High Tech Research and Development Services at Low Cost

1. Our R&D Resources

 - Central Research Institute of Merchant Marine, St. Petersburg, Russia
 - Marine Navigation System, St. Petersburg, Russia
 - Marine Complex and Systems, St. Petersburg, Russia
 - State Electrotechnical University of St. Petersburg, Saint Petersburg, Russia
 - Saint-Petersburg State Polytechnical University
 - Saint-Petersburg State University of Aerospace Instrumentation, Saint Petersburg, Russia
 - Saint-Petersburg State University of Telecommunications, Saint Petersburg, Russia
 - Independent Experts from Canada, France, Israel, Russia, New Zealand, Norway, UK, Ukraine, USA

2. Our Customers

We could present an extensive list of our customers, however it is our policy to keep their names commercially confidential. We are sure you appreciate that this is an important condition of preserving our customer's interests in a very competitive world. As an indication of our customers' geography, we can say that they are based in Australia, Japan, Germany, Norway, Russia, UK, USA.

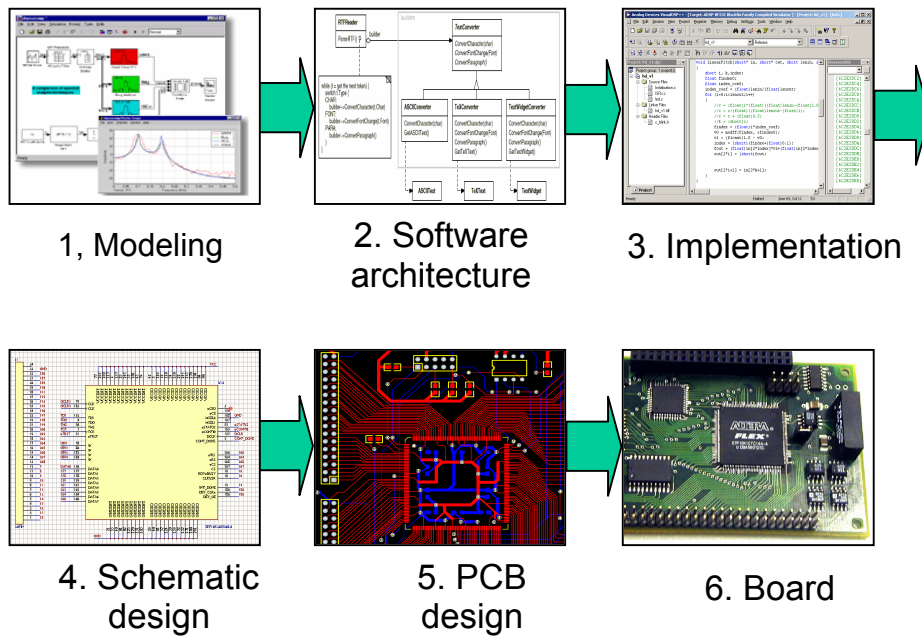## 3. Examples of completed R&D Projects (in Communication Area)

 - Audio Signal Recognition, Recording and Analysing System
 - BER Tester and Performance Analyser for Synchronous and Asynchronies Channels
 - Communication Complex for Data Transfer over High Impaired Channels with Long Delay
 - Data Traffic Monitoring System for Satellite Channels
 - Digital Selective Calling System for GMDSS radios
 - DSP based GMSK Modem for VHF communications
 - DSP DAC-ADC Satellite Channel – PSTN interface
 - PC based Digital Selective Calling and Data Transmission System (HF/VHF) with Navtex and Weather Map facilities (design and serial production)
 - PC based HF data communication System operating in accordance with CIRM 476 и 625 (ARQ, FEC)
 - PC Based Modem for PSTN
 - Navigation Warning Transmitting System
 - SatModem File Transfer Protocol
 - Weather Map transmission System for Maritime Mobile Service
 - Microprocessor based low level VHF signal detector.

The intellectual property rights for the listed project were either transferred to our customers or retained by us, in the cases when the projects were developed without external financing. In these cases the products are available both for sale or licensing.

4.R&D Project Development Chart

Customer	®	R&D Project Definition, Draft Specification / Statement of Work
SEDAM Communications Ltd	®	R&D Resources Allocation: Selection of the Project Leader, R&D Team formation
SEDAM Communications Ltd Customer R&D Team	®	Specification / Statement of Work Clarification
SEDAM Communications Ltd R&D Team	®	R&D Project Planning (Gantt Chart)
SEDAM Communications Ltd Customer R&D Team	®	R&D Project Schedule Clarification and Approval
Customer (to SEDAM Communications Ltd)	®	PO Phase One*
SEDAM Communications Ltd R&D Team	®	Project Phase One, Report, Invoice to Customer
Customer	®	Report Acceptance, Payment Phase One, PO Project Phase Two
SEDAM Communications Ltd R&D Team	®	Project Phase Two, Report, Invoice to Customer
Customer	®	Report Acceptance, Payment Phase Two

*   The two-phase approach proved to be a popular option for our new customers as they have an opportunity to asses the level of service provided before making the decision of proceeding with the final stages of the project. Phase One normally includes, theory of operation, mathematical modelling, performance prediction, design of the algorithms, hardware requirements, i.e. the first and part of the second boxes as presented in the chart below. Phase One usually costs about 25% of the total project cost.

1, Modeling

2. Software architecture

3. Implementation

4. Schematic design

5. PCB design

6. Board

5. Key Advantages of Our Approach to R&D

- Our specialists in Microelectronics, Information technology have long-term experience of working together on R&D projects for western customers.
- Affiliation with leading Academic and Research establishments provides for expertise in any area of natural science and engineering: Mathematics, Communications, Navigation etc.
- A substantial pool of R&D development resources allows the selection of the right project leader and the forming of a strong project development team.
- Each project is carefully planned and separate tasks are clearly defined.
- Manpower are allocated to the specific tasks in accordance with required time and skills. This approach results in unbeatable low average development costs and timely delivery of the results.
- Project price is calculated on the basis of a Gantt Chart schedule agreed between customer and SEDAM Communications Ltd.
- Current rate is 15US$/hour and valid for R&D Projects ordered by 01/01/2009.
- All communication and correspondence is in English.

6. Component and OS Base

We can design complex electronic systems based on a variety of microprocessors and using different operating systems. However, we would like to emphasise our experience in fast, low-cost, power-efficient ARM processors and Embedded Linux Operating System.

7. Project Development Example (PC Based Modem for PSTN)
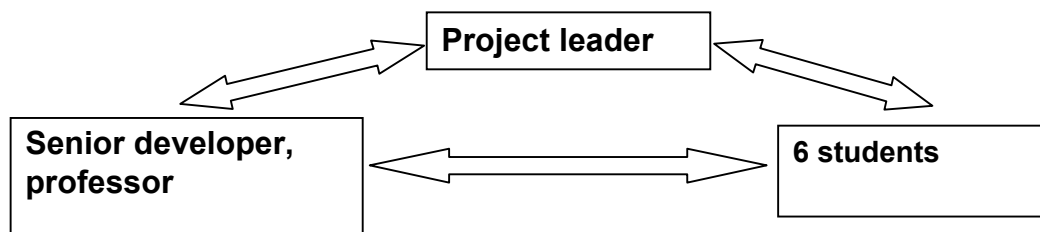
7.1 Project Definition

7.2 Customer's Statement of Work

 - Create PSTN modem PCM part software model
 - Investigate the model performance
 - Research and design of enhanced model with improved performance
 - Develop enhanced modem algorithms and software

Major PSTN line problems to be investigated and taken into account during all stages of R&D project (as per customer request):

 - Attenuation, loss
 - Group delay distortion
 - Noise
 - Frequency offset

7.3 R&D Project Leader Selection, R&D Team formation

```
                          ┌──────────────────┐
                          │  Project leader  │
                          └──────────────────┘
        ┌──────────────────────┐      ┌──────────────┐
        │ Senior developer,    │ ───  │  6 students  │
        │ professor            │      │              │
        └──────────────────────┘      └──────────────┘
```

Hardware resources - 9 PC for modeling and code development

Special software

MatLab Simulink Tool
— **Analog and discrete systems modeling**
— **C++ integration**
— **Development process visualisation**
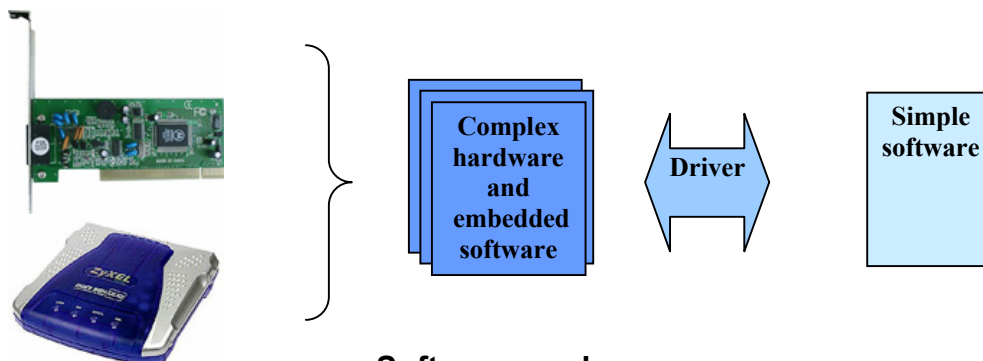— **DSP libraries**

Visual C++
— **Object-oriented language programming C++**
— **MFC**
— **Much C++ freeware examples**
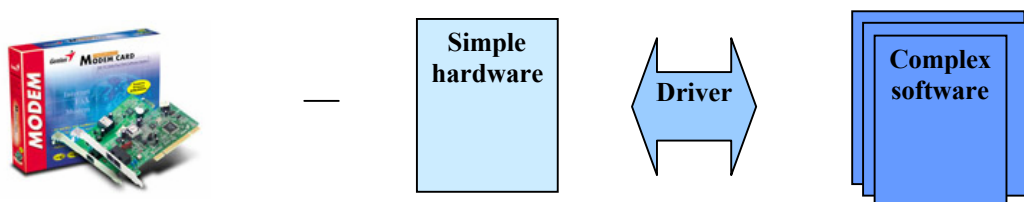
7.4 Specification / Statement of Work Clarification

(Sections I and II below are provided for clarification of the subject of a specific R&D Project
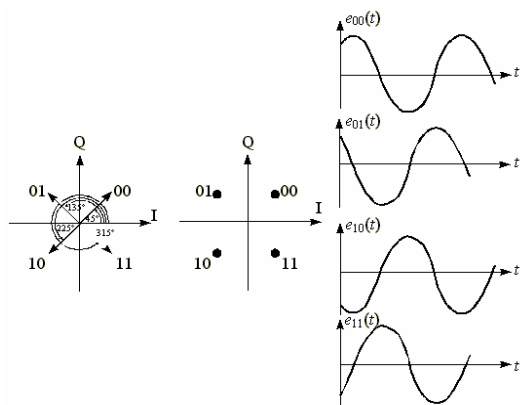
I,   Modem types

Hardware modem

| Complex hardware and embedded software | Driver | Simple software |

Software-modem

| Simple hardware | Driver | Complex software |

II.   Transmitted data types

QAM
Quadrature amplitude modulation

PCM
Pulse code modulation
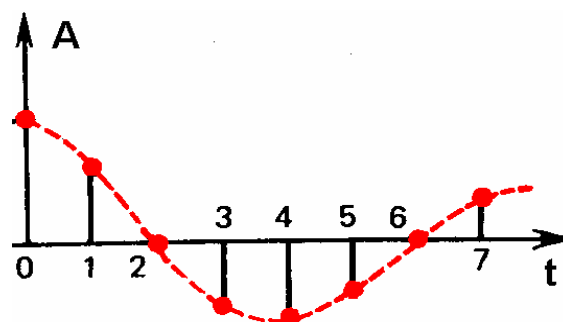
Symbol is coded as amplitude and phase   **Symbol is coded as amplitude**

7.5 Approved Project Schedule

Project duration – 3 months

7.6 Project Milestones

Development of different R&D Project tasks is conducted in parallel under coordination of the Project Leader. Examples of Tasks Are Provided below.
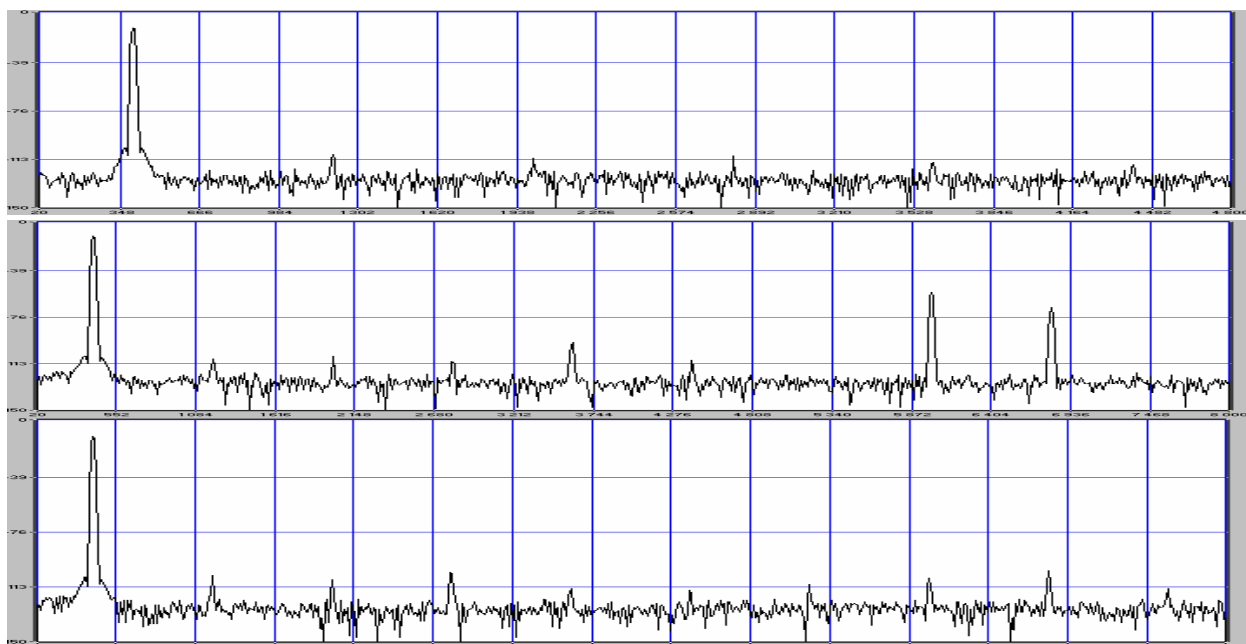
7.6.1. Phone Line Modeling In Simulink
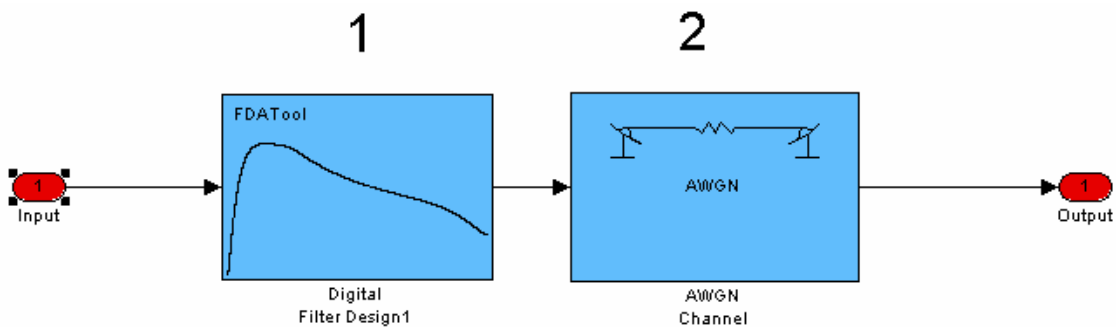
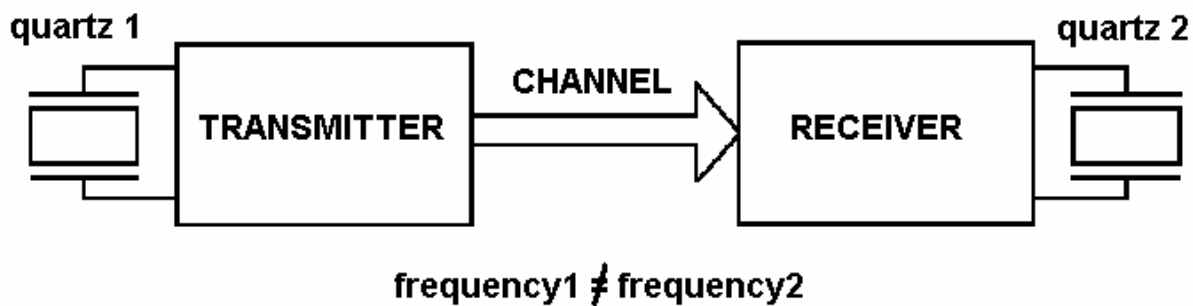**1** – Filter for inter-symbol interference modeling
2 – Gauss noise generator

7.6.2. Interpolation

- Change frequency for 9600 Hz to 16000 Hz
- Rejection bad frequency components

7.6.2a. Interpolator Testing

7.6.3. Phase Locking
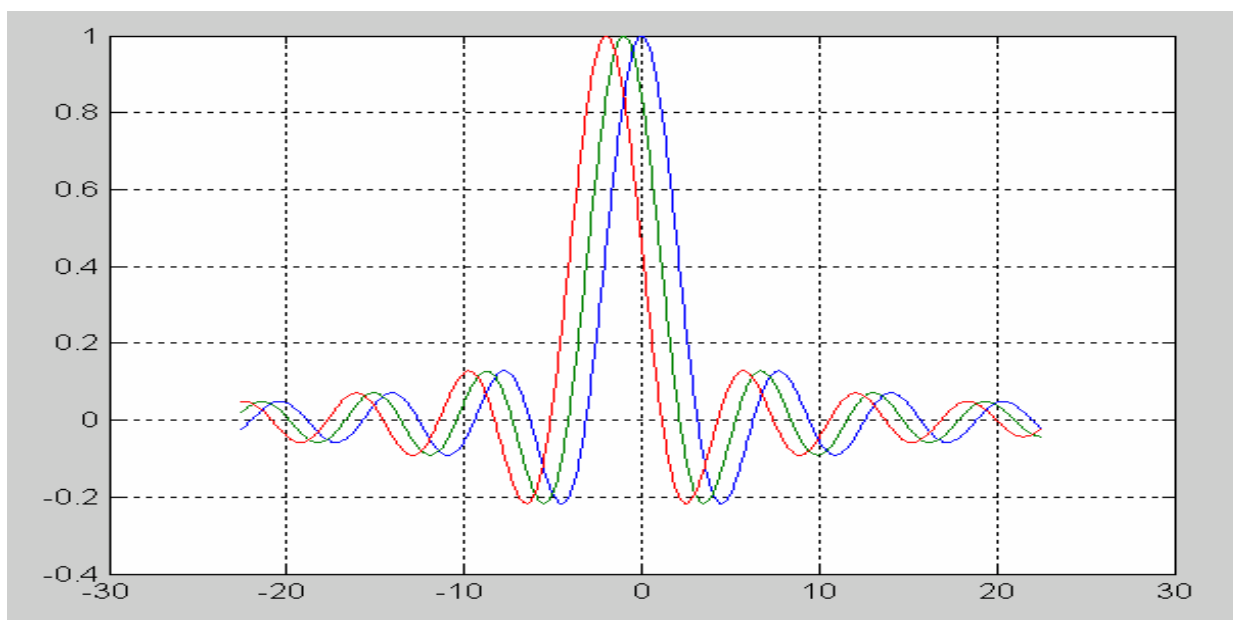

quartz 1 TRANSMITTER CHANNEL RECEIVER quartz 2

frequency1 ≠ frequency2

Increase in time shifting reduces input sample loss

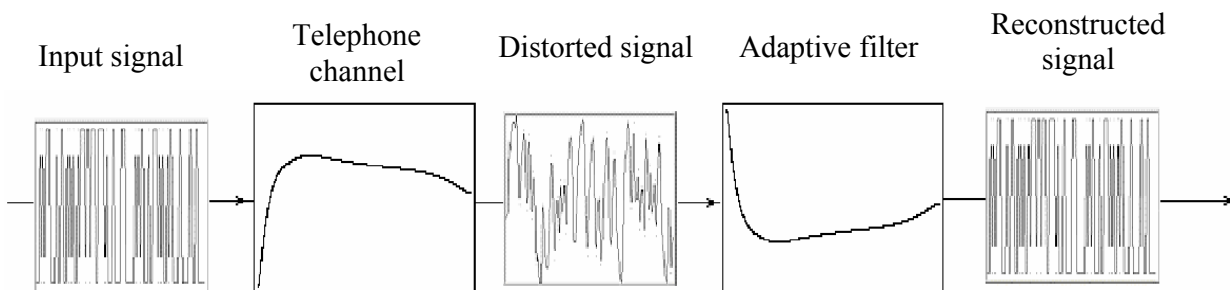Equations for compensation of time shifting:

$$e_k = d \cdot \sum_{i=0}^{W} \frac{e_{k-i}}{b_{k-i-1}} \qquad\qquad t_{k+1} = t_k + a \cdot e_k$$
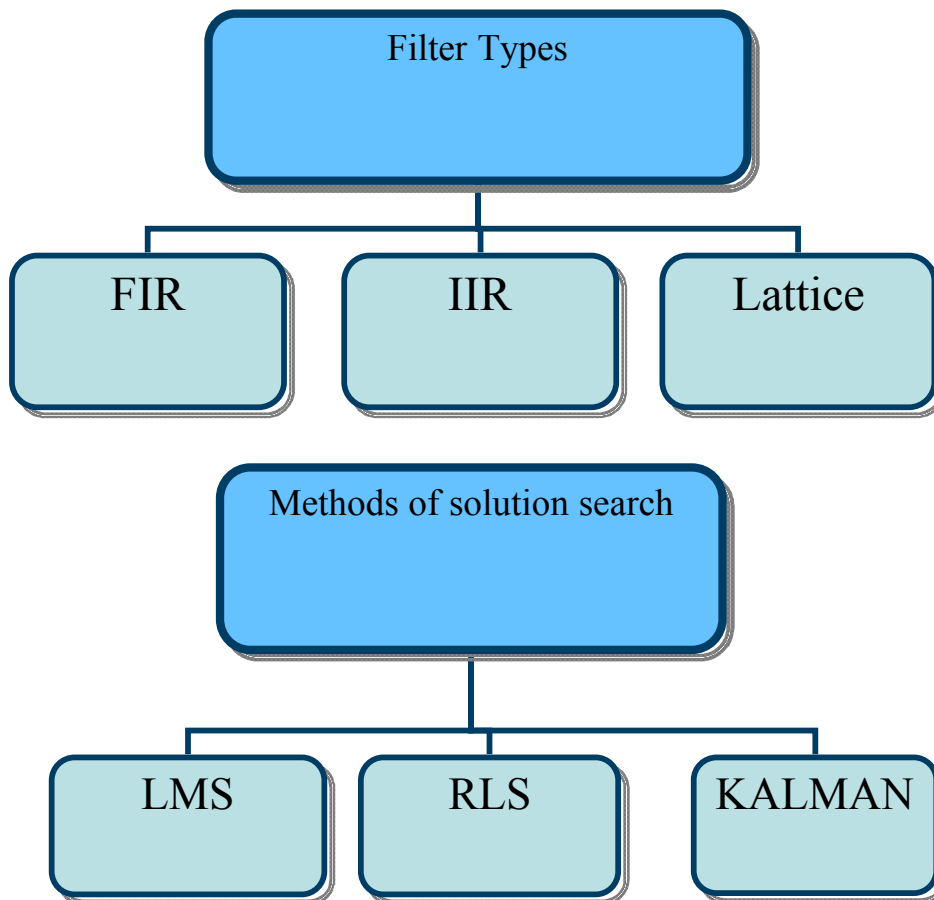
7.6.3a. Low Pass Filters for Phase Locking

$$y_n = \sum_{k=0}^{N} \frac{\sin(k - shift)}{k - shift} \cdot x_{n-k} \cdot Win(k - shift)$$
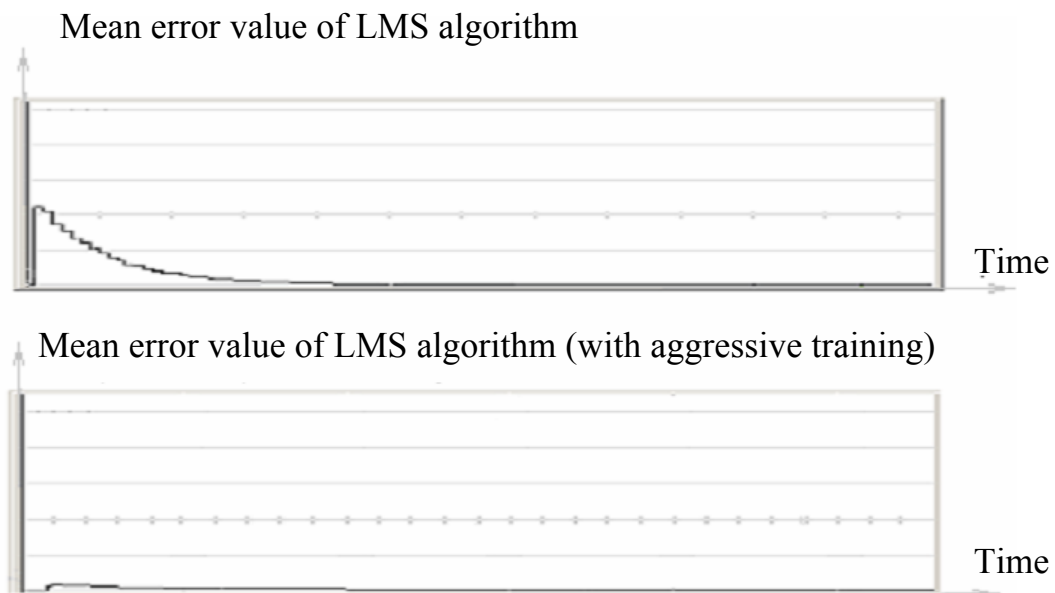
7.6.4. Compensation of Inter-symbol Interference

Input signal	Telephone channel	Distorted signal	Adaptive filter	Reconstructed signal

7.6.4a. Adaptive Equalizing Methods

Filter Types

FIR   IIR   Lattice

Methods of solution search

LMS   RLS   KALMAN

7.6.5. LMS Algorithm with Aggressive Training

Mean error value of LMS algorithm

Time

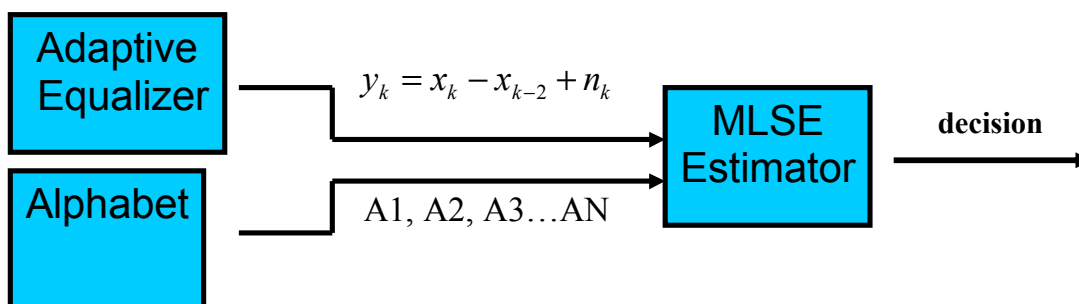Mean error value of LMS algorithm (with aggressive training)

Time

7.6.6. MLSE module
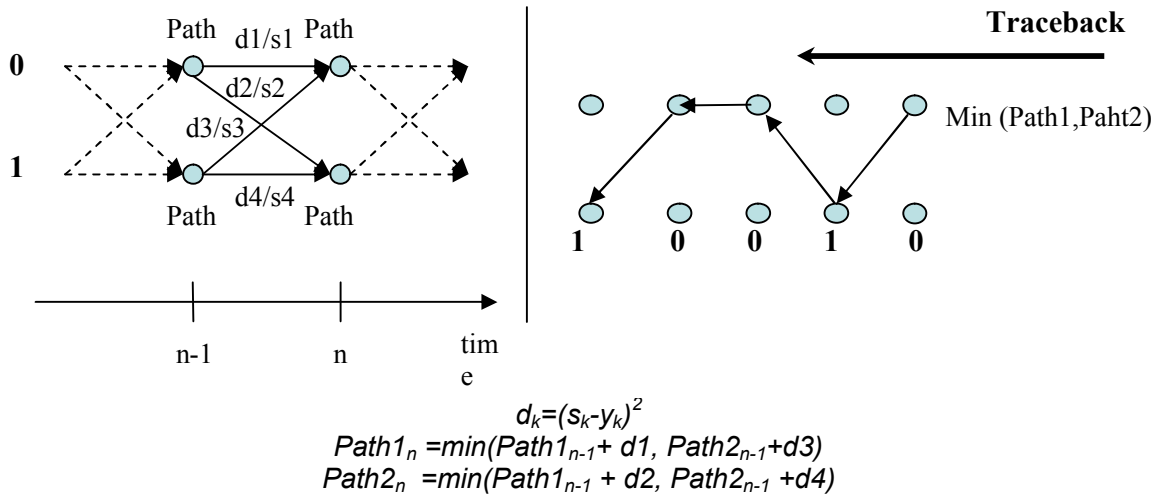
Definition: MLSE – Maximum Likelihood Sequence Estimator

MLSE estimator features

- 1-D^2 inverse transformation
- Dynamic alphabet size
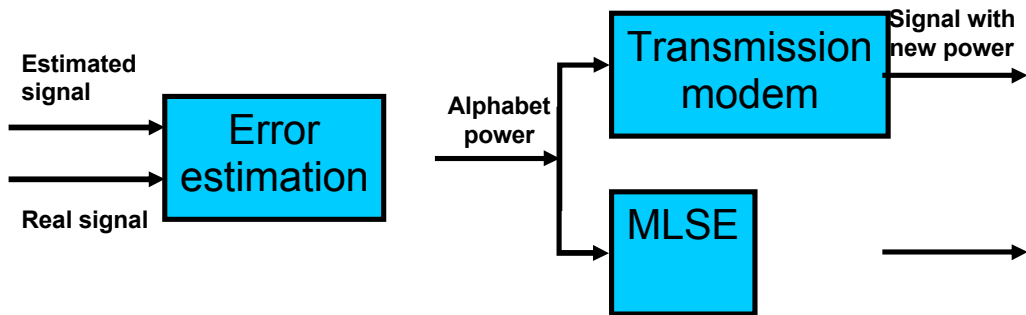- Dynamic backtracking size
- Noise reduction

Adaptive Equalizer

Alphabet

$y_k = x_k - x_{k-2} + n_k$

A1, A2, A3…AN

MLSE Estimator

decision

7.6.6a. MLSE basic principals

Viterbi decoder algorithm

$$d_k=(s_k-y_k)^2$$
$$Path1_n =min(Path1_{n-1}+ d1, Path2_{n-1}+d3)$$
$$Path2_n =min(Path1_{n-1} + d2, Path2_{n-1} +d4)$$
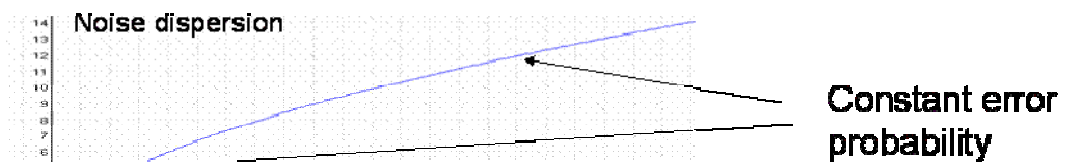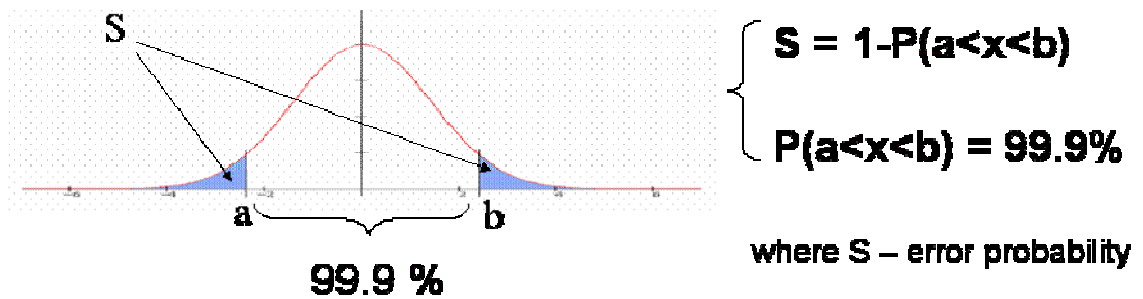
7.6.7. Channel characteristics estimation module

Error estimation features

- Noise power estimation
- Alphabet power design
- Bit rate = 8000*(alphabet power)

7.6.7a. Channel characteristics estimation

Noise distribution in telephone channel

$$S = 1-P(a<x<b)$$

$$P(a<x<b) = 99.9\%$$

where S – error probability

99.9 %

Noise dispersion

Constant error probability

7.7. Report Acceptance (Main Results of R&D Project)

 - Research and development of telephone line model in Simulink
 - Development of sample frequency interpolator
 - Development of phase lock algorithm
 - Research and development of adaptive equalizer with LMS algorithm and aggressive training
 - Development of MLSE algorithm
 - Development algorithm of power alphabet estimation
 - Research and development of PCM-receiver complex model

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