

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

95

|    |  |          |
|----|--|----------|
| 1  | you see where it says at Line 7:                 | 11:45:45 |
| 2  | "Such an accumulator may be considered           | 11:45:49 |
| 3  | a block coder whose input block X sub one        | 11:45:51 |
| 4  | through X sub N and output block Y sub one       | 11:45:55 |
| 5  | through Y sub N are related by the               | 11:45:59 |
| 6  | formula," and then it provides a formula?        | 11:46:02 |
| 7  | A.    I see that.                                | 11:46:04 |
| 8  | Q.    That's the same description as Divsalar on | 11:46:04 |
| 9  | Page 5 where it says:                            | 11:46:08 |
| 10 | "The accumulator can be viewed as a              | 11:46:09 |
| 11 | truncated rate-1 recursive convolutional         | 11:46:12 |
| 12 | encoder with a transfer function, one over       | 11:46:14 |
| 13 | one plus N, but we prefer to think of it         | 11:46:17 |
| 14 | as a block code whose input block X sub          | 11:46:21 |
| 15 | one through X sub N and output block Y sub       | 11:46:24 |
| 16 | one through Y sub N are related by the           | 11:46:28 |
| 17 | formula," and it provides a formula,             | 11:46:31 |
| 18 | right?   | 11:46:33 |
| 19 | MR. GLASS: Same objection. Outside the           | 11:46:33 |
| 20 | scope. Calls for a legal conclusion.             | 11:46:34 |
| 21 | THE WITNESS: There is some similarities          | 11:46:35 |
| 22 | in language, some similarities in words, yes.    | 11:46:37 |
| 23 | BY MR. DOWD:                                     | 11:46:41 |
| 24 | Q.    And the code -- the formula that's written | 11:46:41 |
| 25 | there is the same formula, right?                | 11:46:43 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

96

|    |  |          |
|----|--|----------|
| 1  | MR. GLASS: Same objections.                        | 11:46:45 |
| 2  | THE WITNESS: It doesn't have exactly the           | 11:46:46 |
| 3  | same formula.                                      | 11:46:48 |
| 4  | BY MR. DOWD:                                       | 11:46:50 |
| 5  | Q. Other than in Divsalar, the plus sign does      | 11:46:50 |
| 6  | not have a circle around it and in the '781 patent | 11:46:55 |
| 7  | the plus sign has a circle, is there any other     | 11:47:00 |
| 8  | difference that you can identify?                  | 11:47:03 |
| 9  | MR. GLASS: Same objection. Outside the             | 11:47:04 |
| 10 | scope.   | 11:47:06 |
| 11 | THE WITNESS: I have not studied that in            | 11:47:06 |
| 12 | detail. I feel uncomfortable making on-the-spot    | 11:47:06 |
| 13 | judgements about the --                            | 11:47:06 |
| 14 | THE REPORTER: Wait. You're going to have           | 11:47:06 |
| 15 | to slow down for me. Repeat your answer.           | 11:47:12 |
| 16 | THE WITNESS: I have not made an in-depth           | 11:47:12 |
| 17 | analysis of that. I feel uncomfortable making an   | 11:47:14 |
| 18 | on-spot judgment about the exact differences in    | 11:47:18 |
| 19 | these two paragraphs.                              | 11:47:20 |
| 20 | BY MR. DOWD:                                       | 11:47:21 |
| 21 | Q. Well, sitting here today, can you identify      | 11:47:22 |
| 22 | any difference between the formula in Divsalar and | 11:47:25 |
| 23 | the formula at Column 3 of the '781 patent?        | 11:47:28 |
| 24 | MR. GLASS: Same objections.                        | 11:47:31 |
| 25 | THE WITNESS: As I said, they are                   | 11:47:32 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

97

1 certainly not the same. One are plus signs; the 11:47:33  
2 other ones are symbols that perhaps are X or 11:47:36  
3 symbols. 11:47:40  
4 BY MR. DOWD: 11:47:41  
5 Q. Do you see at Line 24 it says: 11:47:41  
6 "Where the plus with a circle denotes 11:47:43  
7 mod 2 or exclusive OR addition"? 11:47:43  
8 THE REPORTER: "Where the plus" -- 11:47:43  
9 MR. DOWD: "With a circle around it." 11:47:43  
10 THE REPORTER: Start there, please. 11:47:43  
11 MR. DOWD: I will. 11:47:49  
12 BY MR. DOWD: 11:47:49  
13 Q. "Where the plus with a circle around it 11:47:51  
14 denotes mod 2 or exclusive OR addition"? 11:47:53  
15 A. I see that. 11:47:57  
16 Q. All right. So if the plus in Divsalar is 11:47:59  
17 an exclusive OR addition, we can agree that the 11:48:02  
18 formula is the same in both documents, right? 11:48:05  
19 MR. GLASS: Outside the scope. 11:48:07  
20 THE WITNESS: As I said, if, you know, 11:48:08  
21 that was an opinion that would be asked from me, I 11:48:11  
22 would like to actually study that question in detail 11:48:13  
23 and then come to a conclusion after a thoughtful 11:48:16  
24 process. 11:48:19  
25 ///

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

98

|    |   |          |
|----|---|----------|
| 1  | BY MR. DOWD:  | 11:48:20 |
| 2  | Q. Okay. "Yes," "no," or "I don't know,"            | 11:48:20 |
| 3  | sitting here today the two formulas are the same?   | 11:48:25 |
| 4  | MR. GLASS: Same objections.                         | 11:48:28 |
| 5  | THE WITNESS: I don't know.                          | 11:48:29 |
| 6  | BY MR. DOWD:  | 11:48:30 |
| 7  | Q. Okay. Let's go back to Divsalar.                 | 11:48:35 |
| 8  | Am I correct that information bit X1 is             | 11:48:42 |
| 9  | going to appear in every one of the subsets from Y1 | 11:48:48 |
| 10 | down to YN?   | 11:48:54 |
| 11 | MR. GLASS: Outside the scope.                       | 11:48:57 |
| 12 | THE WITNESS: In formula 5.1, I see a                | 11:48:57 |
| 13 | symbol X1 appearing on the right-hand side.         | 11:49:01 |
| 14 | BY MR. DOWD:  | 11:49:04 |
| 15 | Q. And that appears for every subset Y1             | 11:49:04 |
| 16 | through YN, right?                                  | 11:49:07 |
| 17 | MR. GLASS: Same objections.                         | 11:49:07 |
| 18 | THE WITNESS: It appears for those lines             | 11:49:08 |
| 19 | that are visible, yes.                              | 11:49:10 |
| 20 | BY MR. DOWD:  | 11:49:12 |
| 21 | Q. And then there's a second information bit        | 11:49:12 |
| 22 | X2 that appears in subsets Y2, Y3, down through YN, | 11:49:15 |
| 23 | right?  | 11:49:20 |
| 24 | A. I see a symbol X2 appearing on the               | 11:49:21 |
| 25 | right-hand side.                                    | 11:49:24 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

99

|    |    |  |          |
|----|----|--|----------|
| 1  | Q. | Uh-huh. And it appears in each of the                | 11:49:25 |
| 2  |    | subsets Y2 down the YN, right?                       | 11:49:28 |
| 3  |    | MR. GLASS: Same objections.                          | 11:49:31 |
| 4  |    | THE WITNESS: As I said, I have not                   | 11:49:32 |
| 5  |    | studied this. It appears in three places. This may   | 11:49:34 |
| 6  |    | or may not mean what you are implying.               | 11:49:38 |
| 7  |    | BY MR. DOWD:   | 11:49:41 |
| 8  | Q. | Well, can you -- withdrawn.                          | 11:49:41 |
| 9  |    | Am I correct that the number of subsets in           | 11:49:43 |
| 10 |    | which the information bit appears varies from bit X1 | 11:49:46 |
| 11 |    | to bit X2?   | 11:49:50 |
| 12 | A. | An accumulator accumulates the past.                 | 11:49:55 |
| 13 |    | Simply at any point in time a bit comes in or        | 11:49:58 |
| 14 |    | whatever the number is, it will add it to the        | 11:50:02 |
| 15 |    | current running sum. That's what an accumulator      | 11:50:05 |
| 16 |    | does.  | 11:50:07 |
| 17 | Q. | Okay. So in the first recursive operation            | 11:50:08 |
| 18 |    | you only have one bit, right, X1?                    | 11:50:11 |
| 19 | A. | This is simply the state of the system.              | 11:50:14 |
| 20 |    | The state of the system stays there. At any point    | 11:50:17 |
| 21 |    | in time the state of the system is updated. That's   | 11:50:20 |
| 22 |    | what it is.  | 11:50:22 |
| 23 | Q. | All right. And let's just talk about how             | 11:50:23 |
| 24 |    | an accumulator operates for a second.                | 11:50:25 |
| 25 |    | So in the first clockcycle, you have one             | 11:50:27 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

100

|    |  |          |
|----|--|----------|
| 1  | bit in, right?                                       | 11:50:33 |
| 2  | A. At every clockcycle you have one bit in.          | 11:50:33 |
| 3  | Q. Right. And so I'm starting with the first         | 11:50:36 |
| 4  | clockcycle; so far I only have one bit, right?       | 11:50:40 |
| 5  | A. You start with the first bit that appears.        | 11:50:43 |
| 6  | You have -- you have a certain basic state that you  | 11:50:43 |
| 7  | have. You --   | 11:50:43 |
| 8  | THE REPORTER: Wait. Wait. Wait. Slow                 | 11:50:43 |
| 9  | down and start your answer again, please.            | 11:50:51 |
| 10 | THE WITNESS: The accumulator will be in a            | 11:50:51 |
| 11 | particular state. As soon as a bit arrives, the      | 11:50:54 |
| 12 | state will be updated by whatever the incoming bit   | 11:50:56 |
| 13 | is.  | 11:51:01 |
| 14 | BY MR. DOWD:   | 11:51:01 |
| 15 | Q. Okay. So let's, for the sake of my                | 11:51:01 |
| 16 | example, assume that the initialization state of the | 11:51:04 |
| 17 | accumulator is 0, okay?                              | 11:51:07 |
| 18 | A. Correct.  | 11:51:09 |
| 19 | Q. And the first bit that's presented is a 1,        | 11:51:10 |
| 20 | okay? Am I correct that what happens is that you     | 11:51:15 |
| 21 | combine the 0 with the incoming one and it is the    | 11:51:18 |
| 22 | result of that combination that gets, then, written  | 11:51:22 |
| 23 | to the accumulator?                                  | 11:51:25 |
| 24 | A. That's correct.                                   | 11:51:26 |
| 25 | Q. And the result of that combination is             | 11:51:27 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

101

|    |   |          |
|----|---|----------|
| 1  | neither the 1 or the 0 but the product of combining | 11:51:31 |
| 2  | them?   | 11:51:36 |
| 3  | A. It's the sum of combining these two.             | 11:51:37 |
| 4  | it's -- it's -- it's taking the sum of the current  | 11:51:40 |
| 5  | state with whatever's coming in. That's going to be | 11:51:42 |
| 6  | the output; that's going to be the new state.       | 11:51:46 |
| 7  | Q. Okay. And that new state is a bit that is        | 11:51:49 |
| 8  | created by performing the summing?                  | 11:51:54 |
| 9  | MR. GLASS: Objection. Vague.                        | 11:51:58 |
| 10 | THE WITNESS: It's the state. It's simply            | 11:51:58 |
| 11 | a state. It's not a bit. It's the state, and the    | 11:52:00 |
| 12 | state could have -- be binary as it's in this form. | 11:52:03 |
| 13 | It could be a higher dimension. It could be over a  | 11:52:07 |
| 14 | bigger field, for example. It's whatever the state  | 11:52:10 |
| 15 | is at that point.                                   | 11:52:12 |
| 16 | BY MR. DOWD:  | 11:52:13 |
| 17 | Q. Okay. I'm -- I'm just doing a simple             | 11:52:13 |
| 18 | accumulation --                                     | 11:52:15 |
| 19 | A. Sure.  | 11:52:16 |
| 20 | Q. -- where we only have -- it can be a one 1       | 11:52:17 |
| 21 | or a 0.   | 11:52:19 |
| 22 | A. Okay. So if the state is binary, then            | 11:52:20 |
| 23 | there will be a binary state and it will have a     | 11:52:20 |
| 24 | value in the state and --                           | 11:52:20 |
| 25 | THE REPORTER: I'm sorry, state your                 | 11:52:20 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

102

|    |  |          |
|----|--|----------|
| 1  | answer again, please.                                | 11:52:25 |
| 2  | THE WITNESS: Sure. So if the state is                | 11:52:25 |
| 3  | indeed binary, then it will take whatever state that | 11:52:28 |
| 4  | was before it. It will add the current bit to the    | 11:52:33 |
| 5  | state. This will give you a new state, and the size  | 11:52:36 |
| 6  | of the state doesn't change, so it will still be     | 11:52:40 |
| 7  | binary.  | 11:52:43 |
| 8  | BY MR. DOWD:   | 11:52:45 |
| 9  | Q. Okay. And as each new bit comes in, a new         | 11:52:45 |
| 10 | state is created by combining the -- the current     | 11:52:50 |
| 11 | state in the accumulator with the new bit, correct?  | 11:52:58 |
| 12 | A. According to the description that I gave          | 11:53:02 |
| 13 | before, if the state at any point is updated and     | 11:53:05 |
| 14 | changed according to the value of the new incoming   | 11:53:08 |
| 15 | bit, that is correct.                                | 11:53:13 |
| 16 | Q. And that's done -- am I correct that              | 11:53:15 |
| 17 | that's done using mod 2 addition?                    | 11:53:17 |
| 18 | A. That's done according to addition in the          | 11:53:20 |
| 19 | field GF(2).   | 11:53:23 |
| 20 | Q. Okay. Just so I make sure I understand            | 11:53:24 |
| 21 | what that is, what is GF(2)?                         | 11:53:27 |
| 22 | A. GF(2) is the Galois field that contains           | 11:53:29 |
| 23 | two elements.  | 11:53:33 |
| 24 | Q. Is the addition the same as ordinary              | 11:53:35 |
| 25 | arithmetic, with the exception that one plus one     | 11:53:40 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

103

1 equals 0 in that case? 11:53:44  
2 A. There's -- it's -- it's whatever the 11:53:46  
3 addition is over  $GF(2)$ . So that has a well-defined 11:53:48  
4 mathematical concept and that is the addition. 11:53:53  
5 Q. Okay. Let me -- let me try it another 11:53:56  
6 way. 11:53:58  
7 Would the truth table for that addition be 11:53:58  
8 one plus one equals 0, one plus 0 equals one, one -- 11:54:01  
9 I'm sorry, 0 plus one equals one, 0 plus 0 equals 0? 11:54:06  
10 A. That's correct. 11:54:11  
11 Q. Okay. Have you ever heard that called mod 11:54:12  
12 2 addition before? 11:54:20  
13 A. I certainly am aware of the mod 2 11:54:20  
14 addition. 11:54:24  
15 Q. Okay. That's all the truth table for mod 11:54:24  
16 2 addition, right? 11:54:27  
17 A. That might very well be also the truth 11:54:28  
18 table of mod 2 addition. 11:54:39  
19 Q. When you say: "It might very well be," is 11:54:39  
20 that a guess or --  
21 THE REPORTER: Hold on. Hold on.  
22 "That very well might be the" --  
23 THE WITNESS: The truth table of mod 2  
24 addition. 11:54:43  
25 ///

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

104

|    |   |          |
|----|---|----------|
| 1  | BY MR. DOWD:                                    | 11:54:43 |
| 2  | Q. Well, is it or isn't it?                     | 11:54:44 |
| 3  | MR. GLASS: Outside the scope.                   | 11:54:45 |
| 4  | THE WITNESS: This is not what my expert         | 11:54:46 |
| 5  | report is about.                                | 11:54:48 |
| 6  | BY MR. DOWD:                                    | 11:54:49 |
| 7  | Q. Irrespective of whether it's in your         | 11:54:49 |
| 8  | expert report, is it true?                      | 11:54:51 |
| 9  | MR. GLASS: Same objection.                      | 11:54:52 |
| 10 | THE WITNESS: There are many things that         | 11:54:59 |
| 11 | might be true, but I've been called for --      | 11:55:01 |
| 12 | THE REPORTER: Wait. I'm sorry. Did you          | 11:55:01 |
| 13 | say an objection?                               | 11:55:01 |
| 14 | MR. GLASS: I said: "Same objection."            | 11:55:01 |
| 15 | THE WITNESS: There are many things that         | 11:55:01 |
| 16 | might be true, but I've been called for a       | 11:55:01 |
| 17 | specific -- a specific purpose and that's my -- | 11:55:03 |
| 18 | whatever is -- is written in my expert report.  | 11:55:06 |
| 19 | BY MR. DOWD:                                    | 11:55:06 |
| 20 | Q. Well --                                      | 11:55:11 |
| 21 | THE REPORTER: Hold on. I need to go off         | 11:55:11 |
| 22 | the record.                                     | 11:55:13 |
| 23 | MR. DOWD: All right. Let's go off the           | 11:55:13 |
| 24 | record.   | 11:55:13 |
| 25 | THE VIDEOGRAPHER: This marks the end of         | 11:55:13 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

105

|    |  |          |
|----|--|----------|
| 1  | Video No. 1 in the deposition of                     | 11:55:15 |
| 2  | Dr. Rüdiger Urbanke. We are off the record at        | 11:55:19 |
| 3  | 11:55 a.m.   | 11:55:22 |
| 4  | (Recess taken at 11:55 a.m.)                         | 11:55:22 |
| 5  | THE VIDEOGRAPHER: Here begins Video No. 2            | 12:07:59 |
| 6  | in the deposition of Dr. Rüdiger Urbanke. We are     | 12:08:01 |
| 7  | back on the record at 12:08 p.m.                     | 12:08:04 |
| 8  | BY MR. DOWD:   | 12:08:09 |
| 9  | Q. Dr. Urbanke, before the break I was asking        | 12:08:11 |
| 10 | you whether the truth table of a mod 2 addition is   | 12:08:14 |
| 11 | the same as the GF(2) truth table that you told me   | 12:08:20 |
| 12 | about; do you recall that?                           | 12:08:25 |
| 13 | A. Yes.  | 12:08:27 |
| 14 | Q. And your answer was: There are many               | 12:08:28 |
| 15 | things that may be true but you're only going to     | 12:08:30 |
| 16 | tell me what's in your report; do you recall that?   | 12:08:34 |
| 17 | MR. GLASS: Objection. Mischaracterizes               | 12:08:37 |
| 18 | testimony.   | 12:08:39 |
| 19 | THE WITNESS: I recall in a sense that you            | 12:08:39 |
| 20 | asked me about whether or not these two things were  | 12:08:42 |
| 21 | true. Since I have not studied the exact             | 12:08:45 |
| 22 | definitions of how these terms are defined, either   | 12:08:48 |
| 23 | in the patents or on the paper, I prefer not to give | 12:08:50 |
| 24 | an ad hoc opinion on these.                          | 12:08:53 |
| 25 | ///  |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

106

|    |  |          |
|----|--|----------|
| 1  | BY MR. DOWD:   | 12:08:56 |
| 2  | Q. Well, do you recall at the outset today           | 12:08:56 |
| 3  | you swore to tell the truth, the whole truth and     | 12:08:58 |
| 4  | nothing but the truth?                               | 12:09:01 |
| 5  | A. Absolutely.                                       | 12:09:02 |
| 6  | Q. So is it true that the truth table of mod         | 12:09:03 |
| 7  | 2 addition is one plus one equals 0, one plus 0      | 12:09:10 |
| 8  | equals one, 0 plus one equals one, one plus one      | 12:09:14 |
| 9  | equals 0?  | 12:09:19 |
| 10 | A. If you define the mod 2 addition in terms         | 12:09:21 |
| 11 | of this truth table, then indeed that's what the     | 12:09:23 |
| 12 | truth table is, but that's a tautology. So unless    | 12:09:26 |
| 13 | you have given me a definition of what mod 2 is and  | 12:09:28 |
| 14 | I have not looked in the patents exactly how this is | 12:09:32 |
| 15 | defined, I cannot answer this question.              | 12:09:35 |
| 16 | Q. So you can't explain what mod 2 addition          | 12:09:36 |
| 17 | is?  | 12:09:39 |
| 18 | A. I have some definition of a mod 2, but I          | 12:09:39 |
| 19 | don't know if in these patents it's exactly the same | 12:09:42 |
| 20 | definition that's used.                              | 12:09:45 |
| 21 | Q. Well, irrespective of the patents, what is        | 12:09:46 |
| 22 | your definition of mod 2 addition?                   | 12:09:49 |
| 23 | A. One definition of mod 2, it would be              | 12:09:50 |
| 24 | exactly the truth table that you mentioned.          | 12:09:54 |
| 25 | Q. Okay. Now, if we go back to the two               | 12:10:05 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

107

1 formula, the Divsalar formula 5.1 and the formula of 12:10:08  
2 the '781 patent, Column 10 through Column 3 -- 12:10:13  
3 sorry, Line 10 through about Line 23, those two 12:10:17  
4 formulae show the same form of accumulation, right? 12:10:23  
5 MR. GLASS: Objection. Outside the scope. 12:10:27  
6 THE WITNESS: Those two formulae show a 12:10:28  
7 certain mathematical relationship between some 12:10:31  
8 sequence X and some sequence Y. 12:10:34  
9 BY MR. DOWD: 12:10:36  
10 Q. And it's the same relationship, right? 12:10:36  
11 MR. GLASS: Same objections. 12:10:38  
12 THE WITNESS: I don't know how XOR in this 12:10:39  
13 case is defined. I cannot answer this question to 12:10:41  
14 you. 12:10:46  
15 BY MR. DOWD: 12:10:46  
16 Q. Okay. If it is defined in the same way 12:10:46  
17 that we've been discussing, the mod 2 addition, then 12:10:48  
18 it would be the same? 12:10:50  
19 MR. GLASS: Same objection. 12:10:51  
20 THE WITNESS: I don't know the subtleties 12:10:52  
21 of the exact definition. As I said, I didn't study 12:10:54  
22 the patents, the exact claims to that extent. I 12:10:57  
23 don't know if there are any subtle issues of how 12:11:00  
24 these things are defined. 12:11:02  
25 ///

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

108

|    |  |          |
|----|--|----------|
| 1  | BY MR. DOWD:   | 12:11:07 |
| 2  | Q. Now, let's go back to Figure 3 that you           | 12:11:07 |
| 3  | reproduced in your report, there's an output from    | 12:11:10 |
| 4  | the accumulator qN, right?                           | 12:11:13 |
| 5  | A. That's correct.                                   | 12:11:15 |
| 6  | Q. And that output is the code word produced         | 12:11:15 |
| 7  | by the encoder, right?                               | 12:11:19 |
| 8  | A. Whatever comes out of this construction is        | 12:11:23 |
| 9  | indeed what is considered the code word              | 12:11:26 |
| 10 | corresponding to whatever the input is.              | 12:11:29 |
| 11 | Q. And that code word would include what are         | 12:11:30 |
| 12 | called "parity bits," right?                         | 12:11:34 |
| 13 | A. That code word is simply the output.              | 12:11:36 |
| 14 | Unless you can give me an exact definition what you  | 12:11:43 |
| 15 | mean with "parity bits," it's not possible for me to | 12:11:46 |
| 16 | decide whether or not that fits that definition.     | 12:11:49 |
| 17 | Q. Have you heard the term "parity bits"             | 12:11:51 |
| 18 | before?  | 12:11:54 |
| 19 | A. Certainly.  | 12:11:54 |
| 20 | Q. What do you understand "parity bits" to           | 12:11:54 |
| 21 | mean?  | 12:11:58 |
| 22 | A. Parity bits are -- would be bits that             | 12:11:58 |
| 23 | depend on information bits and would -- may or may   | 12:12:04 |
| 24 | not be part of a code word.                          | 12:12:14 |
| 25 | THE REPORTER: "Be part of" --                        | 12:12:14 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

109

|    |  |          |
|----|--|----------|
| 1  | THE WITNESS: A code word.                            | 12:12:14 |
| 2  | THE REPORTER: Thank you.                             | 12:12:20 |
| 3  | BY MR. DOWD:   | 12:12:20 |
| 4  | Q. Now, using that definition of parity bits,        | 12:12:21 |
| 5  | am I correct that the output of an RA encoder, the   | 12:12:28 |
| 6  | code word output by an RA encoder like that shown in | 12:12:36 |
| 7  | Figure 3 would include parity bits?                  | 12:12:41 |
| 8  | A. In this case, if that's your definition,          | 12:12:42 |
| 9  | you would say that actually all the output bits are  | 12:12:44 |
| 10 | parity bits, using the particular definition that I  | 12:12:48 |
| 11 | mentioned.   | 12:12:50 |
| 12 | Q. Okay. Now, are you familiar with --               | 12:12:52 |
| 13 | withdrawn.   | 12:12:52 |
| 14 | Are you familiar with systematic codes?              | 12:13:02 |
| 15 | A. Yes.  | 12:13:08 |
| 16 | Q. What is a systematic code?                        | 12:13:08 |
| 17 | A. A systematic code would be a code in which        | 12:13:10 |
| 18 | the actual data that is to be encoded in an          | 12:13:14 |
| 19 | unaltered form appears as part of the code word.     | 12:13:19 |
| 20 | Q. So in a systematic code, the code word            | 12:13:23 |
| 21 | includes both the original information bits and the  | 12:13:26 |
| 22 | parity bits, correct?                                | 12:13:30 |
| 23 | A. Indeed, it -- it includes the original            | 12:13:35 |
| 24 | bits plus some additional bits which one might       | 12:13:38 |
| 25 | characterize as parity bits.                         | 12:13:42 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

110

|    |    |  |          |
|----|----|--|----------|
| 1  | Q. | Okay. And systematic codes were known                | 12:13:43 |
| 2  |    | before 1998, right?                                  | 12:13:46 |
| 3  | A. | In principle you can take a code -- you              | 12:13:49 |
| 4  |    | know, this depends now very much on the world in --  | 12:13:52 |
| 5  |    | in the turbo coding world --                         | 12:13:52 |
| 6  |    | THE REPORTER: What?                                  | 12:13:58 |
| 7  |    | THE WITNESS: Sorry. Okay. In the turbo               | 12:13:58 |
| 8  |    | code world, this distinction between systematic and  | 12:14:00 |
| 9  |    | parity bits is a very natural one, because the       | 12:14:05 |
| 10 |    | viewpoint is one of an actual encoder in which the   | 12:14:07 |
| 11 |    | bits are being taken. The bits are being             | 12:14:13 |
| 12 |    | transformed in some way and then these bits are      | 12:14:15 |
| 13 |    | being output and perhaps there's a direct branch in  | 12:14:18 |
| 14 |    | which the information bits are also seen.            | 12:14:21 |
| 15 |    | So there's a very natural representation             | 12:14:23 |
| 16 |    | between information bits or the actual systematic    | 12:14:26 |
| 17 |    | bits and the parity bits.                            | 12:14:29 |
| 18 | Q. | Okay.  | 12:14:30 |
| 19 | A. | But if you look at the world of LDPC codes           | 12:14:30 |
| 20 |    | and you look at a standard representation, like a    | 12:14:35 |
| 21 |    | Gallagher representation, there's no a priori notion | 12:14:38 |
| 22 |    | unless you do something specific which of the bits   | 12:14:42 |
| 23 |    | would be parity bits or systematic bits.             | 12:14:45 |
| 24 |    | MR. DOWD: Let's mark as Exhibit 7 a copy             | 12:14:48 |
| 25 |    | of the Figure 3.                                     | 12:14:51 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

111

|    |    |  |          |
|----|----|--|----------|
| 1  | Q. | Actually, before I do that, you mentioned            | 12:14:57 |
| 2  |    | in your explanation that there might be a direct     | 12:15:00 |
| 3  |    | branch of the original information bits; do you      | 12:15:03 |
| 4  |    | recall that?   | 12:15:05 |
| 5  | A. | So -- so one way of indicating in a                  | 12:15:05 |
| 6  |    | systems point of view that they're systematic bits   | 12:15:09 |
| 7  |    | would be to draw a direct line from the input to the | 12:15:13 |
| 8  |    | output.  | 12:15:16 |
| 9  |    | MR. DOWD: Okay. So let me show you what              | 12:15:16 |
| 10 |    | I've created as Exhibit 7, please.                   | 12:15:18 |
| 11 |    | (Urbanke Exhibit 7 was marked for                    | 12:15:21 |
| 12 |    | identification and attached to the                   | 12:15:21 |
| 13 |    | transcript.)   | 12:15:50 |
| 14 |    | BY MR. DOWD:   | 12:15:50 |
| 15 | Q. | Do you have Exhibit 7?                               | 12:15:51 |
| 16 | A. | Yes.   | 12:15:52 |
| 17 | Q. | Do you see what I've added is a direct               | 12:15:52 |
| 18 |    | branch from the original information bits to the     | 12:15:55 |
| 19 |    | output?  | 12:15:57 |
| 20 | A. | Yes.   | 12:15:57 |
| 21 | Q. | That's shown in red?                                 | 12:15:58 |
| 22 | A. | Yes.   | 12:15:59 |
| 23 | Q. | And if I wanted to make the RA encoder of            | 12:16:00 |
| 24 |    | Figure 3 a systematic code, Exhibit 7 shows how to   | 12:16:06 |
| 25 |    | do that, right?                                      | 12:16:10 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

112

|    |  |          |
|----|--|----------|
| 1  | MR. GLASS: Objection. Vague. Outside                 | 12:16:12 |
| 2  | the scope.   | 12:16:14 |
| 3  | THE WITNESS: That might be one of the                | 12:16:14 |
| 4  | ways of creating a systematic code.                  | 12:16:15 |
| 5  | BY MR. DOWD:   | 12:16:19 |
| 6  | Q. Okay. And a person of ordinary skill in           | 12:16:19 |
| 7  | the field in 1998 or 1999 would have known how to do | 12:16:22 |
| 8  | what I've shown in Exhibit 7, right?                 | 12:16:26 |
| 9  | MR. GLASS: Objection. Vague. Outside                 | 12:16:28 |
| 10 | the scope.   | 12:16:30 |
| 11 | THE WITNESS: As I mentioned, there are               | 12:16:30 |
| 12 | many ways of taking a code word. And if you're       | 12:16:33 |
| 13 | actually having a code which is defined as a set of  | 12:16:37 |
| 14 | code words, there's no a priori definition of what   | 12:16:40 |
| 15 | systematic bits and the parity bits are.             | 12:16:44 |
| 16 | So even though in this representation the            | 12:16:45 |
| 17 | output bits in your original presentation in         | 12:16:48 |
| 18 | Figure 3, in the paper we talked about, the output   | 12:16:51 |
| 19 | bits in some interpretation can naturally be defined | 12:16:55 |
| 20 | as parity bits.                                      | 12:17:01 |
| 21 | You might very well go back and decide               | 12:17:01 |
| 22 | that some of these bits are actually information     | 12:17:04 |
| 23 | bits and some are parity bits and even make a        | 12:17:07 |
| 24 | definition from a nonsystematic code as to one and   | 12:17:10 |
| 25 | revert it to a systematic one in a very different    | 12:17:15 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

113

|    |  |          |
|----|--|----------|
| 1  | way from what you have drawn here. So there's one    | 12:17:18 |
| 2  | way to do it as it's drawn here, but that's          | 12:17:18 |
| 3  | not --   | 12:17:18 |
| 4  | THE REPORTER: Wait. Slow down. Slow                  | 12:17:18 |
| 5  | down. Start again with:                              | 12:17:18 |
| 6  | "So there's one way" --                              | 12:17:25 |
| 7  | THE WITNESS: So there's one way to do it             | 12:17:25 |
| 8  | and that's the way you show it. But that's not       | 12:17:27 |
| 9  | necessarily the only way you can create a systematic | 12:17:29 |
| 10 | code.  | 12:17:32 |
| 11 | BY MR. DOWD:   | 12:17:33 |
| 12 | Q. Fair enough. Let's -- let's break that            | 12:17:33 |
| 13 | down, though, a little bit.                          | 12:17:34 |
| 14 | Understanding there may be other ways that           | 12:17:35 |
| 15 | you could implement Divsalar Figure 3 as a           | 12:17:39 |
| 16 | systematic code, one way to do that would be the way | 12:17:43 |
| 17 | shown in Exhibit 7, correct?                         | 12:17:45 |
| 18 | MR. GLASS: Objection. Outside the scope              | 12:17:47 |
| 19 | of the expert report.                                | 12:17:48 |
| 20 | THE WITNESS: You could create a                      | 12:17:50 |
| 21 | systematic code in that way, yes.                    | 12:17:52 |
| 22 | BY MR. DOWD:   | 12:17:54 |
| 23 | Q. Okay.   | 12:17:55 |
| 24 | MR. DOWD: And let's mark as Exhibit 8 a              | 12:17:55 |
| 25 | further kind of refinement of what that would look   | 12:18:03 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

114

|    |  |          |
|----|--|----------|
| 1  | like.  | 12:18:06 |
| 2  | (Urbanke Exhibit 8 was marked for                    | 12:18:07 |
| 3  | identification and attached to the                   | 12:18:07 |
| 4  | transcript.)   | 12:18:07 |
| 5  | BY MR. DOWD:   | 12:18:07 |
| 6  | Q. So do you have Exhibit 8?                         | 12:18:31 |
| 7  | A. Yes.  | 12:18:33 |
| 8  | Q. And so in Exhibit 8, I'm -- the only thing        | 12:18:33 |
| 9  | I'm really adding is showing what the code word is   | 12:18:36 |
| 10 | at the bottom. Can we agree that Exhibit 8 shows     | 12:18:41 |
| 11 | one way that you could create a systematic code word | 12:18:45 |
| 12 | from the Figure 3 RA code?                           | 12:18:49 |
| 13 | MR. GLASS: Outside the scope of the                  | 12:18:52 |
| 14 | expert report.                                       | 12:18:54 |
| 15 | THE WITNESS: So what this figure --                  | 12:18:58 |
| 16 | there's some interpretation of this figure that      | 12:19:00 |
| 17 | might show a systematic code.                        | 12:19:03 |
| 18 | BY MR. DOWD:   | 12:19:03 |
| 19 | Q. Okay. And so you've got the direct branch         | 12:19:05 |
| 20 | from the original information bits shown in red,     | 12:19:08 |
| 21 | contributing N information bits to the code word; do | 12:19:12 |
| 22 | you see that?  | 12:19:16 |
| 23 | A. I see N information bits appearing                | 12:19:16 |
| 24 | somewhere --   | 12:19:19 |
| 25 | Q. And --  | 12:19:19 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

115

|    |    |  |          |
|----|----|--|----------|
| 1  | A. | -- and labeled:                                      | 12:19:20 |
| 2  |    | "N information bits."                                | 12:19:21 |
| 3  | Q. | Right. And then you've got the qN parity             | 12:19:22 |
| 4  |    | bits from the output of the accumulator, and they're | 12:19:26 |
| 5  |    | contributing those qN parity bits to the code word;  | 12:19:32 |
| 6  |    | do you see that there?                               | 12:19:37 |
| 7  | A. | I see a gray box labeled: "Parity bits,"             | 12:19:37 |
| 8  |    | yes.   | 12:19:41 |
| 9  | Q. | Okay. And am I correct that Exhibit 8                | 12:19:41 |
| 10 |    | shows one way in which you could implement the RA    | 12:19:44 |
| 11 |    | code of Figure 3 as a systematic code?               | 12:19:47 |
| 12 |    | MR. GLASS: Objection. Outside the scope              | 12:19:50 |
| 13 |    | of the expert report.                                | 12:19:51 |
| 14 |    | THE WITNESS: If you wanted to create a               | 12:19:52 |
| 15 |    | systematic RA code, that might be one of the ways    | 12:19:59 |
| 16 |    | that you could do it.                                | 12:20:02 |
| 17 |    | BY MR. DOWD:   | 12:20:03 |
| 18 | Q. | Okay. And that would have been within the            | 12:20:03 |
| 19 |    | skill -- within the toolbox of a person working in   | 12:20:06 |
| 20 |    | this field in 1998, correct?                         | 12:20:10 |
| 21 |    | MR. GLASS: Objection. Vague. And                     | 12:20:11 |
| 22 |    | outside the scope of the expert report.              | 12:20:12 |
| 23 |    | THE WITNESS: I don't have formed a                   | 12:20:14 |
| 24 |    | particular opinion on that.                          | 12:20:19 |
| 25 |    | ///  |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

116

|    |   |          |
|----|---|----------|
| 1  | BY MR. DOWD:  | 12:20:21 |
| 2  | Q. What -- what is your best understanding?         | 12:20:21 |
| 3  | MR. GLASS: Same objection.                          | 12:20:23 |
| 4  | THE WITNESS: I don't know. I have not               | 12:20:23 |
| 5  | studied --  | 12:20:23 |
| 6  | THE REPORTER: Wait. Wait. Wait. You                 | 12:20:23 |
| 7  | have to hold on.                                    | 12:20:23 |
| 8  | Objection, please?                                  | 12:20:27 |
| 9  | MR. GLASS: Same objection. Outside the              | 12:20:27 |
| 10 | scope.  | 12:20:30 |
| 11 | THE WITNESS: I have not been asked to               | 12:20:30 |
| 12 | form an opinion in my expert report and I'd rather  | 12:20:33 |
| 13 | not do this in an ad hoc fashion.                   | 12:20:37 |
| 14 | BY MR. DOWD:  | 12:20:40 |
| 15 | Q. If you asked a Ph.D. in information theory       | 12:20:40 |
| 16 | with two- to three-years' experience in encoding as | 12:20:43 |
| 17 | of 1999, I'd like you to implement the RA code of   | 12:20:48 |
| 18 | Figure 3 as a systematic code, that person would be | 12:20:53 |
| 19 | able to create what we have here on Exhibit 8,      | 12:20:56 |
| 20 | correct?  | 12:21:00 |
| 21 | MR. GLASS: Same objection.                          | 12:21:00 |
| 22 | THE WITNESS: That person might be able to           | 12:21:00 |
| 23 | create a systematic code. Whether or not it would   | 12:21:03 |
| 24 | look like that is anyone's guess.                   | 12:21:05 |
| 25 | ///   |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

117

|    |  |          |
|----|--|----------|
| 1  | BY MR. DOWD:                                   | 12:21:08 |
| 2  | Q. Okay. But one of the -- one of the ways     | 12:21:08 |
| 3  | you could implement exhibit -- withdrawn.      | 12:21:10 |
| 4  | One of the ways you could implement            | 12:21:12 |
| 5  | Figure 3 as a systematic code is as shown in   | 12:21:15 |
| 6  | Exhibit 8, right?                              | 12:21:18 |
| 7  | MR. GLASS: Same objection. Outside the         | 12:21:18 |
| 8  | scope.   | 12:21:20 |
| 9  | THE WITNESS: That might be true that that      | 12:21:20 |
| 10 | is one of the ways that you could create a     | 12:21:24 |
| 11 | systematic code might have been related to the | 12:21:26 |
| 12 | figure that you've shown me.                   | 12:21:29 |
| 13 | MR. DOWD: Let's mark as Exhibit 9 a copy       | 12:21:52 |
| 14 | of the Luby '97 reference.                     | 12:21:54 |
| 15 | (Urbanke Exhibit 9 was marked for              | 12:21:57 |
| 16 | identification and attached to the             | 12:21:57 |
| 17 | transcript.)                                   | 12:22:21 |
| 18 | (Discussion off the record.)                   | 12:22:21 |
| 19 | BY MR. DOWD:                                   | 12:22:22 |
| 20 | Q. Do you have Exhibit 9?                      | 12:22:27 |
| 21 | A. Yes.  | 12:22:28 |
| 22 | Q. Did you recognize it?                       | 12:22:28 |
| 23 | A. Yes. It appears to be the Luby '97 paper.   | 12:22:30 |
| 24 | Q. Okay. If you could, turn to Page 152.       | 12:22:34 |
| 25 | A. Yes.  | 12:22:45 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

118

|    |    |  |          |
|----|----|--|----------|
| 1  | Q. | And there's a heading there:                       | 12:22:45 |
| 2  |    | "Terminology?"                                     | 12:22:47 |
| 3  |    | Do you see that?                                   | 12:22:49 |
| 4  | A. | Yes.   | 12:22:50 |
| 5  | Q. | The second sentence reads:                         | 12:22:50 |
| 6  |    | "In a systematic code, the transmitted             | 12:22:53 |
| 7  |    | symbols can be divided into message                | 12:22:56 |
| 8  |    | symbols and check symbols."                        | 12:22:58 |
| 9  |    | Do you see that?                                   | 12:22:59 |
| 10 | A. | Yes.   | 12:23:00 |
| 11 | Q. | And if we compare that to Exhibit 8, the           | 12:23:02 |
| 12 |    | code word at the bottom has both message symbols,  | 12:23:09 |
| 13 |    | which would be the information bits, and check     | 12:23:17 |
| 14 |    | symbols, which would be the parity bits, right?    | 12:23:21 |
| 15 |    | MR. GLASS: Objection. Vague. Outside               | 12:23:23 |
| 16 |    | the scope.   | 12:23:25 |
| 17 |    | THE WITNESS: Yeah, I don't know what he            | 12:23:25 |
| 18 |    | has defined here as message symbols and check      | 12:23:31 |
| 19 |    | symbols.   | 12:23:34 |
| 20 |    | BY MR. DOWD:                                       | 12:23:35 |
| 21 | Q. | So when you read Luby, you didn't know             | 12:23:35 |
| 22 |    | what a message symbol was?                         | 12:23:38 |
| 23 | A. | There might be a specific definition what          | 12:23:40 |
| 24 |    | he defines here as a message and check symbol. The | 12:23:42 |
| 25 |    | main scope of this paper is not systematic versus  | 12:23:46 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

119

|    |   |          |
|----|---|----------|
| 1  | nonsystematic. The main scope of this paper is to   | 12:23:51 |
| 2  | come up with coding schemes that are linear time    | 12:23:51 |
| 3  | encodable and linear time --                        | 12:23:51 |
| 4  | THE REPORTER: Wait. Hold on. You've got             | 12:23:51 |
| 5  | to slow down. I just can't keep up with you. Okay?  | 12:24:00 |
| 6  | THE WITNESS: Sorry. The main scope of               | 12:24:00 |
| 7  | that paper is to define as coding is come up with a | 12:24:01 |
| 8  | coding scheme that is linear time encodable, linear | 12:24:05 |
| 9  | time decodable and to come up with a particular     | 12:24:10 |
| 10 | analysis for how these various components could be  | 12:24:16 |
| 11 | chosen.   | 12:24:18 |
| 12 | What they came up with is a scheme that             | 12:24:20 |
| 13 | resembles a hierarchical scheme component that look | 12:24:24 |
| 14 | like LDPC components but are much more complicated. | 12:24:28 |
| 15 | That's what the main scope of the paper is about.   | 12:24:33 |
| 16 | MR. DOWD: Move to strike as                         | 12:24:36 |
| 17 | nonresponsive.                                      | 12:24:38 |
| 18 | BY MR. DOWD;  | 12:24:38 |
| 19 | Q. My question, sir, is --                          | 12:24:38 |
| 20 | MR. GLASS: Objection to that -- that                | 12:24:38 |
| 21 | motion.   | 12:24:40 |
| 22 | BY MR. DOWD:  | 12:24:41 |
| 23 | Q. When you read Luby, did you know what Luby       | 12:24:42 |
| 24 | meant by "message symbols"?                         | 12:24:45 |
| 25 | A. There is some interpretation in which I          | 12:24:47 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

120

|    |  |          |
|----|--|----------|
| 1  | can assume what he means on this thing by "message | 12:24:51 |
| 2  | symbols," yes.                                     | 12:24:53 |
| 3  | Q. What do you understand Luby to mean by          | 12:24:53 |
| 4  | "message symbols"?                                 | 12:24:56 |
| 5  | A. A -- one possible interpretation is that        | 12:24:57 |
| 6  | these are symbols that represent the data.         | 12:25:00 |
| 7  | Q. And by "the data," you're referring to          | 12:25:02 |
| 8  | information bits to be encoded?                    | 12:25:06 |
| 9  | A. Yes.  | 12:25:08 |
| 10 | Q. And what did you understand Luby to mean        | 12:25:08 |
| 11 | by "check symbols"?                                | 12:25:11 |
| 12 | A. One possible interpretation is that these       | 12:25:13 |
| 13 | are parity check symbols.                          | 12:25:16 |
| 14 | Q. Okay. And so the check symbols would be         | 12:25:19 |
| 15 | the -- like the parity bits that we've been        | 12:25:22 |
| 16 | discussing, right?                                 | 12:25:24 |
| 17 | MR. GLASS: Outside the scope.                      | 12:25:25 |
| 18 | THE WITNESS: They could be these symbols.          | 12:25:27 |
| 19 | BY MR. DOWD:                                       | 12:25:29 |
| 20 | Q. Okay. Now, Luby is in 1997, right?              | 12:25:29 |
| 21 | A. Yes, that's correct.                            | 12:25:33 |
| 22 | Q. And that's the year before Divsalar in          | 12:25:35 |
| 23 | 1998, right?                                       | 12:25:39 |
| 24 | A. That is correct.                                | 12:25:42 |
| 25 | Q. So before Divsalar people knew about            | 12:25:42 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

121

|    |  |          |
|----|--|----------|
| 1  | systematic codes, right?                             | 12:25:45 |
| 2  | A. Certainly a definition of systematic code         | 12:25:46 |
| 3  | was known beforehand, yes.                           | 12:25:48 |
| 4  | Q. And they knew that you could produce a            | 12:25:50 |
| 5  | code word that had information bits followed by      | 12:25:55 |
| 6  | parity bits, right?                                  | 12:25:58 |
| 7  | A. That is correct.                                  | 12:25:59 |
| 8  | Q. And so if somebody looking at the Divsalar        | 12:26:02 |
| 9  | Figure 3 wanted to implement it as a systematic code | 12:26:07 |
| 10 | as described on Page 152 of Luby '97, one way to do  | 12:26:11 |
| 11 | that is shown in Exhibit 8.                          | 12:26:19 |
| 12 | A. Sorry. Can you please repeat the last             | 12:26:21 |
| 13 | sentence?  | 12:26:25 |
| 14 | Q. Yeah, sure. Let me do it a step at a              | 12:26:25 |
| 15 | time.  | 12:26:28 |
| 16 | If somebody looking at the Divsalar                  | 12:26:28 |
| 17 | Figure 3 wanted to implement it as a systematic code | 12:26:30 |
| 18 | as described on Page 152 of Luby '97, one way to do  | 12:26:33 |
| 19 | so is shown in Exhibit 8, correct?                   | 12:26:39 |
| 20 | MR. GLASS: Objection. Outside the scope.             | 12:26:42 |
| 21 | THE WITNESS: If we take a definition of              | 12:26:44 |
| 22 | systematic code that has -- that is my understanding | 12:26:50 |
| 23 | of systematic codes but that does not refer          | 12:26:53 |
| 24 | particularly to the Luby one, then this picture that | 12:26:56 |
| 25 | you drew might be one way of, perhaps, getting to a  | 12:27:00 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

122

|    |  |          |
|----|--|----------|
| 1  | systematic code.                                   | 12:27:04 |
| 2  | BY MR. DOWD:                                       | 12:27:05 |
| 3  | Q. Okay.   | 12:27:05 |
| 4  | A. Now, whether or not in Luby he has exactly      | 12:27:05 |
| 5  | the same definition or exactly the same objective, | 12:27:09 |
| 6  | that I would have to study further.                | 12:27:13 |
| 7  | Q. Okay. We'll -- we'll come back to that          | 12:27:14 |
| 8  | piece.   | 12:27:17 |
| 9  | MR. DOWD: Why don't we take that lunch             | 12:27:25 |
| 10 | break; I'm about to move to something new.         | 12:27:27 |
| 11 | MR. GLASS: Sure.                                   | 12:27:30 |
| 12 | THE VIDEOGRAPHER: Going off the record.            | 12:27:31 |
| 13 | The time is 12:27 p.m.                             | 12:27:32 |
| 14 | (Lunch recess taken at 12:27 p.m.)                 | 12:27:34 |
| 15 | THE VIDEOGRAPHER: We are back on the               | 01:18:00 |
| 16 | record. The time is 1:18 p.m.                      | 01:18:02 |
| 17 | BY MR. DOWD:                                       | 01:18:07 |
| 18 | Q. Before the break we talked about how an         | 01:18:08 |
| 19 | accumulator operates by combining bits; do you     | 01:18:10 |
| 20 | recall that?                                       | 01:18:13 |
| 21 | A. Exactly.  | 01:18:13 |
| 22 | Q. What is the difference between how an           | 01:18:15 |
| 23 | accumulator operates and how a repeater operates?  | 01:18:17 |
| 24 | A. An accumulator adds information or adds         | 01:18:20 |
| 25 | bits or adds numbers. A repeater repeats bits.     | 01:18:23 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

123

|    |    |  |          |
|----|----|--|----------|
| 1  | Q. | And what does that mean?                             | 01:18:31 |
| 2  | A. | It might in one version prior                        | 01:18:33 |
| 3  |    | copy-and-paste or it might reuse bits, you know, in  | 01:18:38 |
| 4  |    | a number of times, whatever the factor is that the   | 01:18:41 |
| 5  |    | repetition claims.                                   | 01:18:46 |
| 6  | Q. | Okay. Are you familiar with Tanner                   | 01:18:58 |
| 7  |    | graphs?  | 01:19:01 |
| 8  | A. | Yes.   | 01:19:02 |
| 9  |    | MR. DOWD: Let me show you what's been                | 01:19:17 |
| 10 |    | marked as Exhibit 10, a copy of a Tanner graph.      | 01:19:18 |
| 11 |    | (Urbanke Exhibit 10 was marked for                   | 01:19:26 |
| 12 |    | identification and attached to the                   | 01:19:26 |
| 13 |    | transcript.)   | 01:19:27 |
| 14 |    | BY MR. DOWD:   | 01:19:27 |
| 15 | Q. | Do you have Exhibit 10?                              | 01:19:27 |
| 16 | A. | Yes, thank you.                                      | 01:19:28 |
| 17 | Q. | Exhibit 10 is the Tanner graph for a                 | 01:19:29 |
| 18 |    | regular repeat-accumulate code, correct?             | 01:19:35 |
| 19 | A. | Yes. These days, in 2015, that would be              | 01:19:38 |
| 20 |    | how we interpret that.                               | 01:19:40 |
| 21 | Q. | Okay. Now, if I wanted to make this an               | 01:19:43 |
| 22 |    | irregular repeat, one way to do that would be to add | 01:19:48 |
| 23 |    | an additional edge from one of the information nodes | 01:19:55 |
| 24 |    | at the top down to the random permutation box,       | 01:20:02 |
| 25 |    | right?   | 01:20:06 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

124

|    |   |          |
|----|---|----------|
| 1  | MR. GLASS: Objection. Outside the scope.            | 01:20:06 |
| 2  | THE WITNESS: There are many ways of                 | 01:20:07 |
| 3  | taking a code and making it irregular. What you     | 01:20:09 |
| 4  | claim is one particular way.                        | 01:20:11 |
| 5  | But there is a very, very large number of           | 01:20:13 |
| 6  | ways of making a code irregular.                    | 01:20:16 |
| 7  | MR. DOWD: Okay. So let me show you what             | 01:20:19 |
| 8  | I'll mark as Exhibit 11.                            | 01:20:22 |
| 9  | (Urbanke Exhibit 11 was marked for                  | 01:20:35 |
| 10 | identification and attached to the                  | 01:20:35 |
| 11 | transcript.)  | 01:20:40 |
| 12 | BY MR. DOWD:  | 01:20:40 |
| 13 | Q. Do you have Exhibit 11?                          | 01:20:40 |
| 14 | A. Yes.   | 01:20:42 |
| 15 | Q. And do you see that what I've done between       | 01:20:44 |
| 16 | Exhibit 10 and Exhibit 11 is I've added one line in | 01:20:49 |
| 17 | red at the top right. Do you see that?              | 01:20:52 |
| 18 | A. That is correct.                                 | 01:20:55 |
| 19 | Q. And that -- the addition of that                 | 01:20:56 |
| 20 | additional edge makes Exhibit 11 an irregular       | 01:20:59 |
| 21 | repeat-accumulate code, correct?                    | 01:21:05 |
| 22 | MR. GLASS: That's outside the scope.                | 01:21:06 |
| 23 | THE WITNESS: Let me first remark that               | 01:21:07 |
| 24 | that code is extremely small and that adding a      | 01:21:09 |
| 25 | single edge to any code would not have any          | 01:21:13 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

125

|    |  |          |
|----|--|----------|
| 1  | noticeable performance difference. So it means you   | 01:21:15 |
| 2  | might do that in -- perhaps in some particular       | 01:21:18 |
| 3  | version of definition you might be able to interpret | 01:21:20 |
| 4  | it as irregular, but it would have no effect on the  | 01:21:22 |
| 5  | actual performance of the code.                      | 01:21:25 |
| 6  | BY MR. DOWD:   | 01:21:27 |
| 7  | Q. Okay. So I wanted to break that down. I           | 01:21:27 |
| 8  | was going to come to the performance difference in a | 01:21:27 |
| 9  | moment, but --                                       | 01:21:27 |
| 10 | THE REPORTER: Slow down, again. Start                | 01:21:27 |
| 11 | over.  | 01:21:30 |
| 12 | BY MR. DOWD:   | 01:21:30 |
| 13 | Q. Let's break that down. I'll come to the           | 01:21:31 |
| 14 | performance difference between the two in a moment.  | 01:21:35 |
| 15 | But just as a matter of first principles, the        | 01:21:38 |
| 16 | addition of the additional edge at the top right     | 01:21:42 |
| 17 | shown in red makes the code of Exhibit 11 an         | 01:21:46 |
| 18 | irregular repeat-accumulate code, correct?           | 01:21:50 |
| 19 | MR. GLASS: Same objection.                           | 01:21:53 |
| 20 | THE WITNESS: It's a particular version of            | 01:21:54 |
| 21 | making it irregular out of a very large number of    | 01:21:56 |
| 22 | ways of making it irregular.                         | 01:21:59 |
| 23 | BY MR. DOWD:   | 01:22:01 |
| 24 | Q. Okay. Now, the code of Exhibit 11,                | 01:22:01 |
| 25 | because it's an irregular repeat-accumulate code,    | 01:22:15 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

126

|    |  |          |
|----|--|----------|
| 1  | that would be covered by the claims of the asserted  | 01:22:18 |
| 2  | patents, right?                                      | 01:22:22 |
| 3  | MR. GLASS: Objection. Outside the scope.             | 01:22:22 |
| 4  | Calls -- calls for a legal conclusion.               | 01:22:23 |
| 5  | THE WITNESS: I did not study the patents             | 01:22:25 |
| 6  | or the claims or how they relate to the papers in    | 01:22:27 |
| 7  | here.  | 01:22:29 |
| 8  | BY MR. DOWD:   | 01:22:30 |
| 9  | Q. Okay. So you -- you can't tell me one way         | 01:22:30 |
| 10 | or the other?  | 01:22:34 |
| 11 | A. No.   | 01:22:34 |
| 12 | Q. The irregular repeat-accumulate code of           | 01:22:35 |
| 13 | Exhibit 11, that would be an IRA code as you have    | 01:22:39 |
| 14 | described it in your report, correct?                | 01:22:46 |
| 15 | A. You're saying what is -- what is shown in         | 01:22:50 |
| 16 | Exhibit 11, that that would be -- qualify as an IRA  | 01:22:53 |
| 17 | code that is irregular?                              | 01:22:57 |
| 18 | Q. Yes, that's my question.                          | 01:22:58 |
| 19 | A. That is the question?                             | 01:22:59 |
| 20 | Yes, but just to repeat, if you take a               | 01:23:02 |
| 21 | code -- first of all, this code is a ridiculously    | 01:23:07 |
| 22 | small code, it's a toy example so it would not be of | 01:23:09 |
| 23 | any practical use.                                   | 01:23:12 |
| 24 | And in, you know, in any real application            | 01:23:14 |
| 25 | in any -- and -- and to get any benefit, this would  | 01:23:18 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

127

|    |  |          |
|----|--|----------|
| 1  | not be something that is usable in an actual world   | 01:23:21 |
| 2  | because what you have to do is you have to actually  | 01:23:25 |
| 3  | change a fraction of the bits to make them           | 01:23:29 |
| 4  | irregular. Otherwise, it's simply a -- you know, a   | 01:23:32 |
| 5  | mathematical coincidence, perhaps, that you can call | 01:23:35 |
| 6  | that item as irregular depending on how exactly that | 01:23:40 |
| 7  | the definition is --                                 | 01:23:44 |
| 8  | THE REPORTER: Wait. Hold on.                         | 01:23:44 |
| 9  | "...you can call that item..."                       | 01:23:44 |
| 10 | Start there and slow down.                           | 01:23:52 |
| 11 | THE WITNESS: If you could just please                | 01:23:52 |
| 12 | read back to me.                                     | 01:23:52 |
| 13 | THE REPORTER:  | 01:23:52 |
| 14 | "...a mathematical coincidence,                      | 01:23:35 |
| 15 | perhaps, that you can call that item..."             | 01:23:38 |
| 16 | THE WITNESS: That item, an irregular                 | 01:23:53 |
| 17 | repeat-accumulate code, depending on how your        | 01:23:55 |
| 18 | definition is set. But it would have no difference   | 01:23:58 |
| 19 | and could act in essentially exactly the same as a   | 01:24:01 |
| 20 | regular accumulate code.                             | 01:24:04 |
| 21 | BY MR. DOWD:   | 01:24:07 |
| 22 | Q. Okay. So let's take that step by step.            | 01:24:07 |
| 23 | The code that we have as Exhibit 11, that            | 01:24:09 |
| 24 | code -- the performance of that code would not       | 01:24:14 |
| 25 | approach the Shannon limit, correct?                 | 01:24:18 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

128

|    |    |  |          |
|----|----|--|----------|
| 1  | A. | For several reasons it would not even get          | 01:24:20 |
| 2  |    | close. Number one, it's a code that has extremely  | 01:24:23 |
| 3  |    | small length. So a code that has such short length | 01:24:26 |
| 4  |    | could not approach the Shannon limit.              | 01:24:30 |
| 5  |    | Number two, it has essentially no                  | 01:24:32 |
| 6  |    | irregularity.                                      | 01:24:34 |
| 7  | Q. | Well, it does have one irregularity,               | 01:24:34 |
| 8  |    | right?   | 01:24:39 |
| 9  | A. | If that's your definition, "irregularity,"         | 01:24:39 |
| 10 |    | even the regular IRA code is already irregular.    | 01:24:41 |
| 11 | Q. | Well, you testified a moment ago that              | 01:24:45 |
| 12 |    | Exhibit 11 is an irregular repeat-accumulate code, | 01:24:47 |
| 13 |    | right?   | 01:24:51 |
| 14 | A. | That is true according to some definition.         | 01:24:51 |
| 15 |    | I just claimed that even --                        | 01:24:53 |
| 16 | Q. | Okay.  | 01:24:53 |
| 17 | A. | -- Exhibit 10 might also qualify as an             | 01:24:55 |
| 18 |    | irregular one.                                     | 01:24:58 |
| 19 | Q. | Okay. Well, in Exhibit 10 all of the               | 01:24:59 |
| 20 |    | information nodes are repeated the same number of  | 01:25:02 |
| 21 |    | times.   | 01:25:04 |
| 22 | A. | That's not the definition of --                    | 01:25:04 |
| 23 |    | THE REPORTER: Wait. Wait. You cut him              | 01:25:04 |
| 24 |    | off at the end. Please wait for him to finish.     | 01:25:04 |
| 25 |    | THE WITNESS: Sorry.                                | 01:25:10 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

129

|    |  |          |
|----|--|----------|
| 1  | BY MR. DOWD:   | 01:25:10 |
| 2  | Q. So my question is, in Exhibit 10, all of          | 01:25:10 |
| 3  | the information bits are repeated the same number of | 01:25:15 |
| 4  | times, correct?                                      | 01:25:17 |
| 5  | A. That is correct. But that's not --                | 01:25:18 |
| 6  | Q. Okay.   | 01:25:20 |
| 7  | A. That is not the definition of an irregular        | 01:25:21 |
| 8  | code.  | 01:25:23 |
| 9  | Q. Well, let's take it a step at a time.             | 01:25:23 |
| 10 | You're answering questions that I haven't asked.     | 01:25:26 |
| 11 | In Exhibit 11, some number of information            | 01:25:29 |
| 12 | nodes have a degree sequence three and one has a     | 01:25:37 |
| 13 | degree sequence four, right?                         | 01:25:42 |
| 14 | A. That is correct.                                  | 01:25:43 |
| 15 | Q. Okay. Now, the performance of some IRA            | 01:25:45 |
| 16 | codes is better than other IRA codes, right?         | 01:25:53 |
| 17 | A. That is correct.                                  | 01:25:56 |
| 18 | Q. And Exhibit 11 is an example of a poorly          | 01:25:56 |
| 19 | performing IRA code, right?                          | 01:26:00 |
| 20 | A. That I don't know. I have not checked it          | 01:26:02 |
| 21 | out. I don't know whether this code performance      | 01:26:04 |
| 22 | good or well. Depends -- you have to make sure that  | 01:26:07 |
| 23 | the code is corresponding to its length and not      |          |
| 24 | corresponding to --                                  |          |
| 25 | THE REPORTER: Wait. Slow down.                       |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

130

|    |   |          |
|----|---|----------|
| 1  | "You have to..."                                    |          |
| 2  | Start there.  |          |
| 3  | THE WITNESS: I cannot assert that. It               | 01:26:14 |
| 4  | depends on your definition of what a -- a bad code  | 01:26:16 |
| 5  | is. Clearly, the code is very short, so it will     | 01:26:20 |
| 6  | never be an absolute scale it could code. But if    | 01:26:23 |
| 7  | you compare it to the shortest length, I don't know | 01:26:27 |
| 8  | how good this code could be.                        | 01:26:30 |
| 9  | BY MR. DOWD:  | 01:26:32 |
| 10 | Q. Okay.  | 01:26:32 |
| 11 | A. You cannot say that without closer               | 01:26:32 |
| 12 | analysis.   | 01:26:35 |
| 13 | Q. Well, can we agree that the patents cover        | 01:26:35 |
| 14 | bad IRA codes as well as they do good IRA codes?    | 01:26:38 |
| 15 | MR. GLASS: Objection. Outside the scope             | 01:26:42 |
| 16 | of the expert report. Calls for a legal conclusion. | 01:26:43 |
| 17 | THE WITNESS: That I don't know. I've not            | 01:26:45 |
| 18 | studied the patents.                                | 01:26:47 |
| 19 | BY MR. DOWD:  | 01:26:47 |
| 20 | Q. You can't tell me one way or the other?          | 01:26:48 |
| 21 | A. No.  | 01:26:50 |
| 22 | Q. Okay.  | 01:26:54 |
| 23 | MR. DOWD: Let's mark as Exhibit 12                  | 01:27:04 |
| 24 | another copy of what I had previously marked as     | 01:27:07 |
| 25 | Exhibit 10, but I'm going to make one change.       | 01:27:10 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

131

|    |  |          |
|----|--|----------|
| 1  | (Urbanke Exhibit 12 was marked for               | 01:27:13 |
| 2  | identification and attached to the               | 01:27:13 |
| 3  | transcript.)                                     | 01:27:45 |
| 4  | BY MR. DOWD:                                     | 01:27:45 |
| 5  | Q. Do you have Exhibit 12?                       | 01:27:45 |
| 6  | A. Yes.  | 01:27:46 |
| 7  | Q. And let me explain what I'm intending by      | 01:27:46 |
| 8  | the change that I just made.                     | 01:27:49 |
| 9  | Now, instead of only having one of the           | 01:27:50 |
| 10 | information nodes repeated four and all the rest | 01:27:54 |
| 11 | three, now one-half of the information nodes are | 01:27:57 |
| 12 | degree three, the other half are degree four.    | 01:28:04 |
| 13 | A. I understand.                                 | 01:28:07 |
| 14 | Q. And you can have any number of information    | 01:28:07 |
| 15 | nodes so you can get it long.                    | 01:28:09 |
| 16 | A. I understand.                                 | 01:28:12 |
| 17 | Q. Exhibit 12 is an IRA code, right?             | 01:28:14 |
| 18 | A. Yes, I agree.                                 | 01:28:17 |
| 19 | Q. It's an IRA code as you would describe it     | 01:28:19 |
| 20 | in your report, right?                           | 01:28:22 |
| 21 | A. Yes, I agree.                                 | 01:28:23 |
| 22 | Q. And this IRA code would have a fine           | 01:28:24 |
| 23 | performance, right?                              | 01:28:28 |
| 24 | MR. GLASS: Objection. Vague.                     | 01:28:30 |
| 25 | THE WITNESS: I don't know. This is not           | 01:28:31 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

132

|    |   |          |
|----|---|----------|
| 1  | possible to tell simply from looking at a graph.    | 01:28:32 |
| 2  | BY MR. DOWD:  | 01:28:35 |
| 3  | Q. Okay. This IRA code in Exhibit 12 would          | 01:28:36 |
| 4  | be within the scope of the claims of the patent,    | 01:28:39 |
| 5  | correct?  | 01:28:41 |
| 6  | MR. GLASS: Objection. Outside the scope             | 01:28:41 |
| 7  | of the expert report. Calls for a legal conclusion. | 01:28:43 |
| 8  | Go ahead.   | 01:28:45 |
| 9  | THE WITNESS: I have not -- as I mentioned           | 01:28:46 |
| 10 | before, I have not looked at the actual patent      | 01:28:48 |
| 11 | claims. So I cannot determine this.                 | 01:28:52 |
| 12 | BY MR. DOWD:  | 01:28:54 |
| 13 | Q. Okay. But the change to get from an RA           | 01:28:54 |
| 14 | code of Exhibit 10 to the IRA code of Exhibit 12 is | 01:29:01 |
| 15 | you allow for any number of information nodes and   | 01:29:06 |
| 16 | you divide them into two groups, one with a first   | 01:29:10 |
| 17 | degree sequence, the other with a different degree  | 01:29:14 |
| 18 | sequence, right?                                    | 01:29:18 |
| 19 | MR. GLASS: Objection. Vague.                        | 01:29:18 |
| 20 | THE WITNESS: This is your construction.             | 01:29:19 |
| 21 | So it's your definition.                            | 01:29:20 |
| 22 | BY MR. DOWD:  | 01:29:22 |
| 23 | Q. Okay. But if I -- if I make those changes        | 01:29:22 |
| 24 | and none other, that gets me an IRA code, right?    | 01:29:25 |
| 25 | A. As I mentioned, Exhibit 10 already shows         | 01:29:29 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

133

|    |  |          |
|----|--|----------|
| 1  | an IRA code.   | 01:29:31 |
| 2  | Q. Well --   | 01:29:31 |
| 3  | A. With your definition.                             | 01:29:33 |
| 4  | Q. Can you tell me how it is that you                | 01:29:35 |
| 5  | testified when I first showed you Exhibit 10 that it | 01:29:38 |
| 6  | was an RA code?                                      | 01:29:41 |
| 7  | A. It is an RA code, but it can also be --           | 01:29:41 |
| 8  | with your definition of what irregularity means,     | 01:29:45 |
| 9  | it's also already an irregular code.                 | 01:29:47 |
| 10 | Q. Why is that?                                      | 01:29:50 |
| 11 | A. Because the nodes on the bottom have not          | 01:29:51 |
| 12 | the same degree sequence than the nodes on the top.  | 01:29:53 |
| 13 | Q. The nodes on the bottom do not have the           | 01:29:56 |
| 14 | same degree sequence?                                | 01:29:58 |
| 15 | A. They have degree two versus on top have           | 01:29:59 |
| 16 | degree three.  | 01:30:03 |
| 17 | Q. Why is that?                                      | 01:30:03 |
| 18 | A. That's how it is drawn.                           | 01:30:04 |
| 19 | Q. Where do you see the degree two to the --         | 01:30:05 |
| 20 | you're talking about the black nodes at the bottom?  | 01:30:07 |
| 21 | A. No, I'm talking about the black circular          | 01:30:10 |
| 22 | but white inside nodes on the bottom.                | 01:30:13 |
| 23 | Q. Okay. So the very bottom nodes?                   | 01:30:15 |
| 24 | A. Exactly.  | 01:30:18 |
| 25 | Q. Okay. Let me ask you this.                        | 01:30:19 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

134

|    |    |   |          |
|----|----|---|----------|
| 1  | A. | But let me also mention that these are              | 01:30:36 |
| 2  |    | irregular, according to definition, but they're not | 01:30:39 |
| 3  |    | irregular repeat codes. So your definition simply   | 01:30:42 |
| 4  |    | doesn't imply repetition. Your definition of        | 01:30:45 |
| 5  |    | irregularity has nothing to do with repetition.     | 01:30:48 |
| 6  | Q. | Well, what I mean to say is, is Exhibit 10          | 01:30:50 |
| 7  |    | an irregular repeat-accumulate code?                | 01:30:54 |
| 8  | A. | That is true. But according to the expert           | 01:30:56 |
| 9  |    | report of Dr. Frey to which I respond, the          | 01:31:02 |
| 10 |    | definition of irregularity that he uses is not one  | 01:31:05 |
| 11 |    | that was commonly used and is not one that, you     | 01:31:08 |
| 12 |    | know, is the standard definition of irregularity in | 01:31:10 |
| 13 |    | the realm of Tanner graph or LDPC codes.            | 01:31:13 |
| 14 | Q. | Well, let me ask you this, in Exhibit 10            | 01:31:18 |
| 15 |    | you agree that the repetition is regular, not       | 01:31:21 |
| 16 |    | irregular?  | 01:31:24 |
| 17 | A. | If you're talking about repetitions, yes.           | 01:31:25 |
| 18 | Q. | Okay. And let's focus on irregular                  | 01:31:29 |
| 19 |    | repeat-accumulate codes where it's the repetition   | 01:31:32 |
| 20 |    | step that is irregular, okay?                       | 01:31:34 |
| 21 | A. | This is not the definition that's used in           | 01:31:39 |
| 22 |    | the expert report.                                  | 01:31:41 |
| 23 | Q. | Whether that's what Dr. Frey meant or not,          | 01:31:42 |
| 24 |    | can you have that in mind?                          | 01:31:46 |
| 25 | A. | I -- my reaction is to whatever the expert          | 01:31:47 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

135

|    |  |          |
|----|--|----------|
| 1  | report is, that's what I was asked to react, and my  | 01:31:50 |
| 2  | claim is that the definition of irregularity in      | 01:31:55 |
| 3  | there used is not the correct definition. It's not   | 01:31:57 |
| 4  | the definition that was used in time.                | 01:32:00 |
| 5  | It's a definition that's perhaps suitable            | 01:32:01 |
| 6  | for the particular purpose of showing whatever he    | 01:32:04 |
| 7  | wanted to show. But it's not a valid definition.     | 01:32:07 |
| 8  | Q. What's the definition that's correct?             | 01:32:09 |
| 9  | A. The standard definition in a round of LDPC        | 01:32:11 |
| 10 | codes is the definition that a regular code would be | 01:32:14 |
| 11 | one in which all the variable nodes would be --      | 01:32:23 |
| 12 | THE REPORTER: Wait. I'm sorry.                       | 01:32:23 |
| 13 | "A regular code"?                                    | 01:32:23 |
| 14 | THE WITNESS: A regular code would be one             | 01:32:26 |
| 15 | in which all the nodes would have one particular     | 01:32:28 |
| 16 | degree and all the check nodes would have one        | 01:32:30 |
| 17 | particular degree.                                   | 01:32:30 |
| 18 | BY MR. DOWD:   | 01:32:30 |
| 19 | Q. And do those degrees have to be the same?         | 01:32:30 |
| 20 | A. No.   | 01:32:33 |
| 21 | MR. DOWD: Okay. So why don't we -- why               | 01:32:48 |
| 22 | don't we do this, first let's mark as Exhibit 13     | 01:32:50 |
| 23 | a -- another Tanner graph.                           | 01:33:12 |
| 24 | ///  |          |
| 25 | ///  |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

136

|    |  |          |
|----|--|----------|
| 1  | (Urbanke Exhibit 13 was marked for                   | 01:33:16 |
| 2  | identification and attached to the                   | 01:33:16 |
| 3  | transcript.)   | 01:33:22 |
| 4  | BY MR. DOWD:   | 01:33:23 |
| 5  | Q. Do you have Exhibit 13?                           | 01:33:24 |
| 6  | A. Yes.  | 01:33:25 |
| 7  | Q. Is Exhibit 13 using your understanding of         | 01:33:25 |
| 8  | what a -- an irregular repeat-accumulate code is for | 01:33:33 |
| 9  | purposes of this case? Is it -- is Exhibit 13 an     | 01:33:35 |
| 10 | IRA code or an RA code?                              | 01:33:41 |
| 11 | A. Exhibit 13, if I see this correctly, and          | 01:33:45 |
| 12 | all the -- so simply seeing that itself, okay, would | 01:33:50 |
| 13 | require a lot of interpretation. It's not obvious    | 01:33:54 |
| 14 | from the pictures, so let me just explain a little   | 01:33:57 |
| 15 | bit. I'm not trying to nitpick here but explain      | 01:34:00 |
| 16 | why.   | 01:34:02 |
| 17 | Q. Sure.   | 01:34:04 |
| 18 | A. Standard way of representing RA codes at          | 01:34:05 |
| 19 | the time was not that picture. So to getting from    | 01:34:08 |
| 20 | the original representation, a representation        | 01:34:08 |
| 21 | that --  | 01:34:11 |
| 22 | THE REPORTER: Wait. Wait. We're going                | 01:34:14 |
| 23 | to start again, and you're going to go slower this   | 01:34:14 |
| 24 | time.  | 01:34:15 |
| 25 | THE WITNESS: The standard representation             | 01:34:15 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

137

|    |  |          |
|----|--|----------|
| 1  | of RA codes at that time is not according to this    | 01:34:17 |
| 2  | picture. The standard representation of RA codes at  | 01:34:21 |
| 3  | that time used the system's point of view, the one   | 01:34:25 |
| 4  | that we had talked about beforehand in Exhibit 6 --  | 01:34:28 |
| 5  | no, 7, I believe, and 8.                             | 01:34:35 |
| 6  | BY MR. DOWD:   | 01:34:38 |
| 7  | Q. So if it I can just pause there to                | 01:34:38 |
| 8  | understand the difference you're drawing.            | 01:34:40 |
| 9  | You're saying that at the time you would             | 01:34:42 |
| 10 | use a figure like Figure 3 of Divsalar, not a Tanner | 01:34:44 |
| 11 | graph like what I've marked as Exhibit 13?           | 01:34:47 |
| 12 | A. Exactly. Yes.                                     | 01:34:50 |
| 13 | Q. Okay. With that, setting that aside, is           | 01:34:52 |
| 14 | Exhibit 13 a regular or irregular repeat-accumulate  | 01:34:56 |
| 15 | code?  | 01:34:59 |
| 16 | A. So if you'd just allow me a little bit to         | 01:35:00 |
| 17 | elaborate on the point.                              | 01:35:04 |
| 18 | Whether or not that corresponds to an IRA            | 01:35:06 |
| 19 | code, it's one interpretation that it could be an RA | 01:35:09 |
| 20 | code or IRA code. But there are many other possible  | 01:35:12 |
| 21 | representations in the realm of LDPC codes. So this  | 01:35:15 |
| 22 | is not one particular code.                          | 01:35:18 |
| 23 | What it requires would be a certain                  | 01:35:19 |
| 24 | interpretation of what these nodes actually mean.    | 01:35:22 |
| 25 | So, for example, it would require that I interpret   | 01:35:24 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

138

|    |  |          |
|----|--|----------|
| 1  | the top nodes as information bits and the bottom     | 01:35:26 |
| 2  | nodes as parity bits, but this is not actually on    | 01:35:30 |
| 3  | the figure.  | 01:35:33 |
| 4  | Q. Okay.   | 01:35:33 |
| 5  | A. No one tells me that that is.                     | 01:35:33 |
| 6  | Q. Assume that that's true, assume that in           | 01:35:36 |
| 7  | each of the figures that I've handed you, like from  | 01:35:38 |
| 8  | Exhibit 10 through 13, the top open circles are      | 01:35:43 |
| 9  | information nodes, the bottom open circles are --    | 01:35:46 |
| 10 | let me make sure I have it right -- parity nodes,    | 01:36:00 |
| 11 | and the filled in circles in between are check       | 01:36:13 |
| 12 | nodes, okay?   | 01:36:16 |
| 13 | A. Yes.  | 01:36:18 |
| 14 | Q. So with that, in Exhibit 13, is this an           | 01:36:19 |
| 15 | irregular repeat-accumulate code or a regular        | 01:36:27 |
| 16 | repeat-accumulate code?                              | 01:36:30 |
| 17 | A. So just to make sure. This requires a lot         | 01:36:32 |
| 18 | of interpretation. So more than half the terms       | 01:36:35 |
| 19 | that, you know, require me to give you an answer are | 01:36:38 |
| 20 | actually not on that picture. So, you know, with     | 01:36:40 |
| 21 | this kind of interpretation, with these Luby         | 01:36:45 |
| 22 | interpretation, I could claim that this is quite a   | 01:36:49 |
| 23 | few different code structures. I could claim, for    | 01:36:51 |
| 24 | example, it was an LDPC code if you allow me to      | 01:36:55 |
| 25 | interpret the various nodes in a particular way.     | 01:36:57 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

139

|    |  |          |
|----|--|----------|
| 1  | And there might be many other codes that I           | 01:36:59 |
| 2  | can interpret like this. So there is one particular  | 01:37:02 |
| 3  | way that I can interpret this --                     | 01:37:02 |
| 4  | THE REPORTER: Hold on. Slow down. Start              | 01:37:02 |
| 5  | again.   | 01:37:08 |
| 6  | THE WITNESS: There is -- there is a way              | 01:37:08 |
| 7  | that I can interpret that as an RA code, but it      | 01:37:09 |
| 8  | requires many, many jumps from the original          | 01:37:12 |
| 9  | representation. It would require me to know that     | 01:37:15 |
| 10 | the original system's point of view can be connected | 01:37:19 |
| 11 | or can be represented in this way. It would require  | 01:37:21 |
| 12 | me to understand what the roles of the various nodes | 01:37:24 |
| 13 | are, and it would require to understand exactly what | 01:37:28 |
| 14 | the relationship between the two are.                | 01:37:32 |
| 15 | These are fairly giant steps to be done in           | 01:37:34 |
| 16 | order to come to this interpretation. And if you     | 01:37:38 |
| 17 | allow me that degrees of freedom, there are many,    | 01:37:40 |
| 18 | many interpretations I can give you of this picture. | 01:37:43 |
| 19 | MR. DOWD: Well, why don't we set                     | 01:37:46 |
| 20 | Exhibit 13 aside, and we can go back to Exhibit --   | 01:37:49 |
| 21 | Exhibits 10 and 12, okay.                            | 01:37:51 |
| 22 | Q. And I'd like to, for the purposes of the          | 01:37:59 |
| 23 | next series of questions, just assume that in order  | 01:38:03 |
| 24 | to be an irregular repeat-accumulate code, the       | 01:38:06 |
| 25 | repetition has to be -- you have to have different   | 01:38:12 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

140

|    |  |          |
|----|--|----------|
| 1  | degrees for different subsets of bits, okay?         | 01:38:15 |
| 2  | A. Sure.   | 01:38:19 |
| 3  | Q. Under -- under that understanding, we can         | 01:38:20 |
| 4  | agree that Exhibit 10 is regular, right?             | 01:38:24 |
| 5  | A. So with an additional -- with the                 | 01:38:27 |
| 6  | additional interpretation of what these nodes        | 01:38:31 |
| 7  | actually mean, that the top nodes would be -- would  | 01:38:33 |
| 8  | have to be interpreted as information bits, that the | 01:38:37 |
| 9  | black nodes would have to be interpreted as parity   | 01:38:41 |
| 10 | bits, and that the bottom bits would have to be      | 01:38:44 |
| 11 | interpreted as parity -- sort of parity checks, and  | 01:38:47 |
| 12 | the bottom one as parity bits. Then a valid          | 01:38:51 |
| 13 | interpretation of that graph would be of an RA code. | 01:38:55 |
| 14 | Q. And if we go to Exhibit 12, to change             | 01:38:58 |
| 15 | Exhibit 10 to an irregular repeat-accumulate code,   | 01:39:07 |
| 16 | you would simply make half of the information nodes  | 01:39:11 |
| 17 | have a different degree than the other half, right?  | 01:39:17 |
| 18 | A. It depends what your definition of                | 01:39:20 |
| 19 | irregular RA code is. If your definition is what     | 01:39:22 |
| 20 | the expert, Dr. Frey, was irregularity --            | 01:39:26 |
| 21 | THE REPORTER: Wait. Wait.                            | 01:39:29 |
| 22 | "...what the expert..."                              | 01:39:29 |
| 23 | Slow down, please.                                   | 01:39:29 |
| 24 | THE WITNESS: If the definition is                    | 01:39:31 |
| 25 | according to what, you know, Dr. Frey said, into --  | 01:39:32 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

141

|    |  |          |
|----|--|----------|
| 1  | a very particular definition of irregularity which   | 01:39:37 |
| 2  | is not the standard definition so that you have very | 01:39:41 |
| 3  | strict restrictions of how you have to interpret     | 01:39:43 |
| 4  | those nodes, then you could interpret that has an RA | 01:39:45 |
| 5  | code.  | 01:39:48 |
| 6  | But if you didn't have that in place,                | 01:39:48 |
| 7  | there would be many ways to interpret that.          | 01:39:52 |
| 8  | BY MR. DOWD:   | 01:39:54 |
| 9  | Q. Okay. Before I began this set of                  | 01:39:54 |
| 10 | questions, I said: Assume with me that for these     | 01:39:56 |
| 11 | questions an irregular repeat-accumulate code, the   | 01:40:00 |
| 12 | irregular is of the repetition, okay? Do you recall  | 01:40:06 |
| 13 | that?  | 01:40:09 |
| 14 | A. Uh-huh.   | 01:40:09 |
| 15 | Q. So with that in mind, Exhibit 12 shows            | 01:40:10 |
| 16 | what you need to do to make an RA code an IRA code,  | 01:40:14 |
| 17 | right?   | 01:40:23 |
| 18 | A. It shows that if you assume that you have         | 01:40:23 |
| 19 | Picture 10, that you interpret that as an RA Code,   | 01:40:26 |
| 20 | which is not the standard, you know, definition at   | 01:40:29 |
| 21 | the time, and it's not the standard view. It's the   | 01:40:31 |
| 22 | view now, in 2015, in hindsight, you can interpret   | 01:40:34 |
| 23 | going from Picture 10 to Picture 12 in adding these  | 01:40:38 |
| 24 | irregularity, I agree.                               | 01:40:42 |
| 25 | Q. Okay. Okay. Now, I think you've just              | 01:40:44 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

142

|    |   |          |
|----|---|----------|
| 1  | been getting at this, but if we turn to your report | 01:41:19 |
| 2  | at Paragraph 152. Just let me know when you have    | 01:41:22 |
| 3  | that.   | 01:41:28 |
| 4  | A. Yes.   | 01:41:34 |
| 5  | Q. Now, there you say that:                         | 01:41:34 |
| 6  | "Turbo codes and LDPC codes were                    | 01:41:37 |
| 7  | described using very different language             | 01:41:40 |
| 8  | and representations prior to the                    | 01:41:41 |
| 9  | invention."   | 01:41:43 |
| 10 | Do you see that there?                              | 01:41:44 |
| 11 | A. Yes.   | 01:41:45 |
| 12 | Q. And then if we go back to Paragraph 28,          | 01:41:45 |
| 13 | you're describing different groups of researchers   | 01:41:59 |
| 14 | working on codes. You say there's a traditional     | 01:42:05 |
| 15 | coding theorist's group and a group of researchers  | 01:42:08 |
| 16 | with computer science, physics, and mathematics     | 01:42:11 |
| 17 | backgrounds, right?                                 | 01:42:15 |
| 18 | A. Yes.   | 01:42:16 |
| 19 | Q. And then you say in Paragraph 29 that:           | 01:42:16 |
| 20 | "Although these researchers all had a               | 01:42:21 |
| 21 | common goal, different groups branched off          | 01:42:24 |
| 22 | in different directions and there was not           | 01:42:26 |
| 23 | much interaction between these different            | 01:42:28 |
| 24 | research branches."                                 | 01:42:31 |
| 25 | Right?  | 01:42:34 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

143

|    |    |  |          |
|----|----|--|----------|
| 1  | A. | Yes.   | 01:42:34 |
| 2  | Q. | Did you base the opinions expressed in               | 01:42:35 |
| 3  |    | your report on the belief that a researcher in one   | 01:42:40 |
| 4  |    | of these groups would have been unaware of the       | 01:42:43 |
| 5  |    | publications from researchers in the other group?    | 01:42:46 |
| 6  | A. | It's much more than unaware of                       | 01:42:51 |
| 7  |    | application. You have to imagine that the way these  | 01:42:55 |
| 8  |    | papers were written, they were written in an         | 01:42:57 |
| 9  |    | entirely different language.                         | 01:43:00 |
| 10 |    | So even though, perhaps, you know, you               | 01:43:01 |
| 11 |    | would have one sentence that expresses exactly the   | 01:43:05 |
| 12 |    | same facts, there might not be a single word that    | 01:43:08 |
| 13 |    | actually is common, you know, in these sentences.    | 01:43:10 |
| 14 |    | So it's essentially as if you came in a              | 01:43:13 |
| 15 |    | room where you would have people of all kinds of     | 01:43:16 |
| 16 |    | languages. They might all have a similar aim in      | 01:43:19 |
| 17 |    | mind and they might all talk about -- at the end     | 01:43:22 |
| 18 |    | about the same aim, about the same kind of objects.  | 01:43:25 |
| 19 |    | But if someone speaks Spanish, the second            | 01:43:28 |
| 20 |    | person speaks, let's say, Chinese, and the first one | 01:43:32 |
| 21 |    | speaks German, it is quite difficult to actually do  | 01:43:36 |
| 22 |    | the translation.                                     | 01:43:40 |
| 23 |    | So this is not just something whether or             | 01:43:40 |
| 24 |    | not you have something in -- you know, in front of   | 01:43:43 |
| 25 |    | you. But it would be very difficult to interpret     | 01:43:45 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

144

|    |  |          |
|----|--|----------|
| 1  | whatever you have seen in your language seeing       | 01:43:48 |
| 2  | something in a different language.                   | 01:43:50 |
| 3  | MR. DOWD: Okay. Let's -- let's break                 | 01:43:53 |
| 4  | that down because I'm going to move to strike as     | 01:43:53 |
| 5  | nonresponsive.                                       | 01:43:57 |
| 6  | MR. GLASS: And object if you do move to              | 01:43:58 |
| 7  | strike.  | 01:44:00 |
| 8  | BY MR. DOWD:   | 01:44:01 |
| 9  | Q. My question was, is it your -- withdrawn.         | 01:44:02 |
| 10 | Did you base the opinions in your report             | 01:44:06 |
| 11 | on a belief that the researcher in one group would   | 01:44:08 |
| 12 | not have known about the publication of a researcher | 01:44:11 |
| 13 | in another group?                                    | 01:44:15 |
| 14 | A. No.   | 01:44:17 |
| 15 | Q. Okay. All of Divsalar, Luby '97,                  | 01:44:18 |
| 16 | Luby '98, Richardson '99, the Frey '99 paper, they   | 01:44:22 |
| 17 | were all actually written in the English language,   | 01:44:30 |
| 18 | right?   | 01:44:32 |
| 19 | A. English is language that was actually used        | 01:44:32 |
| 20 | to express it.                                       | 01:44:35 |
| 21 | Q. Okay.   | 01:44:36 |
| 22 | A. But the -- no, this is not the same thing.        | 01:44:36 |
| 23 | You -- I can give you easily examples of a sentence  | 01:44:39 |
| 24 | where one in the same sentence would express exactly | 01:44:43 |
| 25 | the same thing and they might share essentially no   | 01:44:46 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

145

|    |  |          |
|----|--|----------|
| 1  | words.   | 01:44:49 |
| 2  | Q. And is it your position that a Ph.D. in           | 01:44:50 |
| 3  | this field with two to three years of experience     | 01:44:57 |
| 4  | with error correction codes would be unable to       | 01:44:59 |
| 5  | understand what was said in one of these papers if   | 01:45:04 |
| 6  | it was published by a person of an opposite group?   | 01:45:07 |
| 7  | A. I can tell you that studying in 1999,             | 01:45:12 |
| 8  | 2000, we had a sequence of workshops trying exactly  | 01:45:17 |
| 9  | to bring these kind of groups together. It has       | 01:45:21 |
| 10 | taken essentially about 10 years until people in the | 01:45:25 |
| 11 | various groups can comfortably talk to each other.   | 01:45:28 |
| 12 | So this is not a trivial effort that is undertaking. | 01:45:31 |
| 13 | It's not something -- imagine like learning another  | 01:45:35 |
| 14 | language.  | 01:45:37 |
| 15 | You know, perhaps some people are more               | 01:45:37 |
| 16 | gifted, some people are less gifted, but it's not a  | 01:45:40 |
| 17 | trivial effort of simply plugging in something and   | 01:45:44 |
| 18 | simply having a dictionary or something like that.   | 01:45:46 |
| 19 | It's a serious effort that is required.              | 01:45:49 |
| 20 | Q. My question is, is it your position that a        | 01:45:51 |
| 21 | traditional coding theorist reading a publication    | 01:45:56 |
| 22 | such as Luby which came from the computer science    | 01:46:00 |
| 23 | group would not be able to understand what Luby was  | 01:46:03 |
| 24 | saying?  | 01:46:05 |
| 25 | A. It's my position that to start with a             | 01:46:05 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

146

|    |  |          |
|----|--|----------|
| 1  | person in coding theory would have not even been     | 01:46:07 |
| 2  | able to judge at that point whatever was written in  | 01:46:13 |
| 3  | Luby was actually of interest to him or her.         | 01:46:16 |
| 4  | Because the way things were represented              | 01:46:19 |
| 5  | were so different that, you know, the -- the kind of | 01:46:21 |
| 6  | objective, if they were done, the standard pictures  | 01:46:24 |
| 7  | that were done to prove that these things were good  | 01:46:28 |
| 8  | were so different that it was far from obvious that  | 01:46:32 |
| 9  | whatever was written in this paper was relevant to   | 01:46:34 |
| 10 | potentially their problem.                           | 01:46:37 |
| 11 | Q. Well, my question is not would they have          | 01:46:39 |
| 12 | been able to judge whether it was of interest or     | 01:46:46 |
| 13 | whether it was good.                                 | 01:46:48 |
| 14 | My question is, if they read the words in            | 01:46:49 |
| 15 | English, would they be able to understand what the   | 01:46:53 |
| 16 | words meant?   | 01:46:55 |
| 17 | A. They might have to read several papers to         | 01:46:58 |
| 18 | understand them. They might have to go back to, you  | 01:47:01 |
| 19 | know, other literature to understand, perhaps, what  | 01:47:05 |
| 20 | is written in there.                                 | 01:47:07 |
| 21 | Q. Okay. But they could read the English             | 01:47:08 |
| 22 | language and they could understand what it meant,    | 01:47:11 |
| 23 | correct?   | 01:47:15 |
| 24 | A. If a physicist, for example, talks about a        | 01:47:15 |
| 25 | long code, he's talking about -- you know, in a      | 01:47:18 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

147

|    |   |          |
|----|---|----------|
| 1  | completely different way. Now, you know, this is a  | 01:47:22 |
| 2  | single word that he's using, we are using, let's    | 01:47:26 |
| 3  | say, a symptotic, right, they --                    | 01:47:26 |
| 4  | THE REPORTER: Wait.                                 | 01:47:26 |
| 5  | "We are using..."                                   | 01:47:41 |
| 6  | THE WITNESS: For example, in our -- in              | 01:47:41 |
| 7  | EE, people would be talking about the symptotic     |          |
| 8  | limit. Physicists would talk --                     |          |
| 9  | THE REPORTER: Wait. Wait. I'm -- I'm                |          |
| 10 | not understanding you. You're going to have to slow |          |
| 11 | down and repeat yourself, please.                   |          |
| 12 | THE WITNESS: For example, to give you one           | 01:47:43 |
| 13 | trivial example, if people in E talking about long  | 01:47:44 |
| 14 | codes, they were talking about, let's say, a        | 01:47:47 |
| 15 | symptotically long codes, a physicist would be      | 01:47:50 |
| 16 | talking about the thermodynamic limit. It's far     | 01:47:53 |
| 17 | from obvious that these two things even relate to   | 01:47:57 |
| 18 | each other. And you would need a person to get      | 01:48:00 |
| 19 | started to tell you which of these terms indeed at  | 01:48:02 |
| 20 | first relate to each other in order to get started. | 01:48:07 |
| 21 | I'm not claiming that it is impossible to           | 01:48:09 |
| 22 | learn. People have learned it. But it is a serious  | 01:48:11 |
| 23 | effort to do and it's by far not obvious to do.     | 01:48:14 |
| 24 | MR. DOWD: Let's mark as Exhibit 14, a               | 01:48:33 |
| 25 | copy of the thesis of Dr. Khandekar.                | 01:48:36 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

148

|    |   |          |
|----|---|----------|
| 1  | (Urbanke Exhibit 14 was marked for              | 01:48:42 |
| 2  | identification and attached to the              | 01:48:42 |
| 3  | transcript.)                                    | 01:48:53 |
| 4  | BY MR. DOWD:                                    | 01:48:53 |
| 5  | Q. Do you have Exhibit 14?                      | 01:48:53 |
| 6  | A. Yes.   | 01:48:54 |
| 7  | Q. Do you recognize it?                         | 01:48:55 |
| 8  | A. It says:                                     | 01:48:57 |
| 9  | "Graph-based Codes in Iterative                 | 01:48:58 |
| 10 | Decoding, Thesis by Aamod Khandekar."           | 01:49:00 |
| 11 | Q. So Exhibit 14 is the Ph.D. thesis that       | 01:49:03 |
| 12 | Dr. Khandekar submitted, right?                 | 01:49:09 |
| 13 | A. That's what it says on the page.             | 01:49:11 |
| 14 | Q. Have you reviewed Dr. Khandekar's thesis     | 01:49:13 |
| 15 | before?   | 01:49:16 |
| 16 | A. I must have leafed through it but not in     | 01:49:17 |
| 17 | any detail.                                     | 01:49:20 |
| 18 | Q. Now, before Dr. Khandekar had been awarded   | 01:49:21 |
| 19 | his Ph.D.; in other words, at the time he was   | 01:49:29 |
| 20 | writing this document, he did not have a Ph.D., | 01:49:31 |
| 21 | right?  | 01:49:36 |
| 22 | A. Presumably not.                              | 01:49:36 |
| 23 | Q. He had not been working in the field for     | 01:49:44 |
| 24 | two to three years, right?                      | 01:49:46 |
| 25 | A. I don't know exactly his employment          | 01:49:48 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

149

|    |  |          |
|----|--|----------|
| 1  | history. I don't know how long he actually studied.  | 01:49:50 |
| 2  | He might have very well started on a master's level. | 01:49:52 |
| 3  | Q. Turn to Page 3311. Now, on this page,             | 01:49:56 |
| 4  | Dr. Khandekar shows a -- an example of the           | 01:50:13 |
| 5  | repeat-accumulate codes introduced in 15; do you see | 01:50:27 |
| 6  | that?  | 01:50:31 |
| 7  | A. I see a picture, yes.                             | 01:50:31 |
| 8  | Q. And there's a representation of a                 | 01:50:33 |
| 9  | repeat-accumulate code like the one we saw in        | 01:50:39 |
| 10 | Figure 3 of Divsalar, right?                         | 01:50:41 |
| 11 | A. The figure heading says: "A small Tanner          | 01:50:42 |
| 12 | graph."  | 01:50:42 |
| 13 | THE REPORTER: Wait. I'm sorry, I didn't              | 01:50:42 |
| 14 | hear that part. Please repeat.                       | 01:50:46 |
| 15 | THE WITNESS: The figure heading says: "A             | 01:50:46 |
| 16 | small Tanner graph."                                 | 01:50:48 |
| 17 | BY MR. DOWD:   | 01:50:49 |
| 18 | Q. You're on Page 3311?                              | 01:50:49 |
| 19 | A. Oh, sorry, 3312, sorry. Okay.                     | 01:50:51 |
| 20 | Q. So on Page 3311 there's Figure 1.4, a             | 01:50:56 |
| 21 | repeat-accumulate code, right?                       | 01:51:01 |
| 22 | A. Figure -- you're talking about Figure 13?         | 01:51:02 |
| 23 | Q. 1.4 in the middle of the page.                    | 01:51:05 |
| 24 | A. 1.4, the heading says: "A                         | 01:51:08 |
| 25 | repeat-accumulate code." Yes.                        | 01:51:12 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

150

|    |    |   |          |
|----|----|---|----------|
| 1  | Q. | And in the paragraph right above that he        | 01:51:12 |
| 2  |    | says:   | 01:51:15 |
| 3  |    | "One example of the SCCC case is the            | 01:51:16 |
| 4  |    | ensemble of repeat-accumulate (RA) codes        | 01:51:20 |
| 5  |    | introduced in 15."                              | 01:51:25 |
| 6  |    | Right?  | 01:51:26 |
| 7  | A. | I see that, yes.                                | 01:51:27 |
| 8  | Q. | And if you turn to Page 3400, near the          | 01:51:28 |
| 9  |    | back.   | 01:51:37 |
| 10 | A. | Yes.  | 01:51:44 |
| 11 | Q. | We see that Reference 15 is the Divsalar        | 01:51:45 |
| 12 |    | 1998 RA codes paper that we've been discussing, | 01:51:48 |
| 13 |    | right?  | 01:51:54 |
| 14 | A. | Okay.   | 01:51:54 |
| 15 | Q. | Do you see that there?                          | 01:51:55 |
| 16 | A. | I see Reference Number 15, yes.                 | 01:51:56 |
| 17 | Q. | And that's the Divsalar RA codes paper,         | 01:51:58 |
| 18 |    | right?  | 01:52:02 |
| 19 | A. | Yes.  | 01:52:02 |
| 20 | Q. | So Dr. Khandekar was aware of the Divsalar      | 01:52:04 |
| 21 |    | RA codes paper, right?                          | 01:52:08 |
| 22 |    | MR. GLASS: Objection. Outside the scope.        | 01:52:10 |
| 23 |    | THE WITNESS: Dr. Khandekar, as far as I         | 01:52:11 |
| 24 |    | know, was a Ph.D. student of Dr. -- or          | 01:52:14 |
| 25 |    | Professor MacKay.                               | 01:52:20 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

151

|    |   |          |
|----|---|----------|
| 1  | BY MR. DOWD:  | 01:52:20 |
| 2  | Q. My question was, Dr. Khandekar, as               | 01:52:20 |
| 3  | demonstrated by his thesis, he was aware of the     | 01:52:24 |
| 4  | Divsalar paper, right?                              | 01:52:26 |
| 5  | MR. GLASS: Same objection.                          | 01:52:28 |
| 6  | THE WITNESS: It was a paper written by              | 01:52:28 |
| 7  | his advisor.  | 01:52:30 |
| 8  | BY MR. DOWD:  | 01:52:32 |
| 9  | Q. So he was aware of it, right?                    | 01:52:32 |
| 10 | MR. GLASS: Same objection.                          | 01:52:34 |
| 11 | THE WITNESS: A student is aware of a                | 01:52:35 |
| 12 | paper by his advisor.                               | 01:52:37 |
| 13 | BY MR. DOWD:  | 01:52:39 |
| 14 | Q. Okay. Now, if we go back to Page 3311, he        | 01:52:40 |
| 15 | uses the Divsalar paper to explain the operation of | 01:52:48 |
| 16 | an RA code, right?                                  | 01:52:50 |
| 17 | MR. GLASS: Objection. Beyond the scope              | 01:52:51 |
| 18 | of the expert report.                               | 01:52:52 |
| 19 | THE WITNESS: I don't know. I have not               | 01:52:53 |
| 20 | looked at that thesis in that detail and so I'm not | 01:52:54 |
| 21 | prepared to answer that.                            | 01:52:57 |
| 22 | BY MR. DOWD:  | 01:52:57 |
| 23 | Q. You can't say one way or the other?              | 01:52:58 |
| 24 | A. It is not what my expert report is about.        | 01:53:00 |
| 25 | And so this thesis is not something that I reviewed | 01:53:02 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

152

|    |  |          |
|----|--|----------|
| 1  | in detail in accordance with my expert report.       | 01:53:06 |
| 2  | Q. Well, if we go to Page 3315, you see              | 01:53:10 |
| 3  | there's a Figure 1.6?                                | 01:53:13 |
| 4  | A. Yes.  | 01:53:16 |
| 5  | Q. And that figure is labeled: "The Tanner           | 01:53:18 |
| 6  | Graph of an RA Code." Right?                         | 01:53:22 |
| 7  | A. That is what the figure heading says.             | 01:53:25 |
| 8  | Q. And so at least Dr. Khandekar was aware           | 01:53:29 |
| 9  | that the RA codes could be represented as Tanner     | 01:53:34 |
| 10 | graphs, right?                                       | 01:53:39 |
| 11 | MR. GLASS: Same objection.                           | 01:53:39 |
| 12 | THE WITNESS: As far as I read, the thesis            | 01:53:40 |
| 13 | was published in 2002.                               | 01:53:42 |
| 14 | BY MR. DOWD:   | 01:53:44 |
| 15 | Q. My question is, Dr. Khandekar was aware           | 01:53:44 |
| 16 | that RA codes could be represented as Tanner graphs, | 01:53:48 |
| 17 | right?   | 01:53:52 |
| 18 | MR. GLASS: Same objection.                           | 01:53:52 |
| 19 | THE WITNESS: That's something I think you            | 01:53:52 |
| 20 | would have to ask him. And the only thing I know is  | 01:53:53 |
| 21 | that the thesis was published in 2002.               | 01:53:56 |
| 22 | BY MR. DOWD:   | 01:54:00 |
| 23 | Q. All right. Well, let's go back to                 | 01:54:00 |
| 24 | Page 3293. Do you have the abstract there?           | 01:54:04 |
| 25 | A. Yes.  | 01:54:17 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

153

|    |    |  |          |
|----|----|--|----------|
| 1  | Q. | Now, in the third paragraph, that                    | 01:54:18 |
| 2  |    | paragraph starts:                                    | 01:54:21 |
| 3  |    | "We also introduce a new class of                    | 01:54:22 |
| 4  |    | codes called irregular repeat-accumulate             | 01:54:25 |
| 5  |    | (IRA) codes which are adapted from the               | 01:54:31 |
| 6  |    | previously known class of                            | 01:54:35 |
| 7  |    | repeat-accumulate codes."                            | 01:54:37 |
| 8  |    | Do you see that?                                     | 01:54:38 |
| 9  | A. | Yes.   | 01:54:39 |
| 10 | Q. | And Dr. Khandekar is correct that IRA                | 01:54:40 |
| 11 |    | codes are adapted from RA codes, right?              | 01:54:48 |
| 12 | A. | I don't know the history of how they came            | 01:54:53 |
| 13 |    | about it; but if he says so, then I trust him.       | 01:54:55 |
| 14 | Q. | Okay. So you have no reason to disagree              | 01:54:59 |
| 15 |    | with that statement, right?                          | 01:55:01 |
| 16 | A. | No.  | 01:55:02 |
| 17 | Q. | And then he goes on, in the next sentence,           | 01:55:03 |
| 18 |    | to describe irregular LDPC codes, which he says are: | 01:55:07 |
| 19 |    | Quote, arguably the best class of                    | 01:55:14 |
| 20 |    | codes known today, at least for long                 | 01:55:16 |
| 21 |    | locked lengths.                                      | 01:55:20 |
| 22 |    | Right?   | 01:55:22 |
| 23 | A. | Yes, I see that sentence.                            | 01:55:22 |
| 24 | Q. | So Dr. Khandekar was also aware of                   | 01:55:24 |
| 25 |    | irregular LDPC codes, right?                         | 01:55:29 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

154

|    |  |          |
|----|--|----------|
| 1  | MR. GLASS: Objection. Outside the scope.           | 01:55:31 |
| 2  | THE WITNESS: That, I think, is best posed          | 01:55:33 |
| 3  | to him. I wouldn't know. I know that, you know,    | 01:55:35 |
| 4  | what I can see here, and I know the thesis is      | 01:55:37 |
| 5  | titled -- is dated 2002.                           | 01:55:41 |
| 6  | BY MR. DOWD:                                       | 01:55:42 |
| 7  | Q. Okay. Well, let's turn to Page 3354 --          | 01:55:42 |
| 8  | sorry, 3345. You see there's a Chapter 3 that      | 01:55:57 |
| 9  | begins there on irregular repeat-accumulate codes? | 01:56:08 |
| 10 | A. Yes.  | 01:56:12 |
| 11 | Q. And one of the first things that he talks       | 01:56:13 |
| 12 | about in the middle of the second paragraph are    | 01:56:15 |
| 13 | irregular LDPC codes by Luby, right?               | 01:56:19 |
| 14 | A. I see a sentence there, yes.                    | 01:56:24 |
| 15 | Q. And the two references that he cites are        | 01:56:26 |
| 16 | Luby '97 and Luby '98, right?                      | 01:56:30 |
| 17 | A. Let me check that. That seems to be             | 01:56:32 |
| 18 | correct.   | 01:56:46 |
| 19 | Q. So at least Dr. Khandekar thought that          | 01:56:47 |
| 20 | Luby 7 -- '97 and Luby '98 were relevant to his    | 01:56:52 |
| 21 | irregular repeat-accumulate codes, right?          | 01:56:57 |
| 22 | MR. GLASS: Objection. Outside the scope            | 01:56:59 |
| 23 | of the expert report.                              | 01:57:00 |
| 24 | THE WITNESS: I would not know what he              | 01:57:01 |
| 25 | thought at that point in time. Again, this was in  | 01:57:02 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

155

|    |  |          |
|----|--|----------|
| 1  | 2002. What he thought, I think it's best to pose     | 01:57:05 |
| 2  | the question to him.                                 | 01:57:09 |
| 3  | BY MR. DOWD:   | 01:57:11 |
| 4  | Q. So you have no opinion on that?                   | 01:57:11 |
| 5  | A. How would I know what he thought at that          | 01:57:12 |
| 6  | time?  | 01:57:15 |
| 7  | Q. Well, in a Chapter 3 entitled: "Irregular         | 01:57:15 |
| 8  | Repeat Accumulate Codes," the first two cited        | 01:57:18 |
| 9  | references are Luby '97 and Luby '98.                | 01:57:21 |
| 10 | Do you see that?                                     | 01:57:24 |
| 11 | A. I see that.                                       | 01:57:24 |
| 12 | Q. And you can't tell me one way or the other        | 01:57:25 |
| 13 | whether that indicates that Dr. Khandekar believed   | 01:57:28 |
| 14 | Luby '97 and Luby '98 were relevant to irregular     | 01:57:35 |
| 15 | repeat-accumulate codes?                             | 01:57:38 |
| 16 | A. I have absolutely no idea, you know, what         | 01:57:39 |
| 17 | his motivation were where to put it. I have not      | 01:57:41 |
| 18 | read the thesis in that detail. I have not been      | 01:57:44 |
| 19 | asked to make a -- you know, a detailed opinion      | 01:57:47 |
| 20 | about this thing. I think this is best posed the     | 01:57:50 |
| 21 | question to him and that could -- he could clarify   | 01:57:52 |
| 22 | the question, what was he thinking and at what point | 01:57:55 |
| 23 | was he thinking that.                                | 01:57:58 |
| 24 | Q. Okay. So respect to the question of how           | 01:58:01 |
| 25 | Luby '97 and Luby '98 related to Dr. Khandekar's IRA | 01:58:06 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

156

|    |  |          |
|----|--|----------|
| 1  | codes discussion, you can't help us answer that      | 01:58:11 |
| 2  | question?  | 01:58:13 |
| 3  | A. I cannot help you in why exactly he put           | 01:58:15 |
| 4  | that particular line at, you know, Line, let's say,  | 01:58:18 |
| 5  | 10 in his thesis, Chapter 3, I don't know.           | 01:58:22 |
| 6  | Q. Okay. So you do see that Dr. Luby                 | 01:58:26 |
| 7  | called -- I'm sorry -- withdrawn.                    | 01:58:31 |
| 8  | You do see that Dr. Khandekar called                 | 01:58:35 |
| 9  | Luby '97 and '98 a, quote, major breakthrough, close | 01:58:39 |
| 10 | quote, right?  | 01:58:43 |
| 11 | A. Yes.  | 01:58:43 |
| 12 | Q. And it is true that Luby '97 and Luby '98         | 01:58:43 |
| 13 | were a major breakthrough, right?                    | 01:58:46 |
| 14 | A. Luby '97 and Luby '98 brought the                 | 01:58:49 |
| 15 | state-of-the-art, the theoretical state-of-the-art   | 01:58:53 |
| 16 | forward in terms of the analysis. They were the      | 01:58:56 |
| 17 | first ones for a very particular channel model, the  | 01:59:01 |
| 18 | BC, which is very particular and what was not        | 01:59:05 |
| 19 | thought about at that point in time to be relevant.  | 01:59:10 |
| 20 | Only in hindsight did it turn out that it was to a   | 01:59:13 |
| 21 | new state-of-the-art.                                | 01:59:17 |
| 22 | Q. Well, Luby '97 and Luby '98 -- let's take         | 01:59:19 |
| 23 | it a step at a time.                                 | 01:59:23 |
| 24 | Luby '97 and Luby '98 did advance the                | 01:59:25 |
| 25 | state-of-the-art, correct?                           | 01:59:29 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

157

|    |    |  |          |
|----|----|--|----------|
| 1  | A. | Yes.   | 01:59:32 |
| 2  | Q. | And in that sense they were a major                  | 01:59:32 |
| 3  |    | breakthrough, as Dr. Khandekar states here, right?   | 01:59:36 |
| 4  | A. | Both papers were theoretically very                  | 01:59:39 |
| 5  |    | important.   | 01:59:43 |
| 6  | Q. | Okay. The next cited paper in this same              | 01:59:43 |
| 7  |    | section on irregular repeat-accumulate codes is your | 01:59:52 |
| 8  |    | Richardson '99 paper, right?                         | 01:59:58 |
| 9  | A. | Let me check the reference, but I believe            | 02:00:00 |
| 10 |    | yes. Yes, that seems to be the case.                 | 02:00:03 |
| 11 | Q. | And that is also a paper on irregular LDPC           | 02:00:15 |
| 12 |    | codes, right?  | 02:00:24 |
| 13 | A. | Just to correct, you know, what I said, it           | 02:00:24 |
| 14 |    | refers to the 2001 paper.                            | 02:00:26 |
| 15 | Q. | I apologize. So it refers to the 2001                | 02:00:28 |
| 16 |    | version?   | 02:00:31 |
| 17 | A. | Yes.   | 02:00:32 |
| 18 | Q. | I see.   | 02:00:32 |
| 19 |    | But that paper, both in its 1999 preprint            | 02:00:35 |
| 20 |    | version and in the 2001 version, relates to          | 02:00:42 |
| 21 |    | irregular LDPC codes, right?                         | 02:00:46 |
| 22 | A. | It relates to irregular LDPC codes but has           | 02:00:49 |
| 23 |    | some significant differences.                        | 02:00:53 |
| 24 | Q. | Okay. We'll get to those.                            | 02:00:54 |
| 25 |    | Now, in your report you do not provide an            | 02:01:22 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

158

|    |  |          |
|----|--|----------|
| 1  | opinion on why Dr. Khandekar chose not to disclose   | 02:01:24 |
| 2  | Luby '97, Luby '98, or Richardson '99 to the         | 02:01:28 |
| 3  | Patent Office, right?                                | 02:01:31 |
| 4  | A. No.   | 02:01:32 |
| 5  | Q. So that -- you've not performed any               | 02:01:33 |
| 6  | opinion on that question?                            | 02:01:36 |
| 7  | A. No. I would have no idea.                         | 02:01:37 |
| 8  | Q. Okay. Now, is it your position that a             | 02:01:41 |
| 9  | person of ordinary skill would not have considered   | 02:01:49 |
| 10 | Divsalar, the two Luby references, and Richardson    | 02:01:52 |
| 11 | 1999 together?                                       | 02:01:56 |
| 12 | MR. GLASS: Objection. Vague.                         | 02:02:03 |
| 13 | Go ahead.  | 02:02:04 |
| 14 | THE WITNESS: If you could, perhaps,                  | 02:02:04 |
| 15 | please specify a little bit more what "together"     | 02:02:06 |
| 16 | means.   | 02:02:08 |
| 17 | BY MR. DOWD:   | 02:02:09 |
| 18 | Q. I mean, is it your position that -- well,         | 02:02:11 |
| 19 | let's take them by groups.                           | 02:02:15 |
| 20 | A person of ordinary skill would not have            | 02:02:16 |
| 21 | considered Divsalar -- the work of Divsalar and      | 02:02:19 |
| 22 | the -- the Luby 1997 paper in the 1999 time frame?   | 02:02:22 |
| 23 | MR. GLASS: Objection. Vague.                         | 02:02:29 |
| 24 | THE WITNESS: So what I looked at in                  | 02:02:34 |
| 25 | particular in my report, are the Luby '97, Luby '98, | 02:02:37 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

159

|    |  |          |
|----|--|----------|
| 1  | and the Richardson/Urbanke paper.                    | 02:02:42 |
| 2  | BY MR. DOWD:   | 02:02:48 |
| 3  | Q. Okay.   | 02:02:48 |
| 4  | A. These are the ones that I consider and            | 02:02:48 |
| 5  | have my opinion on.                                  | 02:02:52 |
| 6  | Q. Okay. So with respect to what a person of         | 02:02:53 |
| 7  | ordinary skill would understand from reading         | 02:02:55 |
| 8  | Divsalar together with Luby '97, you've not provided | 02:02:59 |
| 9  | an opinion on that; is that correct?                 | 02:03:04 |
| 10 | A. I have -- you're talking about the                | 02:03:07 |
| 11 | Divsalar '98 RA code paper?                          | 02:03:13 |
| 12 | Q. Yes.  | 02:03:15 |
| 13 | A. And the second one was the Luby...                | 02:03:16 |
| 14 | Q. '97.  | 02:03:20 |
| 15 | A. I have a very small comment on Page 27 of         | 02:04:19 |
| 16 | my report which relates to the Richardson '99 in     | 02:04:22 |
| 17 | which I opinion that to use the technique that was   | 02:04:31 |
| 18 | introduced in Richardson '99 to -- other than what   | 02:04:37 |
| 19 | in '99 was actually considered in the paper,         | 02:04:43 |
| 20 | low-density parity check codes -- to consider the    | 02:04:50 |
| 21 | technique in the density evolution to schemes other  | 02:04:53 |
| 22 | than low-density parity check codes, that at the     | 02:04:58 |
| 23 | point of time that we -- or the time period that we  | 02:05:02 |
| 24 | are talking about, that that had not been published  | 02:05:03 |
| 25 | or done.   | 02:05:07 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

160

|    |  |          |
|----|--|----------|
| 1  | And I there refer in particular here to 12           | 02:05:08 |
| 2  | where, you know, later on we get to the Divsalar     | 02:05:14 |
| 3  | paper. But I'm sorry, I guess this was -- you were   | 02:05:19 |
| 4  | not referring to the Divsalar paper, 2001 paper, you | 02:05:21 |
| 5  | were referring to the '98 paper, correct?            | 02:05:25 |
| 6  | Q. Correct.  | 02:05:28 |
| 7  | A. I'm sorry. Okay. So I...                          | 02:05:28 |
| 8  | Sorry.   | 02:05:29 |
| 9  | Q. So let's just break that down.                    | 02:05:29 |
| 10 | First, your testimony just now was talking           | 02:05:32 |
| 11 | about Paragraph 135 and the Footnote 12, right?      | 02:05:33 |
| 12 | A. Right.  | 02:05:38 |
| 13 | Q. Okay.   | 02:05:38 |
| 14 | A. But I'm --  | 02:05:39 |
| 15 | Q. And let me give you my question again             | 02:05:39 |
| 16 | because I was --                                     | 02:05:41 |
| 17 | A. Right.  | 02:05:41 |
| 18 | Q. -- asking a somewhat different question.          | 02:05:42 |
| 19 | A. Okay.   | 02:05:44 |
| 20 | Q. My question is, you have not offered an           | 02:05:44 |
| 21 | opinion about what a person of ordinary skill in the | 02:05:46 |
| 22 | art would understand from reading the Divsalar '98   | 02:05:49 |
| 23 | RA codes paper together with the Luby '97 paper,     | 02:05:58 |
| 24 | correct?   | 02:06:04 |
| 25 | A. There is, in my report, I believe no              | 02:06:04 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

161

|    |   |          |
|----|---|----------|
| 1  | bigger section that talks about it.                 | 02:06:10 |
| 2  | Q. Okay.  | 02:06:13 |
| 3  | A. I have to check now whether or not               | 02:06:13 |
| 4  | somewhere I might mention in passing something, but | 02:06:16 |
| 5  | I don't believe so.                                 | 02:06:19 |
| 6  | Q. Okay. And the same is true for Divsalar          | 02:06:20 |
| 7  | plus Luby '98, right?                               | 02:06:23 |
| 8  | A. Yes, I look at -- I look at the Luby '97,        | 02:06:25 |
| 9  | Luby '98, and the -- the Richardson '99 paper.      | 02:06:34 |
| 10 | Q. And -- and my question is, there's no            | 02:06:40 |
| 11 | opinion in your report about what a person of       | 02:06:43 |
| 12 | ordinary skill would understand from reading        | 02:06:47 |
| 13 | Divsalar '98 together with Luby '98, correct?       | 02:06:50 |
| 14 | A. I -- I do have -- I -- I do not mention in       | 02:06:54 |
| 15 | particular the paper. So in that sense, I don't     | 02:06:58 |
| 16 | have that.  | 02:07:01 |
| 17 | Q. Okay.  | 02:07:01 |
| 18 | A. But I do mention RA codes in these               | 02:07:01 |
| 19 | paragraphs. And my argument is that at that point   | 02:07:07 |
| 20 | in time. So I'm not referring to specifically the   | 02:07:13 |
| 21 | papers, if -- if that was your question.            | 02:07:15 |
| 22 | Q. That was my question.                            | 02:07:16 |
| 23 | A. Right. So with respect to particular             | 02:07:16 |
| 24 | paper, no, but I do mention in my report why I      | 02:07:19 |
| 25 | think, and I believe strongly, that a person of     | 02:07:23 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

162

|    |  |          |
|----|--|----------|
| 1  | ordinary skill would have not combined these ideas   | 02:07:25 |
| 2  | and applied them to the standard RA codes. But I     | 02:07:29 |
| 3  | don't refer to it as -- the RA codes as in the '98   | 02:07:34 |
| 4  | paper.   | 02:07:37 |
| 5  | Q. Okay. And we'll come -- we'll come back           | 02:07:37 |
| 6  | to those opinions.                                   | 02:07:39 |
| 7  | But my question -- my next question is,              | 02:07:40 |
| 8  | there's no opinion stated in your report about what  | 02:07:43 |
| 9  | a person of ordinary skill would understand from     | 02:07:47 |
| 10 | reading Divsalar 1998 together with Richardson 1999, | 02:07:51 |
| 11 | correct?   | 02:07:57 |
| 12 | A. Yes, I only refer to it in terms of RA            | 02:07:57 |
| 13 | codes, but not in terms of a specific paper.         | 02:08:00 |
| 14 | Q. Okay. And then there's no -- I think we           | 02:08:03 |
| 15 | covered this already, but just to make sure.         | 02:08:10 |
| 16 | There's no opinion in your report about comparing    | 02:08:15 |
| 17 | any of those three combinations to the actual        | 02:08:17 |
| 18 | limitations of the claims of the patents-in-suit?    | 02:08:20 |
| 19 | A. There's certainly nothing that would look         | 02:08:24 |
| 20 | at the actual limitations of the -- or the claims    | 02:08:26 |
| 21 | themselves and --                                    | 02:08:29 |
| 22 | Q. Okay.   | 02:08:29 |
| 23 | A. -- make a comparison.                             | 02:08:31 |
| 24 | Q. Okay. Now...                                      | 02:08:32 |
| 25 | A. So maybe if I can, you know -- perhaps I          | 02:09:05 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

163

|    |  |          |
|----|--|----------|
| 1  | don't know if I have to correct my statement or not. | 02:09:08 |
| 2  | In Paragraph 141, I opinion on the Paragraphs 578    | 02:09:10 |
| 3  | and 579 in the report by Frey.                       | 02:09:13 |
| 4  | And that report refers to Luby '97 and               | 02:09:18 |
| 5  | repeat-accumulate codes described by Divsalar or     | 02:09:26 |
| 6  | repeat-accumulate code described by Wang.            | 02:09:29 |
| 7  | So I guess the question is whether or not            | 02:09:31 |
| 8  | you insist that the reference is they're implicitly  | 02:09:33 |
| 9  | or explicitly.                                       | 02:09:37 |
| 10 | Q. Let me put it to you this way, there's no         | 02:09:43 |
| 11 | opinion in your report that says that if you take    | 02:09:47 |
| 12 | the Divsalar disclosure and the Luby 1997            | 02:09:50 |
| 13 | disclosure, the following limitation of the          | 02:09:55 |
| 14 | following claim is not present?                      | 02:09:57 |
| 15 | A. I do not compare to the claims. That's            | 02:09:59 |
| 16 | correct.   | 02:10:04 |
| 17 | Q. Okay.   | 02:10:04 |
| 18 | A. But I do opinion on the general papers, if        | 02:10:04 |
| 19 | you so want, without explicitly referring to the     | 02:10:08 |
| 20 | Divsalar paper, I only implicitly refer to it by     | 02:10:12 |
| 21 | referring to paragraphs in Frye's report which       | 02:10:16 |
| 22 | presumably explicitly refers to the paper.           | 02:10:20 |
| 23 | Q. Now, if we go back to the Khandekar               | 02:10:25 |
| 24 | thesis, and if you turn to Page 3301, let me ask     | 02:10:35 |
| 25 | when you have that, you see in the middle of the top | 02:10:50 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

164

|    |  |          |
|----|--|----------|
| 1  | paragraph there's a reference, again, to the       | 02:10:54 |
| 2  | Luby '97 and Luby '98 papers?                      | 02:10:56 |
| 3  | A. Excuse me, is this 3331 or 3301?                | 02:10:59 |
| 4  | Q. I apologize if I misspoke. I meant 3301.        | 02:11:03 |
| 5  | A. Okay, sorry, my mistake.                        | 02:11:08 |
| 6  | Q. And do you see in the middle of the top         | 02:11:25 |
| 7  | paragraph there, there's again a reference to the  | 02:11:28 |
| 8  | Luby '97 and Luby '98 papers?                      | 02:11:30 |
| 9  | A. Yes, that's correct.                            | 02:11:32 |
| 10 | Q. And he says just below that:                    | 02:11:33 |
| 11 | "Luby, et al., also introduced the                 | 02:11:35 |
| 12 | concept of irregularity."                          | 02:11:38 |
| 13 | Do you see that there?                             | 02:11:40 |
| 14 | A. I see that there, yes.                          | 02:11:41 |
| 15 | Q. And is Dr. Khandekar correct that Luby in       | 02:11:42 |
| 16 | Luby '97 and '98 were the first to introduce the   | 02:11:45 |
| 17 | concept of irregularity?                           | 02:11:48 |
| 18 | A. To introduce the particular concept of the      | 02:11:50 |
| 19 | irregularity in the '97 paper, referring to a      | 02:11:52 |
| 20 | particular version of hierarchical LDPC codes.     | 02:11:55 |
| 21 | Q. Now...  | 02:11:59 |
| 22 | A. Just to, you know, amend what I mean,           | 02:12:08 |
| 23 | there are also other versions of irregularity, for | 02:12:11 |
| 24 | example, in the turbo coding literature and other  | 02:12:13 |
| 25 | versions of -- also in the LBC literature of what  | 02:12:17 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

165

|    |  |          |
|----|--|----------|
| 1  | irregularity could mean.                             | 02:12:22 |
| 2  | MR. DOWD: Now, let's mark as Exhibit 15 a            | 02:12:24 |
| 3  | copy of Dr. MacKay's "Gallager Codes Recent Results" | 02:12:29 |
| 4  | paper from the 1999 Allerton conference.             | 02:12:39 |
| 5  | (Urbanke Exhibit 15 was marked for                   | 02:12:44 |
| 6  | identification and attached to the                   | 02:12:44 |
| 7  | transcript.)   | 02:12:46 |
| 8  | BY MR. DOWD:   | 02:12:46 |
| 9  | Q. Do you have Exhibit 15?                           | 02:12:46 |
| 10 | A. Yes.  | 02:12:51 |
| 11 | Q. Do you recognize it?                              | 02:12:55 |
| 12 | A. It says: "Gallager Codes Recent Results."         | 02:12:55 |
| 13 | Q. And this is a paper by Dr. MacKay, right?         | 02:12:59 |
| 14 | A. Yes, according to the authorship, it's            | 02:13:02 |
| 15 | Dave MacKay.   | 02:13:06 |
| 16 | Q. Now, Exhibit 15 is talking about Gallager         | 02:13:09 |
| 17 | codes, right?  | 02:13:13 |
| 18 | MR. GLASS: Objection. Outside the scope.             | 02:13:14 |
| 19 | THE WITNESS: I have not looked at that               | 02:13:15 |
| 20 | paper in a very, very long time. I don't know. But   | 02:13:18 |
| 21 | it has "Gallager Codes" in the -- in the title. But  | 02:13:22 |
| 22 | I have absolutely no idea.                           | 02:13:27 |
| 23 | BY MR. DOWD:   | 02:13:29 |
| 24 | Q. My question is just -- a Gallager code's          | 02:13:30 |
| 25 | just another way of talking about LDPC codes, right? | 02:13:35 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

166

|    |   |          |
|----|---|----------|
| 1  | MR. GLASS: Objection. Vague.                      | 02:13:38 |
| 2  | THE WITNESS: I don't know exactly what he         | 02:13:39 |
| 3  | had in mind in here. Some people use this term.   | 02:13:40 |
| 4  | BY MR. DOWD:                                      | 02:13:43 |
| 5  | Q. Okay. Do you see in the abstract there's       | 02:13:43 |
| 6  | a -- there's a third paragraph which begins:      | 02:13:46 |
| 7  | "This paper reviews low-density parity            | 02:13:48 |
| 8  | check codes (Gallager codes),                     | 02:13:51 |
| 9  | repeat-accumulate codes, and turbo codes"?        | 02:13:57 |
| 10 | A. Yes, I see this.                               | 02:14:00 |
| 11 | Q. And so do you understand this paper is         | 02:14:02 |
| 12 | about all three?                                  | 02:14:05 |
| 13 | MR. GLASS: Objection. Outside the scope.          | 02:14:06 |
| 14 | THE WITNESS: I have no idea. I would              | 02:14:07 |
| 15 | have to read that carefully and that could take a | 02:14:08 |
| 16 | while.  | 02:14:12 |
| 17 | BY MR. DOWD:                                      | 02:14:12 |
| 18 | Q. Okay. When's the last time you read            | 02:14:12 |
| 19 | Exhibit 15?                                       | 02:14:16 |
| 20 | A. I don't recall.                                | 02:14:16 |
| 21 | Q. Would it have been back in the 1999 time       | 02:14:17 |
| 22 | frame?  | 02:14:22 |
| 23 | A. Possible. I don't know.                        | 02:14:22 |
| 24 | Q. If you turn to Page 2, which has the Bates     | 02:14:24 |
| 25 | Page 1847, you see there's a discussion of        | 02:14:32 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

167

|    |   |          |
|----|---|----------|
| 1  | low-density parity check codes, right?              | 02:14:35 |
| 2  | A. Yes, I see that.                                 | 02:14:40 |
| 3  | Q. And there's also a discussion of                 | 02:14:42 |
| 4  | repeat-accumulate codes, right?                     | 02:14:53 |
| 5  | A. Yes.   | 02:14:55 |
| 6  | Q. And he especially cites Divsalar '98,            | 02:14:56 |
| 7  | right?  | 02:15:02 |
| 8  | A. Next to "repeat-accumulate codes," I see         | 02:15:02 |
| 9  | in parentheses "Divsalar '98"; yes, that's correct. | 02:15:04 |
| 10 | Q. And it also discusses turbo codes, right?        | 02:15:14 |
| 11 | A. I also see turbo codes in the paragraph          | 02:15:20 |
| 12 | below.  | 02:15:23 |
| 13 | Q. And if we turn to Page 1850, he says:            | 02:15:26 |
| 14 | "The best -- "                                      | 02:15:40 |
| 15 | This is in the bottom paragraph.                    | 02:15:41 |
| 16 | "The best binary Gallager codes found               | 02:15:43 |
| 17 | so far are irregular codes whose parity             | 02:15:46 |
| 18 | check matrices have nonuniform weight per           | 02:15:51 |
| 19 | column."  | 02:15:55 |
| 20 | Right?  | 02:15:56 |
| 21 | A. I see that sentence there, yes.                  | 02:15:56 |
| 22 | Q. And in 1999 that was true, right?                | 02:15:57 |
| 23 | A. I believe it to be true, yes.                    | 02:16:01 |
| 24 | Q. And the two references that he cites are         | 02:16:04 |
| 25 | the Luby '99 -- withdrawn.                          | 02:16:08 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

168

|    |  |          |
|----|--|----------|
| 1  | The two references he cites are the                  | 02:16:09 |
| 2  | Luby '98 paper and your Richardson '99 paper, right? | 02:16:13 |
| 3  | A. Yes, I see that in parentheses.                   | 02:16:15 |
| 4  | Q. So it was true in 1999 that people were           | 02:16:22 |
| 5  | actually looking at Divsalar, those two Luby papers, | 02:16:25 |
| 6  | and the Richardson 1999 reference together, right?   | 02:16:31 |
| 7  | A. He mentions all these three names together        | 02:16:38 |
| 8  | in a paper, yes.                                     | 02:16:41 |
| 9  | Q. And he's comparing those different types          | 02:16:42 |
| 10 | of codes, right?                                     | 02:16:44 |
| 11 | A. That I don't know. I have not read that           | 02:16:46 |
| 12 | paper in detail to say what he's actually doing.     | 02:16:48 |
| 13 | Q. Okay. But you can at least tell from the          | 02:16:52 |
| 14 | abstract that the paper reviews all three types,     | 02:16:54 |
| 15 | right?   | 02:16:54 |
| 16 | A. He mentions --                                    | 02:16:57 |
| 17 | MR. GLASS: Objection. Outside the scope.             | 02:16:57 |
| 18 | THE WITNESS: He mentions some of these               | 02:16:59 |
| 19 | names. What exactly he means with these terms, how   | 02:17:01 |
| 20 | he defines them, what he does with them, I have no   | 02:17:04 |
| 21 | idea.  | 02:17:05 |
| 22 | BY MR. DOWD:   | 02:17:06 |
| 23 | Q. Now, Ambleson (verbatim) '99, that was            | 02:17:06 |
| 24 | before the patents in this case, right?              | 02:17:10 |
| 25 | A. I believe so, yes.                                | 02:17:12 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

169

|    |    |   |          |
|----|----|---|----------|
| 1  | Q. | I meant to "Ambleside," I apologize.          | 02:17:13 |
| 2  | A. | Ambleside, yes.                               | 02:17:17 |
| 3  | Q. | It was before Caltech filed the lawsuit,      | 02:17:19 |
| 4  |    | right?  | 02:17:22 |
| 5  | A. | If the conference happened before 2000 --     | 02:17:22 |
| 6  |    | May 2018 (verbatim), then that's true.        | 02:17:25 |
| 7  | Q. | And it was long before you were retained      | 02:17:27 |
| 8  |    | for this case, right?                         | 02:17:30 |
| 9  | A. | That is true.                                 | 02:17:31 |
| 10 | Q. | Now, at Paragraph 153 of your report you      | 02:17:32 |
| 11 |    | say that:                                     | 02:17:39 |
| 12 |    | "RA codes were not considered to be           | 02:17:40 |
| 13 |    | good codes as of about 1999."                 | 02:17:42 |
| 14 |    | Right?  | 02:17:45 |
| 15 | A. | Yes.  | 02:17:45 |
| 16 | Q. | Let's turn back to Page 2 of Exhibit 15,      | 02:17:49 |
| 17 |    | the MacKay Ambleside '99 paper. In the bottom | 02:17:57 |
| 18 |    | paragraph he says:                            | 02:18:08 |
| 19 |    | "All these codes can be decoded."             | 02:18:09 |
| 20 |    | Do you see that?                              | 02:18:12 |
| 21 | A. | Yes, I see that.                              | 02:18:17 |
| 22 | Q. | So he's looked at irregular LDPC codes, RA    | 02:18:18 |
| 23 |    | codes, and turbo codes?                       | 02:18:22 |
| 24 |    | MR. GLASS: Objection.                         | 02:18:24 |
| 25 |    | ///   |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

170

|    |   |          |
|----|---|----------|
| 1  | BY MR. DOWD:                                    | 02:18:26 |
| 2  | Q. Just above that, right?                      | 02:18:27 |
| 3  | MR. GLASS: Objection. Outside the scope.        | 02:18:28 |
| 4  | THE WITNESS: I see that sentence.               | 02:18:29 |
| 5  | BY MR. DOWD:                                    | 02:18:30 |
| 6  | Q. And he says:                                 | 02:18:30 |
| 7  | "All these codes can be decoded by a            | 02:18:31 |
| 8  | local message-passing algorithm."               | 02:18:34 |
| 9  | There's some citation. And then:                | 02:18:37 |
| 10 | "While this algorithm is not the                | 02:18:41 |
| 11 | optimal decoder, the empirical results are      | 02:18:43 |
| 12 | record breaking."                               | 02:18:46 |
| 13 | Right?  | 02:18:48 |
| 14 | A. I see that sentence, yes.                    | 02:18:49 |
| 15 | Q. And so at least MacKay is saying that        | 02:18:51 |
| 16 | repeat-accumulate codes produce record breaking | 02:18:56 |
| 17 | results, right?                                 | 02:19:00 |
| 18 | A. I don't think that's --                      |          |
| 19 | MR. DOWD: Outside --                            |          |
| 20 | THE WITNESS: -- what he says.                   |          |
| 21 | THE REPORTER: Wait. Wait. Wait. I               |          |
| 22 | didn't get the objection.                       |          |
| 23 | MR. GLASS: Just outside the scope.              | 02:19:04 |
| 24 | Go ahead.                                       | 02:19:05 |
| 25 | THE WITNESS: I don't read that in that          | 02:19:06 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

171

|    |  |          |
|----|--|----------|
| 1  | way.   | 02:19:09 |
| 2  | BY MR. DOWD:                                       | 02:19:09 |
| 3  | Q. Okay. So when he says: All these codes,         | 02:19:09 |
| 4  | and then says: The empirical results are record    | 02:19:13 |
| 5  | breaking, you think he actually just means some of | 02:19:16 |
| 6  | these codes?                                       | 02:19:21 |
| 7  | A. I have no idea what he means, but I very        | 02:19:21 |
| 8  | much -- you know -- and that is right now I'm not  | 02:19:25 |
| 9  | really forming a final opinion. I have not studied | 02:19:26 |
| 10 | that in any detail. But it would be strange for me | 02:19:29 |
| 11 | to believe that that's what he meant, given that   | 02:19:33 |
| 12 | these codes were not very good codes.              | 02:19:35 |
| 13 | Q. Well, he goes on to -- so your --               | 02:19:40 |
| 14 | withdrawn.   | 02:19:40 |
| 15 | So your position is because MacKay's paper         | 02:19:44 |
| 16 | is inconsistent with your assertion that RA codes  | 02:19:48 |
| 17 | were not good, you think that can't be what he     | 02:19:52 |
| 18 | meant?   | 02:19:55 |
| 19 | MR. GLASS: Objection. Misstates the                | 02:19:55 |
| 20 | testimony.   | 02:19:57 |
| 21 | THE WITNESS: I -- I don't know what he             | 02:19:57 |
| 22 | meant. But it's a fact that much better codes were | 02:19:58 |
| 23 | known at that time.                                | 02:20:03 |
| 24 | BY MR. DOWD:                                       | 02:20:04 |
| 25 | Q. Okay. Well, he goes on to provide               | 02:20:04 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

172

|    |   |          |
|----|---|----------|
| 1  | performance in Figure 2, 2A and 2B, right? So he is | 02:20:08 |
| 2  | looking at the performance of an RA code, right?    | 02:20:17 |
| 3  | A. I don't know.                                    | 02:20:20 |
| 4  | Q. You don't know. All right.                       | 02:20:20 |
| 5  | Well, let's go back to Divsalar in                  | 02:20:29 |
| 6  | Figure 3. Do you have that still? It should be --   | 02:20:31 |
| 7  | A. Which exhibit are you talking about?             | 02:20:36 |
| 8  | Q. Exhibit 6.                                       | 02:20:38 |
| 9  | A. Exhibit 6. Yes.                                  | 02:20:40 |
| 10 | Q. And in your report, at Paragraph 154, you        | 02:20:49 |
| 11 | say:  | 02:20:55 |
| 12 | "Even if someone thought to modify RA               | 02:20:55 |
| 13 | codes to improve them, there are any                | 02:20:58 |
| 14 | number of modifications that could be               | 02:21:00 |
| 15 | made."  | 02:21:01 |
| 16 | And then in 155:                                    | 02:21:03 |
| 17 | "Even if someone thought to make RA                 | 02:21:05 |
| 18 | codes irregular, there are any number of            | 02:21:08 |
| 19 | ways irregularity could be applied?"                | 02:21:10 |
| 20 | Right?  | 02:21:14 |
| 21 | A. Yes.   | 02:21:24 |
| 22 | Q. The RA code in Figure 3 has three blocks,        | 02:21:26 |
| 23 | right?  | 02:21:38 |
| 24 | A. The way it is in Figure 3?                       | 02:21:38 |
| 25 | Q. Of Divsalar.                                     | 02:21:41 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

173

|    |    |  |          |
|----|----|--|----------|
| 1  | A. | Yes, that is correct.                              | 02:21:43 |
| 2  | Q. | So you could make the repeat block                 | 02:21:45 |
| 3  |    | irregular, right?                                  | 02:21:48 |
| 4  | A. | That might be one of the ways to go.               | 02:21:51 |
| 5  | Q. | Could you make the accumulator block               | 02:21:55 |
| 6  |    | irregular?   | 02:21:59 |
| 7  | A. | You could go do what the standard way of           | 02:22:02 |
| 8  |    | irregular was considered at that point and go back | 02:22:06 |
| 9  |    | to direction of turbo codes. And then have any     | 02:22:09 |
| 10 |    | number of variations on the theme of turbo codes.  | 02:22:11 |
| 11 |    | That would be the most natural codes to make --    | 02:22:15 |
| 12 |    | natural way to make these codes more powerful.     | 02:22:18 |
| 13 | Q. | Well, I'll get to that.                            | 02:22:21 |
| 14 |    | But my question was, could you make the            | 02:22:23 |
| 15 |    | accumulator block irregular?                       | 02:22:26 |
| 16 | A. | Sure. If you had several of them, you              | 02:22:29 |
| 17 |    | could choose each of them to be different.         | 02:22:32 |
| 18 | Q. | Well, in this code you only have one,              | 02:22:33 |
| 19 |    | right?   | 02:22:36 |
| 20 | A. | That's your choice, but that's not a               | 02:22:36 |
| 21 |    | given.   | 02:22:39 |
| 22 | Q. | Okay. Let's just stick with what's                 | 02:22:39 |
| 23 |    | actually in Divsalar, okay?                        | 02:22:42 |
| 24 | A. | But you asked me whether or not you could          | 02:22:43 |
| 25 |    | have made it irregular. And I'm claiming, yes, you | 02:22:45 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

174

|    |   |          |
|----|---|----------|
| 1  | could. And one particular way to do it would have   | 02:22:47 |
| 2  | to be several branches and then make these branches | 02:22:47 |
| 3  | to be any --  | 02:22:47 |
| 4  | THE REPORTER: Wait.                                 | 02:22:47 |
| 5  | "One particular" -- "one particular                 | 02:22:54 |
| 6  | way..."   | 02:22:54 |
| 7  | Start there.  | 02:22:54 |
| 8  | THE WITNESS: Would have been to choose              | 02:22:55 |
| 9  | several branches. And then as for turbo codes,      | 02:22:56 |
| 10 | choose various ways of using the components.        | 02:22:59 |
| 11 | BY MR. DOWD:  | 02:23:02 |
| 12 | Q. Okay. So now -- now I think I understand.        | 02:23:03 |
| 13 | So if I was going to make an IRA code               | 02:23:06 |
| 14 | using Figure 3, you could do that by making the --  | 02:23:09 |
| 15 | having multiple different accumulators?             | 02:23:13 |
| 16 | A. That might be one way, but, you know,            | 02:23:16 |
| 17 | there's any number of ways that you can do it. You  | 02:23:19 |
| 18 | could, for example, branch off there, this one      | 02:23:22 |
| 19 | particular branch having as many as accumulators as | 02:23:24 |
| 20 | you wanted. You could have the permutations in any  | 02:23:27 |
| 21 | way you wanted.                                     | 02:23:31 |
| 22 | You could have, you know, many -- many              | 02:23:32 |
| 23 | other things. You could have several branches in    | 02:23:33 |
| 24 | the beginning and branch off there. You could do    | 02:23:36 |
| 25 | over non-binary alphabets and make them kind of     | 02:23:38 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

175

|    |   |          |
|----|---|----------|
| 1  | different. You could choose different and stronger  | 02:23:42 |
| 2  | component codes. There's any number of ways of      | 02:23:45 |
| 3  | doing this.   | 02:23:49 |
| 4  | Q. Well, I'm not asking about making a              | 02:23:49 |
| 5  | different and stronger code. I'm just making it     | 02:23:51 |
| 6  | irregular; okay?                                    | 02:23:54 |
| 7  | A. The only motivation for making them              | 02:23:54 |
| 8  | irregular would be to make them stronger.           | 02:23:57 |
| 9  | Q. Well, let's just -- without respect to           | 02:23:59 |
| 10 | whether they make them stronger or not stronger. If | 02:24:00 |
| 11 | I wanted to make it irregular, I could make the     | 02:24:03 |
| 12 | repeat irregular, that's one way, right?            | 02:24:05 |
| 13 | A. That's one way.                                  | 02:24:08 |
| 14 | Q. Can I make the permutation irregular?            | 02:24:10 |
| 15 | A. You could have many branches, as I               | 02:24:13 |
| 16 | claimed. There's no reason you have a single box -- | 02:24:15 |
| 17 | THE REPORTER: Slow down, please.                    | 02:24:15 |
| 18 | "There's no reason..."                              | 02:24:15 |
| 19 | Start there.  | 02:24:19 |
| 20 | THE WITNESS: There's no reason that each            | 02:24:19 |
| 21 | of those boxes should be a single box.              | 02:24:20 |
| 22 | BY MR. DOWD:  | 02:24:24 |
| 23 | Q. Okay. And then if I make accumulate              | 02:24:25 |
| 24 | irregular, that would also require multiple boxes,  | 02:24:27 |
| 25 | right?  | 02:24:30 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

176

|    |    |   |          |
|----|----|---|----------|
| 1  | A. | Perhaps there might be other ways of doing          | 02:24:30 |
| 2  |    | it too. This would be a research question. But      | 02:24:32 |
| 3  |    | there must be many, many, many ways of making it    | 02:24:35 |
| 4  |    | irregular.  | 02:24:38 |
| 5  | Q. | Okay. Well, let's break it down.                    | 02:24:38 |
| 6  |    | If I'm going to keep the exact same                 | 02:24:41 |
| 7  |    | structure as Figure 3, so I've got one repeat box,  | 02:24:43 |
| 8  |    | one permute box, one accumulate box, am I correct   | 02:24:47 |
| 9  |    | that the only way to make this an irregular         | 02:24:52 |
| 10 |    | repeat-accumulate code is to make the repeater an   | 02:24:56 |
| 11 |    | irregular repeat?                                   | 02:25:00 |
| 12 | A. | No. Because you could, for example, take            | 02:25:01 |
| 13 |    | symbols which are not bits, you could take bits and | 02:25:03 |
| 14 |    | put -- group them together, and then treat the      | 02:25:06 |
| 15 |    | blocks in these symbols as symbols in the higher    | 02:25:08 |
| 16 |    | alphabet and do any number of operations of them.   | 02:25:11 |
| 17 |    | So there is a large degree of how you               | 02:25:14 |
| 18 |    | could make them irregular.                          | 02:25:17 |
| 19 | Q. | So you're saying upstream, instead of               | 02:25:18 |
| 20 |    | inputting bits, you're inputting something else?    | 02:25:22 |
| 21 | A. | You would still put bits, but there's no            | 02:25:22 |
| 22 |    | reason you have to treat them as bits.              | 02:25:22 |
| 23 |    | THE REPORTER: Repeat your answer.                   | 02:25:26 |
| 24 |    | THE WITNESS: There's no reason -- you               | 02:25:26 |
| 25 |    | would still input bits, but there's no reason that  | 02:25:30 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

177

|    |  |          |
|----|--|----------|
| 1  | internally you have to treat them as bits.           | 02:25:32 |
| 2  | BY MR. DOWD:   | 02:25:34 |
| 3  | Q. Okay. Let's just stick with what Divsalar         | 02:25:34 |
| 4  | says.  | 02:25:38 |
| 5  | Assume that the input N is bits, okay? Do            | 02:25:38 |
| 6  | you have that in mind? You have to answer verbally.  | 02:25:43 |
| 7  | A. Yes.  | 02:25:47 |
| 8  | Q. And assume that you're not going to change        | 02:25:48 |
| 9  | the number of permuters, there's going to be one     | 02:25:50 |
| 10 | box, you're not going to change the number of        | 02:25:54 |
| 11 | accumulators, there's going to be one box, okay?     | 02:25:56 |
| 12 | Do you have that in mind?                            | 02:25:59 |
| 13 | A. Yes.  | 02:26:01 |
| 14 | Q. I'm correct that you could make this an           | 02:26:01 |
| 15 | IRA code by making the repetition irregular, right?  | 02:26:04 |
| 16 | A. Correct.  | 02:26:07 |
| 17 | Q. And you say that I could also make it             | 02:26:08 |
| 18 | irregular by changing the repeater so that it treats | 02:26:11 |
| 19 | the bits as symbols instead of bits?                 | 02:26:16 |
| 20 | A. For example.                                      | 02:26:19 |
| 21 | Q. But that repeater would still be an               | 02:26:20 |
| 22 | irregular repeater, right?                           | 02:26:23 |
| 23 | A. It may or may not. You -- you might -- it         | 02:26:24 |
| 24 | might, for example, keep that regular but simply     | 02:26:28 |
| 25 | treat bits as symbols, and then later on treat them  | 02:26:30 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

178

|    |  |          |
|----|--|----------|
| 1  | in a particular way that it reduces -- introduces    | 02:26:34 |
| 2  | irregularity. There's many number of ways that you   | 02:26:38 |
| 3  | can do that. And these number of ways have been      | 02:26:40 |
| 4  | explored, for example, in an -- in LDPC setting.     | 02:26:43 |
| 5  | Q. So let's talk about where the repetition          | 02:26:46 |
| 6  | requires creating a duplication of the bits, okay?   | 02:26:49 |
| 7  | Do you have that in mind?                            | 02:26:51 |
| 8  | A. We're talking about the first box? You're         | 02:26:53 |
| 9  | referring to the first box?                          | 02:26:56 |
| 10 | Q. I am. If the first box must create a              | 02:26:57 |
| 11 | duplicate, it's duplicating the input bits?          | 02:27:02 |
| 12 | A. It's repeating them, yes.                         | 02:27:06 |
| 13 | Q. Do you have that in mind?                         | 02:27:08 |
| 14 | A. It's repeating them, yes.                         | 02:27:09 |
| 15 | Q. Okay. And so we're not making them                | 02:27:11 |
| 16 | symbols, we're not doing anything else.              | 02:27:13 |
| 17 | In that circumstance, then the way that              | 02:27:15 |
| 18 | you would change Figure 3 to become irregular is you | 02:27:20 |
| 19 | create some number of duplicates for some bits and a | 02:27:25 |
| 20 | different number of duplicates for other bits,       | 02:27:30 |
| 21 | right?   |          |
| 22 | A. That would be --                                  |          |
| 23 | MR. GLASS: Vague.                                    |          |
| 24 | THE WITNESS: -- one way of doing it.                 |          |
| 25 | MR. DOWD: All right.                                 |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

179

1 THE REPORTER: I didn't catch either the  
2 objection nor the answer. Maybe you guys could  
3 separate them.

4 MR. GLASS: Vague.

5 Go ahead.

02:27:39

6 THE WITNESS: That would be one way of  
7 doing it. But as I claimed, you can do this in any  
8 number of other ways. Even if you repeated a  
9 constant number of times and they were bits, you  
10 could later on, for example, combine this bits to  
11 symbols. You can do this at any stage.

02:27:39

02:27:41

02:27:45

02:27:48

02:27:51

02:27:53

12 And there's no reason that you would fix  
13 every single thing so that the conclusion -- only  
14 conclusion can be that the only thing you can do is  
15 repetition. You -- if you're telling me to tie your  
16 hands behind --

02:27:55

02:27:58

02:28:00

02:28:02

17 THE REPORTER: Wait.

18 THE WITNESS: -- behind your back so --

19 THE REPORTER: Hold on. Hold on. Slow  
20 down. Okay?

21 THE WITNESS: You're telling me,

02:28:08

22 basically, if you tie your hands behind your back

02:28:09

23 and, you know, disallow any of the reasonable things

02:28:11

24 you could have done, then the only thing you could

02:28:14

25 have done is the one thing that you can do, given

02:28:17

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

180

|    |  |          |
|----|--|----------|
| 1  | that they're restricted in so much.            | 02:28:19 |
| 2  | My claim is that that's not the way code       | 02:28:22 |
| 3  | design works.                                  | 02:28:25 |
| 4  | BY MR. DOWD:                                   | 02:28:26 |
| 5  | Q. My -- my actual question is different than  | 02:28:27 |
| 6  | that.  | 02:28:29 |
| 7  | Any one of those would have produced an        | 02:28:30 |
| 8  | irregular repeat code, right, irregular        | 02:28:33 |
| 9  | repeat-accumulate code?                        | 02:28:36 |
| 10 | A. Which one?                                  | 02:28:36 |
| 11 | Q. Any one of the options that you are --      |          |
| 12 | (Overlapping speakers.)                        |          |
| 13 | THE REPORTER: Wait. I didn't -- I didn't       |          |
| 14 | hear the -- his -- I didn't hear his question. |          |
| 15 | MR. DOWD: I'll ask the question again.         |          |
| 16 | THE REPORTER: Please. Thank you.               | 02:28:42 |
| 17 | BY MR. DOWD:                                   | 02:28:42 |
| 18 | Q. Any one of the options that you are         | 02:28:44 |
| 19 | describing would produce an irregular          | 02:28:46 |
| 20 | repeat-accumulate code?                        | 02:28:48 |
| 21 | A. No.   | 02:28:49 |
| 22 | Q. No?   | 02:28:50 |
| 23 | A. No.   | 02:28:50 |
| 24 | Q. Okay.                                       | 02:28:52 |
| 25 | THE REPORTER: Can we take a break,             | 02:28:52 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

181

|    |   |          |
|----|---|----------|
| 1  | please?   | 02:28:55 |
| 2  | MR. DOWD: Sure.                                     | 02:28:56 |
| 3  | THE VIDEOGRAPHER: This marks the end of             | 02:28:56 |
| 4  | Disc No. 2 in the deposition of Dr. Urbanke. We are | 02:28:58 |
| 5  | off the record at 2:29 p.m.                         | 02:29:03 |
| 6  | (Recess taken at 2:29 p.m.)                         | 02:29:21 |
| 7  | THE VIDEOGRAPHER: This begins Tape No. 3            | 02:41:47 |
| 8  | in the deposition of Dr. Rüdiger Urbanke. We are    | 02:41:51 |
| 9  | back on the record at 2:41 p.m.                     | 02:41:56 |
| 10 | BY MR. DOWD:  | 02:42:01 |
| 11 | Q. Before the break we were talking about           | 02:42:01 |
| 12 | Figure 3 of Divsalar, and I'd like to continue with | 02:42:04 |
| 13 | that. Do you still have that in front of you?       | 02:42:06 |
| 14 | A. You're talking about Exhibit 6?                  | 02:42:09 |
| 15 | Q. I am.  | 02:42:11 |
| 16 | A. Yes.   | 02:42:12 |
| 17 | Q. Now, right below the figure, do you see it       | 02:42:12 |
| 18 | says:   | 02:42:17 |
| 19 | "The outer repetition code is                       | 02:42:17 |
| 20 | trivial"?   | 02:42:20 |
| 21 | A. You're talking about the heading of              | 02:42:21 |
| 22 | Figure 3?   | 02:42:26 |
| 23 | Q. I'm saying, if you look at the last              | 02:42:27 |
| 24 | sentence on the page below the figure, it says:     | 02:42:30 |
| 25 | "The outer repetition code is                       | 02:42:32 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

182

|    |  |          |
|----|--|----------|
| 1  | trivial."  | 02:42:35 |
| 2  | A. Okay.   | 02:42:35 |
| 3  | Q. And then it continues. Do you see that?           | 02:42:35 |
| 4  | A. Yes.  | 02:42:37 |
| 5  | Q. If a person of ordinary skill, back in            | 02:42:38 |
| 6  | '98, '99, wanted to make the repetition code         | 02:42:43 |
| 7  | irregular, they would have been able to do so,       | 02:42:49 |
| 8  | right?   | 02:42:53 |
| 9  | A. What is your definition of irregular?             | 02:42:53 |
| 10 | Q. That some subset of the bits are repeated         | 02:42:55 |
| 11 | one number of times and at least one other subset of | 02:43:03 |
| 12 | bits is repeated a different number of times.        | 02:43:07 |
| 13 | A. It seems to me that if you're asking that         | 02:43:10 |
| 14 | if you tell someone make it so, then you're telling  | 02:43:14 |
| 15 | exactly what to do. So I don't quite understand      | 02:43:17 |
| 16 | what do you mean, they would have been able to do    | 02:43:20 |
| 17 | so. Because in order to tell him what to do, you     | 02:43:23 |
| 18 | would have to give them the exact description what   | 02:43:26 |
| 19 | to do. Otherwise, you have not given me a            | 02:43:28 |
| 20 | definition of what irregular means.                  | 02:43:30 |
| 21 | Q. Okay. So with the understanding that              | 02:43:32 |
| 22 | irregular means that some of the bits are repeated   | 02:43:34 |
| 23 | one number of times and other of the bits are        | 02:43:37 |
| 24 | repeated a different number of times. Do you have    | 02:43:40 |
| 25 | that in mind?  | 02:43:44 |



VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

183

|    |    |  |          |
|----|----|--|----------|
| 1  | A. | If that is your definition.                          | 02:43:44 |
| 2  | Q. | Yes, for purposes of this question.                  | 02:43:46 |
| 3  |    | A person of ordinary skill in 1999 would             | 02:43:53 |
| 4  |    | have been able to take the RA encoder of Figure 3 in | 02:43:59 |
| 5  |    | Divsalar and make the repetition an irregular        | 02:44:07 |
| 6  |    | repetition, correct?                                 | 02:44:11 |
| 7  | A. | It seems to me that, again, you're putting           | 02:44:13 |
| 8  |    | into the question exactly what the -- what you want  | 02:44:15 |
| 9  |    | the person to do. The question was, if I rephrase    | 02:44:17 |
| 10 |    | it, and please correct me if I'm wrong, if you tell  | 02:44:20 |
| 11 |    | a person to repeat different bits a different number | 02:44:23 |
| 12 |    | of times, would that person have been able to repeat | 02:44:27 |
| 13 |    | different bits a different number of times?          | 02:44:31 |
| 14 |    | If that's your question, then it's a                 | 02:44:33 |
| 15 |    | tautology and the answer's yes.                      | 02:44:35 |
| 16 | Q. | Okay. So let's start there. So if you                | 02:44:37 |
| 17 |    | said to somebody in this field: Take Divsalar        | 02:44:41 |
| 18 |    | Figure 3 and I want you to repeat different numbers  | 02:44:44 |
| 19 |    | of bits a different number of times, that wouldn't   | 02:44:46 |
| 20 |    | have been difficult to do at all, right?             | 02:44:49 |
| 21 | A. | If you're telling them exactly what to do,           | 02:44:51 |
| 22 |    | then no.   | 02:44:53 |
| 23 | Q. | Okay. And, no, it wouldn't have been                 | 02:44:55 |
| 24 |    | difficult?   | 02:45:00 |
| 25 | A. | Because it's in the description of what              | 02:45:00 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

184

|    |  |          |
|----|--|----------|
| 1  | you tell them to do.                                 | 02:45:02 |
| 2  | Q. Okay. So there's nothing difficult about          | 02:45:04 |
| 3  | following that instruction, right?                   | 02:45:07 |
| 4  | A. If the instruction is as explicit as              | 02:45:08 |
| 5  | telling them exactly what to do, then it's simply a  | 02:45:11 |
| 6  | program that you have to follow.                     | 02:45:15 |
| 7  | Q. Okay. And if you said to a person in the          | 02:45:17 |
| 8  | field, without more: I'd like you to take the        | 02:45:21 |
| 9  | repetition code of Divsalar Figure 3 and make it an  | 02:45:25 |
| 10 | irregular repetition code, they'd be able to do that | 02:45:29 |
| 11 | too, right?  | 02:45:33 |
| 12 | A. If you could tell me what your definition         | 02:45:33 |
| 13 | of irregular repetition code is.                     | 02:45:35 |
| 14 | Q. Using any definition.                             | 02:45:38 |
| 15 | A. I think it seems -- your question -- or           | 02:45:39 |
| 16 | the answer to the question hinges exactly on what    | 02:45:42 |
| 17 | you tell a person to do.                             | 02:45:45 |
| 18 | I'm sorry if I repeat myself. But if you             | 02:45:46 |
| 19 | tell the person explicitly what to do, then          | 02:45:49 |
| 20 | inherently it's easy to do. But if you tell a        | 02:45:53 |
| 21 | person, you know, fairly vague things, improve,      | 02:45:57 |
| 22 | let's say, the code, or any other number of          | 02:45:59 |
| 23 | questions that perhaps at that point might have come | 02:46:01 |
| 24 | up, the question is an entirely different one, and   | 02:46:03 |
| 25 | my answer would be entirely different.               | 02:46:06 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

185

|    |    |  |          |
|----|----|--|----------|
| 1  | Q. | Okay. And my question is, if the                     | 02:46:08 |
| 2  |    | instruction was: Take Divsalar Figure 3, I want you  | 02:46:11 |
| 3  |    | to change the repeater so that it performs an        | 02:46:15 |
| 4  |    | irregular repetition, would a person of ordinary     | 02:46:19 |
| 5  |    | skill know how to do that?                           | 02:46:23 |
| 6  | A. | I would say yes because you would have, in           | 02:46:25 |
| 7  |    | the -- in the question, told the person exactly what | 02:46:30 |
| 8  |    | to do.   | 02:46:32 |
| 9  | Q. | Okay. And, in fact, are you aware of                 | 02:46:32 |
| 10 |    | people in 1998 taking a repeat-accumulate code and   | 02:46:38 |
| 11 |    | making the repeat an irregular repeat?               | 02:46:42 |
| 12 | A. | In 1998, for the -- you're talking about             | 02:46:46 |
| 13 |    | RA codes themselves?                                 | 02:46:55 |
| 14 | Q. | Yes.   | 02:46:55 |
| 15 | A. | I am not aware of other results than the             | 02:46:56 |
| 16 |    | one -- you know, if we're talking about strict sense | 02:47:03 |
| 17 |    | RA codes as they're described in here, I'm not aware | 02:47:07 |
| 18 |    | of other people doing it.                            | 02:47:10 |
| 19 |    | MR. DOWD: Let me show you what I'll mark             | 02:47:27 |
| 20 |    | as Exhibit 16, a copy of a document that bears Bates | 02:47:29 |
| 21 |    | number HUGHES1858 through 1873, entitled: "RA.c."    | 02:47:33 |
| 22 |    | (Urbanke Exhibit 16 was marked for                   | 02:47:44 |
| 23 |    | identification and attached to the                   | 02:47:44 |
| 24 |    | transcript.)   | 02:47:54 |
| 25 |    | ///  |          |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

186

|    |  |          |
|----|--|----------|
| 1  | BY MR. DOWD:   | 02:47:54 |
| 2  | Q. Do you have Exhibit 16?                           | 02:47:55 |
| 3  | A. Yes.  | 02:47:56 |
| 4  | Q. Do you recognize it?                              | 02:47:56 |
| 5  | A. It seems to be some computer code.                | 02:47:58 |
| 6  | Q. Have you seen Exhibit 16 before?                  | 02:48:03 |
| 7  | A. I believe that a program was mentioned in         | 02:48:05 |
| 8  | Brendan Frey's report. I have not -- I don't         | 02:48:12 |
| 9  | believe I've seen the actual computer code to that.  | 02:48:15 |
| 10 | Q. Okay. So let me start with, with respect          | 02:48:17 |
| 11 | to Exhibit 16, you have formed no opinion about what | 02:48:21 |
| 12 | this is, sitting here today?                         | 02:48:25 |
| 13 | A. No.   | 02:48:27 |
| 14 | Q. All right. Do you see there's a date at           | 02:48:27 |
| 15 | the top that says September 28, 1998?                | 02:48:30 |
| 16 | A. I see '98, 09/28, yes.                            | 02:48:34 |
| 17 | Q. And the initials next to that are David           | 02:48:37 |
| 18 | J.C. MacKay; do you see that?                        | 02:48:41 |
| 19 | A. I see the "DJCM," and that might stand for        | 02:48:42 |
| 20 | David MacKay.  | 02:48:47 |
| 21 | Q. And the title of this in the comment right        | 02:48:49 |
| 22 | below that is a repeat-accumulate code simulator,    | 02:48:52 |
| 23 | right?   | 02:48:57 |
| 24 | A. That is correct.                                  | 02:48:57 |
| 25 | Q. Now, if you look a few lines down there's         | 02:49:00 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

187

|    |   |          |
|----|---|----------|
| 1  | a -- a line that says:                              | 02:49:03 |
| 2  | "N sub 1, N sub 2, dot, dot, dot, N                 | 02:49:04 |
| 3  | sub K."   | 02:49:08 |
| 4  | A.    Yes.  | 02:49:10 |
| 5  | Q.    And there's a description there that says:    | 02:49:11 |
| 6  | "Number of repetition of each source                | 02:49:14 |
| 7  | bit."   | 02:49:17 |
| 8  | Right?  | 02:49:17 |
| 9  | A.    I see that, yes.                              | 02:49:18 |
| 10 | Q.    And so what's happening there is you've       | 02:49:19 |
| 11 | got at least three subsets of source bits, N sub 1, | 02:49:22 |
| 12 | N sub 2, through N sub K, right?                    | 02:49:27 |
| 13 | A.    That I don't know. I have not looked at       | 02:49:30 |
| 14 | the program. I've never run it. I have not looked   | 02:49:31 |
| 15 | at what the definition of the variables are. That   | 02:49:34 |
| 16 | is a program that seems to have 16 pages. It's not  | 02:49:37 |
| 17 | a triviality to say what this code actually does.   | 02:49:40 |
| 18 | THE REPORTER: Hold on. State the last               | 02:49:42 |
| 19 | part over.  | 02:49:44 |
| 20 | THE WITNESS: It's a program that seems to           | 02:49:44 |
| 21 | be containing about 16 pages of source code. It is  | 02:49:46 |
| 22 | not a triviality to determine what such a code      | 02:49:48 |
| 23 | actually does.                                      | 02:49:52 |
| 24 | BY MR. DOWD:  | 02:49:53 |
| 25 | Q.    Okay. And so you've formed no opinion         | 02:49:54 |

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE  
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

188

|    |  |          |
|----|--|----------|
| 1  | about what this "N sub 1, N sub 2, N sub K" means, | 02:49:58 |
| 2  | right?   | 02:50:07 |
| 3  | A. No.   | 02:50:07 |
| 4  | Q. Is that correct?                                | 02:50:08 |
| 5  | A. Yes.  | 02:50:12 |
| 6  | Q. And to the extent that that is setting the      | 02:50:12 |
| 7  | number of repetitions of each source bit, you have | 02:50:15 |
| 8  | no opinion about that, right?                      | 02:50:20 |
| 9  | A. I don't know what these variables are. It       | 02:50:22 |
| 10 | would take, you know, a fairly extensive study to  | 02:50:25 |
| 11 | determine what this program actually does and what | 02:50:28 |
| 12 | these parameters might be for.                     | 02:50:31 |
| 13 | Q. Okay. Now, let's assume that you've got a       | 02:50:33 |
| 14 | repeat-accumulate code like the Divsalar code,     | 02:50:36 |
| 15 | Figure 3?  | 02:50:39 |
| 16 | A. Uh-huh.   | 02:50:40 |
| 17 | Q. And assume that you divide the input block      | 02:50:41 |
| 18 | of N bits into three subgroups: N1, N2, NK, okay?  | 02:50:49 |
| 19 | A. Correct.  | 02:50:57 |
| 20 | Q. And assume also that the number of              | 02:50:57 |
| 21 | repetitions for each subgroup will be different,   | 02:51:01 |
| 22 | okay?  | 02:51:04 |
| 23 | A. Okay.   | 02:51:08 |
| 24 | Q. In that case, the code would be an IRA          | 02:51:08 |
| 25 | code, right?                                       | 02:51:14 |