Indian Institute of Technology Kanpur
National Programme on Technology Enhanced Learning (NPTEL)
Course Title
Error Control Coding: An Introduction to Convolution Codes

Lecture – 10A
Application of convolution codes

by
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Welcome to the course on error control coding an introduction to convolutional codes today we are going to discuss some of the applications of convolutional.

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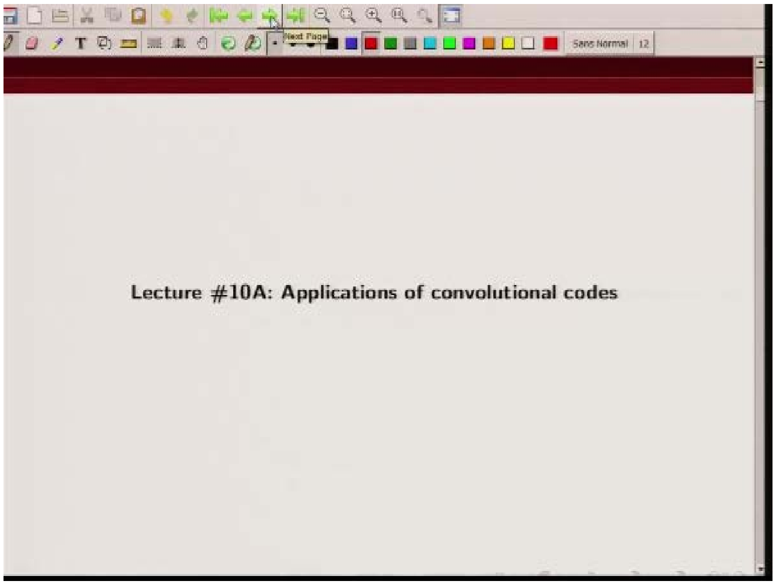

Codes and practice.

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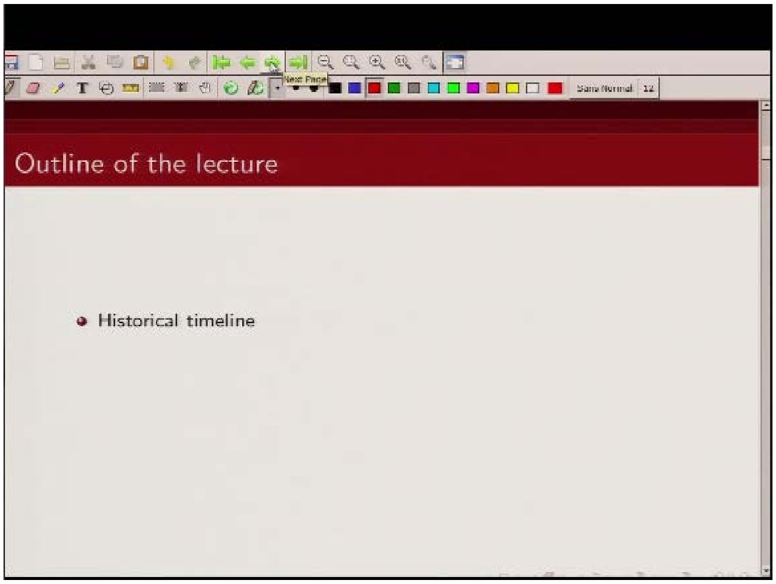

So before that we will just do a very brief historical time line of how coding theory as progressed over here is and then.

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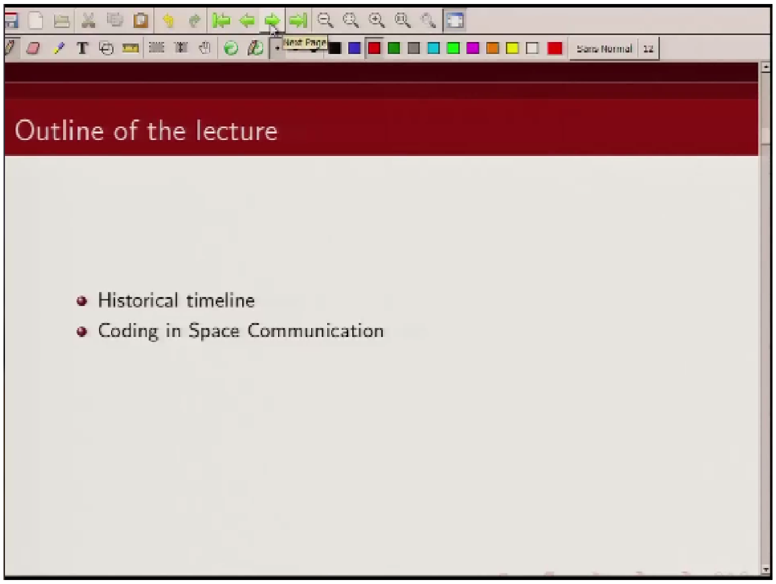

And then we will talk about some application of convolutional code we will first discuss some application since for deep space.

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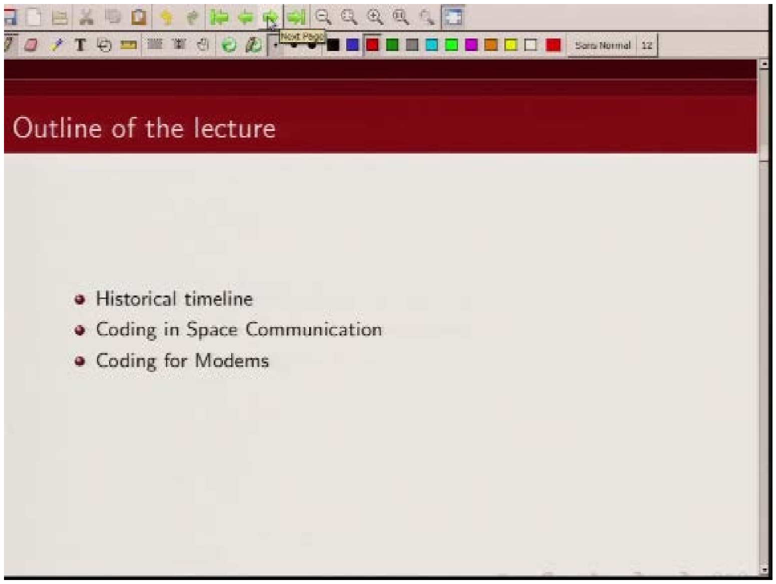

And some applications for modems

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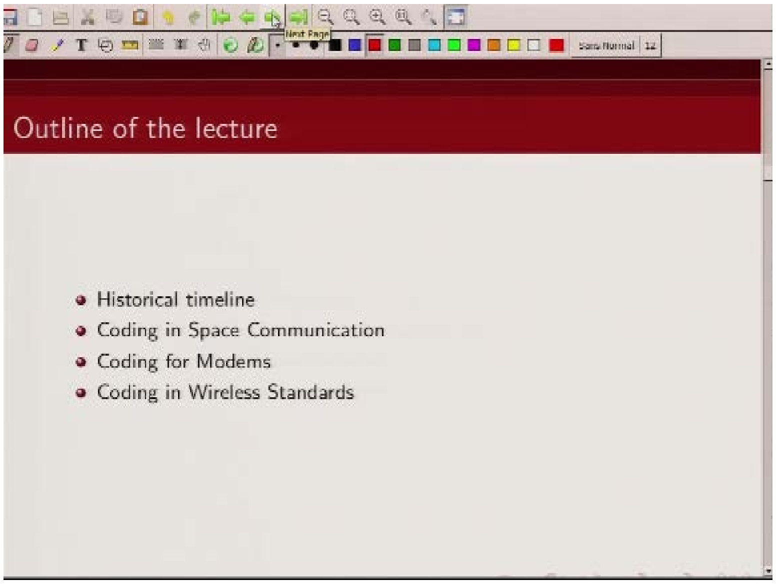

And finally some applications of convolutional code in wireless communication standers.

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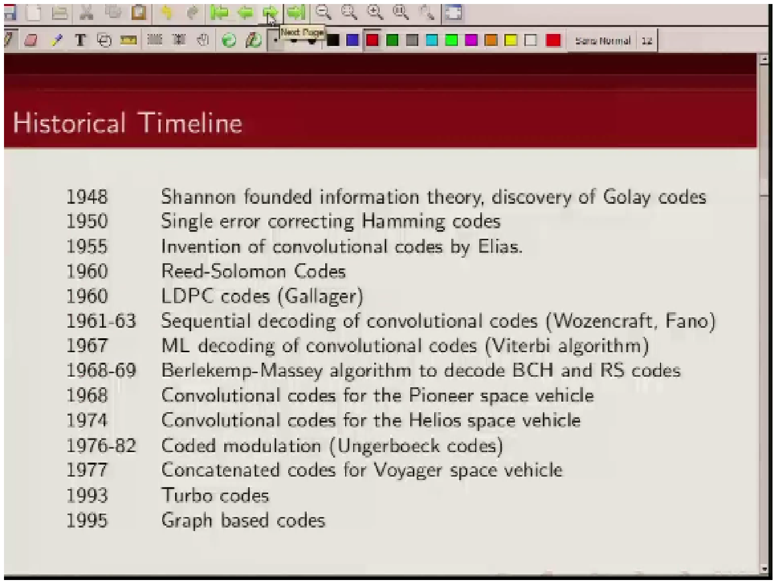

So we know 1948 Shannon founded information theory, and then sub sequently around 1955 Elias came with convolutional codes around 1960's Reed Solomon code and LDPC codes for discovered and around 61, 63 was Wozencraft and Fano came of a sequential decoding of convolutional code which allowed us to decode convolutional code very large memory order 1960 someone 68 Viterbi algorithms for maximum likely would decoding of convolutional code came and then on 74 BCG are algorithm was proposed.

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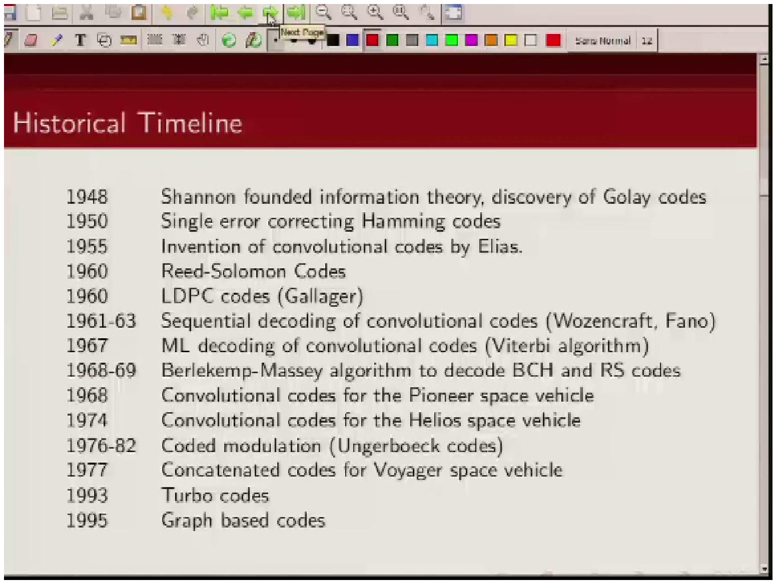

In late 60’s and early 70’s convolutional codes and concatenated codes found applications for deep space applications and around 1977 coding and modulation was combined together to design trellis coded modulation and they sub sequently found lot of application is designing coding form modems and then finally around 1993 turbo codes where discovered and LDPC codes where rediscovered and then from late 90’s on words all deep 2000 and people started proposing these codes for various standards and they found applications and many communication standers so that is a brief outline of how things have evolved over 50, 60 years.

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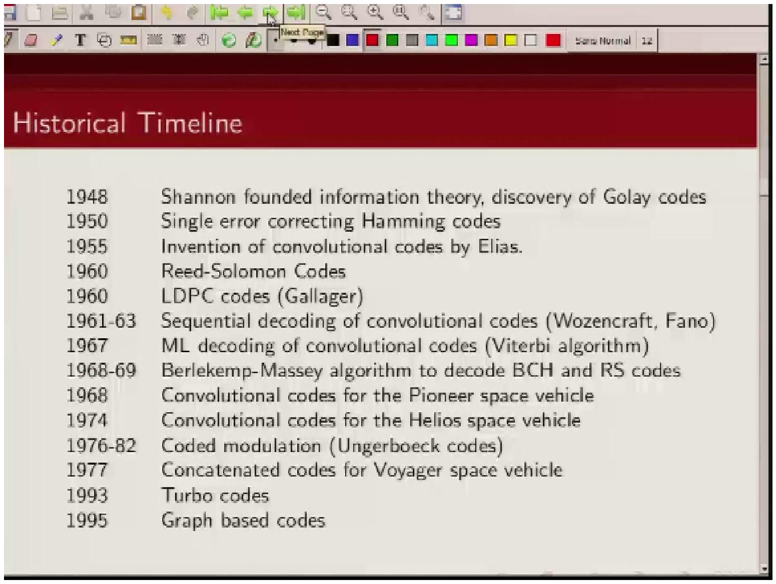

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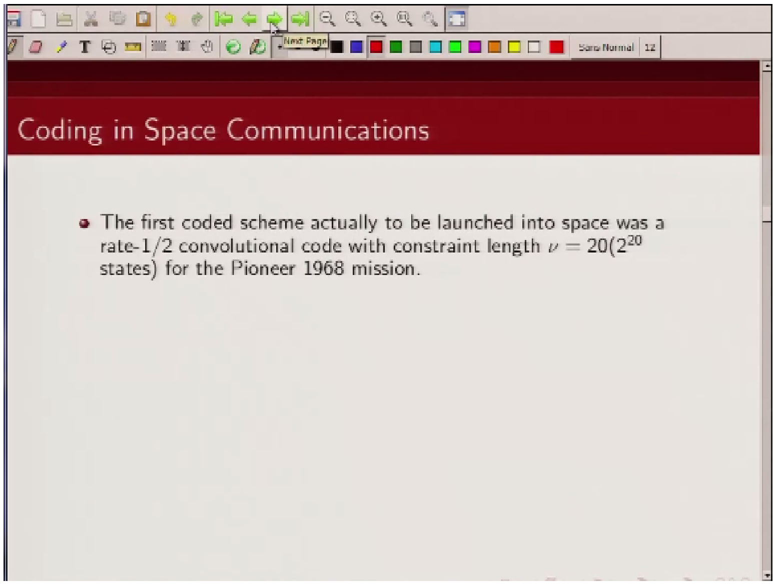

So let us start with applications of convolutional code

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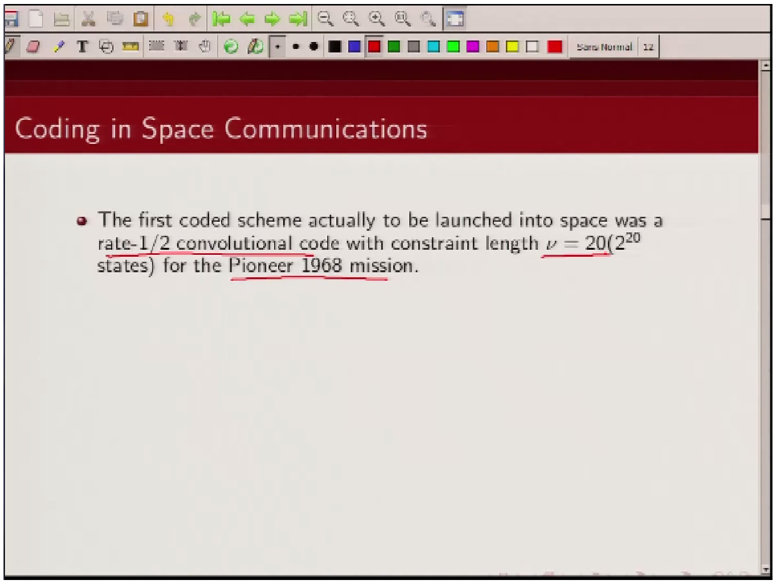

Now pioneer mission was 1968 and they use a rate of convolutional code which as constrained length of 20 so there were 2 to out 20 states and they use sequential decoding

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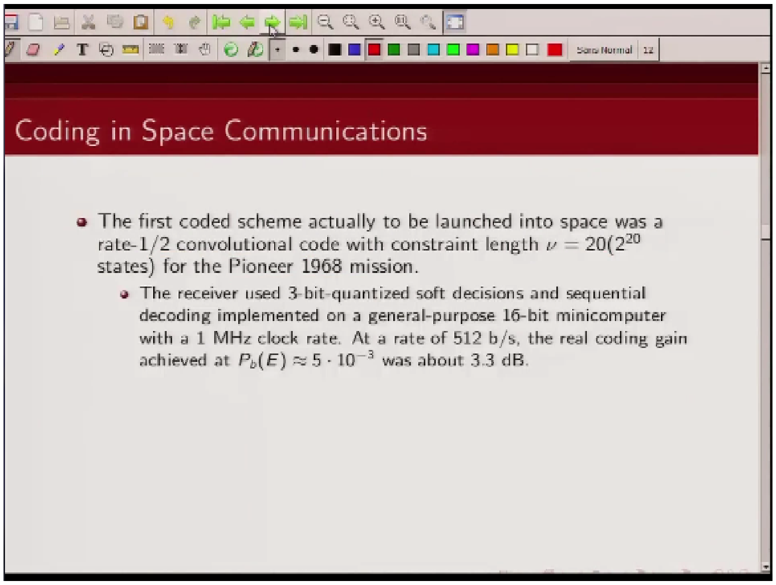

To decode this code the receiver used a

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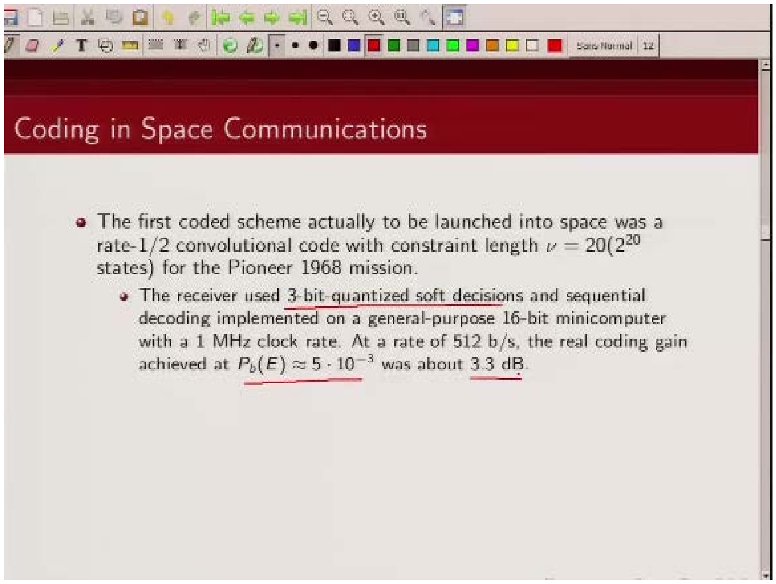

3 bit quantized soft decision and it was implemented on 16 bit minicomputer it provided a coding again of roughly 3.3 so it got a like for a probability for around this it give a coding again for about 3.3 dB

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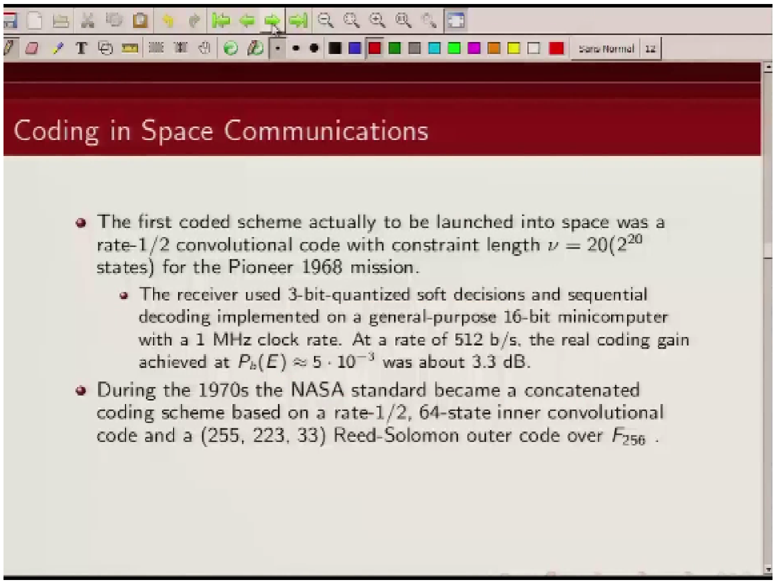

Next around 70's NASA started using this concatenated code outer code was a Reed Solomon code and inner code was 64 state convolutional code rate

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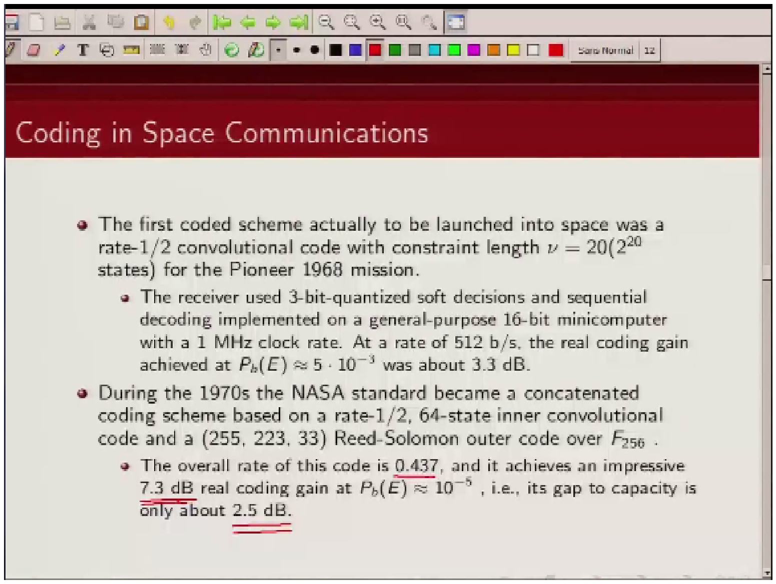

Half convolutional code and it found lot of applications the overall code rate of this was .43 and it a gab to capacity was only 2.5dB it provided coding again around 7.3 dB at bit a rate of 10^{-5}

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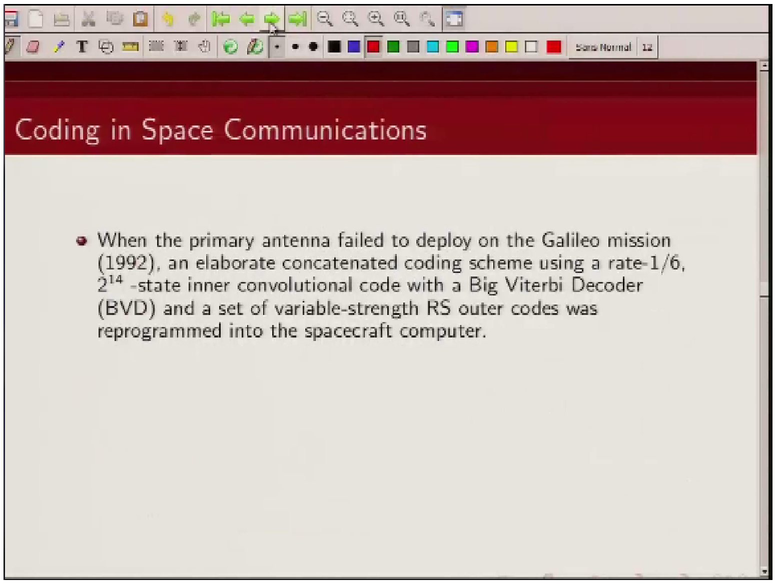

Another big development was when in Galileo's mission this antenna failed to deploy a primary antenna when it fail to deploy so there was an elaborate concatenated coded scheme which used a.

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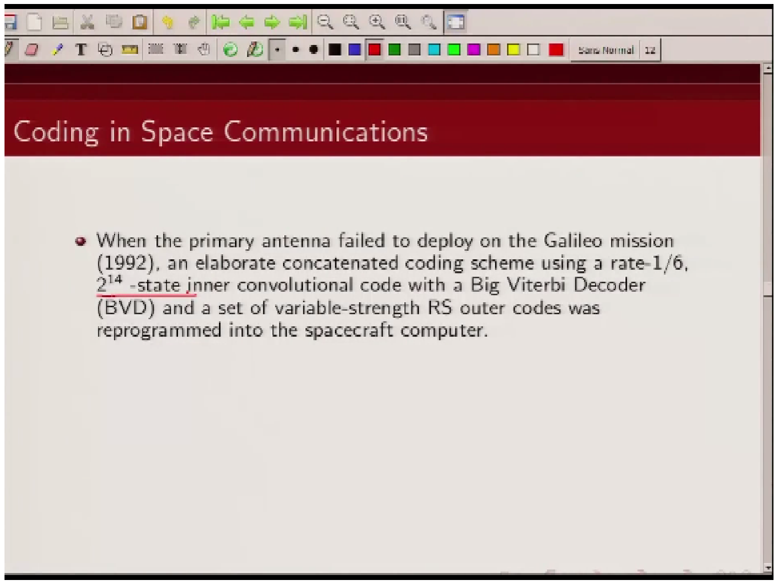

2^{14} state convolutional code assigner code and Reed Solomon code as outer code and a big viterbi decoding viterbi decoding algorithm was prospected which could work over such a large number of sates

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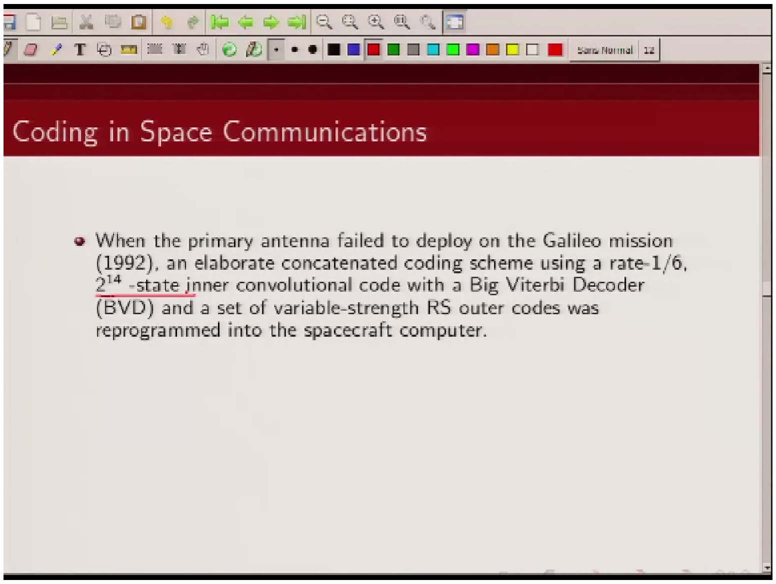

Very impressive step forward in terms of a coding a application is concern is because it was able to salvage this missions because of this very nice concatenated code used and it was successfully.

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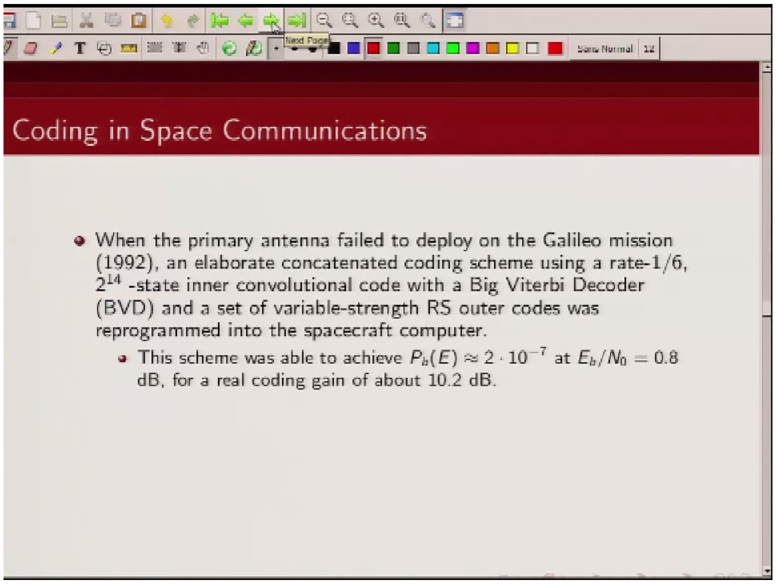

Deployed it provide a coding gain of around

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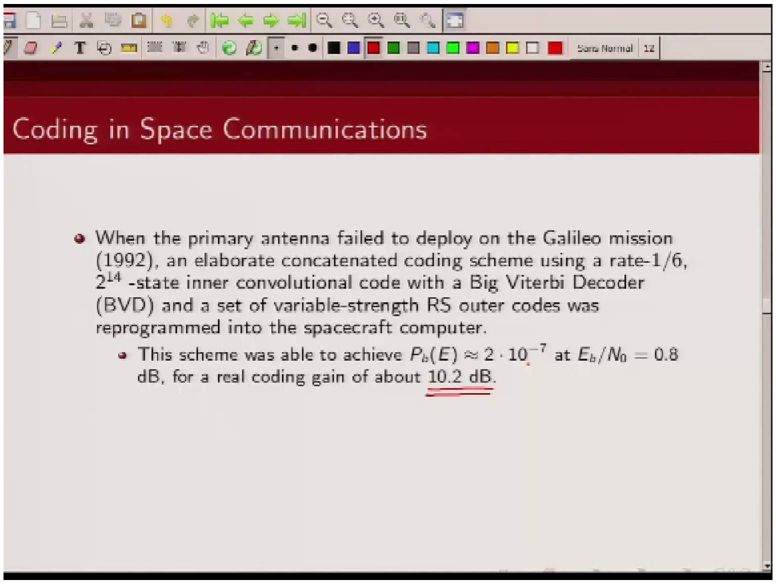

10.2dB at and it was able to achieve bit a rate close to 10^{-7}

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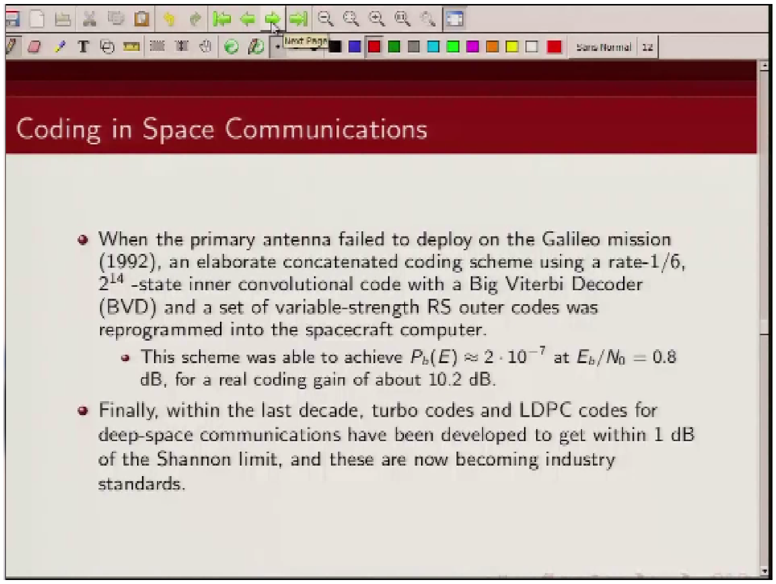

And finally as I said from early 2000 now this is error of turbo code and LDPC codes and they are finding applications from deep- space to mobile communication standards TV broadcasting and things like that.

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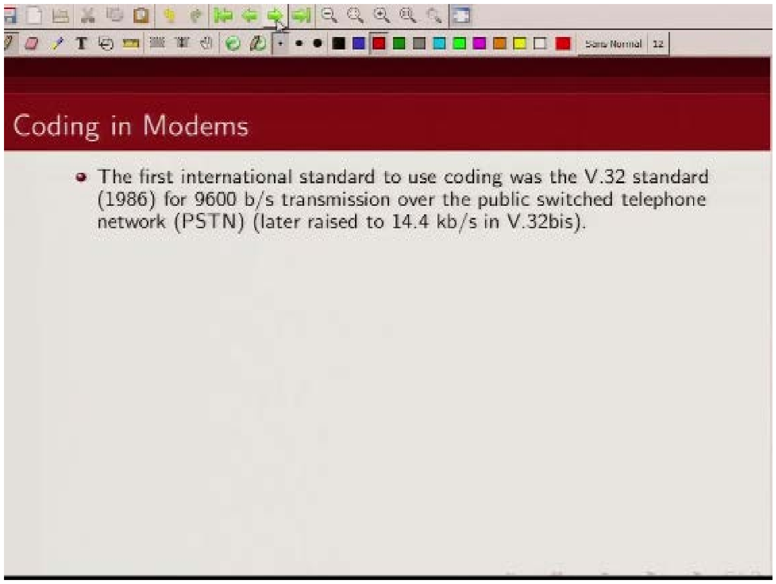

Now another area where error control coding and this convolutional code made a major impact was encoding for modems so around mid 70’s hunger box came with how to combine coding and modulation and it came up with trellis coded modulation and these codes where heavily used in design a coding schemes for data transmission basically over public switch telephone network.

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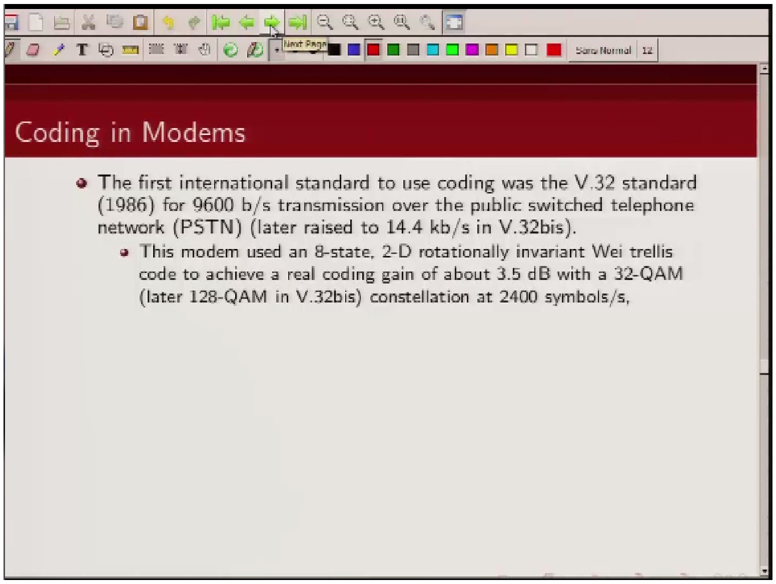

So some of the applications have listed here so initially we had 9.6 kb/s transmission that uses a an eight state code then finally.

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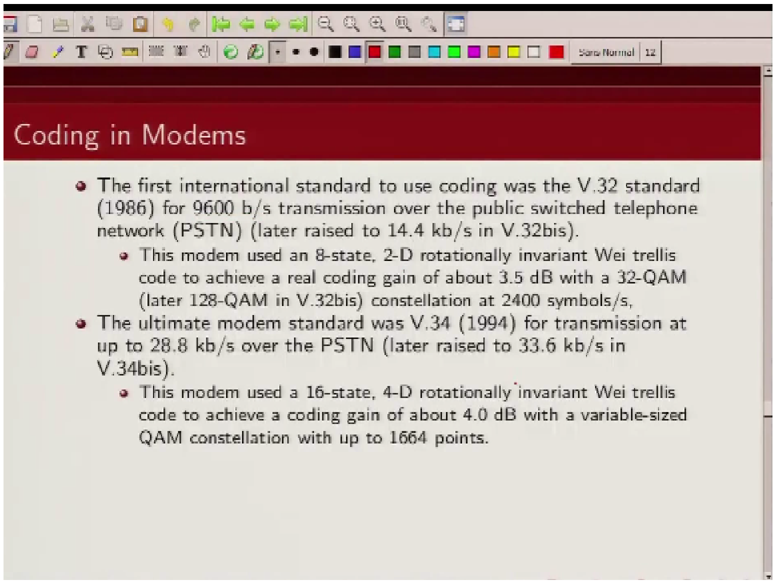

For a 33 kb/s transmission they use a 16 state four dimensional trellis codes modulation scheme and.

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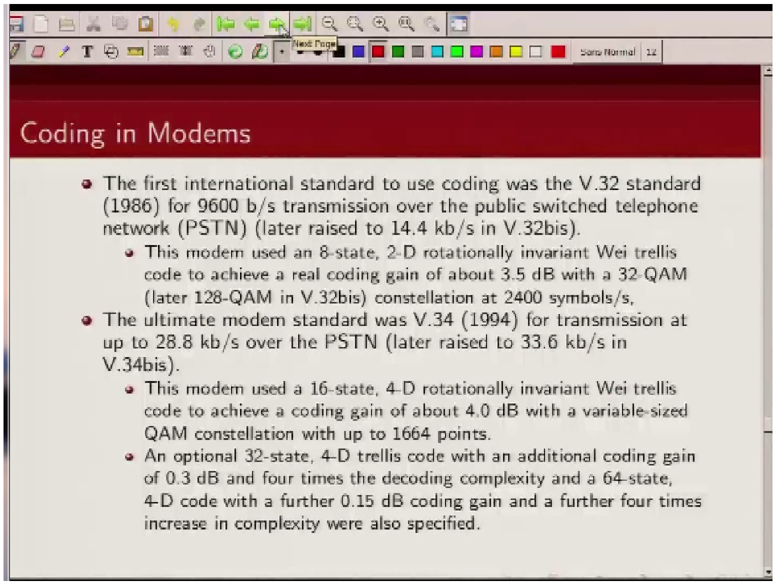

And there was an optional 32 state 4 dimensional trellis code which as all specified in this standard but when we progress to digital backbones then,, then basically there was no need for these codes and so the v 90 v92 standers says essentially do not use any of these coding techniques but in mid 80’s and eerily 90’s there was lot of they are very successfully these codes where applied for coding for modems.

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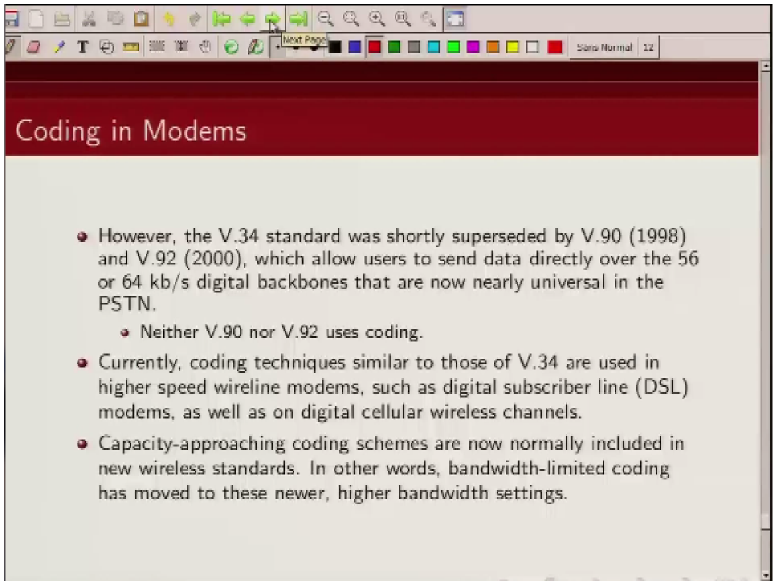

Now currently these techniques are also used for high speed wire line modems like ADC aniline other applications and off course turbo codes and there variants also finding applications here.

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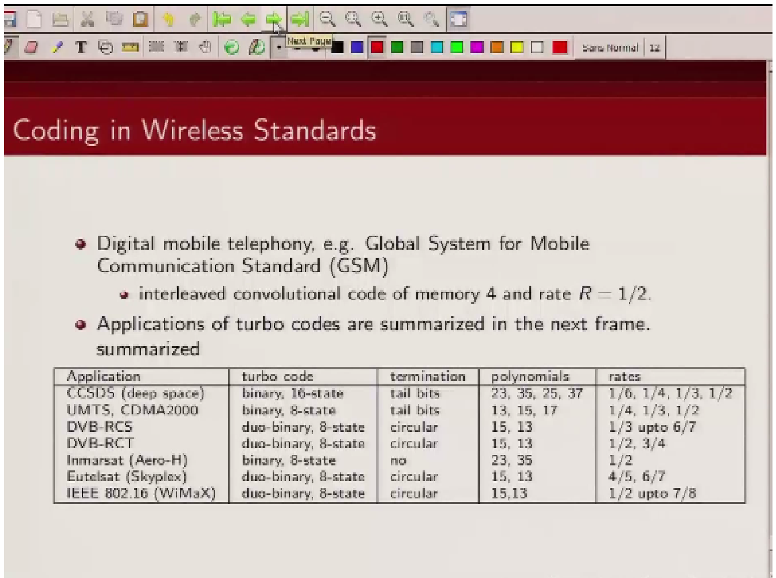

So I like to conclude basically with a giving some examples of communications systems so our GSM use a convolutional code of

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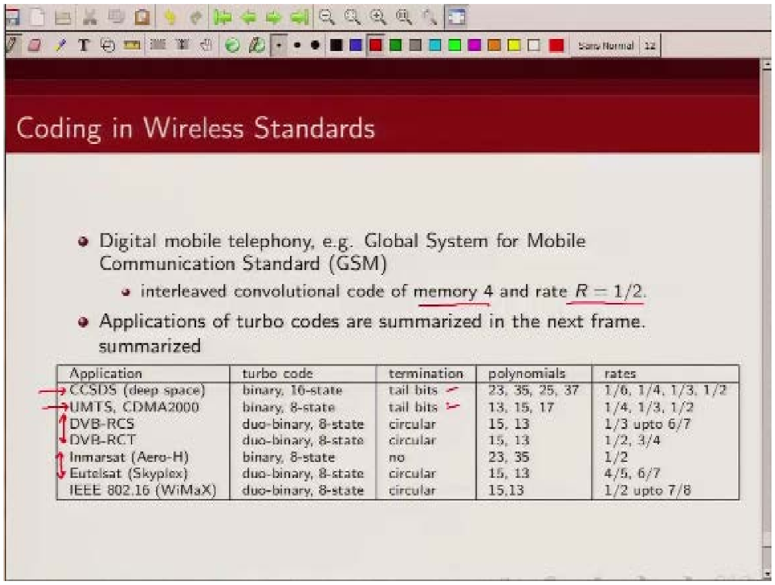

Memory 4 and rate 1 of code and in the table I have a listed some of the applications of turbo codes in rece4nt standards I mean source starting from digital video broadcasting stander to third generation wireless standard to deep space exploration to stateliest communication applications and you can see there are this binary turbo code that we talked about this two binary turbo code essentially uses like rate k/ n code which is greater than 1 and there are additional bit that have been added in some of the cases for termination of this encoder

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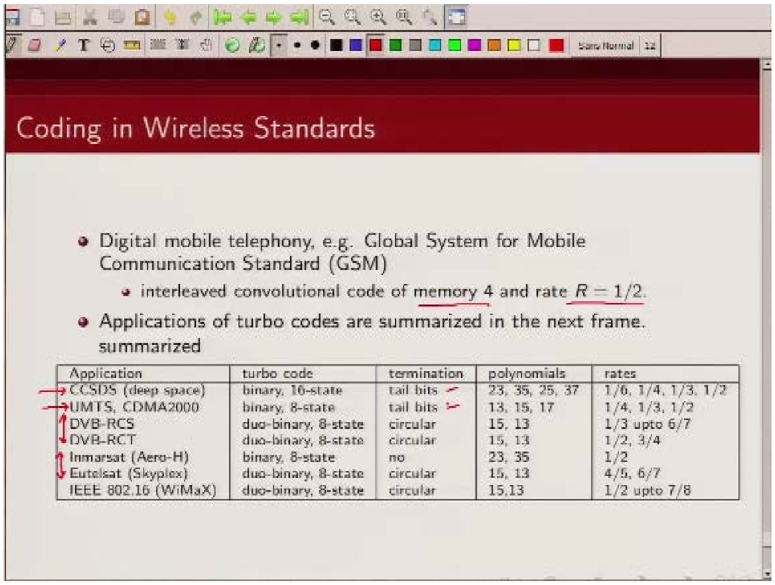

And in some cases for where you see these curricular thing they have used a curricular recoveries encoders so these are what they called what is known as tale biting encoders o they are starting and ending state are same so the so this is like circulation trills so they do not need any termination bits and these.

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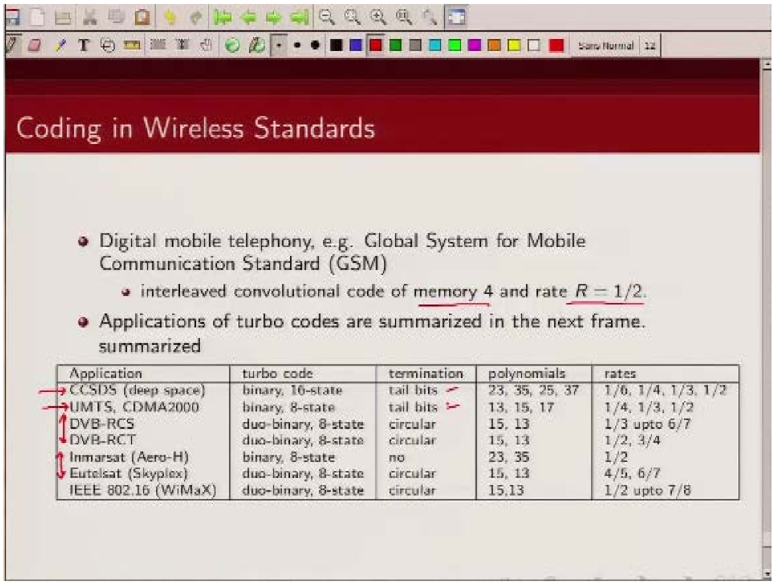

And these are the code generator polynomial in octal notation and some of the rates that have been used for these codes thank you.

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