UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.
Petitioner

v.

BELL NORTHERN RESEARCH, LLC
Patent Owner

Patent No. 8,416,862

DECLARATION OF DR. LEONARD J. CIMINI
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 8,416,862

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

TABLE OF CONTENTS

I. INTRODUCTION 1
II. BACKGROUND AND QUALIFICATIONS 2
III. MATERIALS REVIEWED 6
IV. PERSON OF ORDINARY SKILL IN THE ART AND THE TIME OF THE ALLEGED INVENTION 10
V. TECHNICAL BACKGROUND 12
A. Multiple Input Multiple Output (MIMO) Wireless Communications 12
B. Matrices 29
C. Channel Estimation and Beamforming, and Singular Value Decomposition (SVD) 36
D. Givens Decomposition 43
VI. THE '862 PATENT 51
A. Description 51
B. The '451 Provisional and '793 Application 57
VII. CLAIM CONSTRUCTION 59
VIII. OVERVIEW OF THE PRIOR ART 60
A. *Roh* 60
B. *Maltsev* 67
C. *Haykin* 75
D. *Yang* 82
E. *Lin* 84
IX. THE PRIOR ART DISCLOSES OR SUGGESTS ALL RECITED FEATURES OF CLAIMS 9-12 OF THE '862 PATENT 93

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

A. *Roh*, *Maltsev*, and *Haykin* Disclose or Suggest the Features of Claims 9, 11, and 12 93

1. Claim 9 93

a) 9[a] A wireless communication device comprising: 93

b) 9[b] a plurality of Radio Frequency (RF) components operable to receive an RF signal and to convert the RF signal to a baseband signal; and 96

c) 9[c] a baseband processing module operable to: 106

d) 9[d] receive a preamble sequence carried by the baseband signal; 113

e) 9[e] estimate a channel response based upon the preamble sequence; 124

f) 9[f] determine an estimated transmitter beamforming unitary matrix (V) based upon the channel response and a receiver beamforming unitary matrix (U); 132

g) 9[g] decompose the estimated transmitter beamforming unitary matrix (V) to produce the transmitter beamforming information; and 138

h) 9[h] form a baseband signal employed by the plurality of RF components to wirelessly send the transmitter beamforming information to the transmitting wireless device. 143

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

2. Claim 11 148

a) "The wireless communication device of claim 9, wherein the channel response (H), estimated transmitter beamforming unitary matrix (V), and the receiver beamforming unitary matrix (U) are related by the equation: *H=UDV where, D is a diagonal matrix."** 148

3. Claim 12 153

a) "The wireless communication device of claim 9, wherein in determining the estimated transmitter beamforming unitary matrix (V) based upon the channel response and the receiver beamforming unitary matrix (U), the baseband processing module performs Singular Value Decomposition (SVD) operations." 153

B. *Roh*, *Maltsev*, *Haykin*, and *Yang* Disclose or Suggest the Features of Claim 10 155

1. Claim 10 155

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

a) "The wireless communication device of claim 9, wherein in determining an estimated transmitter beamforming unitary matrix (V) based upon the channel response and a receiver beamforming unitary matrix (U), the baseband processing module is operable to: produce the estimated transmitter beamforming unitary matrix (V) in Cartesian coordinates; and convert the estimated transmitter beamforming unitary matrix (V) to polar coordinates." 155

C. *Lin*, *Haykin*, and *Maltsev* Disclose or Suggest the Features of Claims 9, 11, and 12 160

1. Claim 9 160

a) 9[a] A wireless communication device comprising: 160

b) 9[b] a plurality of Radio Frequency (RF) components operable to receive an RF signal and to convert the RF signal to a baseband signal; and 163

c) 9[c] a baseband processing module operable to: 173

d) 9[d] receive a preamble sequence carried by the baseband signal; 179

e) 9[e] estimate a channel response based upon the preamble sequence; 187

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.