IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Volume 10, PP 34-39

Estimating SINR In A Millimeter-Wave Propagation

Prof.Jyoti Dange[1], Dr. R.P. Singh[2] , Dr.Vikas Gupta[3]
[1](Electronics And Telecommunication/ Sssutms,Sehore, India)
[2](Electronics And Telecommunication/ Sssutms,Sehore, India
[3](Electronics And Telecommunication/ Vcert,Thane India)

Abstract: *A New Edge For Cellular Communication Is Defined By Millimeter-Wave (Mmw)With Fre-Quencies Between 30 And 300 Ghz To Offers The Assurance In Orders Of Magnitude Greater Bandwidths Which Is Combined With Further Gains Via Beam Forming And Spatial Multiplexing From Multielement Antenna Ar-Rays. To Brought A Focus On Small Cell Deployments In Urban Environments Special Studies Is Made On Sur-Veys Of Measurements And Capacity. On The Basis Of Statistical Model Obtain From Demonstratation Of 28 And 73 Ghz In An Urban Environment It Is Proved That Mmw Systems Can Present Extra Than An Order Of Magni-Tude Add To In Capacity Over Current State-Of-The-Art 4G Cellular Networks At Current Cell Densities. Cellular Systems, However, Will Need To Be Significantly Recontruct To Fully Realize These Gains. The Requirement Of Highly Directional And Adaptive Transmissions, Directional Isolation Between Links, And Significant Possibilities Of Outage Have Strong Implications On Multiple Access Channel Structure, Synchronization, And Receiver De-Sign. To Address These Objective, Paper Discusses How Various Technologies Including Adaptive Beam Forming,. Multihop Relaying, Heterogeneous Network Architectures, And Carrier Aggregation Can Be Leveraged .In This Paper We Proposed Model For Mmw Frequencies Used In Conventional Cellular Systems. In Cellular Wireless Networks, Mmw Signals Range Of Wavelengths From 1 To 10 Mm, And Frequencies Approximately In The Range Of 30–300 Ghz.*

Keywords *-Cellular Systems; Channel Models;SINR, Millimeter- Wave Radio; Urban Deployments; Millimeter- Wave Radio; Urban Deployments*

I. Introduction

In Cellular World, The Network Is Distributed Over Land Areas Those Are Served By The Fixed Location Transceiver. The Base Ations Are Provided With The Cell Whose The Network Coverage Can Be Used For Voice And Data Transmission. A Cell Typically Uses A Different Set Of Frequencies From Neighbor-Ing Cells, To Avoid Interference And Provide Guaranteed Service Quality Within Each Cell.[1] Cellular Data Has A Tremendous Demand With Conservative Estimates Ranging From 40% To 70% With The Increasing Traffic Year By Year. With This Incredible Growth It Will Become Necessary That Cellular Network Is To Provide With1000 Times Cellular Data Speed As Compared To The Current Level. As Benefits Of Connectivity Goes Beyond In Area Of Smart Phones And Tablet. This Paper Studies Capacity And Measurement To Acsess This Technology With The Focus Of Small Cell Deployments In The Urban Environment. With The Increase In Traffic Demand For Cellular Data Has Been Growing At A Staggering Pace, With Conservative Estimates Ranging From 40% To 70% Year Upon Year [1]–[3]. This Incredible Growth Implies That Within Current Levels Capacity May Need To Deliver As Much As 1000times The Relative To The Next Decades, Cellular Networks . At The Same Time, As The Bene-Fits Of Wireless Connectivity Reaches To Beyond Smartphones And Tablets, Many New Devices Will Require Wireless Service Perhaps As Many As 50 Billion Devices Will Be Connected By 2020 Approximately [4]. Meeting This Been Growing At A Staggering Pace, With Conservative Estimates Ranging From 40% To 70% Year Upon Year [1]–[3]. This Incredible Growth Implies That Within Current Levels Capacity May Need To Deliver As Much As 1000times The Relative To The Next Decades, Cellular Networks . At The Same Time, As The Bene-Fits Of Wireless Connectivity Reaches To Beyond Smartphones And Tablets, Many New Devices Will Require Wireless Service Perhaps As Many As 50 Billion Devices Will Be Connected By 2020 Approximately [4]. Meeting This Demand Will Be A Difficult Task. Many Of The Equirements Envisioned For What Are Now Being Called Beyond Fourth-Generation (4G) And Fifth-Generation (5G)Cellular Systems, Such As Multi-Gigabits Per Second (Gb/S) Peak Throughputs And Tens Of Megabits Per Second (Mb/S) Cell Edge Rates [5], Are Already Daunting. In Addition, On Basis Of Statistical Channel Models , It Is Shown That Mmw Systems Can Offer The Magnitude Increase In Capacity Over Current State-Of-The-Art 4G Cellular Sys-Tems. For Extremely Directional And Adaptive Transmissions, It Is A Requirement Of Strongly Implica-Tion Of Multiple Access, Channel Structure, Synchronization, And Receiver Design. The Main Purpose Of This Paper Is To Study Recent Results And Understand How Significant These Challenges Are To Provide A Realistic Assessment Of Mmw Systems Can Be Viable, And Also Take Account Of Potential Gain They Can Provided By Mmwave. In Perception To This Evaluation To Offer Guidance In Next Generation Cellular System

Realization

II. MILLIMETER-WAVE CELLULAR NETWORKS

The First Millimeter Communications Is Demonstrated By Bose More Than 100 Years Ago. Consequent To Frequencies Approximately In The Range Of 30–300 Ghz ,The Pathway To Millimeter-Wave Cellular, Mmw Signals Will Refer To Wavelengths From 1 To 10 Mm. Currently, Mmw Bands Are Extensively Used For Satellite Communications And Cellular Backhaul . Wireless Communications In These Mmw Bands Are Not New .More Recently, Mmw Transmissions Is Used For Very High Throughput Wireless Local Area Network (Lans) And Personal Area Network (PAN) Systems In The Newly Unlicensed 60-Ghz Bands.

While These Systems Offer Standard In Overload With 1 Gb/S, The Grounds Are Typically For Lacking-Frequent Or Instant To-Point LOS(Line Of Sight) Settings. While Mmw Vision Sacrifice Vastly Major Bandwidths Than Current Porous Situation, There Is A Fear That The Propagation Of Mmw Sign Is Much Less Favoring. The Request Of Mmw Pledge For Longer Row, NLOS Favose Scenarios Is A Modern Bordering And The Feasibility Of Such Systems Has Been The Submissive Of Considerable Debate. As We Will See Be-Low, Mmw Signals Suffer From Severe Shadowing, Recurrent Connectivity And Will Have Higher Doppler Spreads. With These Limits There Has Been Remarkable Uncertainty That Mmw Stripe Would Be Viable For Porous Systems That Exact Authentic Communication Across Longer Range And NLOS Paths. Two Re-Cent Gravitate Have Bucked Up A Reconsideration Of The Viability Of Mmwave Cellular. First, Heighten In CMOS RF And Digital Processing Have Enabled Cost Mmw Chips Correspondent For Commercial Mo-Biles Devices . Significantly Advance Has Been Made, In Exact, In Power Amplifiers And Unrestrained Space Adaptable Dispose Confederate, And These Technologies Are Likely To Advance Fur-Ther With The Effect Of 60-Ghz Wireless LAN And PAN Systems . In Increase, Due To The Very Small Wavelengths, Diffusive Dispose Can Now Be Fabricated In A Short Area Of Less Than 1 Or 2 Cm.To Furnish Path Dissimilitude From Blockage By Human Obstructions (Such As A Deed Holding A Part Of The Device, Or The Embody Blockade The Path To The Spore), Several Arrays May Be Placed Throughout A Excitable Device.

In Many Dense Areas, Cell Sizes Are Now Frequently Less Than 100–200 M In Radius, Possibly Within The Range Of Mmw Signals Based On Our Measurements .In The Absence Of New Spectrum, Increasing Capaci-Ty Of Current Networks Will Require Even Greater ‘‘Densification’’ Of Cells. While Greater Densification Is Likely To Play A Central Role For Cellular Expansion , Building Networks Beyond Current Densities May Not Be Cost Effective In Many Settings Due To Expenses In Site Acquisition, Rollout, And Delivering Quality Backhaul.

. In Contrast, In Very High Density Deployments, The Wide Bandwidths Of Mmw Signals May Provide An Alternative To Cell Splitting By Significantly Increasing The Capacity Of Individual Small Cells. Indeed, Backhaul By Now Represents 30%–50% Of The Operating Costs By Some Estimates And That Share Will Only Grow As Other Parts Of The Network Infrastructure Decrease In Price Backhaul May Also Be Provided In The Mmw Spectrum, Further Reducing Value . Despite The Potential Of Mmw Cellular Systems, There Are A Number Of Key Challenges To Realizing The Vision Of Cellular Networks In These Bands.

The Smaller Wavelength Of Mmw Signals Also Enables Proportionally Greater Feeler Gain For The Same Antenna Dimension Consequently, The Higher Frequencies Of Mmwsignals Do Not In Them Selves Result In Any Increased Free Space Dissemination Loss, Provided The Remains Fixed And Suitable Directional Transmissions Are Utility. We Will Corroborate This Property From Our Measurements. How-Ever, The Reliance On Highly Directional Transmissions Will Force Incontrovertible Design.A More Momentous Concern For Row Is That Mmw Signals Are Extremely Susceptible To Shadowing. For Example, Materials Such As Brickcan Attenuate Token By As Much As 40–80 Db .Also, The Human Body And Many Outdoor Materials Being Very Reflective Allow Them To Be Important Scatterers For Mmw Propagation .For A Given Mobile Velocity, Channel Coherence Time Is Linear In The Carrier Frequency, Meaning That It Will Be Very Small In The Mmw Range. In Path Loss, High Levels Of Investigation Imply That The Appearance Of Obstacles Will Lead To Much More Dramatic Swings , Although Beam Steering May Overcome This . Also, Mmwsystems Will Be Essentially Built Of Small Cells,Meaning That Relative Path Losses And Cell Association Also Change Rapidly.. Current Applications For Mmw Transmissions Are Gen-Erally For Point-To Point Links (Such As Cellular Backhaul , Or LAN And PAN Systems With A Limited Number Of Users Or MAC-Layer Protocols That Prohibit Multiple Simultaneous Transmissions. From A Systems Perspective, This Implies That Connectivity Will Be Highly Intermittent And Communication Will Need To Be Rapidly Adaptable Though, For High Spatial Use And Spectral Efficiency, On Multiple Interfer-Ing Links Cellular Systems Require Simultaneous Transmissions, And New Mechanisms Will Be Needed To Coordinate These Transmissions In Mmw Networks. A Significant Challenge In Leveraging The Gains Of Multiantenna, Wide-Bandwidth Mmw Systems Is The Power Consumption In The Analog-To-Digital (A/D) Conversion. Power

Consumption Generally Balances Linearly In The Sampling Rate And Exponentially In The Number Of Bits Per Samples.

ESTIMATING SINR IN A MILLIMETER-WAVE PROPAGATIONS

III. SYSTEM MODEL

Using The Experimentally Derived Channel Models From The Collected Data ,Provided A Few Sim-Ple System Simulation To Assess The Potential Mmw Cellular Systems. We Summarize Some Of The Key Findings In That Work Along With Other Studies To Estimate The Possible Capacity Of Mmw Systems And Recognize The Main Design Issues. Standard Cellular Evaluation Methodology Follow In Our Work De-Scribe Where The Bss And Ues Are Randomly Placed According To Some Statistical Model, And The Per-Formance Metrics Are Measured Over A Number Of Arbitrary Realizations Of The Network.

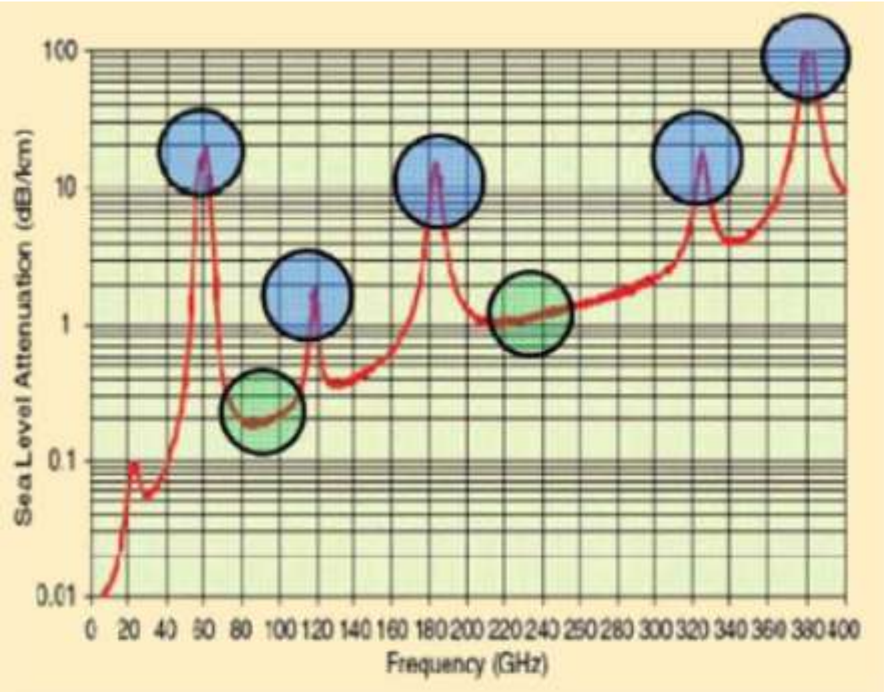

Fig. 1. Millimeter-Wave (Mmw) Bands Between 30 And 300 Ghz Offer More Than 200 Times The Spec-Trum Than Current Cellular Allocations, With Ample Regions With Sufficiently Low Attenuation For Small Outdoor Cells. In Bands With The Green Bubbles, The Oxygen Attenuation Is Only A Fraction Of A Decibel Greater Than Free Space Over Distances Of Several Hundred Meters.

Our Work Here Follow A Standard Cellular Evaluation Methodology Where The Bss And Ues Are Random-Ly Placed According To Some Statistical Model, And The Performance Metrics Were Then Measured Over A Number Of Random Realizations Of The Network. Since The Interest Is In Miniature Cell Networks, We Fol-Lowed A BS And UE Distribution Similar To The 3GPP Umi Model In Some Parameters Taken From [7] And [8]. The Specific Parameters Are Shown In Table 2. Observe That We Have Assumed An Intersite Dis-Tance (ISD) Of 200 M, Corresponding To A Cell Radius Of 100 M. Also, The Maximum Transmit Powers Of 20 Dbm At The UE And 30 Dbm Were Taken From [7] And [8]. These Transmit Powers Are Reasonable

ESTIMATING SINR IN A MILLIMETER-WAVE PROPAGATIONS

Since Current CMOS RF Power Amplifiers In The Mmw Range Exhibit Peak Efficiencies Of At Least 8%–20% [6], We Considered A Network Exclusively With Mmw Cells.Of Course, In Reality, Mmw Systems Will Be Deployed With An Overlay Of Conventional Larger UHF/Microwave Cells.

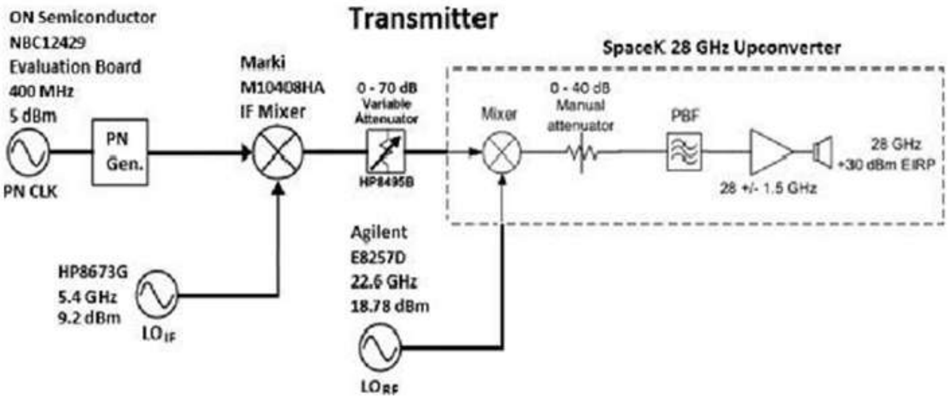

Fig. 6. The 28-GHz channel sounder transmitter block diagram

Thus, Practical Mmw Heterogeneous Network Will Have A Higher Capacity, Particularly In Terms Of Cell Edge Rates. To Model The Beamforming, Which Is Essential In Mmw Systems, We Followed A Conserva-Tive Model, Making The Simplifying Assumption That Only Single Stream Processing (I.E., No Single-User Or Multiuser Spatial Multiplexing) Was Used. Of Course, Intercell Coordinated Beamforming And Multi-Ple-Input–Multiple-Output (MIMO) Spatial Multiplexing [23], May Offer Further Gains, Particularly For Mobiles Close To The Cell. Although These Gains Are Not Considered Here, Following , We Considered Multibeam Combining That Can Capture Energy From Optimally Non Coherently Combining Multiple Spa-Tial Directions To Obtain Capacity. We Have Consider Long-Term Beamforming To Stay Away From Tracking Of Small-Scale Fading, To Be Slightly Challenging At Very High Doppler Frequencies At Mmw. Both Downlink And Uplink Assumed Proportional Fair Scheduling With Full Buffer Traffic. In The Uplink, It Is Important To Recognize That Different Multiple-Access Schemes Result In Different Capacities. If The BS Allows One UE To Transmit For A Portion Of Time In The Whole Band, The Total Receive Power Will Be Lim-Ited To That Offered By A Single User. If Multiple Ues Are Allowed To Transmit At The Same Time But On Different Subbands, Then The Total Receive Power Will Be Greater, Which Is Advantageous For Users That Are Not Bandwidth Limited. The Simulations Below Thus Assume That Subband Frequency-Division Multi-Ple Access (FDMA) Is Possible. This Enables Much Greater Capacity As Well As Other Benefits At The MAC Layer.

Estimating SINR In A Millimeter-Wave Propagations

Parameter	Description
BS layout and sectorization	Hexagonally arranged cell sites placed in a 2km x 2km square area with three cells per site.
UE layout	Uniformly dropped in area with average of 10 UEs per BS cell (i.e. 30 UEs per cell site).
Inter-site distance (ISD)	200 m
Carrier frequency	28 and 73 GHz
Duplex mode	TDD
Transmit power	20 dBm (uplink), 30 dBm (downlink)
Noise figure	5 dB (BS), 7 dB (UE)
BS antenna	8x8 $\lambda/2$ uniform linear array
UE antenna	4x4 $\lambda/2$ uniform linear array for 28 GHz and 8x8 array for 73 GHz.
Beamforming	Long-term beamforming without single-user or multi-user spatial multiplexing

Table 2 Default Network Parameters

IV. Sinr And Rate Distributions

We Plot Signal-To-Interference-Plus-Noise Ratio (SINR) And Rate Distributions In Fig. 2. The Distributions Are Plotted For Both 28 And 73 Ghz. We Expect Future Mmw Bss To Have Thousands Of Antenna Element Leading To Much Greater Gains And Directionality. There Are Two Immediate Conclusions We Can Draw From The Curves. First, Based On This Evaluation, The Complete Capacity Of A Potential Mmw System Is Enormous. Cell Capacities Are Often Greater Than 1 Gb/S And The Users With The Lowest 5% Cell Edge Rates Experience Greater Than 10 Mb/S. These Rates Would Likely Satisfy Many Of The Envisioned Requirements For Beyond 4G Systems. Second, For The Same Number Of Antenna Elements, The Rates For 73 Ghz Are Approximately Half The Rates For 28 Ghz. Although Our Study Here Was The First To Use The Experimental-Ly Resulting Omnidirectional Channel Models From The Directional Data , The Results Is Roughly Agree With The Findings Of Very High Capacity From Mmw Systems Predicted In Several Earlier Analyses. For Exam-Ple, The Study Estimated Approximately 300 Mb/Sper Cell Throughput In A 500-Mhz System. This Capac-Ity Related To A Somewhat Lower Spectral Efficiency Than What We Show Here But The Study In [7] As-Sumed Only Minimal Beamforming At The Receiver And A Much Larger Cell Radius Of 250 M.In [9], Ray-Tracing Software Is Used To Analyze A Mmw Campus Network, And A Median Total System Capacity Of 32 Gb/S With Five Cell Sites, Each Cell Site Having Four Cells, Is Found. This Number Again Is Lower Than Our Predictions, But [9] Was Limited To Quadrature Phase-Shift Keying (QPSK) Modulation In All These Stud-

Ies, The Cell Edge Rates Compare Similarly To The Predicted Values , Assuming One Normalizes To The Num-Ber Of Users In Each Cell. In A Different Work, A Stochastic Geometry Examination And Predicted Almost 5.4 B/S/Hz Is Used, Which Is Almost Twice Our Predictable Spectral Efficiency. However, That Work Assumed That All Links Can Operate At The Shannon Limit With No Utmost Spectral Efficiency. This Comparison Concludes That, In A Number Of Different Situation And Analysis Methods, The Absolute Spectral Efficiency And Cell Edge Rate Numbers Are Roughly Comparable With Estimates That Used Experimentally Derived Channel Models. Thus, The Broad Message Remains The Similar: Under A Wide Variety Of Simulation Assumptions, Mmw Systems Can Offer Orders Of Magnitude Increases In Capacity And Cell Edge Rate Over State-Of-The-Art Systems In Current Cellular Bands.

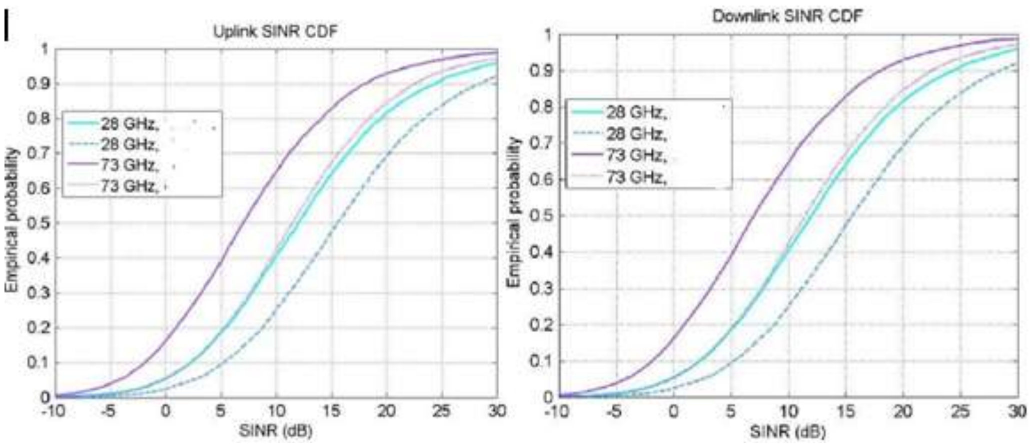

Fig 02 Downlink (Top Plot)/Uplink (Bottom Plot) SINR CDF At 28 And 73 Ghz

V. KEY DESIGN ISSUES AND DIRECTIONS FOR MMW 5G

In This Section, We Identify A Number Of Resulting Design Issues That Need To Be Addressed From A Systems Per-Spective If The Full Gains Of Mmw Cellular Systems Are To Be Achieved. The Above Preface Show That While Mmw Bands Offer Tremendous Potential For Capacity, Cellular Systems May Need To Be Significantly Redesigned. The Most Apparent Implication Of The Above Results Is That The Gains Of The Mmw System Depend On Highly Directional Transmissions. Directionality Gains With Suitable Beamforming Can Completely Compensate For, And Even Further Reduce, Any Increase In The Omnidirectional Path Loss With Frequency. Indeed, Once We Account For Directional Gains Enabled By Lesser Wavelengths, The Path Loss, SNR, And Rate Distributions In The Mmw Range Compare Fa-Vorably With (And May Improve Upon) Those In Current Cellular Frequencies. One Particular Challenge For Relying On Highly Directional Transmissions In Cellular Systems Is The Design Of The Synchronization And Broadcast Signals Used In The Initial Cell Search. Both Bss And Mobiles May Need To Scan Over A Range Of Angles Before These Sig-Nals Can Be Detected. Recognition Of Initial Random Access Signals From The Mobile May Be Delayed Since The

BS May Need To Be Associated In The Correct Way Even After A Mobile Has Detect A BS,. A Related Issue Is Supporting Intermittent Communication Which Has Been Essential In Standards Such As LTE For Providing Low Power Con-Sumption With ‘‘Always On’’ Connectivity . In Order That Either A Mobile Or A BS Can Quickly Begin Transmitting, Channel State Information In The Shape Of The Spatial Directions Will Require To Be Maintained At The Transmitter. Even The Second-Order Spatial Information Of The Channel May Change Relatively Fast Implying That Some Sort Of Intermittent Transmissions May Need To Be Performed To Track The Channel State With The Small Cells ,. Heteroge-Neous Networking Issues. Mmw Systems Cannot Be Deployed In A Standalone Manner. To Provide Uniform, Reli-Able Coverage, Fallback To Cellular Systems In Conventional UHF Or Microwave Frequencies Will Be Necessary. While Carrying For Mixed Networks Has Been A Key Design Goal In Recent Cellular Standards, Mmw Systems Will Need To Take For Heterogeneous Networks In Several New Directions.

ESTIMATING SINR IN A MILLIMETER-WAVE PROPAGATIONS

`Mainly The Heterogeneous Network Support In Mmw Will Require Cell Selections And Path Switching At Much Faster Rates Than Current Cellular Systems. Due To Their Liability To Shadowing, Mmw Signals To Any One Cell Will Be Inherently Unreliable And Can Rapidly Change With Small Motions Of The Users Or The User’s Environment. One Avenue To Explore Is The Use Of Carrier Where Mobiles Can Connect To Multiple Bss Simultaneously. Carrier Ag-Gregation Could Provide Macro Multiplicity For Mmw Systems, But Would Require Support For Path Switching And Scheduling In The Network. A Second Issue In The Evolution Of Hetnets For Mm,We Will Be Multi Operator Sup-Port. Indoor Cells And Cells Mounted On Private Buildings May Be Better Operated By A Third Party Who Would Then Provide Roaming Support For Carriers From Many Subscribers. In Addition, With Carrier Aggregation, It May Be Attractive For A Mobile To Be Connected To Cells From Different Operators Simultaneously. The Time Scales For Mmw Roaming Would Be Much Faster, While Roaming Is Commonly Used In Current Networks,. Further Complicat-Ing Matters Is The Fact For The Large Amount Of Spectrum, A Single Operator May Not Be Able To Fully Utilize The Bandwidth. Thus, The Model Where A Single Operator Has Exclusive Rights To A Bandwidth May Not Lead To The Most Efficient Use Of The Spectrum, Particularly With Directionality, Support For Multiple Operators Division Spec-Trum Will Need Much More Sophisticated Inter Cell Interference Coordination Mechanisms. Future Clearing Houses Will Provide Such Measurement And Management For Multiple Carriers And Their Users.

VI. CONCLUSION

With Some Unliking Initial Deployment Presentation Of Some Propagation Measurements Is Done In Challenging Environment, High-Dimensional Antenna Arrays Can Provide Millimeter Systems That Offers Tremendous Poten-Tial With Orders Of Magnitude Greater Spectrum And Further Gains. Through Reflections And Scattering, Mmw Sig-Nals Are Potentially Practical At Distances Of 100–200 M. The Mmw Systems Can Offer At Least An Order Of Magni-Tude In Capacity Over Current State-Of-The-Art LTE Systems With Modest Assumptions On Beamforming. To Obtain The Full Potential Of Mmw Bands Potential Mmw Cellular Systems May Need To Be Extensively Redesigned Rela-Tive To Current 4G Systems. Multiple Access And Channelization Also Become Fixed To Frontend Requirements, Ba-Sically For Analog Beamforming And A/D Conversion. Particularly The Heavy Dependency On Directional Trans-Missions And Beamforming Is Necessary Reconsideration Of Many Basic Procedures Like Cell Search, Synchroniza-Tion, Random Access, And Alternating Communication.Technologies Such As Carrier Aggregation And Multihop Re-Laying That Have Had Only Diffident Benefits In Current Cellular Networks May Play A Very Prominent Role In The Mmw Space As Compared To The , Directional Isolation Between Links Suggests That Interference Mitigation.

REFERENCES

[1] Cisco, ‘‘Cisco Visual Network Index: Global Mobile Traffic Fore Cast Update,’’ 2013.

[2] Ericsson, ‘‘Traffic And Marketdata Report,’’2011.

[3] UMTS Forum, ‘‘Mobile Traffic Forecasts:2010–2020 Report,’’ 2011, Vol. 44.

[4] Ericsson, ‘‘More Than 50 Billion Connected Devices,’’ White Paper. [Online]. Available: Http://Www.Ericsson.Com/Res/Docs/ Whitepapers/Wp-50-Billions.Pdf.

[5] P. E. Mogensen, K. Pajukoski, B. Raaf, E. Tiirola, L. Eva, I. Z. Kovacs,G. Berardinelli, L. G. U. Garcia, L. Hu, Anda. F. Cattoni, ‘‘B4G Local Area: High Level Requirements And Sys-Tem Design,’’ In Proc.IEEE Globecom Workshop, Dec. 2012, Pp. 613–617.

[6] T. S. Rappaport, J. N. Murdock, Andf. Gutierrez, ‘‘State Of The Art In 60-Ghz Integrated Circuits And Systems For Wireless Communications,’’ Proc. IEEE, Vol. 99, No. 8, Pp. 1390– 1436, Aug. 2011.

[7] F. Khan And Z. Pi, ‘‘Millimeter Wave Mobile Broadband (MMB): Unleashing The 3–300 Ghz Spectrum,’’ In Proc. 34th IEEE Sarnoff Symp., Mar. 2011, DOI: 10.1109/ SARNOF.2011.5876482.