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 LTD., SAMSUNG ELECTRONICS AMERICA,  
 15 INC. and SAMSUNG  
 TELECOMMUNICATIONS AMERICA, LLC  
 16

17 UNITED STATES DISTRICT COURT  
 18 NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION  
 19

20 APPLE INC., a California corporation,

21 Plaintiff,

22 vs.

23 SAMSUNG ELECTRONICS CO., LTD., a  
 Korean business entity; SAMSUNG  
 24 ELECTRONICS AMERICA, INC., a New  
 York corporation; SAMSUNG  
 25 TELECOMMUNICATIONS AMERICA,  
 LLC, a Delaware limited liability company,

26 Defendant.  
 27

CASE NO. 11-cv-01846-LHK

**DECLARATION OF TODD M. BRIGGS  
 IN SUPPORT OF SAMSUNG'S OPENING  
 CLAIM CONSTRUCTION BRIEF**

**Date: January 20, 2012**

**Time: 10:00 am**

**Place: Courtroom 8, 4th Floor**

**Judge: Hon. Lucy H. Koh**

**SUBMITTED UNDER SEAL**

1 I, Todd M. Briggs, declare as follows:

2 1. I am an associate with the law firm of Quinn Emanuel Urquhart & Sullivan LLP  
3 and counsel for defendants and counter-claimants Samsung Electronics Co. Ltd., Samsung  
4 Electronics America, Inc., and Samsung Telecommunications America, LLC (collectively,  
5 “Samsung”). I submit this declaration in support of Samsung’s Opening Claim Construction  
6 Brief. I am personally familiar with and knowledgeable about the facts stated in this declaration  
7 and if called upon could and would testify competently as to the statements made herein.

8 1. Attached hereto as **Exhibit A** is a true and correct copy of certain excerpts from the  
9 Deposition of Hun-Kee Kim, Rough Transcript, dated November 30, 2011.

10 2. Attached hereto as **Exhibit B** is a true and correct copy of SAMNDCA0013600, an  
11 online article from Yonhap News describing the selection of SMP technology by the 3GPP  
12 standards setting body. Also attached is a certified translation from Korean to English.

13 3. Attached hereto as **Exhibit C** is a true and correct copy of “Samsung Electronics’  
14 Asynchronous IMT-2000 Technology Adopted as International Standard Specification,”  
15 September 20, 2002, an online news article from iNews24.com. Also attached is a certified  
16 translation from Korean to English.

17 4. Attached hereto as **Exhibit D** is a true and correct copy of certain excerpts from the  
18 Deposition of Richard D. Gitlin, dated December 6, 2011.

19 5. Attached hereto as **Exhibit E** is a true and correct copy of certain excerpts of  
20 Gitlin, Hayes and Weinstein, DATA COMMUNICATIONS PRINCIPLES, Kluwer Academic/Plenum  
21 Publishers (1992).

22 6. Attached hereto as **Exhibit F** is a true and correct copy of certain excerpts from the  
23 Deposition of Tony Givargis, dated December 6, 2011.

24 I hereby declare under penalty of perjury under the laws of the United States that the  
25 foregoing is true and correct.

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DATED: December 8, 2011

QUINN EMANUEL URQUHART &  
SULLIVAN, LLP

By /s/ Todd M. Briggs

Todd M. Briggs  
Attorneys for Defendants/Counter-Claimants  
SAMSUNG ELECTRONICS CO., LTD.,  
SAMSUNG ELECTRONICS AMERICA, INC.  
and SAMSUNG TELECOMMUNICATIONS  
AMERICA, LLC

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**General Order 45 Attestation**

I, Victoria F. Maroulis, am the ECF user whose ID and password are being used to file this Declaration. In compliance with General Order 45(X)(B), I hereby attest that Melissa N. Chan has concurred in this filing.

/s/ Victoria Maroulis

# Exhibit A



5 4495085\_1\_11-30-11 Kim, Hun Kee - ROUGH.TXT  
MR. BRIGGS: In-house counsel.  
6 THE VIDEOGRAPHER: So Corey Anderson of  
7 Merrill Corporation.  
8 The court reporter, will you please swear  
9 in the witness?  
10 Will you please swear in the interpreters  
11 first?  
12 JEESOO JUNG  
13 being called as an interpreter, was first duly sworn  
14 to translate English to Korean and Korean to English  
15 the testimony of the following witness:  
16 SUE MI JONES  
17 being called as a check interpreter, was first duly  
18 sworn to translate English to Korean and Korean to  
19 English the testimony of the following witness:  
20 HUN KEE KIM, Ph.D.  
21 having been first duly sworn through the  
22 English-Korean interpreter, testified as follows:  
23 THE VIDEOGRAPHER: Please begin.  
24  
25

8

(415) 357-4300

♀

HIGHLY CONFIDENTIAL, ATTORNEYS' EYES ONLY

1 EXAMINATION  
2 BY MR. KOLOVOS:  
3 Q. Good morning, Dr. Kim.  
4 A. Good morning.  
5 Q. We were introduced earlier. But for the  
6 record, my name is Peter Kolovos, I am counsel for  
7 Apple. And I am -- thank you for coming here to be

17 A. I don't quite recall.  
18 CHECK INTERPRETER: I cannot recall that  
19 at all.

20 BY MR. KOLOVOS:

21 Q. Just to be clear, and I don't want to  
22 know, I don't want to know what you did a couple  
23 months ago.

24 But in your answer you said you submitted  
25 some relevant documents to the IP team a few months

54

(415) 357-4300

♀

HIGHLY CONFIDENTIAL, ATTORNEYS' EYES ONLY

1 ago. Was that work that was done helping the IP  
2 team with respect to this litigation with Apple?

3 A. I don't know whether it is related, but I  
4 was asked to provide materials, if any, that are  
5 related to this by the IP team.

6 Q. Okay. My question is about anything you  
7 did in 2000 or 2001, or for that matter 2002. Do  
8 you remember providing any documents to the IP team  
9 in connection with the patent application for the  
10 '792 patent other than a patent application?

11 A. As to that, I don't quite recall because  
12 it was such a long time ago.

13 Q. Okay.

14 A. I don't recall.

15 Q. For any of your patent applications that  
16 you have been involved in, have you ever provided  
17 research articles to the IP team?

18 A. I'm not quite sure because it was a long  
19 time ago. But technical documents involving SMP

4495085\_1\_11-30-11 Kim, Hun Kee - ROUGH.TXT  
20 that were submitted to the 3GPP was -- were  
21 provided, and I think there were some articles  
22 related to SMP technology after the technology was  
23 adopted by the 3GPP.

24 So I think, you know, they have those kind  
25 of articles and that kind of information.

55

(415) 357-4300

†

HIGHLY CONFIDENTIAL, ATTORNEYS' EYES ONLY

1 CHECK INTERPRETER: I'm not quite sure  
2 because it was a long time ago. But some technical  
3 documents involving SMP that was submitted to the  
4 3GPP likely provided to IP team and also was after  
5 our SMP technology was adopted by 3GPP standard,  
6 there were several articles in Korean major  
7 newspapers.

8 So I can only think that they probably  
9 have them.

10 THE WITNESS: But I'm not quite sure  
11 whether they kept those -- that kind of information  
12 for a specific purpose or not. I'm not quite sure.

13 BY MR. KOLOVOS:

14 Q. Well, do you recall providing 3GPP  
15 technical documents about SMP to the IP team?

16 MR. BRIGGS: Objection, vague.

17 THE WITNESS: As I mentioned earlier, a  
18 few months ago I was asked to provide relevant  
19 documents, so I provided them.

20 BY MR. KOLOVOS:

21 Q. And my question is whether you provided  
22 them to the IP team in 2000, 2001, or 2002, at the

# Exhibit B

2002.03.20 (수) |

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### 삼성전자 IMT-2000 비동기기술 국제표준 채택

(서울=연합뉴스) 김범수기자= 삼성전자는 최근 세계 정보통신기술 협회(TTA)주관으로 신라호텔에서 열린 3GPP(3세대 프로젝트그룹)회의에서 자체개발한 IMT-2000비동기 접속방식인 'SMP'기술이 국제 표준 기술로 채택됐다고 20일 밝혔다.

삼성전자의 SMP(Symbol Mapping based on Priority)는 잡음에 의한 오차를 최소화해 고속 데이터 전송을 구현하는 기술이다.

삼성전자는 'IMT-2000기술의 표준화 과정에서 퀄컴, 노키아 등과 함께 선두그룹에 속하게 됐다'며 '차세대 이동통신 사업선점에 유리한 고지를 확보하게 됐다'고 설명했다.

[bumsoo@yna.co.kr](mailto:bumsoo@yna.co.kr) (끝)

2002/03/20 11:00 송고

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[대덕밸리](#)

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CERTIFICATION OF TRANSLATION

I certify that the Korean to English translation of the Korean internet newspaper article entitled **SAMNDCA00146000** is an accurate and complete rendering of the contents of the source document to the best of my knowledge and ability. I further certify that I am a qualified professional translator familiar with both languages with more than ten years of experience in Korean to English translation of various legal, technical or business documents including a number of legal evidentiary documents submitted to various courts in the United States.

Date: December 6, 2011

A handwritten signature in black ink, appearing to be 'AJ', written over a horizontal line.

Alex N. Jo, Translator

## **Samsung Electronics'IMT-2000 Asynchronous Technology Adopted as International Standard**

(Seoul = Associated Press) Reported by Bum Soo Kim = Samsung Electronics announced on March 20 that its 'SMP' technology, which is an IMT-2000 asynchronous connectivity mode developed in-house, was adopted as the international standard technology at the 3GPP (3<sup>rd</sup> Generation Project Group) meeting recently held by the International Telecommunication Technology Association (TTA) at Shilla Hotel.

Samsung Electronics' SMP (Symbol Mapping based on Priority) is a technology that minimizes error caused by noise. Thus enabling implementation of high-speed data transmission.

Samsung Electronics said, "In the course of IMT-2000 standardization process, we have emerged as a leader group company along with some other companies such as Qualcomm and Nokia, which enables us to preemptively secure an advantageous position in the next generation mobile communications business."

bumsoo@yna.co.kr (The End)

Sent on March 20, 2002 11:00

# Exhibit C



TBC

미투

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댓글쓰기

뉴스정정요청

트위터 페이스북 유튜브

IT는 아이뉴스24, 연예·스포츠는 조이뉴스24(Copyright © 아이뉴스24. 무단전재 및 재배포 금지)

IT정책 컴퓨팅 통신·미디어 과학 글로벌 디지털기 기업 자동차 금융 유통 경제일반 정치 사회 문화 생활

▶ **그랜저 에쿠스 A급 중고차 급매물 반값초특가**

- ▶ **[속보] 82kg주부 4주만에 48kg폭탄감량**
- ▶ **[이슈] 불티나게 팔리는 "서울대의자" 3일 만에 매진**

**비즈 링크**

농구황제 우지원 192cm키성장 비법	주식투자로 10억 아파트 장만했다~!!
불티나게 팔리는 "서울대의자" 3일 만에 매진	로또1등 75회적중 명당! 어디야?
결혼하고픈 선남선녀 맞선 신청하세요!	임플란트 월 8만원에 가능??
가수P양 홍콩명품 물레빠다 '적발' 굴욕!	82kg주부 4주만에 48kg폭탄감량

**오늘의 주요 뉴스**

- 한나라당, '홍준표 체제' 당분간 유지
- 김진표 "중편 출범, 그들만의 잔치될 것"
- 410g 초경량...에이서, 태블릿 무게 종결자 출시
- 박주영 '68분 출전'...아스널 8강서 무릎
- 김동률 "이승환 '다만', 사랑 고백 위해 만든 곡"

홈 | IT/서사 | 연예/스포츠 | 엠톡 | 게임 | 오피니언

**통신·미디어 최신뉴스**

- NHN '네이버 톨바'에서 메모·공유 기능 활용 하...
- 오버추어코리아, 11번가 검색광고 재계약 체결
- 네이버재팬 모바일메신저 '라인' 상승세 났다
- 한컴 '싱크프리 모바일', 방통위원장상 수상

**칼럼/연재**

- [정기수]"맹장수술 900만원?" 한미F...
- [김영리]"반칙' 잦은 소셜커머스, ...
- [박재덕의 턴]"강용석 해프닝' 일단...
- [박계현]넥스 해킹사고와 '두마리토...
- [KISTI의 과학향기]삼각팬티도 특허...

**프리미엄/정보**

- [11. 29]세계 스마트폰 시장 지형도...
- [통계뉴스] 정가 소셜게임 '캐슬빌' ...
- [11. 28]미국 블랙프라이데이 '엄청...
- [통계뉴스] 미국 이동통신 시장 현황
- [11. 24]그림으로 보는 삼성 vs 애플...

**한국콘텐츠진흥원**

[A&U&E~"o"]A&U&E u&E... AI&I'... [..E&O'T]A&U&A=A÷÷÷ A&I'æ±â] ... [..E&O'T]E&D æE'« »y'E&I AI æO'1.p...

애플의 혁신을 이끌었던 스티브 잡스가 세상을 떠났습니다. 이에 따라 잡스 없는 애플이 IT 시장의 주도권을 계속 잡을 수 있을지에 관심이 쏠리고 있습니다. 여러분들은 어떻게 생각하십니까?

투표하기

**매가 없어서 임플란트를 못하십니까?**

**톱스타 신은경 7일만에 파격 15kg 나인걸**

**강남 엄마들이 아이에게 사주는**

잠만자고 4주만에 -48kg 했어요!  
비만여성들이 환장하는 바로 이것!  
'윈도우7 태블릿' 1주일간 50% 더  
하루 1알로 매달 평균 5cm 더  
[속보] 당일완성 임플란트가 8...

**오라클 백서 다운로드**

**블랙베리 9800이 공개**

2011년 10월 10일 ~ 11월 9일

다운로드하기

너무따뜻해 무게는것  
베스트셀러

**기업비즈**

**몸짱 연예인 꼭천화 변비로 고생하다**

여자들이 싫어하는 0순위

지금 바로 보안전문가에 도전하라

"나는 한류 Seller다" 지마켓, 중...

지마켓, '2011 웨딩&리빙 페어' 개...

**오늘 내가 읽은 뉴스**

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news24.com

**inews24.com** [르포]디지털전환 취약계층 지원현장 가보니... bit.ly/w2c3ph  
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CERTIFICATION OF TRANSLATION

I certify that the Korean to English translation of the Korean internet newspaper article entitled *news-inews24-com* is an accurate and complete rendering of the contents of the source document to the best of my knowledge and ability. I further certify that I am a qualified professional translator familiar with both languages with more than ten years of experience in Korean to English translation of various legal, technical or business documents including a number of legal evidentiary documents submitted to various courts in the United States.

Date: December 6, 2011



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Alex N. Jo, Translator

## **Samsung Electronics' Asynchronous IMT-2000 Technology Adopted as International Standard Specification**

Entered at 15:32, September 20, 2002

**[Exclusive] Developed a solar power Smartphone battery that "lasts 15 days with 1-time charge"**

Soon, Samsung Electronics' SMP (Symbol Mapping based on Priority) technology is slated to be formally adopted as an international standard specification of the International Telecommunication Union (ITU).

The Telecommunications Technology Association (TTA) held a '3<sup>rd</sup> Generation Project Group (3GPP)' meeting at Shilla Hotel last week with about 400 attendees in the field of information communications technology from 20 or so countries. Samsung Electronics announced on March 20 that its own 'SMP' technology became an international standard technology after it was finally selected as a standard specification for the IMT-2000 asynchronous technology at the meeting.

Samsung Electronics' 'SMP' technology which just became the international standard is the technology that minimizes error caused by noise, thus enabling a high-speed data transmission. It is the core asynchronous technology in the IMT-2000. This technology improves communication quality by reducing noise during a telephone call between a mobile communications system and a user terminal as well as during data transmission, and also supports a greater number of concurrent users.

A person affiliated with Samsung Electronics says, "Samsung's SMP technology analyzes the correlation among the information bits with different degrees of reliability, thus arraying "information bits" in a position of higher reliability, and arraying "excess bits" in a position of lower reliability. This method plays a role of reducing data packet transmission error."

Meanwhile, with its numerous technologies adopted as standards in the course of IMT-2000 standardization, Samsung emerged as one of the leading [standards] companies along with some other companies such as Qualcomm and Nokia.

Samsung Electronics said, "We came to secure an advantageous position in the next generation mobile communications business based on our technological prowess selected as international standards. Also, we expect to gain considerable income associated with our technologies."

Reported by Hwi Jong Yoon hwiparam@inews24.com

# Exhibit D

1                   IN THE UNITED STATES DISTRICT COURT  
2                   NORTHERN DISTRICT OF CALIFORNIA  
3                   SAN JOSE DIVISION

4           APPLE INC., a California  
5           corporation,

6                   Plaintiff,

7           vs.

                  Case No.:  
                  11-cv-01846-LHK

8           SAMSUNG ELECTRONICS CO., LTD., a  
9           Korean business entity; SAMSUNG  
10          ELECTRONICS AMERICA, INC., a  
11          New York corporation; SAMSUNG  
12          TELECOMMUNICATIONS AMERICA, LLC,  
13          a Delaware limited liability  
14          company,

15                   Defendants.

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16                   VIDEOTAPED DEPOSITION OF RICHARD D. GITLIN, Sc.D.

17                   Taken on Behalf of the Defendants

18           DATE TAKEN:           Tuesday, December 6, 2011

19           TIME:                 9:06 a.m. - 3:26 p.m.

20           PLACE:                Embassy Suites Downtown Tampa  
21                                   513 South Florida Avenue  
22                                   Tampa, Florida

23           Stenographically Reported by:  
24           Donna L. Peterson  
25           Registered Diplomate Reporter  
              Certified Realtime Reporter  
              JOB NO: 44339

1 APPEARANCES:

2

3 Counsel for Plaintiff:

4 PETER J. KOLOVOS, ESQUIRE  
5 WilmerHale  
6 60 State Street  
7 Boston, Massachusetts 02109

8 Counsel for Defendants:

9 TODD M. BRIGGS, ESQUIRE  
10 Quinn Emanuel Urquhart & Sullivan  
11 555 Twin Dolphin Drive  
12 Redwood Shores, California 94065

13 Also Present:

14 Thomas Hallahan, videographer

15

16

17

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25

## P R O C E E D I N G S

1  
2 THE VIDEOGRAPHER: Good morning, ladies and  
3 gentlemen. Today's date is Tuesday, December the  
4 6th, 2011. The time is approximately 9:06 a.m. My  
5 name is Thomas Hallahan; I'm the videographer. The  
6 court reporter is Donna Peterson.

7 We are present at the Embassy Suites, 513 South  
8 Florida Avenue, Tampa, Florida. We're here for  
9 the purpose of taking the deposition of  
10 Dr. Richard D. Gitlin. The case is instituted in  
11 the United States District Court, Northern District  
12 of California, San Jose Division, case entitled  
13 Apple Incorporated versus Samsung Electronics  
14 Company, Limited, et al.

15 I will now ask the attorneys to introduce  
16 themselves, starting with the noticing attorney.

17 MR. BRIGGS: Todd Briggs from Quinn Emanuel for  
18 Samsung.

19 MR. KOLOVOS: Peter Kolovos of Wilmer Cutler  
20 Pickler Hale and Dorr for Apple.

21 THE VIDEOGRAPHER: Would the court please swear  
22 in the witness.

23 RICHARD D. GITLIN, Sc.D., called as a witness  
24 by the Defendants, having been first duly sworn,  
25 testified as follows:

1 THE WITNESS: Yes, I do.

2 DIRECT EXAMINATION

3 BY MR. BRIGGS:

4 Q. Good morning, Dr. Gitlin.

5 A. Good morning.

6 Q. Can you state your name for the record?

7 A. Richard Gitlin.

8 Q. And where do you live?

9 A. Just down the road in here, Tampa, 415 Knights  
10 Run Avenue, Tampa.

11 Q. Okay. How long have you lived in Tampa?

12 A. We've -- this is my fourth academic year. We  
13 also have a residence in New Jersey.

14 Q. How long did you live in New Jersey?

15 A. About 40 years.

16 Q. How many times have you been deposed?

17 A. As an expert or including as a fact witness?

18 Q. How about both.

19 A. Somewhere between 15 and 20.

20 Q. How many times as an expert witness?

21 A. This is probably about my 10th, 12th time.

22 Q. When was the most recent deposition you had?

23 A. I think this lady was handling my most recent  
24 one. That was in the spring of this year.

25 Q. Okay. And what case was that for?

1 respect to that HSDPA patent in the InterDigital versus  
2 Samsung case?

3 A. Similarly, that validity -- both sides, and  
4 infringement.

5 Q. So you wrote a report stating that or opining  
6 that Samsung infringed that HSDPA patent?

7 A. Yes.

8 Q. And you also wrote a report opining that that  
9 HSDA (sic) patent was valid?

10 A. Yes. There were, I mean, there were reports,  
11 plural. They were -- they went back and forth in this,  
12 with supplementary reports and -- in that case. And  
13 then the cases were -- you know, the first case was  
14 part -- was -- everything I did in the first case was  
15 part of the second case. So by the end, I think I had  
16 seven or eight reports that I was the author of.

17 Q. Do you -- do you remember the number of the  
18 patent in that case, that you were working on?

19 A. I -- I don't want to guess. No.

20 Q. Okay.

21 A. I'm sure you could find it out.

22 Q. What did the technology in that case -- or in  
23 that patent involve, at a little bit lower level?

24 A. It dealt with the control channel for HSDPA.

25 I can tell you a little more if you --

1 Q. Yeah.

2 A. It dealt with a -- the patent dealt with a  
3 mechanism for signaling on the channel in a -- with a  
4 minimum use of bits. It was a clever way of doing this.  
5 In fact now, when I teach my wireless course, I use that  
6 as an example of a clever way to achieve a function.

7 Q. Now, is HSDPA part of any standards?

8 A. Yes.

9 Q. What -- what standard or standards?

10 A. Well, it's in the 3GPP family.

11 Q. Okay. Do you know if InterDigital believed  
12 that that patent was essential to the 3GPP standard?

13 MR. KOLOVOS: Objection.

14 A. I believe that the -- that that -- that would  
15 be a fair statement, yes.

16 Q. So do you know what it means for a patent to be  
17 essential to a standard?

18 A. I think I have a rough understanding, not a  
19 legal understanding, but a rough engineering  
20 understanding, an expert witness understanding.

21 Q. What's -- what's your understanding, you know,  
22 as an expert witness?

23 A. That to -- that to build a piece of equipment  
24 that's compliant with the standard, you necessarily  
25 infringe the patent.

1 Q. Now, in your expert report in that case, did  
2 you take that position that this patent was essential to  
3 the 3GPP standard?

4 A. Yes.

5 Q. Have you ever done any work for Samsung?

6 A. No.

7 Q. Other than this case, have you ever done any  
8 work for Apple?

9 A. No.

10 Q. So this is the first time you've been retained  
11 by Apple?

12 A. Yes.

13 Q. Has Apple retained you only in its lawsuit  
14 against Samsung, or are you also working in other cases  
15 Apple has?

16 A. As far as I know, this is what I'm doing for  
17 Apple.

18 Q. Have you ever done any work for HTC?

19 A. No.

20 Q. Okay. Have you ever done any work for  
21 Motorola?

22 A. No.

23 Q. Okay. Have you ever done any work for Google?

24 A. No.

25 Q. And you're not currently retained by Apple to

1 input bits from some source. And the 120 is the channel  
2 encoder. Here it's a -- understood to be a turbo coder,  
3 or encoder. And it produces S bits, which are  
4 systematic bits, and P bits are the parity bits. And  
5 the S bits are the actual input to the channel encoder,  
6 the output of the CRC generator.

7 And the parity bits are generated by the shift  
8 registers inside the turbo encoder, shift registers and  
9 other elements. And the rate matcher is a -- is a  
10 device which will either puncture or eliminate bits or  
11 repeat bits to match the output rate to the available  
12 transmission capacity.

13 Bless you.

14 The -- so an interleaver is a common device in  
15 wireless systems because wireless -- most codes are  
16 designed to provide very good performance in random  
17 channel areas that are come -- that come randomly.  
18 Wireless systems have a different property. They have  
19 bursty errors. And they have bursty errors because when  
20 you're moving and you are in a fade, when you have,  
21 let's say, a low received signal level. So you're more  
22 likely to make errors in a bunch, in a burst.

23 And so an interleaver is a clever device that,  
24 for example -- it could be done many ways, but similar  
25 to what's described in the patent. You read bits into

1 a -- you think of a matrix. You read bits into a row,  
2 and you read -- and you read them alpha transmission in  
3 a column. So, for example, if you had a burst where a  
4 whole column was errored, then viewed from the -- and it  
5 in the first column, then at the receiver viewed from  
6 the viewpoint of each row, you just have one bit in  
7 error, and the code will be able to correct that.

8 That's the simple -- that's the very simple explanation.  
9 The interleavers in -- in the patent are much more  
10 sophisticated than that.

11 And then the -- and so the -- the notion of the  
12 interleaver is that from the viewpoint of the receiver,  
13 which is not shown in Figure 1 -- this is a  
14 transmitter -- is you -- you turn the phenomenon of a  
15 physically bursty error mechanism in a wireless channel  
16 to a -- as processed by the receiver, independent errors  
17 spread out over a long time. So the errors tend to be  
18 interleaved over time.

19 And so -- and the bit stream at the output of  
20 element 140 goes into a modulator. And I would call  
21 that a mapper, bit mapper. So that's -- in the three  
22 levels of modulation I described, this would be --  
23 that's the first one. And I think that's a nonstandard  
24 use of the term. I'd -- I would say most people would  
25 call that a symbol mapper or a mapper, bit-to-symbol

1 mapping.

2 And then the -- as I said, the controller is  
3 getting information as to the state of the channel and  
4 will adjust the level of encoding, let's say rate  
5 one-half, rate three-quarters, and/or the modulation of  
6 the symbols that you use, let's say a 16 QAM signal  
7 constellation or a 64 QAM signal constellation,  
8 depending upon the quality of the transmission channel.

9 Q. In -- in box 150, I -- I believe you just  
10 testified that a bit stream enters that box, which is  
11 labeled "Modulator."

12 A. Uh-huh.

13 Q. What is the output of the modulator?

14 A. So -- so the -- as it says in paragraph 28, the  
15 modulator can be either QPSK symbol, an 8PSK symbol, a  
16 16 QAM symbol, or a 64 QAM symbol.

17 Q. So is that output, is that digital data, is it  
18 a bit stream, or is it an analog signal? What is it?

19 MR. KOLOVOS: Objection.

20 A. Each -- for example, if you're using choice  
21 three, 16 QAM, 4 bits come in. The output is a number.  
22 It can be an X and Y number. You can think of it as a  
23 vector in the X and Y plane. You can think of it as a  
24 two couple. It will have discrete values. The typical  
25 scaling labels will be, you choose, plus or minus 1,

1 plus or minus 3. That could be volts, millivolts,  
2 microvolts, depending upon the transmitter power.

3 So you asked before: Is that digital? I say  
4 it's discrete valued. There is the 16 discrete points.  
5 You said one of those 16 discrete points.

6 Q. Now, are those values you were just talking  
7 about, are those used to modulate or alter a carrier  
8 wave?

9 A. If you recall my three levels of modulation,  
10 you -- what's not -- it's not shown -- the rest of the  
11 system is not shown here. But typically what you would  
12 do, you would take the -- let's take 16 QAM. You would  
13 take two of the bits, feed it to -- let's call it the  
14 inphase rail, and two of the bits to the quadrature  
15 rail. Then you would use pulse amplitude modulation, my  
16 second level of modulation, and you would -- so in that  
17 16 QAM case, you would -- you would amplitude modulate a  
18 pulse with either a level a plus 1, minus 1, plus 3,  
19 minus 3. And you amplitude modulate a pulse, and this  
20 pulse will define the bandwidth of the signal.  
21 Typically these pulses belong to a family called raised  
22 cosine.

23 And so now what you've done -- and you do the  
24 similar mechanism for the quadrature channel, and you  
25 design what people in the art would call a "baseband

1 bits are segmented at the input to the modulator at  
2 the -- let's say, if we look at case 16 QAM into 4 bit,  
3 you group 4 bits at a time, and that produces a symbol.  
4 That goes then to the second level of modulation, the  
5 third level of modulation. And you -- you -- generally  
6 this goes on for -- you know, you're sending lots of  
7 bits. You may -- it depends upon a particular system,  
8 and you're sending lots of bits, lots of symbols.

9 Q. Okay. So you said that the output of the  
10 mapper is a modulated pattern?

11 A. Yeah. That's -- that's Apple's construction.  
12 It's consistent with what's used in the -- as it says  
13 in -- on page 12, fifty -- paragraph 56, the independent  
14 claims 1 and 6 each recite the mapping, the collected  
15 bits from the first interleaver and second  
16 interleaver -- that's referring out to, I guess, not  
17 Figure 1, but it's the same idea -- onto one modulation  
18 symbol. That's what the patent describes it.

19 Q. So what is -- I'm trying to get an idea of what  
20 this modulated pattern is that you're talking about that  
21 is output from the mapper.

22 Is -- is this modulated pattern, are these --  
23 is this a bit stream?

24 A. It's -- for 16 QAM, you would -- you could --  
25 it -- now, it depends upon implementation, how you're

1 going to implement it. But you -- you -- functionally  
2 or symbolically, you could think of it in the XY plane  
3 or IQ plane as a vector or a point. And that represents  
4 one of the 16 discrete constellation points associated  
5 with 16 QAM constellation. That's what the output is.  
6 And then you separately divide it, as I said, to get the  
7 level -- level 2 pulse amplitude modulation, which then  
8 leads to level 3 RF modulation.

9 Q. So in the case of 16 QAM, if you're looking at  
10 the constellation, would -- would you call one of the  
11 points in the constellation a modulated pattern?

12 A. That's -- well, that's a symbol. Yeah. That's  
13 what -- that's what Apple's construction is, and a --  
14 using the language of the pattern -- of the patent. So  
15 you -- you typically, in a laboratory, would have that  
16 displayed. And you -- you would see various -- if you'd  
17 slow down time, you would see discretely points, one of  
18 those 16 points being illuminated. And that's a  
19 modulated pattern or a mapped pattern of bits.

20 So the symbol is a mapped pattern of bits. You  
21 map 4 bits into this XY two-topper or vector. That's  
22 what a symbol is.

23 Q. Okay. So when you use the term "pattern,"  
24 that's referring to the pattern of bits that are input  
25 into the mapper?

1 A. Yes.

2 Q. Okay. That's where I was getting confused. I  
3 didn't -- I didn't understand what "pattern" meant in  
4 "modulated pattern."

5 So you're referring to, you know, in the case  
6 of 16 QAM, the 4 bits that are coming into the mapper,  
7 that would be the pattern that's modulated?

8 A. That would be the bit pattern, yeah.

9 Q. And so if a bit stream were going into a  
10 mapper, the first 4 bits would map to -- would be a  
11 pattern that maps to one symbol, the second 4 bits would  
12 be a pattern that maps to another symbol?

13 A. Well, it could be a very same symbol point.  
14 You got 16 points. If it's the same quartet of bits, it  
15 would map to the same point.

16 Q. Okay. Well, let's assume they're all unique.

17 A. Right. They can only be unique -- after --  
18 after 16, you got to hit the same spot.

19 Q. But -- well, let's take an example where the  
20 bit stream is 12 bits and you have four unique quartets.

21 A. That's --

22 Q. Or three, three unique quartets.

23 A. Okay.

24 Q. So the first pattern would map to one symbol,  
25 the second pattern would map to a second symbol?

1 A. Yeah.

2 Q. And the third pattern would map to a third  
3 symbol?

4 A. Yeah.

5 Q. Now, why in -- in Figure 1 do you believe that  
6 the output is -- well, strike that.

7 Why do you believe in Figure 1 that the  
8 modulator does not include the pulse amplitude  
9 modulation or the RF modulation?

10 A. I was just looking at the abstract of the  
11 patent, but I'll -- I'll define the reference in the --  
12 in the spec.

13 Well, if I look in column 2, I'm looking sort  
14 of, you know, starting at around 40 and ending at 53.  
15 You got to get down to the bottom. The -- "in order to  
16 adaptively select one of the modulation techniques  
17 according to the radio department."

18 I mean, there's no discussion of my second  
19 level of modulation. There's no, as far as I can tell,  
20 there's no pulse shaping involved. There's certainly no  
21 discussion of carrier frequency. But the -- certainly,  
22 since this is part of HSDPA, there is a standard. One  
23 could assume that.

24 So, I mean, I just -- that's all -- that's all  
25 that I see in the patent, and that's all that's -- are

1 modulator 280, in Figure 3, it outputs a modulated  
2 pattern?

3 A. One of 16 QAM points.

4 Q. Now, is the output of the modulator, is that  
5 4 bits, or what -- what is the output?

6 A. It's -- it's a four -- it's a symbol that is  
7 one of the 16 points in the QAM, in the XY plane.

8 Q. But for it to appear like that, it has to go  
9 through the pulse -- the PAM and the RF modulation,  
10 correct?

11 A. No. You take -- you take 4 bits. You put it  
12 into a lookup table, and it gives you a complex number  
13 or an I and Q number. And you can just put that -- you  
14 can discuss that -- you can represent that in the signal  
15 constellation in the IQ plane or the XY plane as a  
16 signal point. It's understood. There's no figure of 16  
17 QAM here, but.

18 Q. Okay. So going back to what a modulated  
19 pattern is, in the case of 16 QAM, you would -- you  
20 would say that a modulating -- a modulated pattern is  
21 one of the points in the constellation?

22 A. One of the 16 points.

23 Q. One of the 16 points in the constellation.

24 A. And there are various ways to represent that,  
25 as a two-tuple XY pair, X coordinate and Y coordinate,

1 or as a vector.

2 Q. So would you agree that you could also call  
3 that same point a "modulated signal"?

4 A. No.

5 Q. Why not?

6 A. Okay. To me -- and I see that Dr. Wessel uses  
7 that term -- a signal in general has a notion of  
8 bandwidth associated with it. That symbol coming out is  
9 a number. Numbers don't have bandwidth.

10 Now, as he points to my textbook, when you --  
11 when you start out pedagogically and you're teaching  
12 students about statistical decision theory, you  
13 generally start with, are you sending signal one or  
14 signal two. So you're sending, let's say, 1 bit, one  
15 symbol, one signal. So in that pedagogical case, you  
16 can interchange the terms.

17 But in -- understanding of those skilled in the  
18 art, a particular symbol as I'm talking about is a  
19 number. It could be a complex number, I and Q. It's  
20 just a number. It doesn't -- you can't associate  
21 that -- people wouldn't call that "signal."

22 So what would people call a signal? People  
23 would call a signal, after you have a sequence of these  
24 symbols -- oh, let's say -- let's say -- let's say you  
25 wanted to send, in a real signal, just one -- in a real

1 system, I want to get one symbol from me to you. So I  
2 take that one symbol. I pulse amplitude modulate it.  
3 Now it has a bandwidth. And I put it in an RF carrier  
4 and you receive it. So I've sent one symbol, but the  
5 signal is that composite where I can say it has --  
6 exists for time and has a bandwidth.

7 A symbol is just a number. But in actuality,  
8 you send a plurality of such symbols in time, and the  
9 composite is called a signal.

10 Q. So I think you said something in your last  
11 answer. I thought you said a symbol is just a number?

12 A. Yes, I think that's what I said, a complex  
13 number.

14 Q. Okay.

15 A. Or an I and Q number, X and Y. That's --  
16 that's how someone of ordinary skill would interpret  
17 that.

18 Q. And what would that number represent?

19 A. Well, it just -- in the language of the patent  
20 in the more generally, if a 16 QAM, it would -- it would  
21 have an association with 4 bits. You -- you tell me  
22 what symbol point, and I could tell you which 4 bits  
23 you're -- depends if you're the transmitter or the  
24 receiver -- what you're transmitting or what you believe  
25 you received. There's a one-to-one mapping.

1 Q. Now, you would agree that your textbook and  
2 other sources refer to symbols as signals?

3 A. Under -- as I -- as I said in my testimony  
4 which I just gave, that -- I believe the only time that  
5 I did that in my book would be in a pedagogical sense  
6 when you're sending one symbol. So therefore -- and  
7 it's pedagogical to teach students about statistical  
8 decision theory, hypothesis testing, maximum likelihood  
9 detection. So you're sending one signal, and there it's  
10 sending one symbol, and the terms are loosely used.

11 But no one of ordinary -- no one of skill in  
12 the art would say, "I give you a symbol, a 16 QAM  
13 symbol, a 64 -- a 64 QAM symbol," and say that's a  
14 signal. What's its bandwidth? How long does it last?  
15 I don't know.

16 Q. In your -- in your book or any other references  
17 outside of the patent that you've seen, have you ever  
18 seen a symbol referred to as a modulated pattern?

19 MR. KOLOVOS: Objection.

20 A. The -- certainly I don't think I used that in  
21 my book. I don't recall seeing any references. But

22 this is consistent with, as I said, the unusual use of  
23 the term for element 280 as a modulator. I think most  
24 people would call that a mapper. And if you use the  
25 word "mapper," so that -- that would be a map pattern.

1 I think in my book I have the -- I did take a look. I  
2 use the word "pattern" for bit pattern. And I'm sure I  
3 used the word "mapper."

4 And it would be clear -- I mean -- you know,  
5 and also in these books -- mine is a graduate-level text  
6 when I was a faculty member. When I retired from  
7 Bell Labs in 2001, I taught at Columbia University for a  
8 couple years. So this was a Ph.D. level course. They  
9 still use my book. Now it's 20 years old. But, I mean,  
10 it -- this were is Ph.D. students. You didn't -- it  
11 wasn't necessary to define the term. You defined it  
12 used in the context.

13 Q. Have you ever seen in any extrinsic source or  
14 any source outside of the patent the output of a mapper  
15 being referred to as a modulated pattern?

16 A. Again, mapper. Well, if you -- if you have a  
17 mapper, you would say it's the -- it's the output of the  
18 mapper, you know. You have -- that's -- and most  
19 standards have, you know, a signal or mapping table.

20 Q. Okay. So I guess, in summary, you haven't seen  
21 any -- anything in the patent or anything in any other  
22 sources that describe a symbol as a modulated pattern?

23 MR. KOLOVOS: Objection; asked and answered.

24 A. Well, I disagree. I mean, as I said, if you  
25 look at Figure 3, the input is an input bit pattern, it

1 goes to a modulator. So in plane English, that would be  
2 a modulated pattern at the output.

3 I think that the claim construction is  
4 informative more for "symbol" because that's the way  
5 it's used in the patent. In fact, if you didn't do it  
6 that way, you might be confused when you -- you could be  
7 confused when you read that term, because I would say,  
8 to turn it around like you were suggesting but which I  
9 disagreed with, that modulator could have all three  
10 levels of modulation, but clearly it only has the first  
11 level, and it uses it in an unconventional way. So I  
12 think it's wise that Apple use the language of the -- of  
13 the patent to clarify "symbol."

14 Q. Let me ask it one more time.

15 You have not seen anything, either in the  
16 patent or in any other sources, textbooks, treatises,  
17 papers, that describe a symbol as a modulated pattern,  
18 correct?

19 MR. KOLOVOS: Same objection.

20 A. I -- sitting here today, I can't recall the  
21 hundreds of thousands of papers that I've read, you  
22 know. We can put it into Google search. I -- I haven't  
23 done that in Google Scholar. So I can't -- you know,  
24 I'm not going to agree with you to that statement  
25 because, you know, my memory is not that good.

1 Q. But sitting here today, you can't identify the  
2 use of "symbol" in any of these -- in any source where  
3 "symbol" is defined as a modulated pattern?

4 MR. KOLOVOS: Same objection.

5 Q. Correct?

6 A. In any extrinsic? You know, I -- I -- I -- I  
7 think that's -- you know, you're entitled to ask the  
8 question. And I'd say I -- I -- I don't remember. I  
9 can't instantly search all the papers, hundreds, if not  
10 thousands, of papers in my 40-year career that I've  
11 read, things that I've written, you know.

12 It's just simply that the use of the word for  
13 element 280 modulator is, to me, nonstandard in mapping.  
14 So, you know, it's a symbol. A bit mapper would be  
15 pretty common as to what you're doing. You're mapping  
16 bits into a symbol. That's what that element 280 is  
17 doing in this special way in conformance with SMP.

18 Q. Okay. Let me -- let me try one more time.

19 Sitting here today, you cannot identify any  
20 source, any paper, treatise, book, anything that defines  
21 a symbol as a modulated pattern; isn't that correct?

22 MR. KOLOVOS: Objection.

23 A. I -- I haven't tried to. So, you know, if that  
24 was an exercise that I was asked to do, I would go about  
25 searching. But I haven't attempted that. So I'm not

1 going to say it doesn't exist, but I haven't attempted  
2 to do that.

3 Q. But you would agree to me -- with me that  
4 sitting here today you cannot identify any book,  
5 treatise, paper, any source outside of the patent itself  
6 that defines "symbol" as a modulated pattern?

7 MR. KOLOVOS: Objection.

8 A. I'd just repeat my answer. I -- I haven't  
9 attempted to do that. So you're asking me to sort of  
10 reach a negative conclusion when I haven't attempted to  
11 do the work.

12 Q. So my question isn't -- it's not have you  
13 attempted to do it. I'm just saying that sitting here  
14 today you haven't identified in your declaration, and  
15 you can't identify -- sitting here, you can't identify  
16 any paper, book, treatise, any source that defines  
17 "symbol" as a modulated pattern, right?

18 MR. KOLOVOS: Objection.

19 A. I haven't been asked to do it, so I haven't  
20 done it. I haven't attempted to do it. I don't know  
21 the answer to the question.

22 Q. Okay. The next section --

23 MR. KOLOVOS: You want to break for lunch  
24 before we get to the next section?

25 MR. BRIGGS: Sure.

1 THE VIDEOGRAPHER: We're going off the video  
2 record. It's 12:35 p.m.

3 (Luncheon recess from 12:25 p.m. to 1:31 p.m.)

4 THE VIDEOGRAPHER: We're on the video record.  
5 It's 1:31 p.m.

6 BY MR. BRIGGS:

7 Q. Dr. Gitlin, Apple's construction of "symbol"  
8 has an interpretation of a modulated pattern in -- well,  
9 strike that.

10 Apple's construction requires a symbol to be in  
11 a sequence of such patterns. Do you see that?

12 A. Yes.

13 Q. Okay. Now, would you agree with me that a  
14 symbol does not necessarily need to be in a sequence of  
15 symbols?

16 A. Yes. You can send one symbol.

17 Q. Okay. So in defining "symbol," why do you  
18 think it's proper to require that the symbol appear in a  
19 sequence of symbols?

20 A. Well, I think it's -- it's informative because  
21 in these type of wireless and communication systems you  
22 generally send a sequence of symbols.

23 Q. But are you saying that the claim is actually  
24 limited to sending a sequence of symbols?

25 MR. KOLOVOS: Objection.

1 A. You mean claim 11?

2 Q. Yeah, claim 11.

3 A. Well, I mean, an apparatus for receiving data  
4 in the communication system comprising. So it would be  
5 understood of someone in skill in the art that a  
6 communication system, almost every system that I'm  
7 familiar with, sends a sequence of symbols.

8 Q. But other than your understanding of what  
9 somebody with skill in the art would believe, is there  
10 anything in the claim language that you can point to  
11 that requires a sequence of symbols to be sent?

12 A. Well, I think it -- for example, if you look --  
13 it's understood from the spec. So if you look at  
14 Figure 5, for example. So look at the 64 QAM case, they  
15 show you five symbols. And --

16 Q. So that was Figure?

17 A. 5.

18 Q. 5. So it shows five symbols under 64 QAM?

19 A. Yeah. And it -- yes. And there's a reason for  
20 it, yeah, as I'm sure you're familiar with in the text.  
21 But it's illustrative that -- that you're going to --  
22 generally -- in this case, it's to accommodate some  
23 limitation in memory. But you're -- you're going to  
24 have -- I think even in Figure 4 it shows for 64 QAM two  
25 symbols. But I think it's understood by -- when you say

1 I call level-one modulation, and can only talk about  
2 level-one, what it calls, demodulation. So I'll call it  
3 level-one mapping and level-one unmapping or demapping.

4 Q. Okay. So you're disagreeing with how the  
5 patent uses the terms "signal" and "symbol" here?

6 MR. KOLOVOS: Objection.

7 A. I'd like to read the patent in the column 21.

8 Q. Okay.

9 A. Yeah, I'm disagreeing. I mean, if I look at  
10 Figure 17, it -- it clearly shows that there's a signal  
11 sample coming in. And it's the -- the --

12 It's not clear at that point if the signal, the  
13 received signal sample, has been -- was -- has been  
14 resolved to one of 16 QAM points. You don't see that.  
15 So there is some ambiguity. But the demodulator is  
16 simply going from one of 16 -- it's a demapper -- one of  
17 16 points to a 4-bit pattern. And then that 4-bit  
18 pattern has then split the stuff that's going to the  
19 systematic deinterleaver and the parity deinterleaver.

20 Q. Okay. So I -- I guess the answer to my  
21 question is, yes, you do disagree with how the patent  
22 describes the received signal as being a symbol?

23 MR. KOLOVOS: I object to the form.

24 Mischaracterizes both his testimony and what the  
25 patent says.

1           A.    So the -- at the receiver you -- you have a  
2           series of wave forms or samples, and those are proper to  
3           refer to that as "signal" or "signal samples." It's  
4           only, you know, when you're making a decision and  
5           saying, "Which of the 16 constellation points or symbols  
6           do you think has been transmitted," are you back into a  
7           symbol. So, you know, there is -- there is a -- it's  
8           never the case --

9           You're -- you're taking a received signal  
10          sample, and you're mapping it through -- through some  
11          decision device into one of these 16 points. Now you  
12          have a decision as to what you think the received --  
13          what the symbol -- what you think what symbol was  
14          transmitted. And you go through this demodulator which  
15          is, I think, as I said, a poor choice of English, it  
16          would be a demapper.

17          Q.    So can a symbol be transmitted?

18                MR. KOLOVOS:  Objection.

19          A.    A symbol going through the three steps of  
20          modulation. You -- you -- you generate a transmitted  
21          signal by following these three steps. You take a bit  
22          pattern; you map it, in the language of the patent;  
23          modulate it to a symbol. You amplitude modulate PAM,  
24          and then you RFO modulate it. And that whole composite  
25          is called a signal.

1           So yes, that's the way you transmit symbols  
2    or --

3           Q.    Okay.  So symbols are transmitted wirelessly?

4           A.    Symbols are inside a -- if you look inside the  
5    airplane, there are symbols.  If you look -- if you  
6    look -- if you look at the airplane, it's a signal.  And  
7    what goes on the air is referred to as a signal.

8           Q.    And the signal contains symbols, correct?

9           A.    Yes.

10          Q.    So symbols are transmitted in a signal, and  
11   symbols are received in a signal?

12          A.    The receiver operation is more complicated.  So  
13   you -- the patent doesn't describe any of the  
14   operations, other than these what I'll call  
15   demodulated -- it's called demodulating or  
16   demultiplexing.

17                And it -- so you receive a signal and you --  
18   you undo the modulation through carrier frequency.  
19   There are some other parameters in there.  And for phase  
20   acquisition, you undo the effects of the distortion of  
21   channel, and now you're presented with a sequence of  
22   numbers.  So I think people would say that those are the  
23   received signal samples.

24                And if you looked at those on a plot where you  
25   have the 16 possible points, you'd have a bunch of fuzz.

1 A. I read it.

2 Q. Okay. So do you agree or disagree with that?

3 A. I disagree.

4 Q. Okay. So why do you disagree?

5 A. It's the same issue, that the -- so let me read  
6 the word.

7 What Apple, the construction says, a modulator  
8 that is a map pattern. So that's taking a group of bits  
9 and a pattern of bits and modulating it, using the  
10 terminology of the patent.

11 So as I've said many times, in 16 QAM you take  
12 4 bits, and you produce one of those 16 constellation  
13 points.

14 So -- so the demodulator is acting in an  
15 ordinary fashion to convert or -- this is -- you have  
16 a -- at the --

17 The way demodulator is used here is a demapper.  
18 You already decided, for whatever receiver mechanism you  
19 had, that the input of the demodulator is one of  
20 16 points. So the demodulator is simply a demapper  
21 into -- one of those 16 points into 4 bits. And  
22 that's -- you know.

23 And -- and Apple is not claiming that a symbol  
24 is itself a pattern. It's a modulated pattern. So it's  
25 taking the pattern and then modulating it to one of

1 16 points. That's what a symbol is.

2 Q. Let's -- let's turn to the next section of  
3 Dr. Wessel's declaration.

4 A. Where are you?

5 Q. On subsection B, between paragraphs 25 and 26.

6 THE WITNESS: I'm going to need to take a break  
7 in a couple of minutes. Is this a good place to  
8 take it now? I want to go to the bathroom.

9 MR. BRIGGS: Yeah.

10 THE VIDEOGRAPHER: We're going off the video  
11 record. It's 2:17 p.m.

12 (Recess from 2:17 p.m. until 2:28 p.m.)

13 THE VIDEOGRAPHER: We're on the video record.  
14 Its 2:28 p.m.

15 BY MR. BRIGGS:

16 Q. Dr. Gitlin, can you turn back to page 5 of  
17 Dr. Wessel's declaration.

18 So I wanted to ask you some more questions  
19 about Samsung's alternative construction. We just  
20 talked about the first part that says a "modulated  
21 signal," and you disagreed that that was correct.

22 Now I want to ask you if you disagree with the  
23 remainder of that proposed construction, which states --

24 A. How would you parse it?

25 Q. Well, that part says that a symbol represents a

1 number of bits specified according to the modulation  
2 technique.

3 I mean, would you agree that a symbol  
4 represents a number of bits specified according to a  
5 modulation technique?

6 A. Yes.

7 Q. Okay. So your real issue with Samsung's  
8 proposed construction is the portion that states "a  
9 modulated signal"?

10 A. Yes.

11 Q. And you don't agree that it's a signal; you  
12 believe it's a modulated pattern?

13 A. Yes. And that -- that language is what -- the  
14 way the patent refers the use of the word "modulator."  
15 I mean, as I said many times, I'm -- every time I'm  
16 seeing that "modulator," I'm saying "mapper," because  
17 that's the language that I'm familiar with, a bit  
18 mapper. You map bits into the signal -- to a symbol,  
19 excuse me.

20 Q. Yeah, we've got a lot of tongue twisters today.

21 MR. KOLOVOS: And given that the whole dispute  
22 seems to be is it "symbol" or is it "signal."

23 MR. BRIGGS: Hopefully you've been watching  
24 over us.

25 MR. KOLOVOS: I've been trying to, trying to,

1           trying keep an eye on that.

2           Q.     Can you turn to page -- or paragraph 38 of  
3     Dr. Wessel's declaration?

4           A.     Let me -- let me just -- this is in...

5           Q.     And you might want to refer back to  
6     paragraph 74 of your declaration.

7           A.     There's where I'm going.

8                     I have paragraph 74. Let's make sure I got to  
9     the end of it. Yeah. Okay. 38. Let me -- it goes on  
10    to the next page.

11                    Okay. I think I read them all.

12           Q.     Okay. So why don't we start with paragraph 74  
13    of your declaration.

14                    You make a statement in the middle of this  
15    paragraph that it would be -- you state, "It would be  
16    incorrect to refer to the entire sequence as a single  
17    symbol. Accordingly, a construction for symbols such as  
18    a signal representative data would be incorrect because  
19    it would fail to distinguish between a single symbol and  
20    a sequence of such symbols."

21                    Okay. So what is -- what is your concern that  
22    you're expressing here in paragraph 74?

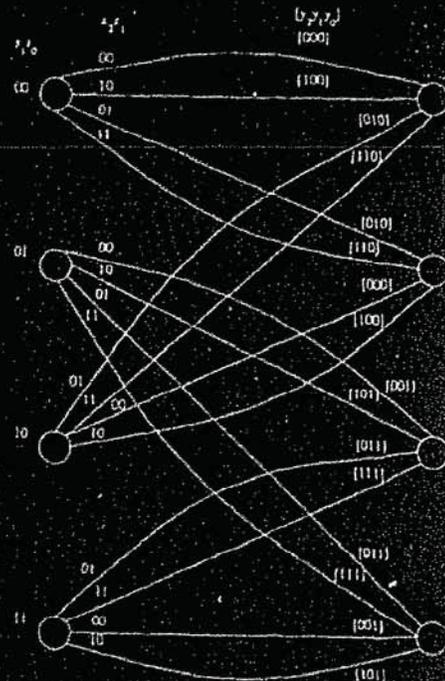
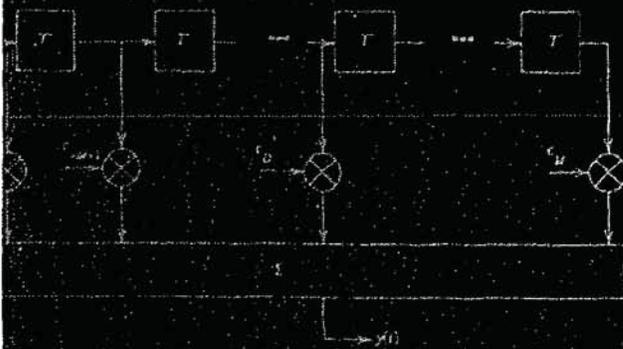
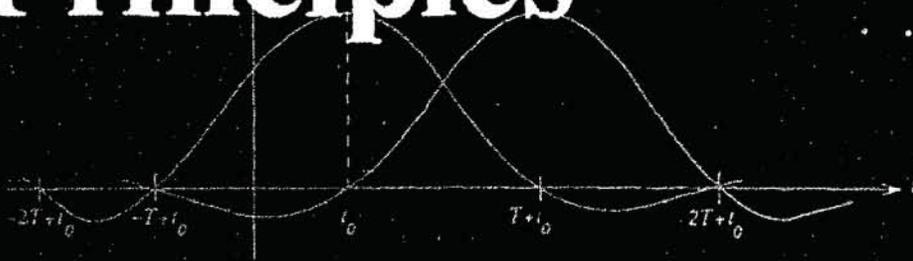
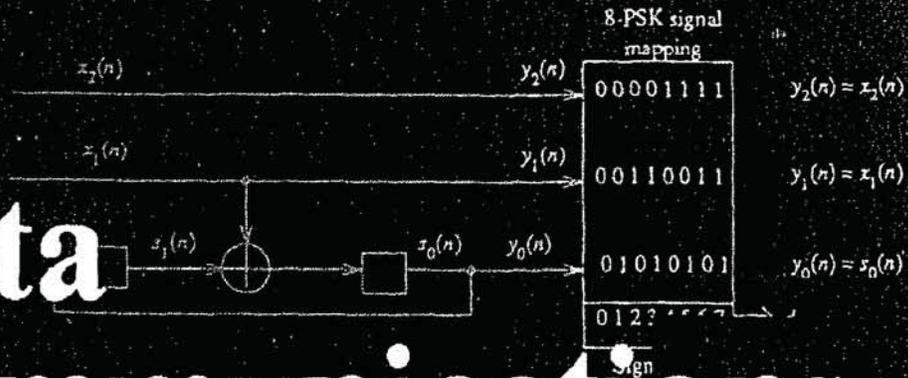
23                    MR. KOLOVOS: Objection.

24           A.     It's, as I recall, it's intended to distinguish  
25    between a symbol and a signal. I mean, it's that the --

# Exhibit E

Applications of Communications Theory  
 Series Editor: R. W. Lucky

# Data Communications Principles



**Richard D. Gitlin**  
**Jeremiah F. Hayes**  
**Stephen B. Weinstein**

one is presented with statistical data whose probability distribution depends on a discrete set of underlying parameters. Decision theory offers tools for processing the data to enable one to choose among these parameters in a statistically optimal fashion. Specifically, we shall be applying elements of the theory to the detection of signals in a digital communication system in which one of a finite set of symbols is transmitted over a channel.

The derivation of optimum decision rules begins with the definition of what is called the *observation space*. This is the raw data that are to be processed by the receiver. The dimensions of this space depend upon the particular application at hand, and the points in the space are the observed output of the channel. Consider the following simple one-dimensional example. A zero or a one is conveyed over a pair of wires by voltage levels of  $+s$  or  $-s$ , respectively. A single observation of the voltage is made. We assume that this observation is disturbed by additive noise, giving

$$Y = X + N, \quad (2.1)$$

where  $X = +s$  or  $-s$ . Assume that the noise voltage,  $N$ , is a zero mean Gaussian random variable.\* The observation space in this case is the range of values assumed by the random variable  $Y$ .

Because of the random nature of the channel, different transmitted symbols may be mapped into the same point in the observation space. In general, all that distinguishes these different transmitted symbols at the channel output are different conditional probability distributions. In the example of (2.1), conditioned on the transmitted symbol,  $Y$  is a Gaussian random variable with either mean  $+s$  or mean  $-s$ . The essential task of detection theory is to decide among the conditional distributions based on the observed values of  $Y$ . In the above example this is done by partitioning the observation space into two nonoverlapping regions (Figure 2.2) which cover the whole space. More generally, when one of  $L$  symbols is transmitted, the observation space is partitioned into  $L$  regions. Each region is identified with a transmitted symbol; a channel output falling in a particular region leads to deciding that the corresponding symbol was transmitted.

The choice of the criterion for partitioning the space led to a great deal of controversy in the formative years of detection theory. Part of the difficulty was in the assignment of *a priori* probabilities to the parameters of the distributions. Fortunately, matters are considerably simplified in the communications context, since the *a priori* probabilities of the transmitted symbols are known. In communications systems, there is also a convenient criterion for partitioning the

\* The Gaussian random variable, which is defined in Appendix 2A, along with other probabilistic concepts, is often a remarkably robust assumption. Many physical processes can be modeled as Gaussian. In other cases where the noise is, strictly speaking, not Gaussian, it can sometimes be assumed Gaussian for the purposes of comparing alternative systems and techniques, considerably simplifying the mathematical analysis. Furthermore, the results obtained for a Gaussian channel often provide a lower bound on the performance of systems operating on a non-Gaussian channel.

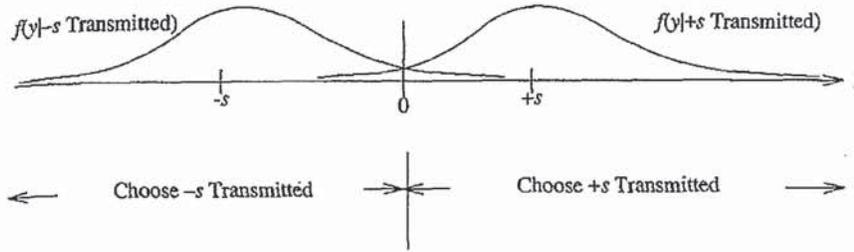


Fig. 2.2 Decision regions for one-dimensional binary transmission example.

observation space. One attempts to minimize the probability of making an error in deciding upon the transmitted symbol.

The derivation of the optimal decision regions is simplified if we assume the binary case, i.e., two transmitted symbols. The results of this analysis form the basis of the general case. The derivation of the detection rule involved partitioning the observation space into two disjoint regions;  $\mathbf{R}_0$  and  $\mathbf{R}_1$ , each region being identified with one or the other signal. A decision is made as to whether the output of the channel falls in  $\mathbf{R}_0$  or  $\mathbf{R}_1$ , respectively. The problem is to find the partition which minimizes probability of error. We shall assume that the observation space is of dimension  $M$ , i.e., all of the variables of equation (2.1) are vectors rather than scalars. We shall see later how signal and noise wave forms can be represented by such vectors. We generalize from  $\pm s$  of the example above by supposing that the symbols  $s_0$  and  $s_1$  are transmitted with probabilities  $P_0$  and  $P_1$ , respectively. If the received sample falls in region  $\mathbf{R}_i$ , the decision is made that  $s_i$  ( $i=0,1$ ) was transmitted. A detection error is made if  $s_0$  is transmitted and the observed random variable  $Y$  falls in the region  $\mathbf{R}_1$  or vice versa. The probability error given that  $s_0$  is transmitted is denoted by

$$Pr[\text{Error}|s_0 \text{ Transmitted}] = Pr\{Y \in \mathbf{R}_1 | s_0 \text{ Transmitted}\}$$

and, similarly,

$$Pr[\text{Error}|s_1 \text{ Transmitted}] = Pr\{Y \in \mathbf{R}_0 | s_1 \text{ Transmitted}\}.$$

From the law of total probability, we may write the probability of error as

$$\begin{aligned} Pr[\text{Error}] &= Pr[\text{Error}, s_0 \text{ Transmitted}] + Pr[\text{Error}, s_1 \text{ Transmitted}] \\ &= P_0 Pr\{Y \in \mathbf{R}_1 | s_0 \text{ Transmitted}\} + P_1 Pr\{Y \in \mathbf{R}_0 | s_1 \text{ Transmitted}\}. \end{aligned} \quad (2.2)$$

We now derive the rule for choosing  $\mathbf{R}_0$  and  $\mathbf{R}_1$  which minimizes the probability of error. In case of a continuous channel output, we have

$$Pr[Error] = P_0 \int_{\mathbf{R}_1} f(\mathbf{y}|s_0 \text{ Transmitted}) d\mathbf{y} + P_1 \int_{\mathbf{R}_0} f(\mathbf{y}|s_1 \text{ Transmitted}) d\mathbf{y}, \quad (2.3)$$

where  $f(\mathbf{y}|s_i \text{ Transmitted})$ ,  $i = 0, 1$  is the probability density function of the channel output conditioned on the transmitted signal. Integration is over the multidimensional regions  $\mathbf{R}_1$  and  $\mathbf{R}_0$ , respectively.

In the case of a discrete channel output, the probability of error may be written as:

$$Pr[Error] = P_0 \sum_{\mathbf{y}_j \in \mathbf{R}_1} Pr(\mathbf{Y}=\mathbf{y}_j|s_0 \text{ Transmitted}) + P_1 \sum_{\mathbf{y}_j \in \mathbf{R}_0} Pr(\mathbf{Y}=\mathbf{y}_j|s_1 \text{ Transmitted}), \quad (2.4)$$

where  $\mathbf{y}_j$ ,  $j = 1, 2, \dots, M$ , are the points in the observation space and  $Pr(\mathbf{Y}=\mathbf{y}_j|s_i \text{ Transmitted})$ ,  $i = 0, 1$ , are the appropriate conditional probabilities.

Since  $\mathbf{R}_0$  and  $\mathbf{R}_1$  partition the observation space,  $\mathbf{R}_0 \cap \mathbf{R}_1 = \phi$  and  $\mathbf{R}_0 \cup \mathbf{R}_1 = \Omega$ , where  $\phi$  denotes the null space and  $\Omega$  denotes the whole space. Based on these relations, and the fact that

$$\begin{aligned} \int_{\mathbf{R}_0} f(\mathbf{y}|s_0 \text{ Transmitted}) d\mathbf{y} + \int_{\mathbf{R}_1} f(\mathbf{y}|s_0 \text{ Transmitted}) d\mathbf{y} \\ = \int_{\Omega} f(\mathbf{y}|s_0 \text{ Transmitted}) d\mathbf{y} = 1, \end{aligned}$$

we may express (2.3) in the following form which makes the minimization problem straightforward:

$$\begin{aligned} Pr[Error] &= P_0 \int_{\Omega} f(\mathbf{y}|s_0 \text{ Transmitted}) d\mathbf{y} + \int_{\mathbf{R}_0} \{-P_0 f(\mathbf{y}|s_0 \text{ Transmitted}) \\ &\quad + P_1 f(\mathbf{y}|s_1 \text{ Transmitted})\} d\mathbf{y} \\ &= P_0 + \int_{\mathbf{R}_0} \{P_1 f(\mathbf{y}|s_1 \text{ Transmitted}) - P_0 f(\mathbf{y}|s_0 \text{ Transmitted})\} d\mathbf{y}. \end{aligned} \quad (2.5)$$

The only unknown quantity in (2.5) is the set of points which compose  $\mathbf{R}_0$ . Observe that  $Pr[Error]$  can be minimized by placing in  $\mathbf{R}_0$  only those points for which the integrand is negative. The proof that this leads to a minimum is by contradiction. Suppose that  $\mathbf{R}_0$  contains a set of points for which the integrand is positive. The probability of error can be decreased simply by placing these points in  $\mathbf{R}_1$ . Points which are exactly equal to zero can be placed in either region without changing the probability of error.

Since they are the product of positive quantities, a probability and a probability density, the two terms in the integrand of (2.5) are positive and the integrand is negative at a point  $y$  if

$$\frac{P_0 f(y|s_0 \text{ Transmitted})}{P_1 f(y|s_1 \text{ Transmitted})} = \frac{Pr(s_0 \text{ Transmitted}|\mathbf{Y}=y)}{Pr(s_1 \text{ Transmitted}|\mathbf{Y}=y)} > 1. \quad (2.6a)$$

Thus the decision rule that minimizes the probability of error is "decide  $s_0$  was transmitted if (2.6a) is true and  $s_1$  otherwise."

The decision rule in (2.6a) chooses the signal which maximizes the *a posteriori probability* of the transmitted symbol, given the observation; accordingly, it is called the maximum *a posteriori* (MAP) detector. As we shall see when we treat source coding in Section 2.4.2, for efficient transmission the *a priori probabilities* should be equal,  $P_0 = P_1$ . In this case the rule is to declare that  $s_0$  was transmitted if

$$f(y|s_0 \text{ Transmitted}) > f(y|s_1 \text{ Transmitted}), \quad (2.6b)$$

otherwise, choose  $s_1$  as the transmitted symbol.

**EXAMPLE 1** We now apply the MAP detector to the one-dimensional Gaussian example that we considered in (2.1) above. Since the Gaussian noise has zero mean and mean square value  $\sigma^2$ , the probability density of  $Y$  is

$$f(y|s_i \text{ Transmitted}) = \exp(-(y \pm s)^2/2\sigma^2)/\sqrt{2\pi\sigma^2}.$$

Applying (2.6), we have the decision rule "choose the transmitted signal as  $s$  if

$$\exp(-(y-s)^2/2\sigma^2) > \exp(-(y+s)^2/2\sigma^2)."$$

Taking logarithms of both sides, we have, after some manipulation, the threshold rule, which is to choose  $+s$  as the transmitted signal if

$$y > 0.$$

The decision space is shown in Figure 2.2, along with the conditional probability density functions. A similar development can be followed in the case of a discrete observation space. Again, the probability of error is minimized by choosing the maximum *a posteriori* estimate (MAP)

$$\frac{P_0 Pr(\mathbf{Y}=y_j|s_0 \text{ Transmitted})}{P_1 Pr(\mathbf{Y}=y_j|s_1 \text{ Transmitted})} = \frac{Pr(s_0 \text{ Transmitted}|\mathbf{Y}=y_j)}{Pr(s_1 \text{ Transmitted}|\mathbf{Y}=y_j)} \quad (2.7a)$$

In the case of equal *a priori probabilities*, it can be shown that the probability of error is minimized for each  $y_j$ ,  $i = 1, 2, \dots, M$ , in the observation space by choosing  $s_0$  as the transmitted signal if

$$Pr(\mathbf{Y} = y_j|s_0 \text{ Transmitted}) > Pr(\mathbf{Y} = y_j|s_1 \text{ Transmitted}). \quad (2.7b)$$

Otherwise, choose  $s_1$  as the transmitted signal.

**EXAMPLE 2** Consider the following example for the discrete case. Suppose that two signals are transmitted with equal probability over an optical fiber line. At the receiver, we assume that the optical detector emits electrons at a Poisson rate whose mean value depends upon the transmitted signal. For the two possible transmitted signals,  $s_0$  and  $s_1$ , we denote these averages as  $\lambda_0$  and  $\lambda_1$  electrons per second, respectively. We decide which of the two signals was transmitted by counting the number of electrons emitted in a  $t$  second interval. Let  $Y_t$  denote the number of electrons emitted by the optical detector over the observation interval  $(0, t)$ ; then the receiver decides in favor of  $s_0$  over  $s_1$  if the actual number of observed electrons,  $n$ , is such that

$$\Pr(Y_t = n | s_0 \text{ Transmitted}) > \Pr(Y_t = n | s_1 \text{ Transmitted}).$$

Since the number of emitted electrons is a Poisson\* random variable, we have

$$\Pr[Y_t = n | s_i \text{ Transmitted}] = \exp(-\lambda_i t) (\lambda_i t)^n / n!, \quad i = 0, 1, \quad n = 0, 1, 2, \dots$$

Since  $Y_t$  conditioned on the transmitted signal is a Poisson random variable, we choose  $s_0$  over  $s_1$  as the average rate if

$$\exp(-\lambda_0 t) (\lambda_0 t)^n / n! > \exp(-\lambda_1 t) (\lambda_1 t)^n / n!$$

or

$$n > (\lambda_0 - \lambda_1)t / (\ln \lambda_0 - \ln \lambda_1).$$

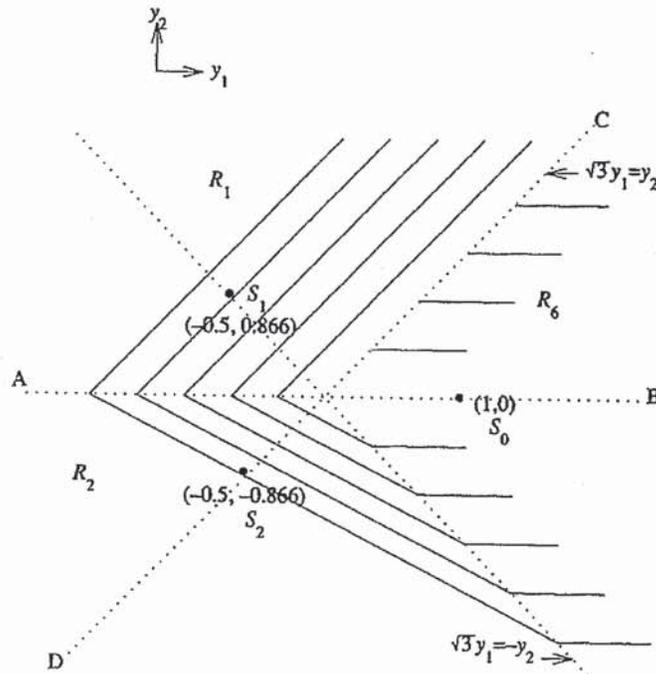
The equation says to choose the decision rule that says to select  $s_0$  if the number of electrons is greater than the threshold on the right-hand side.

There is a related approach to decision making which results in the same decision rule as (2.6b) when the *a priori* probabilities are identical. The technique is called *maximum likelihood*. Given the received signal  $y$  one chooses the input which maximizes the likelihood  $f(y | s_i \text{ Transmitted})$ ,  $i = 0$  or  $1$ . Maximum likelihood is appropriate when there is no way of determining the *a priori* probabilities  $P_0$  and  $P_1$ . For example, in radar, where one attempts to detect the presence or absence of a reflected signal, the *a priori* probabilities generally have no meaning. In this case decisions are made on the basis of costs associated with each kind of error.

### 2.1.2 L-ARY TRANSMISSION

In many applications the channel can be utilized more efficiently by using  $L$ -ary transmission, where one of  $L > 2$  symbols,  $s_i$ ,  $i = 0, 1, \dots, L-1$  is transmitted. It is almost always true that  $L$  is a power of two,  $L = 2^l$ , so that

\* See Appendix 2A for the definition of a Poisson random variable.

Fig. 2.3 Optimum decision boundaries:  $L = 3$ .

encoding a binary data stream is straightforward; each symbol conveys  $\log_2 L$  bits.\*

The results that we have obtained for the detection of binary signals apply directly to  $L$ -ary transmission. We imagine that the search for the most probable transmitted signal is conducted by comparisons of all possible pairs of transmitted signals. In the continuous case, the transmitted signal is chosen as  $s_i$ , where  $i$  is the value of the index such that  $P_i f(y|s_i; \text{Transmitted})$  is maximum over  $i = 0, 1, \dots, L-1$  and where  $P_i$  is the probability that  $s_i$  is transmitted. In the discrete case, for a channel output  $i$ ,  $s_i$  is chosen such that  $P_i \Pr(Y = y_j | s_i; \text{Transmitted})$  is maximum over  $i = 0, 1, \dots, L-1$ . In the usual communications context, where all transmitted symbols are equally probable, the above decision rule is equivalent to maximum likelihood.

The partitioning of the two-dimensional observation space for the simple case of  $L = 3$  is shown in Figure 2.3. Let the transmitted symbols be represented by points on the plane,  $s_0 = (1, 0)$ ,  $s_1 = (-0.5, 0.866)$ , and  $s_2 = (-0.5, -0.866)$ . (In Chapter 5, we shall see that these points might represent the phases of a sinusoidal carrier.) Let us assume that each of the two

\* In speaking of transmitting in bits per second, we are using the expression in its commonly used sense; however, as we shall see in Section 2.4, there is a mathematically rigorous definition of the information-bearing content of a signal in bits.

components of the signal point representing a symbol is disturbed independently by additive Gaussian noise with mean square value  $\sigma^2$ . We also assume that the signals are equally probable. Since the noise components are independent, the joint conditional densities are the product of the marginals. The conditional densities of the channel outputs are:

$$f(y|s_0 \text{ Transmitted}) = \exp(-((y_1 - 1)^2 + y_2^2)/2\sigma^2) / 2\pi\sigma^2$$

$$f(y|s_1 \text{ Transmitted}) = \exp(-((y_1 + 0.5)^2/2 + (y_2 - 0.866)^2/2\sigma^2) / 2\pi\sigma^2$$

$$f(y|s_2 \text{ Transmitted}) = \exp(-((y_1 + 0.5)^2/2 + (y_2 + 0.866)^2/2\sigma^2) / 2\pi\sigma^2$$

The derivation now proceeds in the same fashion as that of the one-dimensional Gaussian example considered above. The signal  $s_0$  is chosen over  $s_1$  if

$$\|Y - s_0\|^2 < \|Y - s_1\|^2,$$

where  $\|\cdot\|$  denotes the familiar Euclidean distance. It is interesting to note that the latter relationship describes a detector that chooses the transmitted signal that is *closest* to the received signal vector. The concept of a receiver which decides in favor of the signal that is at the *minimum distance* from the received signal is an important attribute of many of the receivers we will discuss later in this book. Returning to the above example, we find that after some manipulation, this leads to the criterion choose  $s_0$  over  $s_1$  transmitted if  $\sqrt{3} y_1 \geq y_2$ . The remaining regions are found the same way, with the result in the form of optimum decision regions shown in Figure 2.3. As we see from the figure, the boundaries of the decision regions are the perpendicular bisectors of the lines connecting the signal points.

### 2.1.3 PERFORMANCE—THE UNION BOUND

It is essential to describe the performance of these optimum detectors. In principle, the calculation of performance, i.e., the probability of making an error, is quite direct for the binary case. Having derived the optimum decision regions  $R_0$  and  $R_1$ , one may evaluate (2.3) and (2.4) for the continuous and discrete cases, respectively. In this chapter we shall consider calculations of performance for two types of channels, the additive white Gaussian noise (AWGN) channel and the binary symmetric channel (BSC).

The calculation of performance is somewhat more complicated in the case of  $L$ -ary transmission,  $L > 2$ . From the law of total probability, we may write

$$\begin{aligned} Pr[\text{Error}] &= 1 - Pr[\text{Correct}] = 1 - \sum_{i=0}^{L-1} P_i Pr[\text{Correct}|s_i \text{ Transmitted}] \\ &= 1 - \sum_{i=0}^{L-1} P_i Pr[Y \in R_i | s_i \text{ Transmitted}]. \end{aligned} \quad (2.8)$$

The key to evaluating the probability of error is the calculation of the term

$$Pr[\mathbf{Y} \in \mathbf{R}_i | s_i \text{ Transmitted}] = \int_{\mathbf{R}_i} f(\mathbf{y} | s_i \text{ Transmitted}) d\mathbf{y} \quad (2.9a)$$

in the continuous case, and

$$Pr[\mathbf{Y} \in \mathbf{R}_i | s_i \text{ Transmitted}] = \sum_{\mathbf{y}_i \in \mathbf{R}_i} Pr(\mathbf{Y} = \mathbf{y}_i | s_i \text{ Transmitted}) \quad (2.9b)$$

in the discrete case.

There are many situations in which the calculation of the quantities in (2.9a–b) is not straightforward. We shall see several examples later in the text. In these situations, we can obtain a useful upper bound on the error probability by applying the *union bound*, which is composed of errors involving only pairs of signals.

Suppose that the transmitted signal is  $s_i$ . Let  $E_{ij}$  denote the event that the observed point is such that  $s_j$  rather than  $s_i$  would be chosen. For example, in Figure 2.3, the event  $E_{12}$  would occur if the observation falls below the line A–B when  $s_1$  is transmitted. The actual error event consists of the union of these events over all  $j \neq i$ , and we may write

$$Pr[\text{Error} | s_i \text{ Transmitted}] = Pr[\cup_{i \neq j} E_{ij}]. \quad (2.9c)$$

It is important to observe that the events  $E_{ij}$  and  $E_{ik}$ ;  $i \neq j \neq k$  are not disjoint. This is obvious in the example in Figure 2.3 where  $E_{12}$  and  $E_{10}$  have considerable overlap since  $E_{10}$  consists of points to the right of C–D. An application of the standard laws of probability to (2.9c) yields the *union bound*

$$Pr[\text{Error} | s_i \text{ Transmitted}] \leq \sum_{i \neq j} Pr[E_{ij}]. \quad (2.10)$$

The calculation of the pairwise errors in (2.10) is the same as we have considered for binary transmission. For example, for the case depicted on Figure 2.3, one would integrate the density conditioned on  $s_1$  over the half plane below A–B and the half plane to the right of C–D if the transmitted signal were  $s_1$  [see (2.3) and (2.4)].

## 2.2 THE ADDITIVE WHITE GAUSSIAN NOISE (AWGN) CHANNEL

### 2.2.1 THE MATCHED-FILTER RECEIVER

In physical channels the information symbols are translated into time-varying waveforms or pulses whose form is suitable for transmission over the

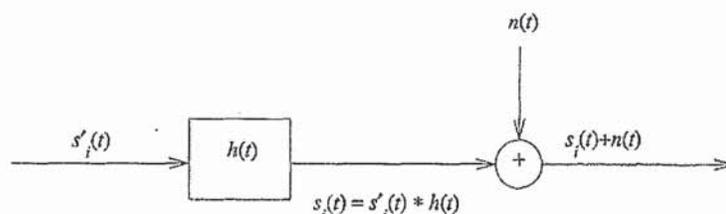


Fig. 2.4 The additive, linear noisy, communications channel.

channel. In a general sense, this process is called *modulation*.<sup>\*</sup> We begin with the binary case, where the waveforms  $s'_0(t)$  and  $s'_1(t)$  are transmitted for a zero and a one, respectively. There are many practical examples of modulation techniques. Perhaps the most basic, known as non-return to zero (NRZ), is the encoding of a zero into a positive pulse and a one into its negative. In frequency shift keying<sup>†</sup> (FSK), data bits are represented by bursts of carrier at different frequencies. Over a short time interval we have  $s'_i(t) = \sin(2\pi f_i t)$ ,  $i = 0, 1$ ;  $f_0 \neq f_1$ .

The signal is transmitted over the channel, where it is subject to the impairments discussed in Section 1.6 of Chapter 1. The model of the channel is depicted in Figure 2.4. The transmitted signal suffers delay and attenuation distortion represented by the channel which has impulse response  $h(t)$  and the corresponding transfer function  $H(f)$ . In this chapter, we shall assume that  $h(t)$  or, equivalently,  $H(f)$  is known at the receiver. Random impairments are presented by additive noise. We also assume that there is no intersymbol interference, where energy from one symbol spills over into adjacent symbol intervals. Under this assumption, we can consider the detection of a single signal in isolation.<sup>\*\*</sup>

Under these assumptions, the output of the channel may be written

$$y(t) = s_i(t) + n(t), \quad i = 0, 1, \quad (2.11)$$

where  $s_i(t)$  is the convolution of the transmitted signal with the channel impulse response,  $s_i(t) = s'_i(t) * h(t)$ ,  $i = 0, 1$ .<sup>‡</sup> The detection problem is to decide upon the transmitted signal,  $s'_0(t)$  or  $s'_1(t)$ , based upon the output of the channel as represented in (2.11). Since the impulse response of the channel is known at

\* There are often two levels of modulation in digital communication systems: the first level maps customer information, e.g., a binary stream, into a discrete set of signals, and the second level translates the signals into a form which is suited to the transmission media, modulation into a passband channel.

† See Section 5.6 for a discussion of FSK.

\*\* In Chapter 4 intersymbol interference and the effect of channel shaping and of transmitter and receiver filtering are considered.

‡ The symbol  $*$  indicates convolution  $s'_i(t) * h(t) = \int_{-\infty}^{\infty} s'_i(\tau) h(t - \tau) d\tau = \int_{-\infty}^{\infty} s'_i(t - \tau) h(\tau) d\tau$ .

# Exhibit F



1 Tuesday, December 6, 2011

2 8:56 a.m.

3

4 VIDEOTAPED DEPOSITION OF TONY GIVARGIS,  
5 PH.D., taken by Defendants, at the offices  
6 of Quinn, Emanuel, Urquhart & Sullivan,  
7 865 South Figueroa Street, Los Angeles,  
8 California, before Susan A. Sullivan, CSR,  
9 RPR, CRR, State of California.

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1 MR. SHAH: Ali Shah, WilmerHale, for the witness  
2 and representing Apple.

3 THE VIDEOGRAPHER: Thank you.

4 And will the reporter now swear or affirm  
5 the witness.

6

7 TONY GIVARGIS, PH.D.,

8 called as a witness, having been duly sworn by  
9 the court reporter, was examined and testified  
10 as follows:

11

12 EXAMINATION

13 BY MS. MAROULIS:

14 Q Good morning, Mr. Givargis. How are you  
15 today?

16 A Good, thank you.

17 Q My name is Victoria Maroulis and I will be  
18 asking you some questions today.

19 Have you ever been deposed before?

20 A No.

21 Q In that case let me briefly run you through  
22 the rules of the deposition.

23 First of all, do you understand that you  
24 are testifying today like you would be in a court of  
25 law under oath even though we're sitting in a

1 publisher that I recognized or they were -- if they  
2 were references on the website, that they were  
3 credible and they were published in a place that I  
4 would consider reasonable.

5 Q Did counsel for Apple instruct you where to  
6 search, what types of publications to search for  
7 extrinsic evidence?

8 MR. SHAH: Object to the extent it calls for  
9 privileged communication, but you can answer it.

10 THE WITNESS: Not necessarily. They told me --

11 MR. SHAH: Again, just a caution on substance of  
12 the communication.

13 Q BY MS. MAROULIS: Let me help you out. I  
14 don't want to ask you what you spoke with them  
15 about, my question is whether you were the one who  
16 selected the extrinsic evidence in your declaration  
17 or it was provided by counsel.

18 A Absolutely, yes, I understand. I selected  
19 all of those.

20 Q In your search for a definition of "applet"  
21 in extrinsic sources have you come across any  
22 definitions that did not support your opinion?

23 A Yes, I did.

24 Q Can you give me examples of those?

25 A One example of those was Microsoft's

1 control panel applet which is -- which was a very  
2 sort of exceptional use of the term "applet," a very  
3 limited in terms of how widely the term "applet" is  
4 used and how Microsoft was using it in that context.  
5 That was one example.

6 Q Why do you consider Microsoft's use of the  
7 term "applet" exceptional?

8 A Yes. Most applets are usually considered  
9 to be Java applets and/or similar to Java, Java,  
10 sort of Java-like applets in the sense that they are  
11 interpreted, they are an application or an app  
12 running within an application.

13 The Microsoft control panel applets are  
14 executable codes, they're actually dynamically-  
15 linked libraries that do not require interpretation,  
16 they run directly on the processor.

17 Q You said that most applets are Java  
18 applets. There are any applets that are not Java  
19 ones?

20 A Yes, a number of them.

21 Q Can you list them, please?

22 A Yes. For example, there are Python  
23 applets, there are AppleScript applets, there are  
24 JavaScript applets, there are applets in the context  
25 of Flash, the Flash programming environment.

1 Q So if a colleague came up to you and said  
2 they're writing an applet you would not necessarily  
3 know which one of those languages they were writing  
4 it in?

5 A I would automatically assume --

6 MR. SHAH: Just give me a second.

7 Objection; vague.

8 You can answer if you understand the  
9 question.

10 THE WITNESS: Yes, I would -- I would assume  
11 Java applets because those are the most common types  
12 of applets.

13 Q BY MS. MAROULIS: But they're not  
14 exclusive, correct?

15 A Correct.

16 Q Besides the reason you stated about why  
17 Microsoft was exceptional in use of applets, is  
18 there any other reason why you did not pick the  
19 Microsoft definition for your declaration?

20 MR. SHAH: Object to form.

21 THE WITNESS: Yes. I felt that that represented  
22 a very small percentage of all of the applets that  
23 or all of the kinds of applets and it would not be  
24 the usual or the common understanding of the term  
25 "applet."

1 Q BY MS. MAROULIS: Do you agree that at  
2 least some people in the programming community when  
3 they hear the word "applet" can think of a Microsoft  
4 control panel applet?

5 A Some, yes.

6 Q And do you agree that was the case in 2005  
7 as well?

8 A Yes.

9 Q Besides coming across the Microsoft control  
10 panel applet, did you see any other definition of  
11 "applets" in your research that diverged from the  
12 one you picked for your declaration?

13 MR. SHAH: Objection; vague.

14 THE WITNESS: No.

15 Q BY MS. MAROULIS: Did you see any  
16 definition of AppleScript applets?

17 A I first came to -- to see AppleScript  
18 applets when I read Mr. Cole's declaration.

19 Q And upon reading Mr. Cole's declaration did  
20 it remind you that there were in fact AppleScript  
21 applets back in 2005?

22 A Yes, that is correct.

23 Q And in your research did you come across  
24 the Python applets?

25 A I was aware of Python applets but I did not

1 necessarily come across a writing or a textbook.

2 Q Is it correct that Python applets existed  
3 in 2005?

4 A Yes, that is correct.

5 Q In your research did you come across Flash  
6 program applets?

7 A I was very well aware of Flash applets but  
8 I did not find or obtain or look for documents  
9 describing Flash applets.

10 Q You are aware they existed in 2005 as well,  
11 correct?

12 A Yes.

13 Q Are you familiar with Linux applets?

14 A I am not.

15 Q Let's turn to your declaration on Page 5.

16 What is the invention of the '711 patent?

17 MR. SHAH: Objection; vague.

18 THE WITNESS: I can summarize the '711 patent as  
19 being a method or a teaching of how to accommodate  
20 multitasking on a mobile device.

21 Q BY MS. MAROULIS: Is there any reference to  
22 Java in this patent?

23 A May I take a look?

24 Q Absolutely.

25 A No.

1 Q Is there any references in this patent to  
2 system independent nature of applets?

3 A You mean operating-system dependent or just  
4 system?

5 Q Yes.

6 A No, there is not.

7 Q If you recall, is there any reference to  
8 Java in the context of applets in the prosecution  
9 history?

10 MR. SHAH: If you need to review any documents,  
11 you can ask for them.

12 THE WITNESS: Yes, I would appreciate it if I  
13 had a copy of the prosecution history.

14 MS. MAROULIS: I'm happy to mark the file  
15 history. It is rather sizeable.

16 Let's mark this as Exhibit 5.

17 (Givargis Exhibit 5, a document, Bates Nos.  
18 SAMNDCA00007840 to SAMNDCA00008459, marked  
19 for identification, as of this date.)

20 Q BY MS. MAROULIS: Sir, I'm placing before  
21 you Exhibit 5. Do you recognize it as the  
22 prosecution history of the '711 patent?

23 A I believe portions of it I have reviewed,  
24 yes.

25 Q You don't remember reviewing the whole

1 thing?

2 A Not the entire thing, no.

3 Q How did you decide what portions of that  
4 file history to review?

5 A The file history was provided to me by the  
6 attorneys.

7 Q The file history that you see before you is  
8 double-sided, so do you remember giving me documents  
9 that is this thick or thicker or was it a smaller  
10 document?

11 A I recall a smaller document.

12 MS. MAROULIS: Counsel, I would appreciate  
13 seeing the version of the file history that was  
14 provided to the witness.

15 MR. SHAH: I can represent that we provided the  
16 certified file history.

17 MS. MAROULIS: The entire file history?

18 MR. SHAH: We did.

19 MS. MAROULIS. Via PDF file, not via paper.

20 Q BY MS. MAROULIS: This is not a memory  
21 test, but do you recall any references to Java in  
22 the context of applets in the file history?

23 A There was absolutely no reference to Java  
24 in the file history that I reviewed.

25 Q Was there any reference to applet being

1 operating-systems independent?

2 A I do not recall any reference to operating-  
3 system-independent applets in the file history that  
4 I reviewed.

5 Q Turning back to Exhibit 2 which is the  
6 patent-in-suit, is it correct, sir, that there's  
7 only one place where applets are mentioned in the  
8 patent?

9 A There is only one place in the  
10 specification that refers to patents.

11 Q Thank you.

12 A And to applet.

13 Q Thank you for correcting me. I did mean  
14 specification.

15 And is it correct, sir, that that place in  
16 the specification is Column 3, Lines 8 through 14?

17 A Yes, that is correct.

18 Q This passage does not mention Java as well,  
19 correct?

20 A That is correct.

21 Q And it does not mention operating-systems  
22 independent.

23 A That is correct, yes.

24 Q Why do you cite this passage to support  
25 your definition in your declaration?

1           A     Yes.  The important element of this passage  
2     is the part that says at least one applet within an  
3     application model -- module or in each of the  
4     application modules, and that relationship of an  
5     applet within an application module or in the  
6     context of an application module is relevant to my  
7     understanding and definition of applets being  
8     interpreted by a host application module.

9           Q     Where do you see the word "within," sir?

10          A     There is no "within" in this, in this  
11     particular text.

12          Q     Okay.

13          A     There's an association, yes.

14          Q     Can you explain how you read this last  
15     sentence to support your definition.

16          A     "Application modules of the portable  
17     terminal include at least one applet and each of the  
18     application modules, that is each menu of the  
19     portable terminal, independently performs multi-  
20     tasking."

21                 So as I interpret it, the applets run  
22     within or execute within an application module or  
23     execute in the context of an application module.

24          Q     Do you draw a distinction between  
25     "application module" and "program"?

1 operating-system independent?

2 A This passage does not make reference to  
3 operating-system independent. However, the  
4 association between an applet and an application  
5 module, together with the claim language and the  
6 prosecution, the file history, does suggest to me  
7 that the applet requires the application module as  
8 a, sort of as a context, and that relationship is  
9 what one would expect from Java applets or Java-like  
10 applets, that interpreted.

11 Q Setting aside the claim language and  
12 prosecution history, is it correct that there's  
13 nothing in this particular passage that indicates  
14 operating-system independence?

15 A Nothing in the passage mentions anything  
16 about being operating-system independent, yes.

17 Q Let's take a look at the claim language.  
18 For example, Claim 1 in Column 7, do you see that?

19 A Yes.

20 Q The relevant limitation is "Generating a  
21 music background play object, wherein the music  
22 background play object includes an application  
23 module including at least one applet."

24 Is there any mention of operating-system  
25 independence here?

1 A No.

2 Q Is there anything in this claim that you  
3 see that supports your notion of operating-system  
4 independence?

5 A What I see in this sentence, passage, is,  
6 again, the association between an applet running or  
7 an applet that is within an application module and  
8 that association to me suggests a Java-like  
9 interpreted environment.

10 Q Did you review the testimony of the  
11 inventor of this patent?

12 A Yes. I reviewed a subset of it.

13 Q Did you see that the inventor who was  
14 developing this technology was working with system-  
15 dependent applets?

16 A That is correct, yes.

17 Q Which system-dependent applets was he  
18 working with, to your understanding?

19 MR. SHAH: If you need to see any documents to  
20 refresh your recollection, you can ask.

21 THE WITNESS: Yes. I think this one I can  
22 answer without the document, but it was a Qualcomm  
23 chipset.

24 Q BY MS. MAROULIS: Do you disagree that the  
25 technology he was working on is described by Claim

1 1?

2 MR. SHAH: Object to the extent it calls for a  
3 legal conclusion.

4 THE WITNESS: I have not formed that position  
5 yet.

6 Q BY MS. MAROULIS: Do you understand that he  
7 was asked during deposition about the embodiments of  
8 the patent?

9 MR. SHAH: Same objection.

10 THE WITNESS: Yes. I'm not sure exactly what he  
11 was asked.

12 Q BY MS. MAROULIS: If the technology that he  
13 was working on embodies this claim would you agree  
14 with me that the claim includes applets that are  
15 also system dependent?

16 MR. SHAH: Same objection.

17 THE WITNESS: Based on -- I recognize that the  
18 inventor was working with a system that was  
19 OS-dependent, specifically the Qualcomm chipset.  
20 However, that use of the term "applet" within that  
21 context was unusual or it was not consistent with  
22 the common understanding of the term "applet" at the  
23 time and the '711 patent does not make that  
24 distinction clear.

25 Q BY MS. MAROULIS: If the '711 patent does

1 are off the record.

2 (Recess)

3 THE VIDEOGRAPHER: The time is 9:59 a.m. and we  
4 are back on the record.

5 BY MS. MAROULIS:

6 Q Mr. Givargis, before the break we were  
7 discussing the '711 patent. Other than the  
8 "specification," quote, we discussed and the coding  
9 language, there's no other portion of the '711  
10 patent that you are relying on in your declaration,  
11 correct?

12 A I believe so, yes.

13 MS. MAROULIS: I would like to now switch to the  
14 prosecution history which is Exhibit 5 and, for the  
15 record, the document control numbers are  
16 SAMNDCA00007840 through 8459.

17 Q What is your understanding, sir, of what a  
18 file history is?

19 A Yes. It has three components, some of it  
20 are identifying information or titles of various  
21 documents and so on. Then it has another component  
22 which is sort of the examiner's rejections and a  
23 description of why those rejections are followed by  
24 a response to the office action which comes from the  
25 applicant in response to the rejections.

1 Q What particular portions of this document  
2 are you relying on in your declaration?

3 MR. SHAH: Look at your declaration if you need  
4 to.

5 THE WITNESS: Yes. May I look at my  
6 declaration?

7 Q BY MS. MAROULIS: Yes.

8 A Yes. I'm relying on the examiner's  
9 suggestion that the phrase "a music background play  
10 object" will be -- will be augmented with "the music  
11 background play objects including an application  
12 module includes at least one applet" to distinguish  
13 it from the Kokubo patent."

14 Q Are you reviewing to the interview with the  
15 examiner on December 8, 2009?

16 A Yes.

17 Q If you would like you can turn to Pages  
18 7871 through 7873 of this exhibit, of Exhibit 5.

19 A Yes.

20 Q Is this the record of the examiner's  
21 interview that we have been talking about?

22 MR. SHAH: Objection. The document speaks for  
23 itself.

24 THE WITNESS: Yes, that's correct.

25 Q BY MS. MAROULIS: And is it correct that

1 the relevant passage you were relying on appears on  
2 Page 7873 of Exhibit 5?

3 A This appears to be a summary of the  
4 interview that is consistent with the passage I have  
5 been relying on, yes.

6 Q Did you interview any participants of this  
7 interview?

8 A No, I did not.

9 Q So the only record of this interview you  
10 are relying on is this summary here, correct?

11 A This summary and some of the additional  
12 text, yes.

13 Q And the --

14 A Surrounding it.

15 Q And the followup filings by the applicants.

16 A Correct.

17 Q Is there anything in this interview summary  
18 that mentions Java?

19 A No, there is not.

20 Q And is there anything in this summary that  
21 mentions applet being system independent?

22 MR. SHAH: Objection. The document speaks for  
23 itself.

24 THE WITNESS: No, there is not.

25 Q BY MS. MAROULIS: What in particular about