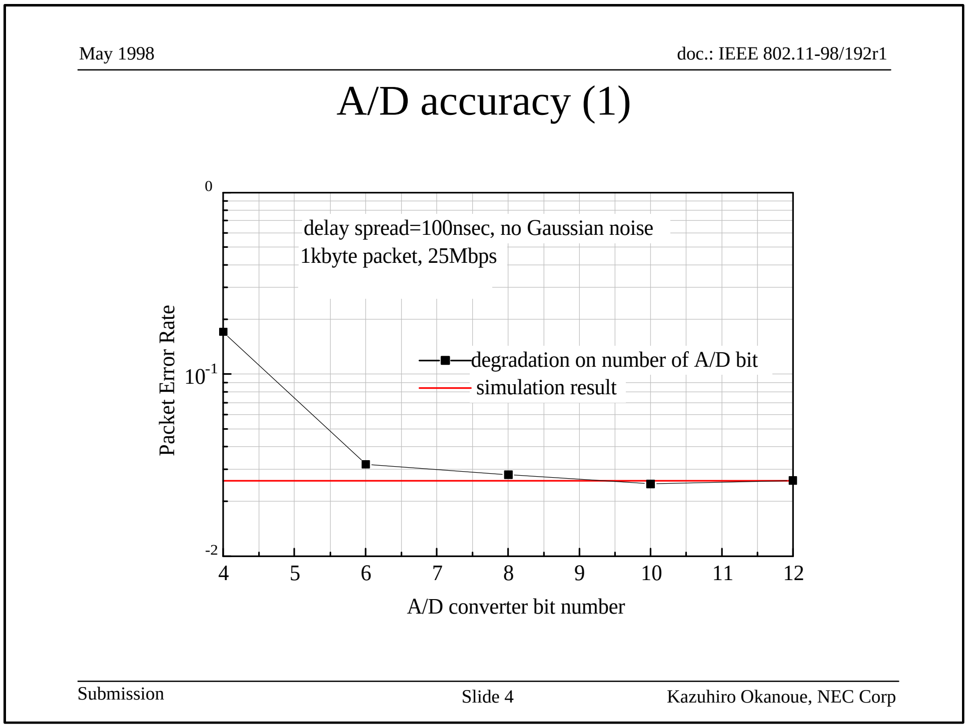
May 1998 doc.: IEEE 802.11-98/192r1

RF/IF chain for O-QPSK

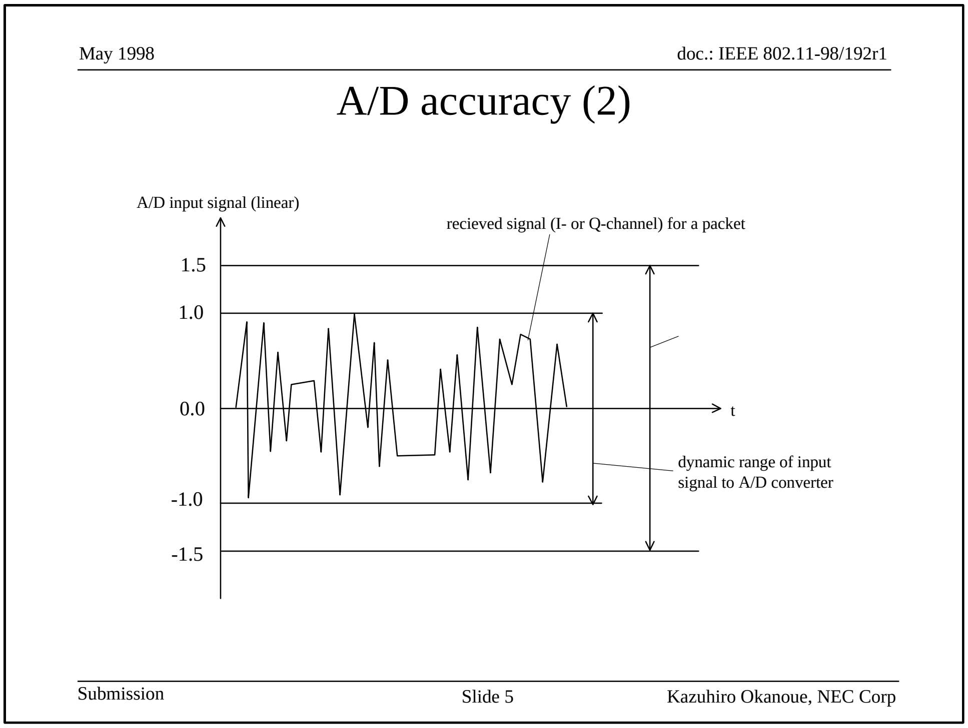


Submission Slide 3 Kazuhiro Okanoue, NEC Corp

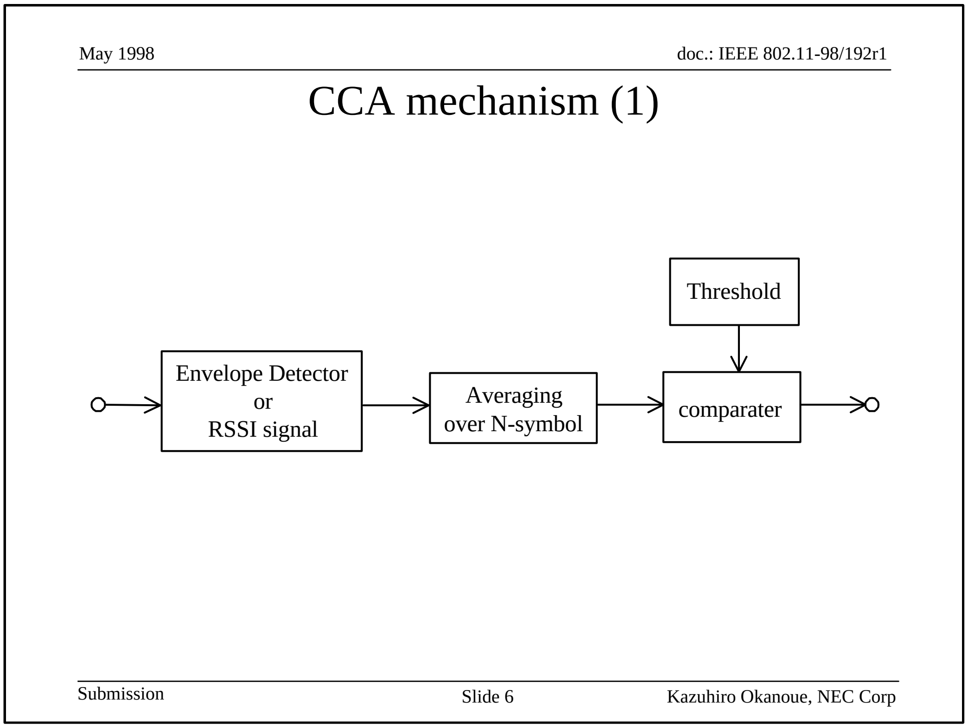
This slide shows an example implementation of RF/IF chain for O-QPSK.



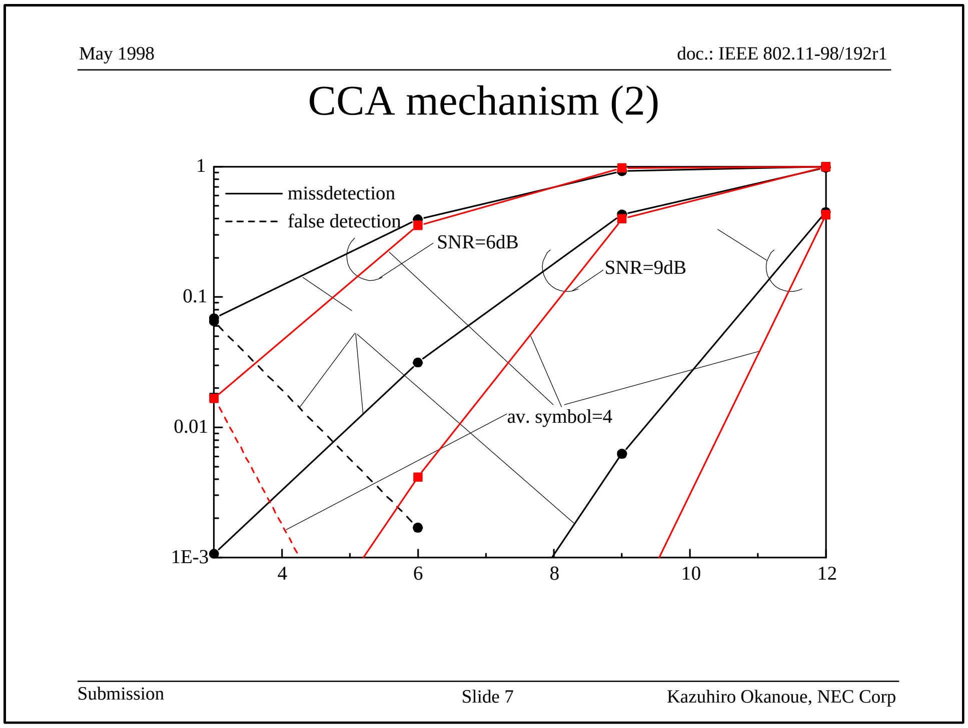
This slide shows a packet error rate (PER) performance vs A/D accuracy in an environment of 100nsec delay spread. This figure indicates that A/D accuracy of 8-bit slightly degrades PER and the degradation seems to be negligible.



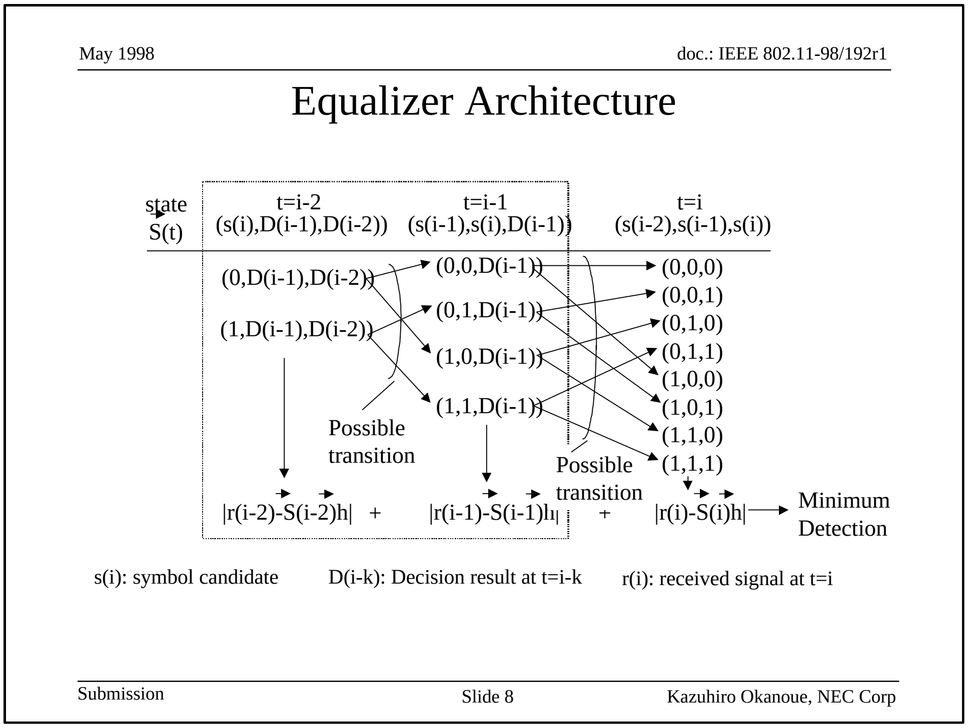
In the simulation, I assumed a dynamic range of input signal level as +/- 1.0 and a dynamic range of A/D converter as +/- 1.5, as shown in this slide.



As a CCA detection mechanism, we propose to adopt envelope or RSSI signal detection mechanism as shown in this slide. When an averaged envelope level of received signals gets over the threshold level, the CCA detector detects that the medium is busy.



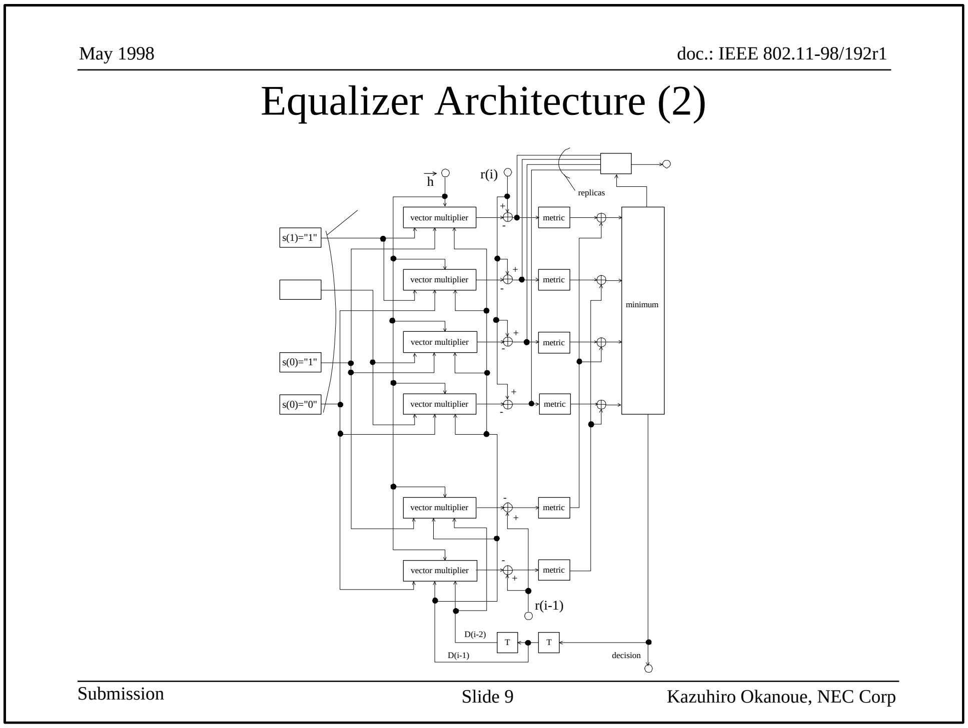
This slide shows performances of the CCA detection mechanism in AWGN channel. In this figure, we assumed to use envelope detector. The graph shows both misdetection and false detection error rates. The misdetection error rate is a probability which a receiver can not detect signals even if the receiver receives signals. The false error rate is a probability which a receiver detects noise as a signal. From the figure, the false error rate can be negligible by setting CCA threshold about 6db higher than noise level. The misdetection rate depends on receiver sensitivity and the number of averaging symbols. Though each vendor can choose the appropriate values for his implementation, it is one suggestion to use 4 symbol duration for averaging and threshold 6dB higher than noise level.



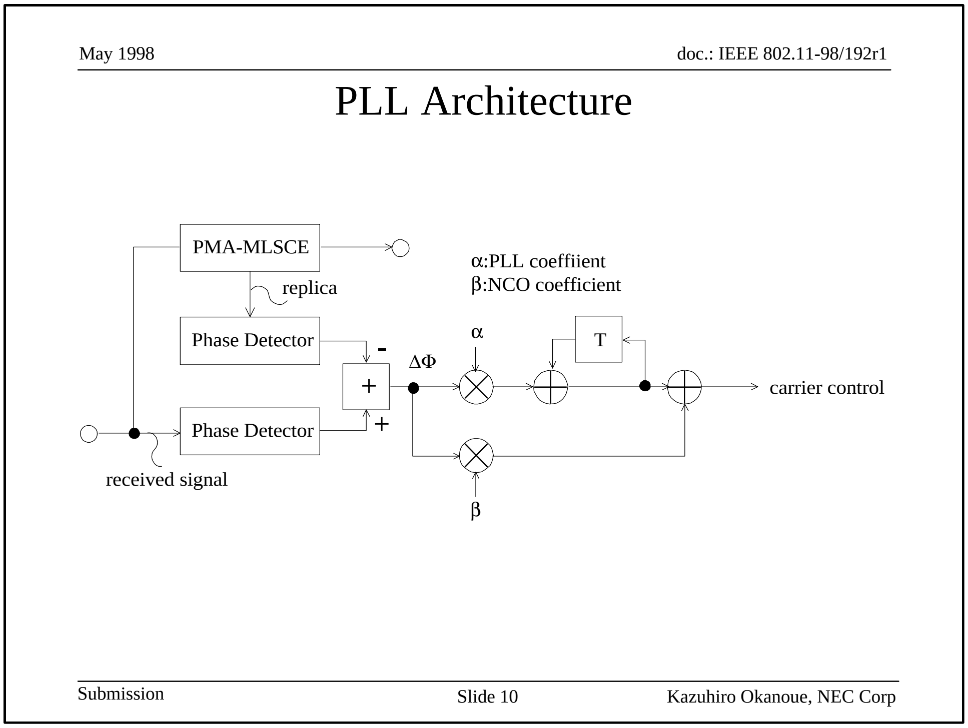
This slide shows an example of state transition for the 3tap PMA-MLSCE to estimate s(i) transmitted symbol at t=i. It is assumed that a transmitted symbol is binary, the length of a channel impulse response is 3 and the current time is i. In this example, the PMA-MLSCE defines three state vectors S(t) for t=i, i-1 and i-2 which are consisted from symbol candidates s(i)'s and/or decision results D(i)s. Because D(i)s are deterministic, each state vector can take only 2^m values where m is the number of symbol candidates in a vector. Then transitions between the state vectors can be defined as shown in the figure.

The PMA-MLSCE calculates metric, for all possible state vector values. The calculated metric are summed up along the transitions as a combined metric. The PMA-MLSCE selects a transition which presents the minimum combined metric and outputs the s(i) in the transition as a estimated results.

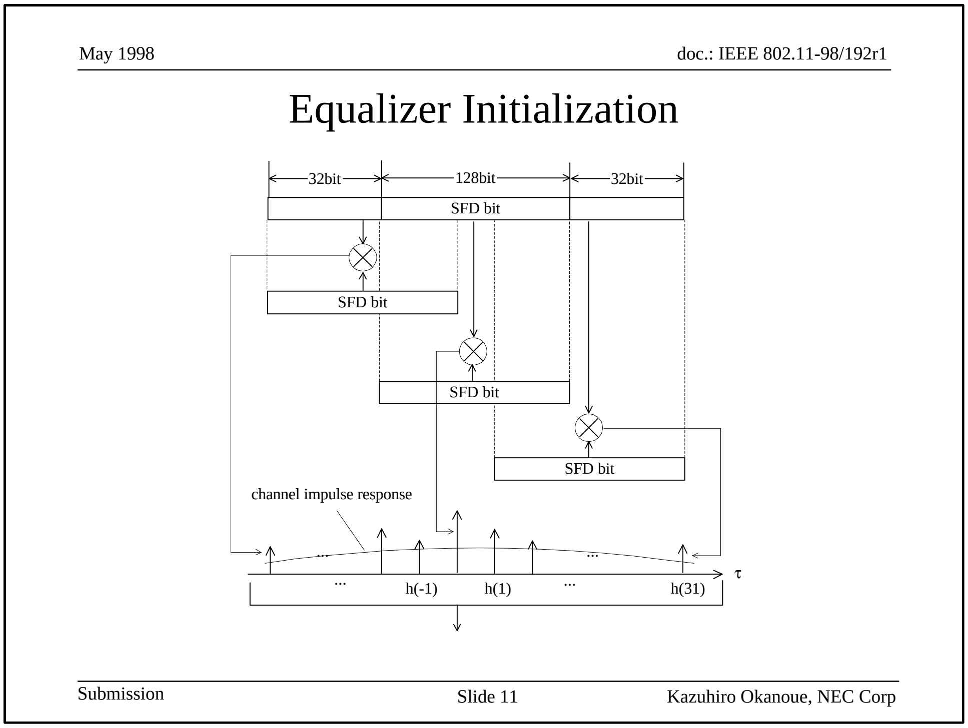
In order to reduce complexity of implementation, it is possible for the PMA-MLSCE to implement the part surrounded by the dotted line. In this case, the PMA-MLSCE uses two candidate symbols and one decision result to detect s(i). We denote the reduced PMA-MLSCE as n-m PMA-MLSCE, where n and m are tap number fed candidate symbols and decision results, respectively. Based on the notation, the part surrounded by the dotted line can be expressed as 2-1 PMA-MLSCE.



The implementation example of 2-1 PMA-MLSCE for O-QPSK is demonstrated in this slide. The vector multipliers produce replica for all possible states. The vector multipliers can be implemented without any multipliers, because input signals, s(1), s(0), D(i-1) and D(i-2) are +1 or -1. After summing up the metrics along the state transition described in the previous slide, the summation corresponding to each state transition are fed to the minimum detector. The minimum detector detects the minimum value all the input signal and outputs the decision results. Moreover, the minimum detector controls the selector so as to output a replica which minimizes the metric.



In order to obtain stable carrier, we use 2^{nd} order PLL by using PMA-MLSCE output and received signal. The PMA-MLSCE calculates replica of received signals. A phase difference between received signal and a replica which produces minimum metric is input to the 2^{nd} order PLL. The PLL output controls carrier frequency and phase.



The MLSCE requires only channel impulse response for its initialization. In order to estimate channel impulse response, a correlation technique between received signal and known preamble sequence can be available as shown in this slide.