



# Joint Workshop on Spectrum Management: University of Chicago, University of Notre Dame and ITU-APT

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# Why a joint spectrum workshop now?

- Collaborations between India and USA at the very highest levels.
  - Joint Statement from the USA and India: [Joint Statement](#)
    - Sharing a vision of secure and trusted telecommunications, resilient supply chains, and global digital inclusion, Prime Minister Modi and President Biden welcomed the signing of a Memorandum of Understanding (MoU) between Bharat 6G Alliance and Next G Alliance, operated by Alliance for Telecommunications Industry Solutions, as a first step towards deepening public-private cooperation between vendors and operators.
- Joint research collaborations initiated by the National Science Foundation (NSF) in India:
  - NSF collaboration with DST: <https://www.nsf.gov/pubs/2023/nsf23114/nsf23114.jsp>
  - NSF Collaboration with MeitY: <https://www.nsf.gov/pubs/2023/nsf23139/nsf23139.jsp>
- Spectrum is central to all future wireless applications.

# The spectrum picture: very little clean spectrum left

## UNITED STATES FREQUENCY ALLOCATIONS

### THE RADIO SPECTRUM

**RADIO SERVICES COLOR LEGEND**

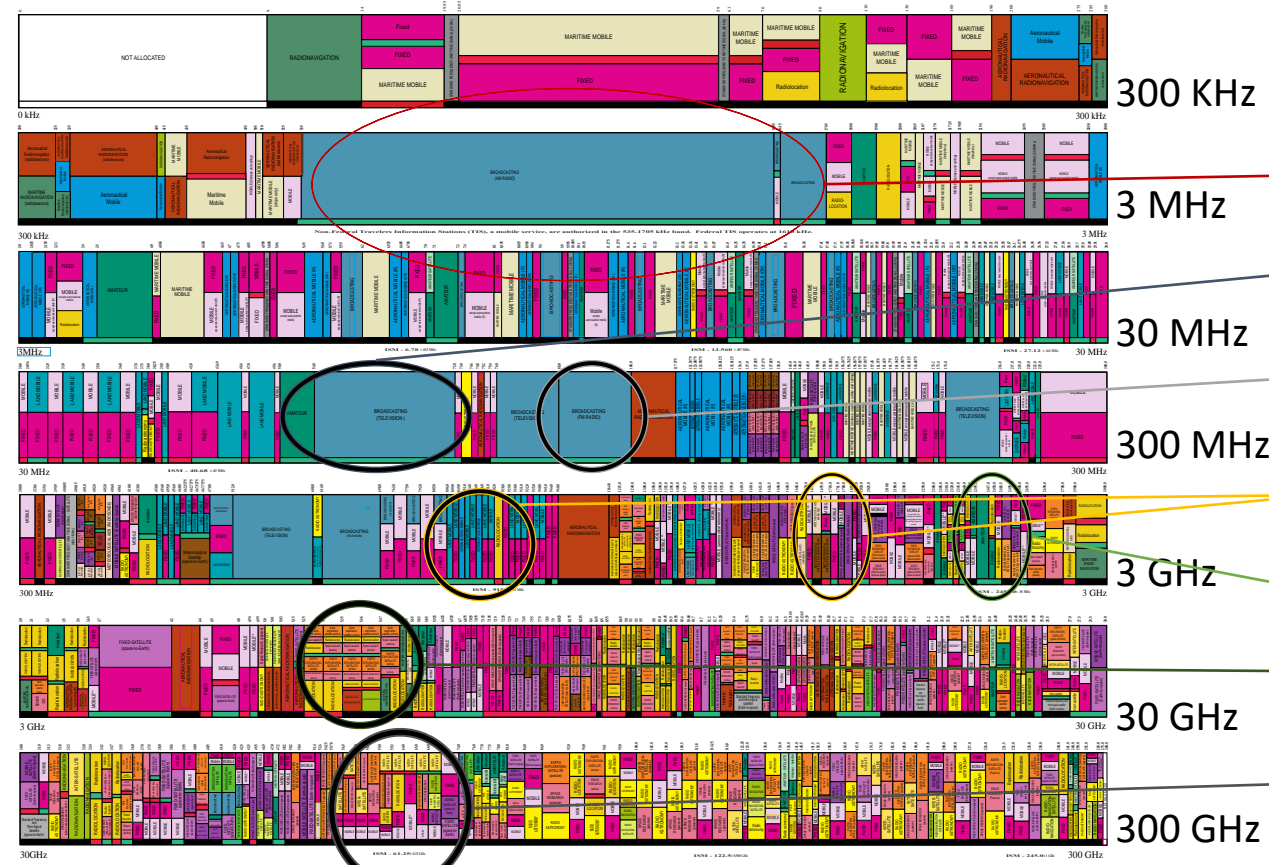
AERONAUTICAL MOBILE	ORBITAL SATELLITE	RADIO ASTRONOMY
AERONAUTICAL MOBILE SATELLITE	LAND MOBILE	RADIO DETERMINATION SATELLITE
AERONAUTICAL RADIO DETERMINATION	LAND MOBILE SATELLITE	RADIOLOGICAL
AMATEUR	MARITIME MOBILE	RADIOLOCATION SATELLITE
AMATEUR SATELLITE	MARITIME MOBILE SATELLITE	RADIO NAVIGATION
BROADCASTING	MARITIME RADIO NAVIGATION	RADIO RELAY SATELLITE
BROADCASTING SATELLITE	METEOROLOGICAL	SPACE OPERATION
CABLE TELEVISION SATELLITE	METEOROLOGICAL SATELLITE	SPACE RESEARCH
FIXED	MOBILE	STANDARD FREQUENCY AND TIME SIGNAL SATELLITE
FIXED SATELLITE	MOBILE SATELLITE	STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

**ACTIVITY CODE**

■ FEDERAL EXCLUSIVE    ■ FEDERAL NON-FEDERAL SHARED

**ALLOCATION USAGE DESIGNATION**

Primary: F, M, S, C, L, P, R, T, U, V, W, X, Y, Z, AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BS, BT, BU, BV, BW, BX, BY, BZ, CA, CB, CC, CD, CE, CF, CG, CH, CI, CJ, CK, CL, CM, CN, CO, CP, CQ, CR, CS, CT, CU, CV, CW, CX, CY, CZ, DA, DB, DC, DD, DE, DF, DG, DH, DI, DJ, DK, DL, DM, DN, DO, DP, DQ, DR, DS, DT, DU, DV, DW, DX, DY, DZ, EA, EB, EC, ED, EE, EF, EG, EH, EI, EJ, EK, EL, EM, EN, EO, EP, EQ, ER, ES, ET, EU, EV, EW, EX, EY, EZ, FA, FB, FC, FD, FE, FF, FG, FH, FI, FJ, FK, FL, FM, FN, FO, FP, FQ, FR, FS, FT, FU, FV, FW, FX, FY, FZ, GA, GB, GC, GD, GE, GF, GG, GH, GI, GJ, GK, GL, GM, GN, GO, GP, GQ, GR, GS, GT, GU, GV, GW, GX, GY, GZ, HA, HB, HC, HD, HE, HF, HG, HH, HI, HJ, HK, HL, HM, HN, HO, HP, HQ, HR, HS, HT, HU, HV, HW, HX, HY, HZ, IA, IB, IC, ID, IE, IF, IG, IH, II, IJ, IK, IL, IM, IN, IO, IP, IQ, IR, IS, IT, IU, IV, IW, IX, IY, IZ, JA, JB, JC, JD, JE, JF, JG, JH, JI, JJ, JK, JL, JM, JN, JO, JP, JQ, JR, JS, JT, JU, JV, JW, JX, JY, JZ, KA, KB, KC, KD, KE, KF, KG, KH, KI, KJ, KK, KL, KM, KN, KO, KP, KQ, KR, KS, KT, KU, KV, KW, KX, KY, KZ, LA, LB, LC, LD, LE, LF, LG, LH, LI, LJ, LK, LL, LM, LN, LO, LP, LQ, LR, LS, LT, LU, LV, LW, LX, LY, LZ, MA, MB, MC, MD, ME, MF, MG, MH, MI, MJ, MK, ML, MM, MN, MO, MP, MQ, MR, MS, MT, MU, MV, MW, MX, MY, MZ, NA, NB, NC, ND, NE, NF, NG, NH, NI, NJ, NK, NL, NM, NN, NO, NP, NQ, NR, NS, NT, NU, NV, NW, NX, NY, NZ, OA, OB, OC, OD, OE, OF, OG, OH, OI, OJ, OK, OL, OM, ON, OO, OP, OQ, OR, OS, OT, OU, OV, OW, OX, OY, OZ, PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PS, PT, PU, PV, PW, PX, PY, PZ, QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM, QN, QO, QP, QQ, QR, QS, QT, QU, QV, QW, QX, QY, QZ, RA, RB, RC, RD, RE, RF, RG, RH, RI, RJ, RK, RL, RM, RN, RO, RP, RQ, RR, RS, RT, RU, RV, RW, RX, RY, RZ, SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SP, SQ, SR, SS, ST, SU, SV, SW, SX, SY, SZ, TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN, TO, TP, TQ, TR, TS, TT, TU, TV, TW, TX, TY, TZ, UA, UB, UC, UD, UE, UF, UG, UH, UI, UJ, UK, UL, UM, UN, UO, UP, UQ, UR, US, UT, UU, UV, UW, UX, UY, UZ, VA, VB, VC, VD, VE, VF, VG, VH, VI, VJ, VK, VL, VM, VN, VO, VP, VQ, VR, VS, VT, VU, VV, VW, VX, VY, VZ, WA, WB, WC, WD, WE, WF, WG, WH, WI, WJ, WK, WL, WM, WN, WO, WP, WQ, WR, WS, WT, WU, WV, WW, WX, WY, WZ, XA, XB, XC, XD, XE, XF, XG, XH, XI, XJ, XK, XL, XM, XN, XO, XP, XQ, XR, XS, XT, XU, XV, XW, XX, XY, XZ, YA, YB, YC, YD, YE, YF, YG, YH, YI, YJ, YK, YL, YM, YN, YO, YP, YQ, YR, YS, YT, YU, YV, YW, YX, YY, YZ, ZA, ZB, ZC, ZD, ZE, ZF, ZG, ZH, ZI, ZJ, ZK, ZL, ZM, ZN, ZO, ZP, ZQ, ZR, ZS, ZT, ZU, ZV, ZW, ZX, ZY, ZZ



- AM Radio
- Television
- FM Radio
- Cellular
- 2.4 GHz Wi-Fi
- 5 GHz Wi-Fi
- 60 GHz Wi-Fi

- Lower frequencies (< 1 GHz) have greater coverage, but less bandwidth.
- Higher frequencies (> 24 GHz) have limited coverage, but more bandwidth)
- Sweet spot for wireless systems: mid-band, 1 – 6 GHz, being extended to 7 – 24 GHz.

# The many uses of spectrum

<b>Commercial systems, spectrum managed by the Federal Communications Commission (FCC) in the US</b>	<b>Federal systems, spectrum managed by the National Telecommunications and Information Administration (NTIA) in the US</b>	<b>Science applications, spectrum managed by the National Telecommunications and Information Administration (NTIA) in the US</b>
<ul style="list-style-type: none"><li>• Cellular: 3G, 4G, 5G and future 6G</li><li>• Unlicensed: Wi-Fi, Bluetooth etc.</li><li>• AM/FM radio, Television, Satellite</li><li>• Public Safety</li><li>• Drone services</li><li>• Amateur (Ham) radio</li></ul> <p><b>Important for ubiquitous connectivity and economic growth.</b></p>	<ul style="list-style-type: none"><li>• Radars: ground, aeronautical, maritime</li><li>• Radionavigation services (GPS)</li><li>• Military applications, usually classified.</li></ul> <p><b>Important for national security and defense.</b></p>	<ul style="list-style-type: none"><li>• Radioastronomy: fixed locations and distributed arrays.</li><li>• Earth Sensing Satellites</li><li>• Weather Satellites</li><li>• Deep space observations</li></ul> <p><b>Important for scientific discoveries, e.g. the images of the black hole.</b></p>

# Goals of the workshop

- Robust discussions about the various spectrum issues faced globally, with special focus on the needs of India and USA.
- Initiate collaborations between academics of both countries to propose research for current and future research solicitations.
- Leverage common interests and expertise across experts in both countries for mutual benefit.