

FRONTIERS OF RADIOCOMMUNICATIONS

2006

FRONTIER TOPICS FOR DISCUSSION

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FORCES IMPACTING FRONTIERS

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**FORCES IMPACTING FRONTIERS
IMT-2000 AND BEYOND (IMT-ADVANCED)**

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**FORCES IMPACTING FRONTIERS
IMT-2000 AND BEYOND (IMT-ADVANCED)
IEEE STANDARDS DEVELOPMENT**

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**FORCES IMPACTING FRONTIERS
IMT-2000 AND BEYOND (IMT-ADVANCED)
IEEE STANDARDS DEVELOPMENT
UNDERLAYS AND INTERFERENCE**

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> 50 GHz**

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POWER LINE TELECOMMUNICATIONS

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- **INTERNET**

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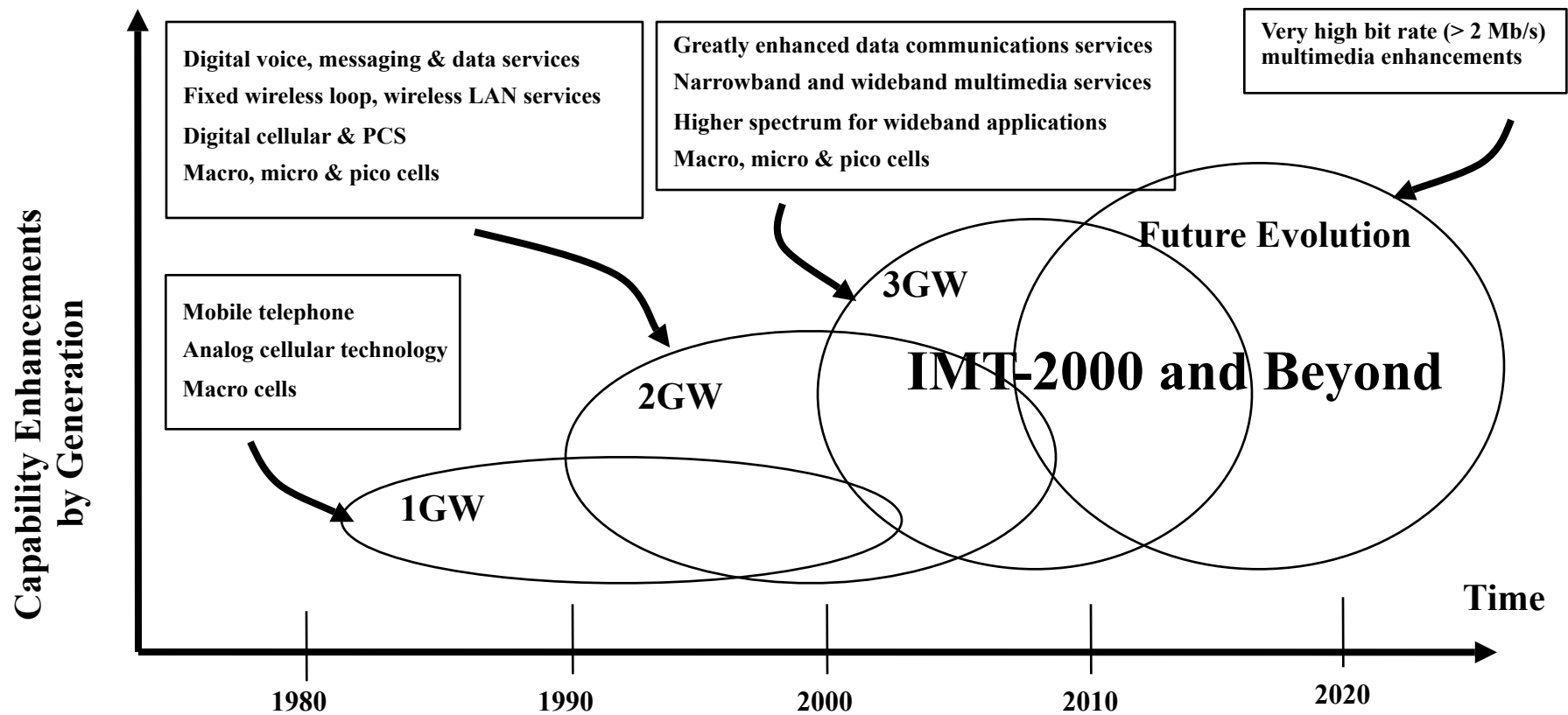
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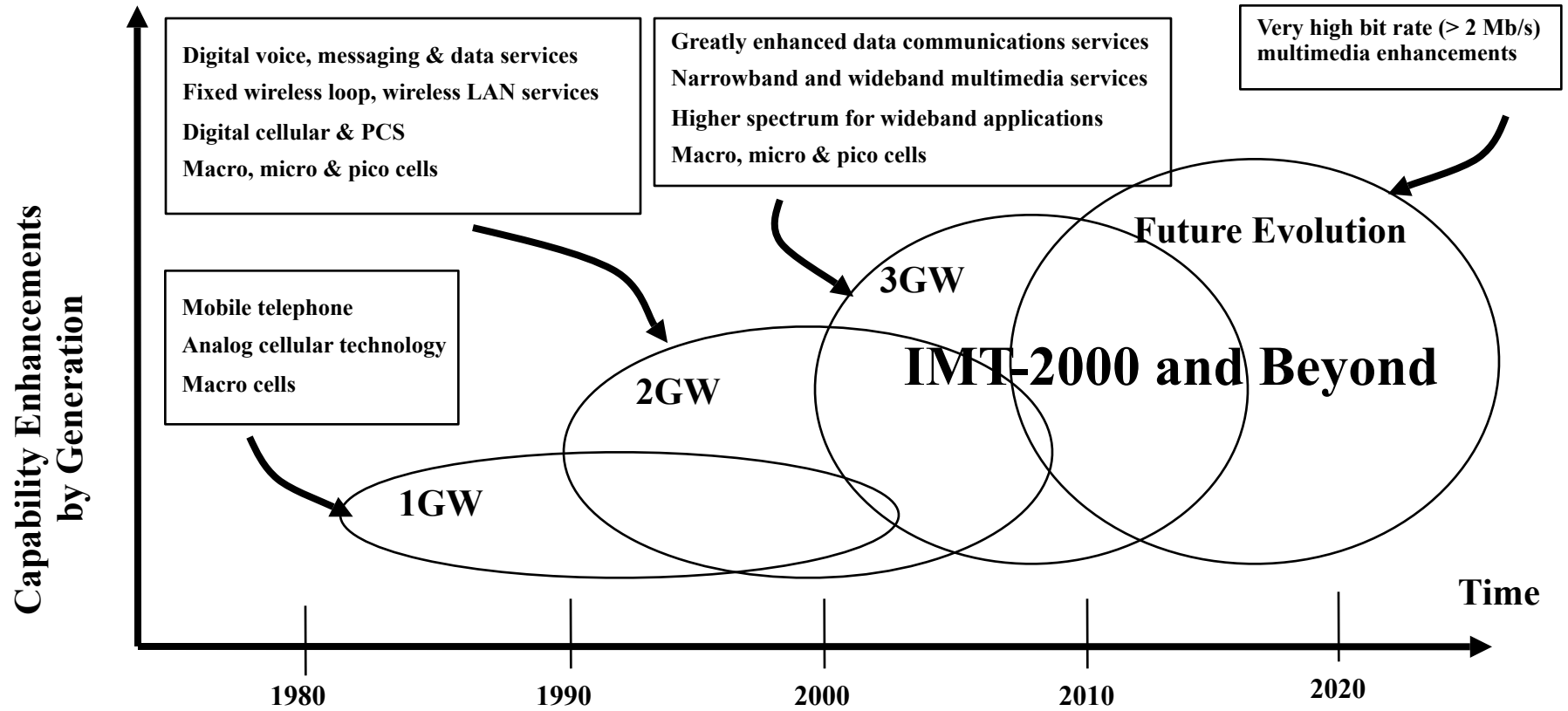
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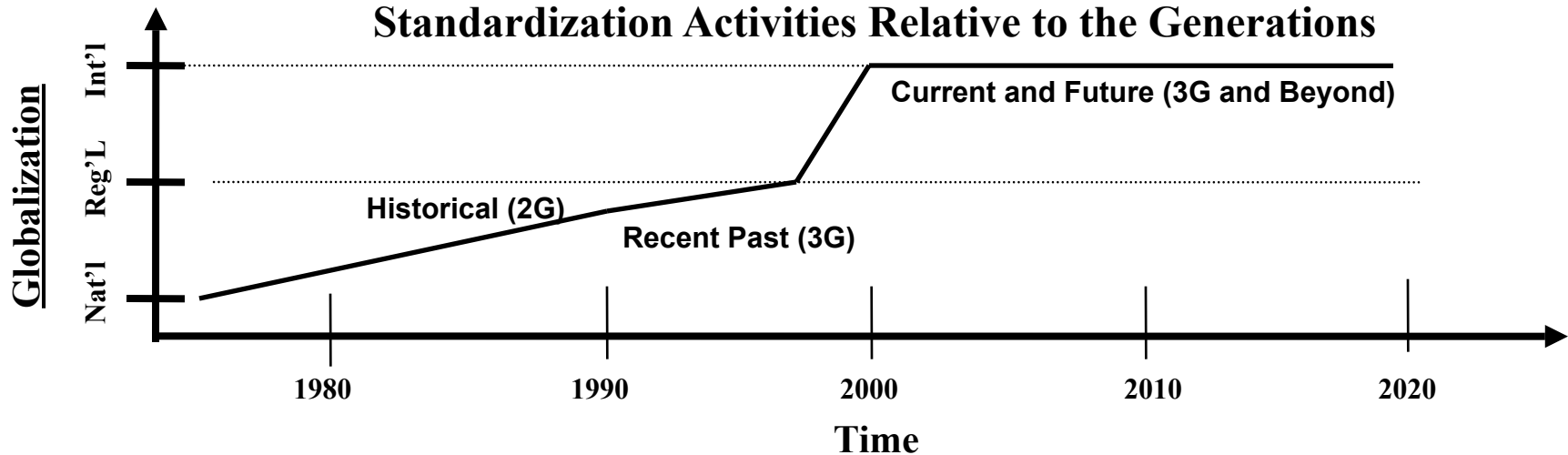
Generations of Terrestrial Commercial Wireless Systems



Generations of Terrestrial Commercial Wireless Systems



Standardization Activities Relative to the Generations



ITU-R WORKING PARTY 8F

ITU-R WORKING PARTY 8F

- **WP8F IS THE GLOBAL FOCAL POINT FOR THE CONTINUING VISION OF NEXT GENERATION WIRELESS SERVICES AND SYSTEMS, ACTING AS A FORUM FOR USER REQUIREMENTS AND AS A CATALYST FOR TRANSLATING THOSE REQUIREMENTS INTO TECHNICAL REALITY**
- **WP8F HAS THE CHALLENGING TASK OF SUPPORTING THE NEAR TERM NEEDS OF THE IMT-2000 MARKETPLACE WHILE EXPLORING WHERE WE MIGHT GO IN THE WIRELESS WORLD OF THE FUTURE (IMT-ADVANCED)**

**MOBILE SERVICE STUDIES
ITU-R WORKING PARTY 8F
(IMT-ADVANCED)**

MOBILE SERVICE STUDIES ITU-R WORKING PARTY 8F (IMT-ADVANCED)

- **FUTURE SYSTEMS WITH DATA RATES > 2 Mbit/s**

MOBILE SERVICE STUDIES ITU-R WORKING PARTY 8F (IMT-ADVANCED)

- **FUTURE SYSTEMS WITH DATA RATES > 2 Mbit/s**
- **SERVICE APPLICATIONS, OBJECTIVES AND USER NEEDS**

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- **GLOBAL CIRCULATION AND MUTUAL RECOGNITION AGREEMENTS**

THIRD GENERATION (IMT-2000 AND BEYOND)

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1710 - 1755 MHz - FIXED & MOBILE

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2110 - 2150 MHz - FIXED & MOBILE

2160 - 2165 MHz - FIXED & MOBILE

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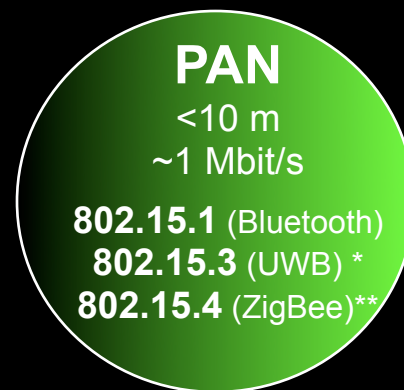
2110 - 2150 MHz - FIXED & MOBILE

2160 - 2165 MHz - FIXED & MOBILE

2500 - 2690 MHz – MMDS, ITFS, BSS

IEEE STANDARDS VIEW OF WIRELESS NETWORK TECHNOLOGIES

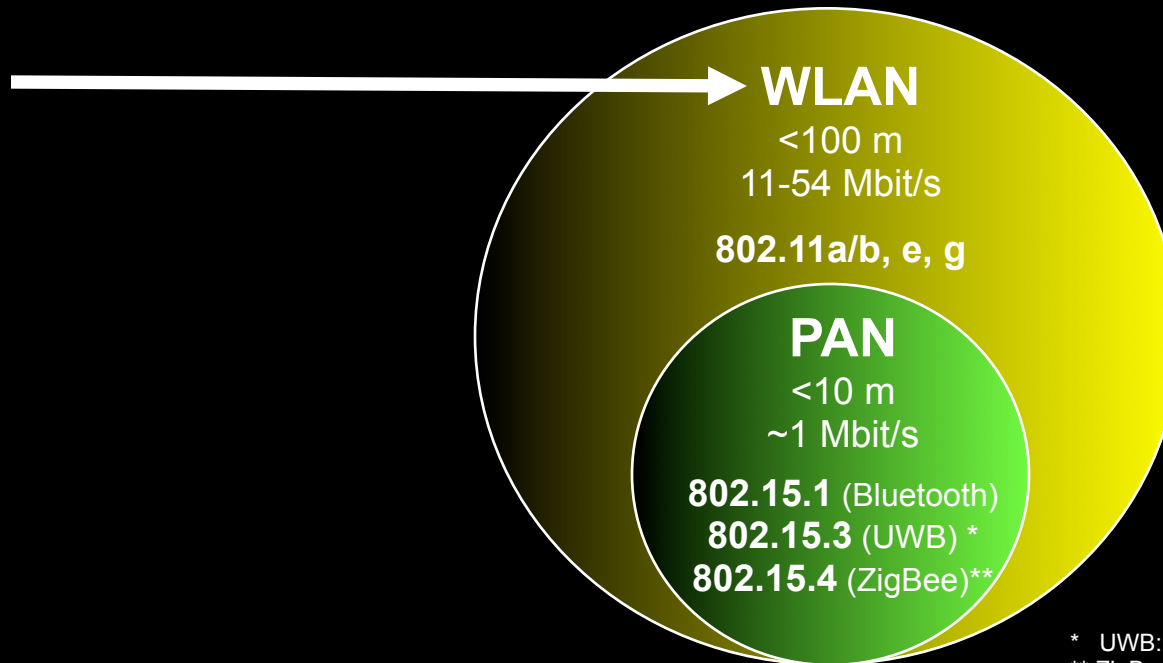
IEEE STANDARDS VIEW OF WIRELESS NETWORK TECHNOLOGIES



8
* UWB: 500 Mbit/s
** ZigBee: 250 kb/s

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Wi-Fi®



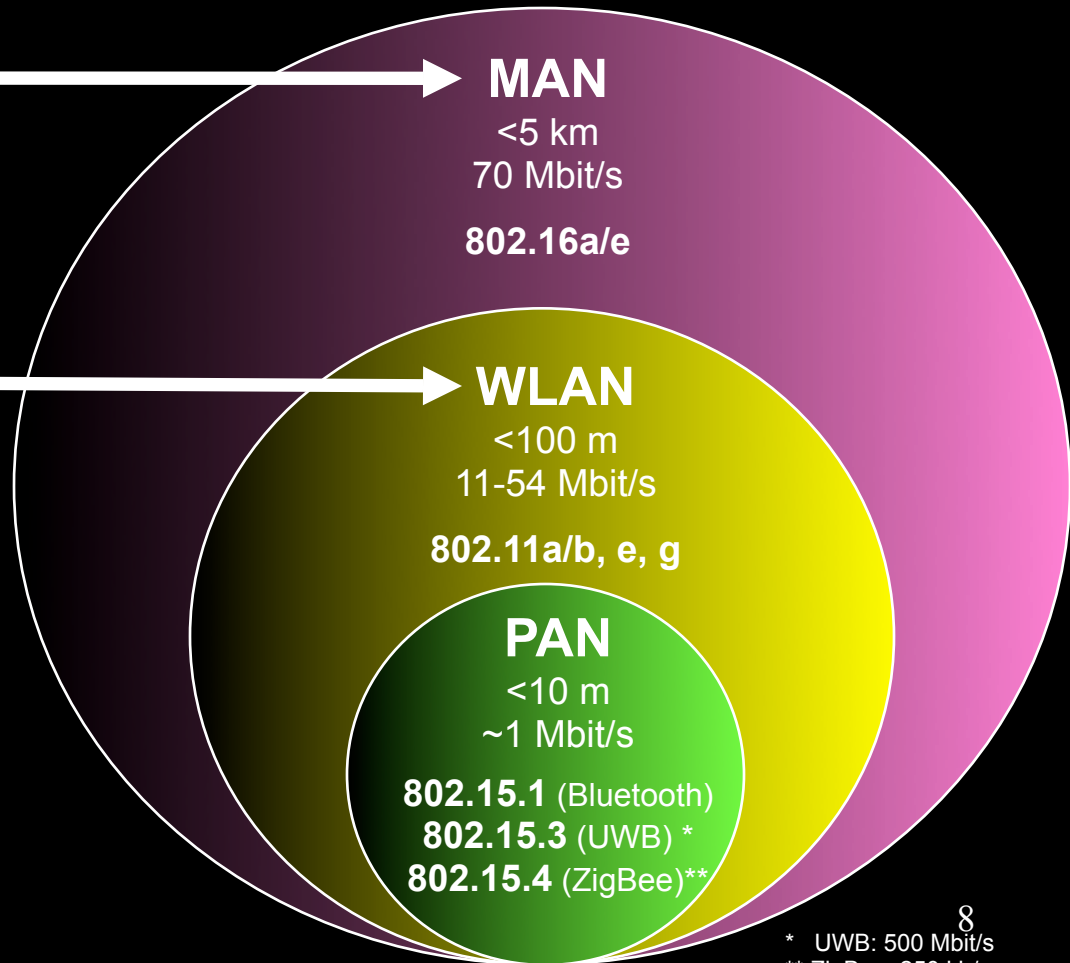
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WiMAX

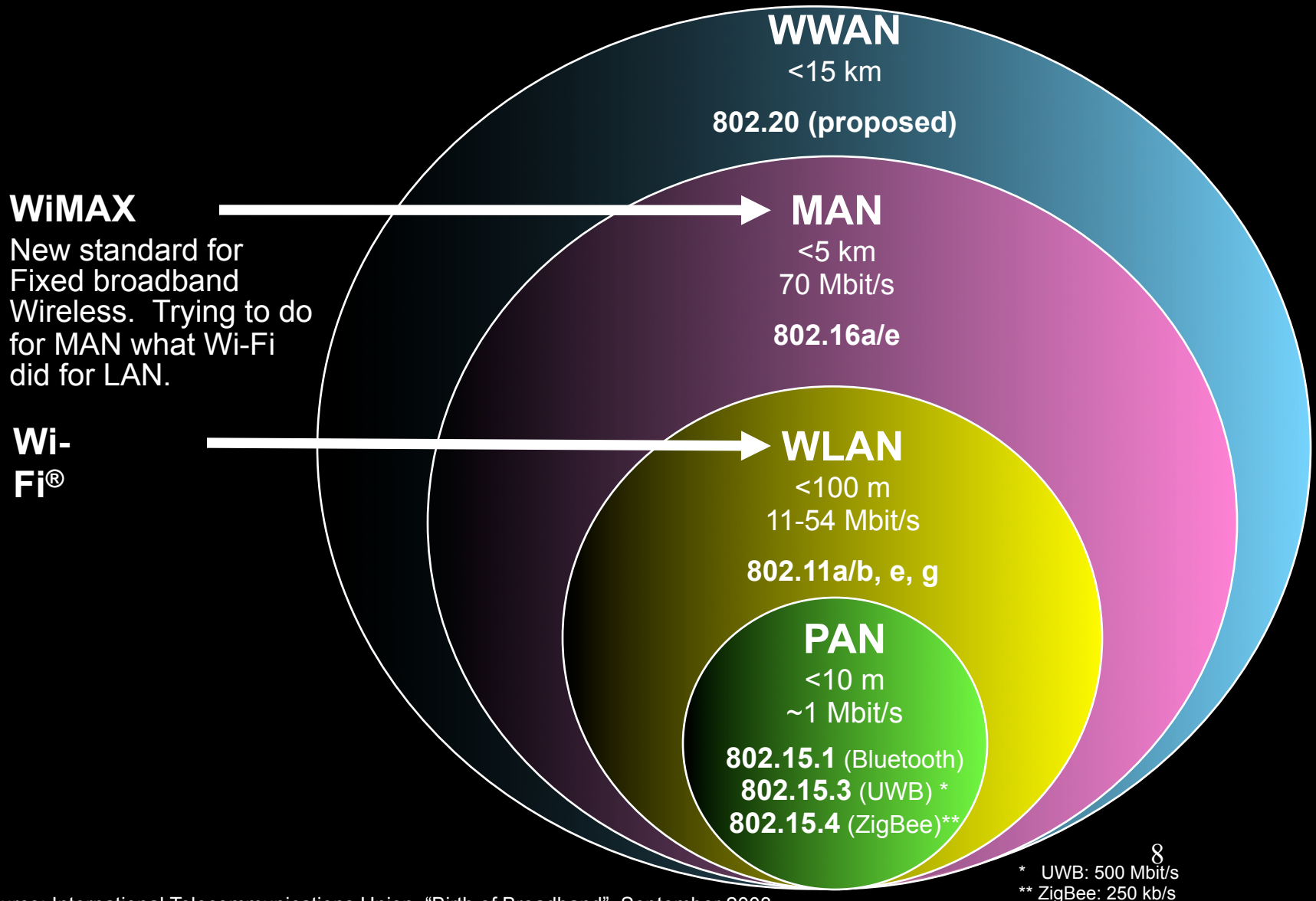
New standard for Fixed broadband Wireless. Trying to do for MAN what Wi-Fi did for LAN.

Wi-Fi®

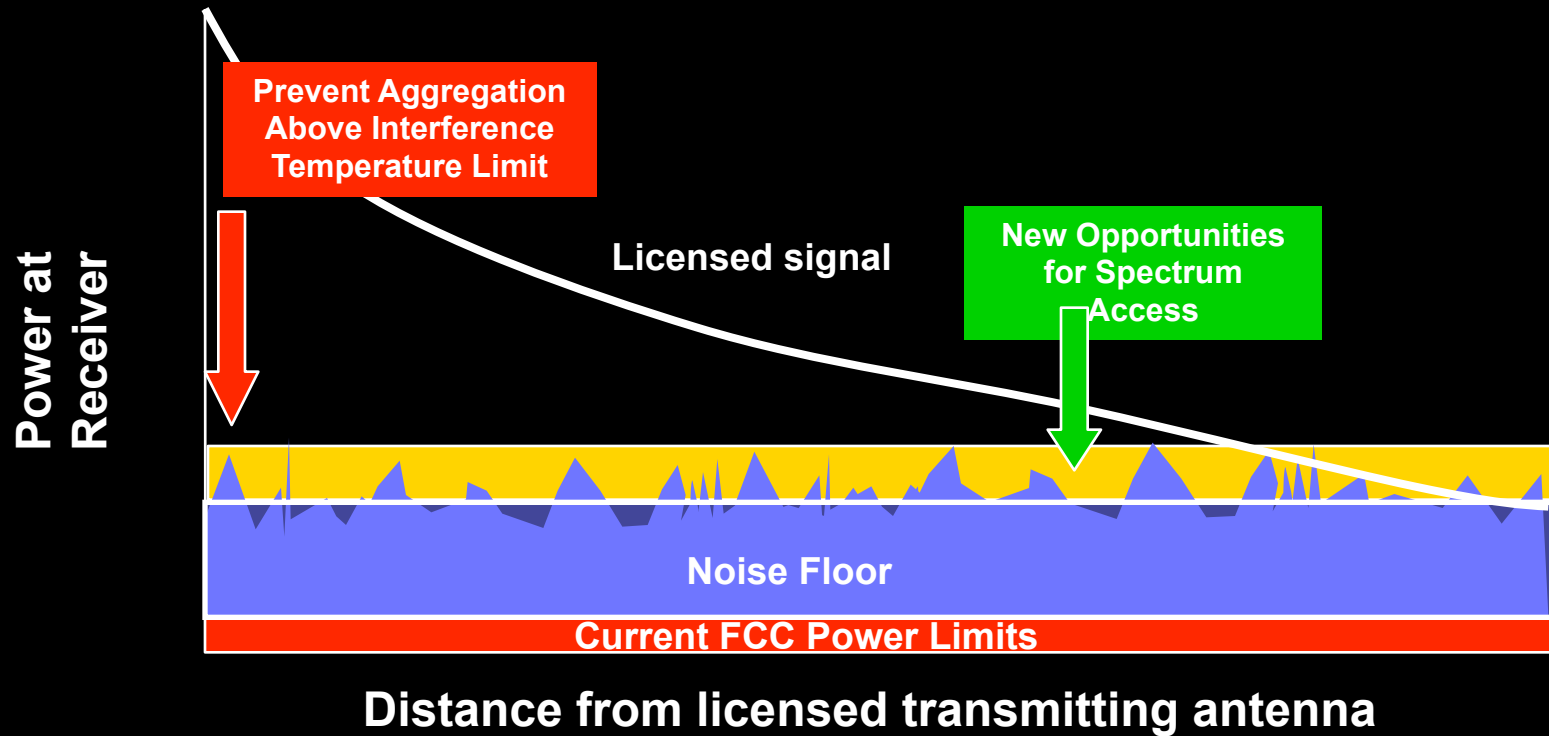


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IEEE STANDARDS VIEW OF WIRELESS NETWORK TECHNOLOGIES



UNDERLAYS AND INTERFERENCE AVOIDANCE



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- **13.2125-13.25 GHz**

SOFTWARE DEFINED RADIO

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A RADIO THAT INCLUDES A TRANSMITTER IN WHICH THE OPERATING PARAMETERS OF FREQUENCY RANGE, MODULATION TYPE OR MAXIMUM OUTPUT POWER (EITHER RADIATED OR CONDUCTED) CAN BE ALTERED BY MAKING A CHANGE IN SOFTWARE WITHOUT MAKING ANY CHANGES TO HARDWARE COMPONENTS THAT AFFECT THE RADIO FREQUENCY EMISSIONS

COGNITIVE RADIO

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A RADIO THAT SENSES ITS ENVIRONMENT AND LOCATION, AND AUTOMATICALLY ADAPTS TO THAT ENVIRONMENT MAKING USE OF AVAILABLE SPECTRUM AND TECHNOLOGY INCLUDING FOR OVERLAYS AND UNDERLAYS

SDR / COGNITIVE RADIO ABILITIES AND PROCESSES

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- 1. USE “EMPTY” SPECTRUM**
- 2. FILL EMPTY TIME SLOTS**
- 3. VARY SIGNAL LEVELS**
- 4. APPLY CODING**
- 5. DIGITALLY PROCESS**
- 6. VARY ROUTING**
- 7. USE ADAPTIVE ANTENNAS**
- 8. ENABLE BOTH NEGOTIATED AND NON-VOLUNTARY SHARING**

(USED TODAY IN WIRELESS LANs AND MOBILE SERVICE NETWORKS BOTH ON A MULTIBAND AND MULTIFUNCTION BASIS)

GLOBAL POSITIONING (RADIONAVIGATION SATELLITE SERVICE)

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GPS

GLOBAL POSITIONING (RADIONAVIGATION SATELLITE SERVICE)

GPS

GLONASS

GLOBAL POSITIONING (RADIONAVIGATION SATELLITE SERVICE)

GPS

GLONASS

GALILEO

GLOBAL POSITIONING (RADIONAVIGATION SATELLITE SERVICE)

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NEW JAPANESE SYSTEM

BSS / FSS SHARING (SKYBRIDGE)

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- **INTERFERENCE TESTING MANDATORY**

MILLIMETER WAVES (ABOVE 50 GHz)

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- **65 - 71 GHz ALLOCATED TO INTERSATELLITE SERVICE FOR SATELLITE NETWORK INTERCONNECTIONS PROMOTING VIDEO TELEPHONY, MEDICAL AND TECHNICAL TELE-IMAGING, HIGH SPEED DATA NETWORKS, AND BANDWIDTH-ON-DEMAND FOR CONSUMERS**

**RF IDENTIFICATION (RFID) TAGS
READ AT ~ 3 OR 4 METER DISTANCE
PRIVACY IS A PARTICULAR ISSUE**

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RAPID TRANSPORTATION

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“BEST CUSTOMER” CARDS

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RAPID TRANSPORTATION

RAIL CARS

TOLLBOOTH PASSES

PARKING GATES

PALLETS

PERSONNEL ENTRY

LIBRARY MANAGEMENT

FINANCIAL PROTECTION

“BEST CUSTOMER” CARDS

PRODUCT INVENTORY

RF IDENTIFICATION (RFID) TAGS

READ AT ~ 3 OR 4 METER DISTANCE

PRIVACY IS A PARTICULAR ISSUE

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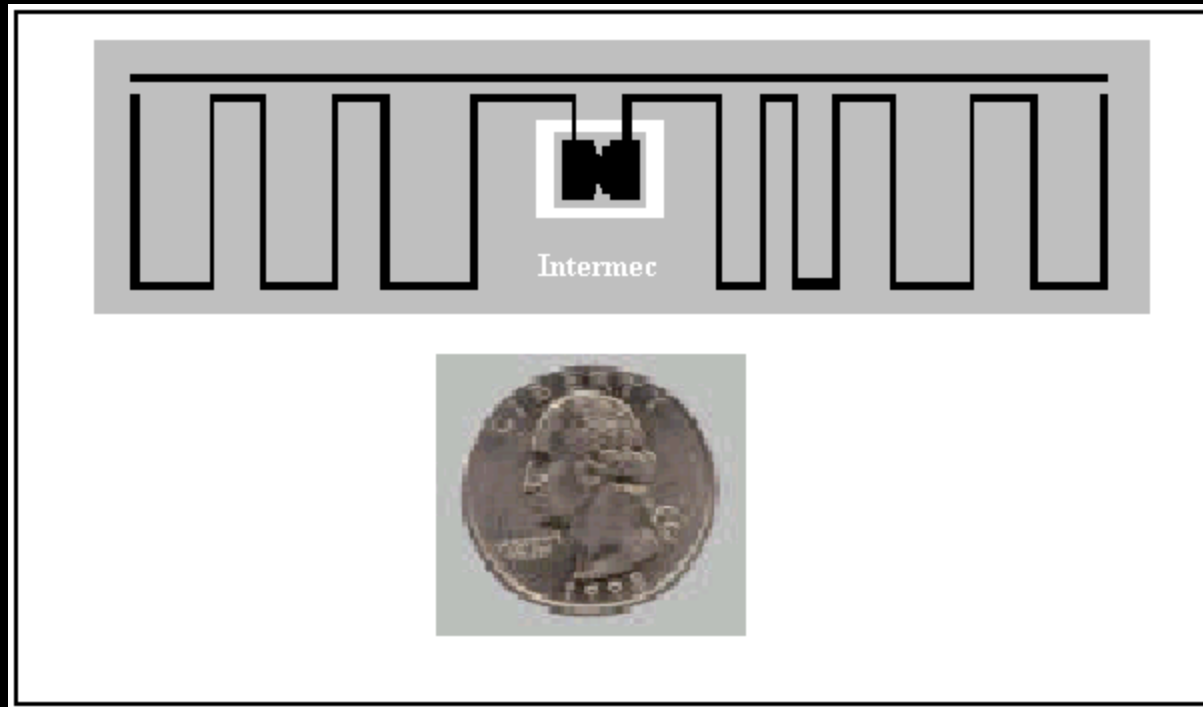
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**ENVIRONMENTAL, ANIMAL,
POULTRY, FISH, WILDLIFE
MANAGEMENT**



COURTESY OF INTERMEC TECHNOLOGIES

SOURCE: WASHINGTON POST

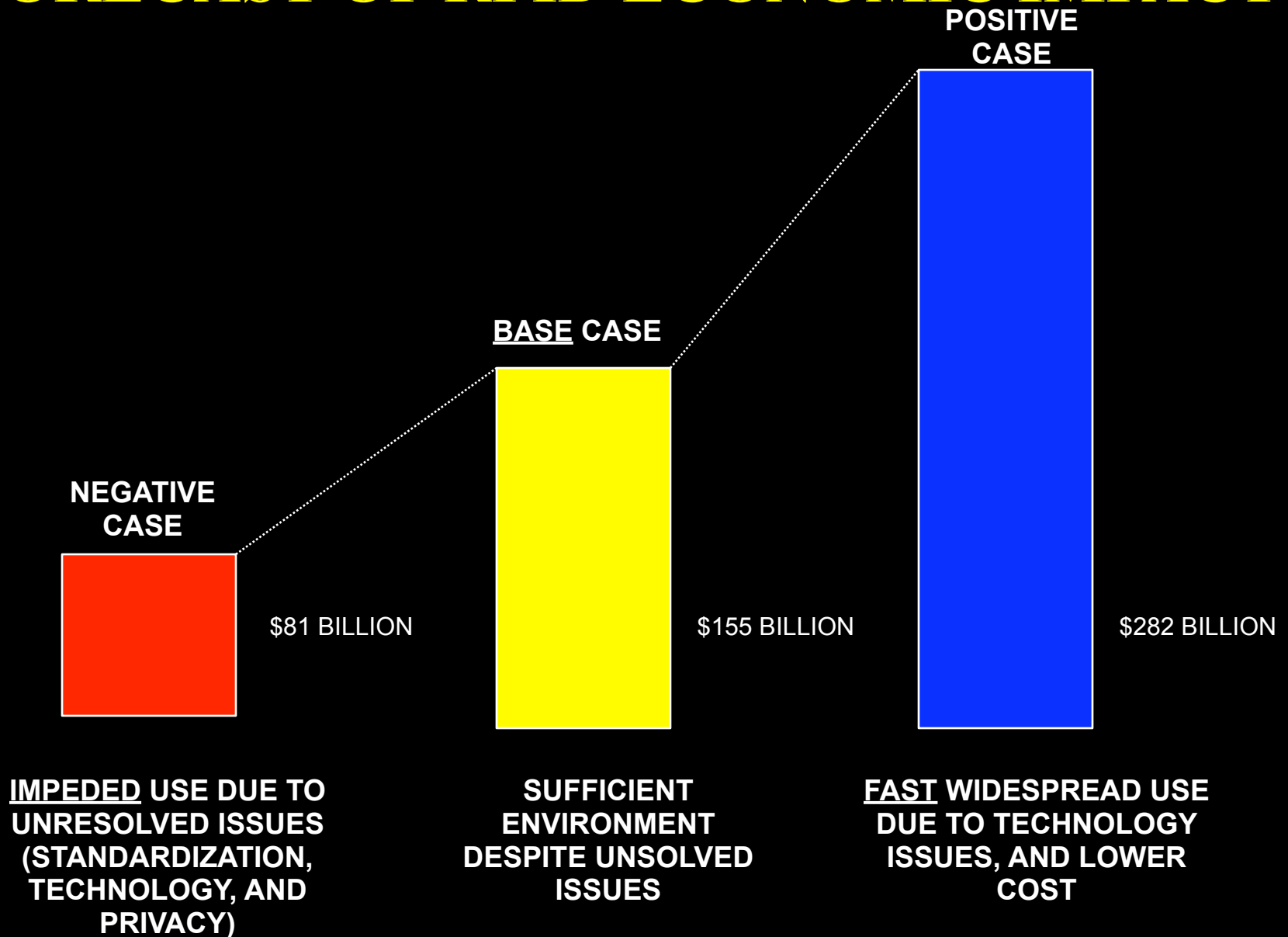
**RFID TAG CONTAINING A MICROCHIP
SURROUNDED BY COPPER STRANDS THAT ACT
AS AN ANTENNA**

CURRENT RFID TAG TYPES BY FORM, DIMENSIONS, AND MAIN APPLICATION

TECHNOLOGY – UWB?

FORM	DIMENSIONS	MAIN APPLICATION
DISK	SEVERAL mm TO TENS OF mm	<ul style="list-style-type: none"> •CLOTHING MANAGEMENT •TAGS FOR EMBEDDING IN DEVICES
TUBE	SEVERAL mm TO TENS OF mm	<ul style="list-style-type: none"> •ANIMAL / AQUATIC MANAGEMENT •PALLET MANAGEMENT
LABEL	SEVERAL mm TO TENS OF mm	<ul style="list-style-type: none"> •TAGS FOR POINT-OF-SERVICE PAYMENT •DOCUMENT MANAGEMENT •FREIGHT MANAGEMENT
CARD	85 x 54 x SEVERAL mm	<ul style="list-style-type: none"> •PUBLIC TRANSPORTATION PASSES •TELEPHONE CARDS •ID CARDS FOR ENTRY / EXIT
BOX	50 x 50 x 10 mm ~	<ul style="list-style-type: none"> •VEHICLE MANAGEMENT •CONTAINER MANAGEMENT

FORECAST OF RFID ECONOMIC IMPACT



POWER LINE TELECOMMUNICATIONS

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- **TELECOMMUNICATIONS ACCESS TO NEIGHBORHOODS OR TO BUILDINGS OR HOMES WHERE EXISTS POWER INFRASTRUCTURE**

BPL BENEFITS

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- **REMOTE NOTIFICATION (SECURITY, TRAFFIC, REMOTE METER READING, INTERNET CONNECTIVITY)**

BPL RULES

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UNLICENSED

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UNLICENSED

NO HARMFUL INTERFERENCE

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LIMITED RF EMISSION (TABLE)

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12 AERONAUTICAL BANDS RESTRICTED (TABLE)

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**REQUIRED CONSULTATION WITH PUBLIC SAFETY AND
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EXCLUSION ZONES

2182 kHz WITHIN 1 km OF A MARITIME STATION

**73-74.6 MHz WITHIN 29 km (OVERHEAD) AND 11 km
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ADAPTIVE IX MITIGATION TECHNIQUES

EXCLUDE OR NOTCH ANY SPECIFIC FREQUENCY

REMOTELY TURN OFF ANY BPL DEVICE

BPL EXCLUDED AERONAUTICAL FREQUENCIES

2850 – 3025 kHz	3400 – 3500 kHz	4650 – 4700 kHz
5450 – 5680 kHz	6525 – 6685 kHz	8815 – 8965 kHz
10005 – 10100 kHz	11275 – 11400 kHz	13260 – 13360 kHz
17900 – 17970 kHz	21924 – 22000 kHz	74.8 – 75.2 MHz

SPECTRUM MANAGEMENT (ITU-R SG 1) STUDIES

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- **HOW ARE INTERACTIVE MULTIMEDIA APPLICATIONS OF TERRESTRIAL FIXED, MOBILE, AND BROADCASTING SERVICES CONVERGING TECHNICALLY?**

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- **IF TECHNICAL CONVERGENCE IMPACTS THE SERVICE DEFINITIONS OF THE RADIO REGULATIONS, HOW SHOULD THE DEFINITIONS (FIXED, MOBILE, AND BROADCASTING) BE REVISED?**

BROADCAST (ITU-R SG 6) STUDIES

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STUDY GROUP 6 STUDIES TERRESTRIAL AND SATELLITE BROADCASTING FROM END-TO-END, INCLUDING VISION, SOUND, MULTIMEDIA AND DATA SERVICES INTENDED FOR THE GENERAL PUBLIC. USE IS MADE OF POINT-TO-EVERYWHERE INFORMATION DELIVERY. WHEN RETURN CHANNELS ARE REQUIRED FOR ACCESS CONTROL, E.G., INTERACTIVITY, AN ASYMMETRICAL INFRASTRUCTURE IS USED.

DIGITAL FM BROADCAST

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- **OTHER STANDARDS BEING DISCUSSED INTERNATIONALLY WITH THE HOPE OF FINDING A COMMON GLOBAL STANDARD**

DIGITAL SOUND BROADCASTING BELOW 30 MHz

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THE WORLD BROADCASTING UNION AND THE ITU HAVE BEEN COOPERATING IN SUPPORT OF STUDIES LEADING TO THE ADOPTION OF SINGLE WORLDWIDE BROADCASTING STANDARDS, PARTICULARLY:

- SINGLE COMMON DIGITAL SOUND BROADCAST SYSTEM IN LF, MF, AND HF**
- DIGITAL CODING AND MODULATION COMPATIBLE WITH EXISTING STATION PLANNING**
- WHAT ARE ADVANTAGES OVER ANALOG?**
- WHAT ARE NEW SERVICES?**
- COMPLEXITY OF DUAL STANDARD (ANALOG AND**

DIGITAL TELEVISION

DIGITAL TELEVISION

- **HIGH DEFINITION DEFINED AS EQUIVALENT TO A 35 mm CINEMA PICTURE**

DIGITAL TELEVISION

- **HIGH DEFINITION DEFINED AS EQUIVALENT TO A 35 mm CINEMA PICTURE**
- **TWO COMMON GLOBAL STANDARD (ANALOG) TELEVISION BROADCAST CHANNEL BANDWIDTHS, 6 MHz AND 8 MHz**

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- VERY POLITICAL (RRC-06)

INTERACTIVE TELEVISION

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STUDIES ARE UNDERWAY OF

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**STUDIES ARE UNDERWAY OF
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- HIGH SPEED INTERNET PROTOCOL?**

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- ANTI-COMPETITIVE BEHAVIOR?**

BSS-TERRESTRIAL SHARING

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- **SHARING WITH GEOSTATIONARY SATELLITE, BROADCAST SATELLITE SERVICE (BSS), IS FEASIBLE**

BSS-TERRESTRIAL SHARING

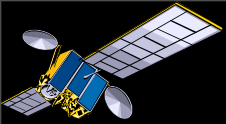
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- **UNIQUE TECHNICAL APPROACH**

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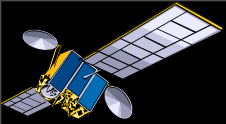
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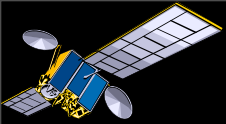


GEOSTATIONARY ORBIT

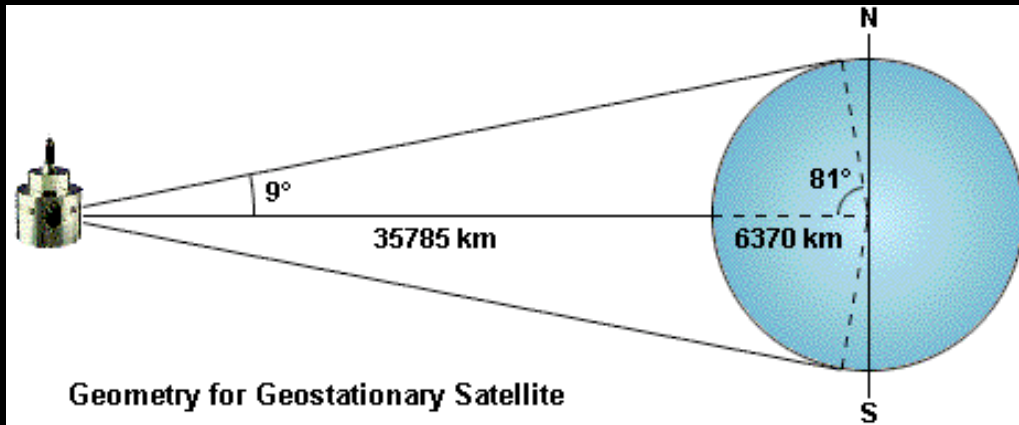


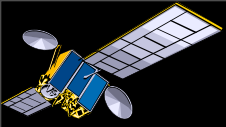
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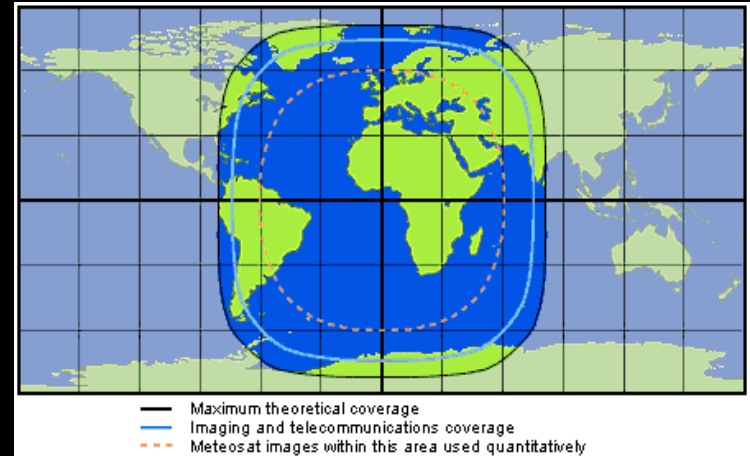
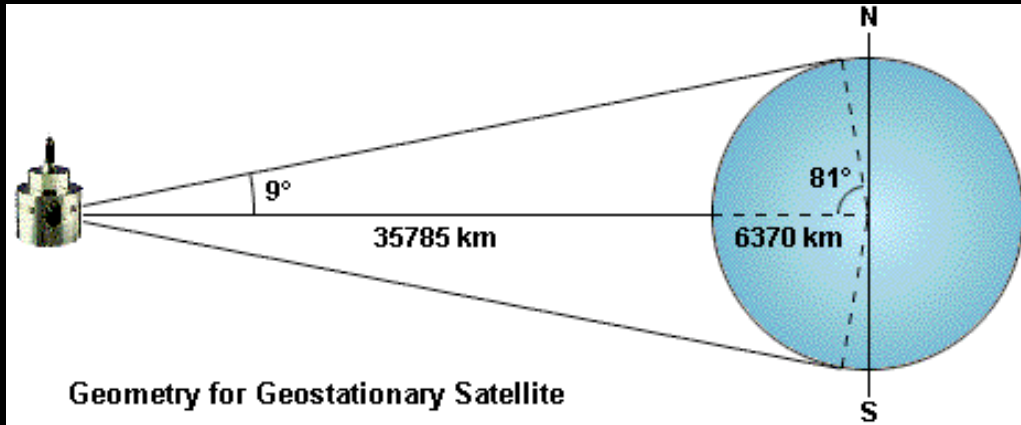
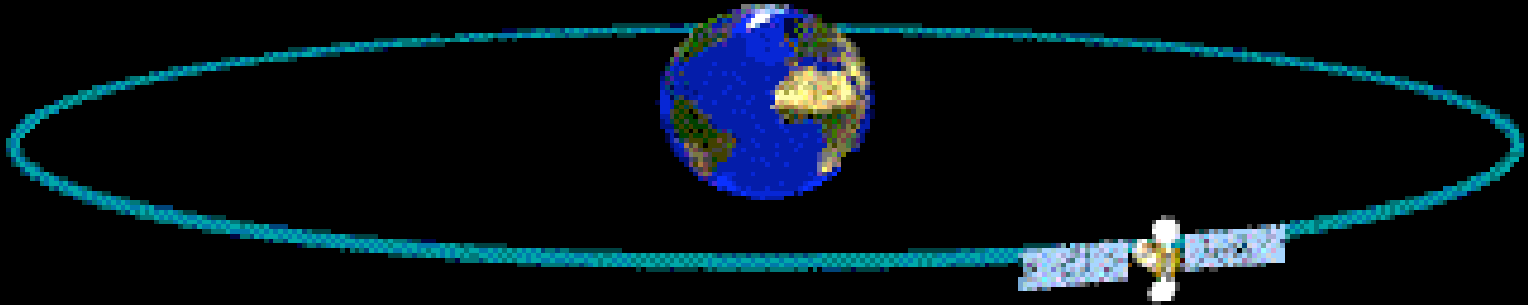


GEOSTATIONARY ORBIT





GEOSTATIONARY ORBIT



THREE-DIMENSIONAL TELEVISION

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JAPAN PLANS, STARTING IN 2006, TO

THREE-DIMENSIONAL TELEVISION

**JAPAN PLANS, STARTING IN 2006, TO
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(MATSUSHITA ELECTRIC INDUSTRIAL

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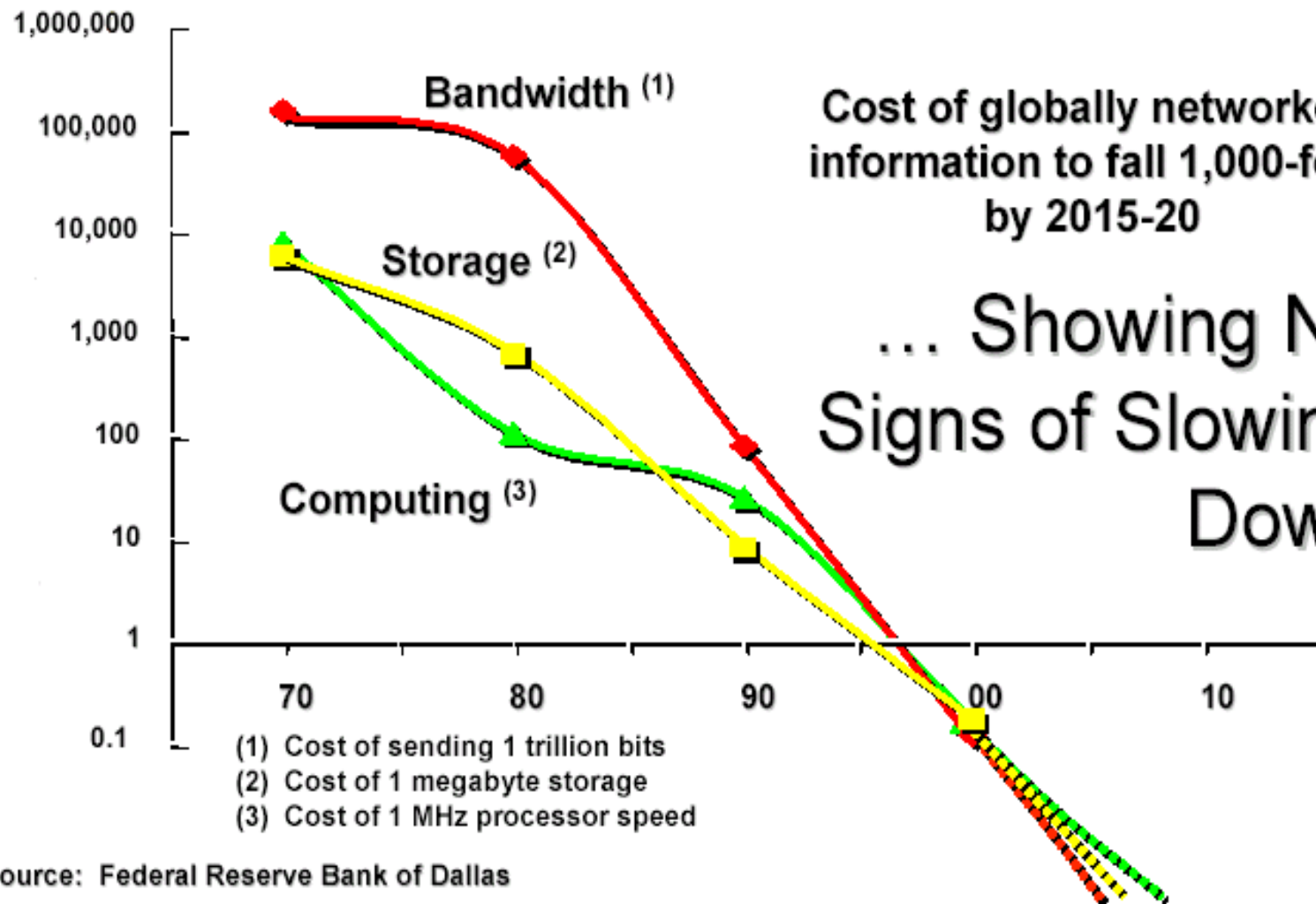
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INTERMIM REPORT, JULY 2005)**

TECHNOLOGY CONTINUES TO EVOLVE

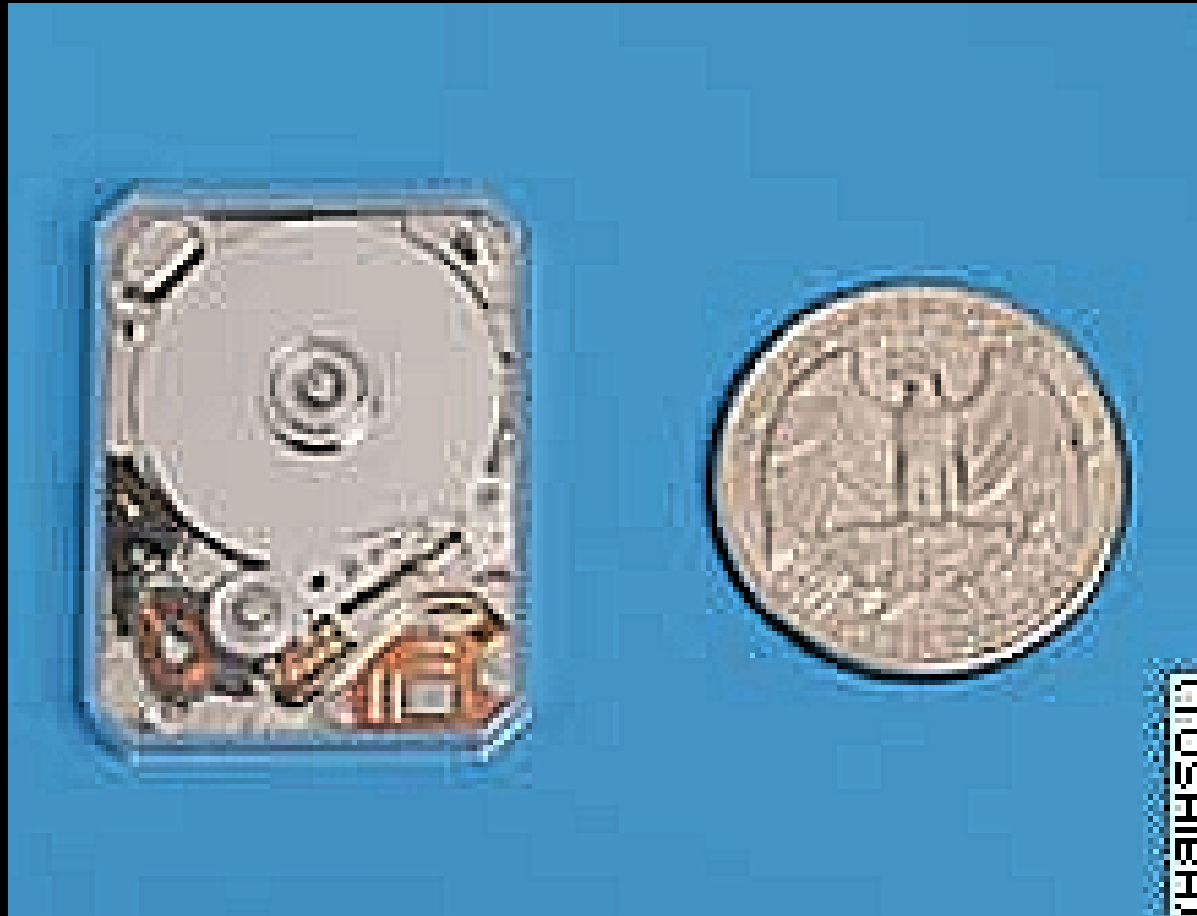
US \$ - LOGARITHMIC SCALE



Source: Federal Reserve Bank of Dallas

NEW COMPUTER TECHNOLOGY

6 GIGABYTES STORAGE IN A SMALL PACKAGE - 2005



SOURCE: TOSHIBA

MOORE'S LAW

FAMOUS FORECAST BY INTEL FOUNDER GORDON MOORE: THE NUMBER OF TRANSISTORS ON A CHIP WOULD ROUGHLY DOUBLE EVERY TWO YEARS

INTEL HAS ACHIEVED A MILESTONE IN SHRINKING THE SIZE OF TRANSISTORS TO POWER ITS NEXT-GENERATION CHIPS TO 35 NANOMETERS

EVEN CURRENT 90 NANOMETER TRANSISTORS HAVE PROBLEMS WITH HEAT AND POWER DISSIPATION

65 NANOMETER TRANSISTORS DELIVERED IN 2005

35 NANOMETER TRANSISTORS (30% SMALLER THAN TODAY'S STATE-OF-THE-ART CHIPS) ARE USED ON 70 MBIT MEMORY CHIPS

POSSIBLE WITH NEW MATERIALS, PROCESSES, AND CHIP STRUCTURES

SLEEP TRANSISTORS SHUT OFF ELECTRICAL CURRENT TO CHIP PARTS (NOT BEING USED) → DECREASING HEAT GENERATION AND HELPING BATTERY-POWERED DEVICES LAST LONGER

MOORE'S LAW HOLDS

NEW COMPUTER CHIPS

MULTIPLE FUNCTIONS REPLACE SPEED AS MAIN FEATURE

NEW CHIPS SIMULTANEOUSLY RUN MULTIPLE TASKS SUCH AS BURNING CDS AND WORD PROCESSING

WORLD'S BIGGEST SEMICONDUCTOR MAKER DESIGNING CHIPS WITH MORE THAN ONE PROCESSOR

“A SEA CHANGE IN COMPUTING” – MOVING FROM FASTER CHIPS TO MULTIPLE FUNCTION CHIPS

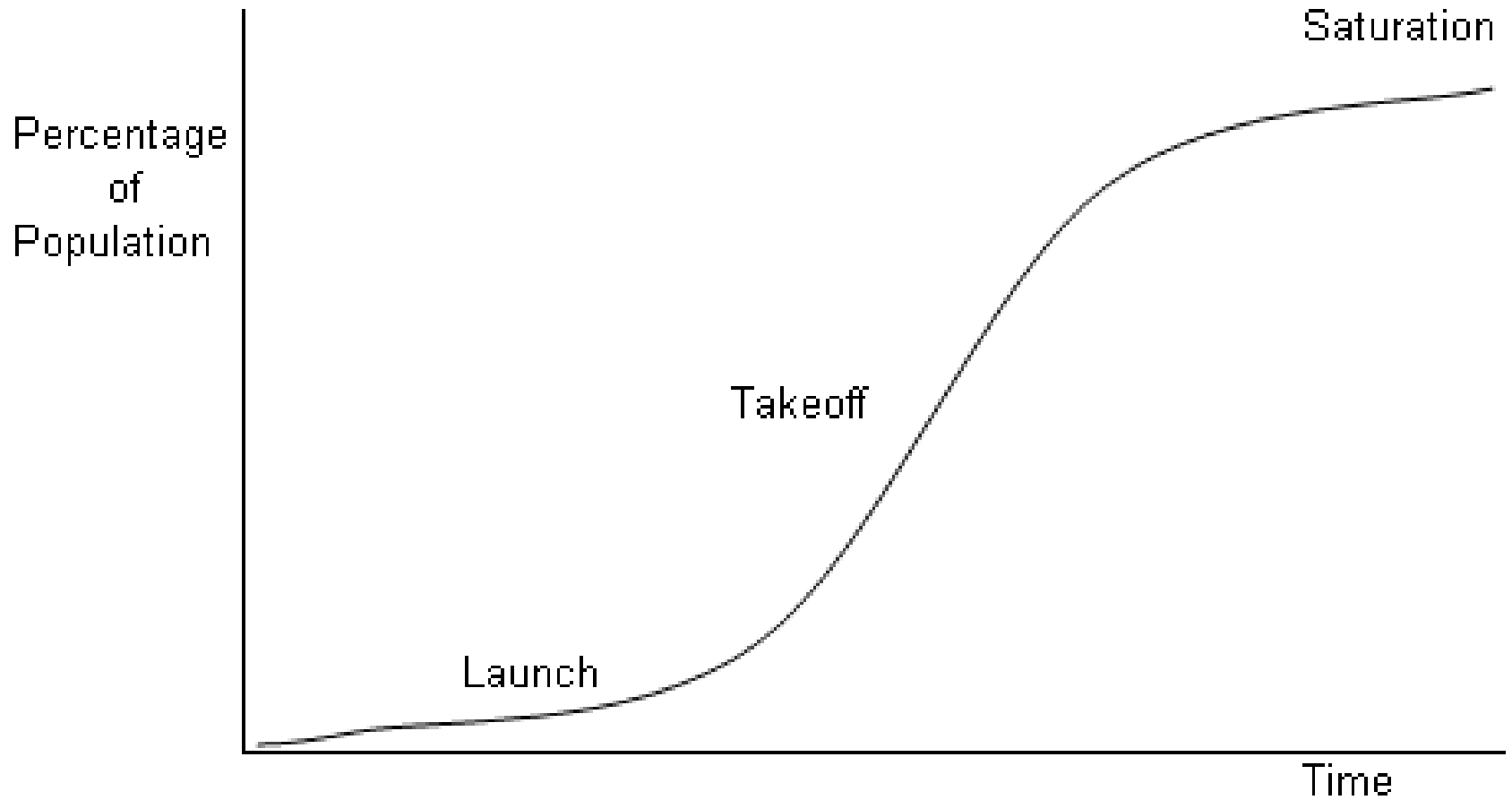
TRADITION HAS BEEN INCREASING CHIP

“CLOCKSPEED” (NUMBER OF CALCULATIONS PER SECOND)

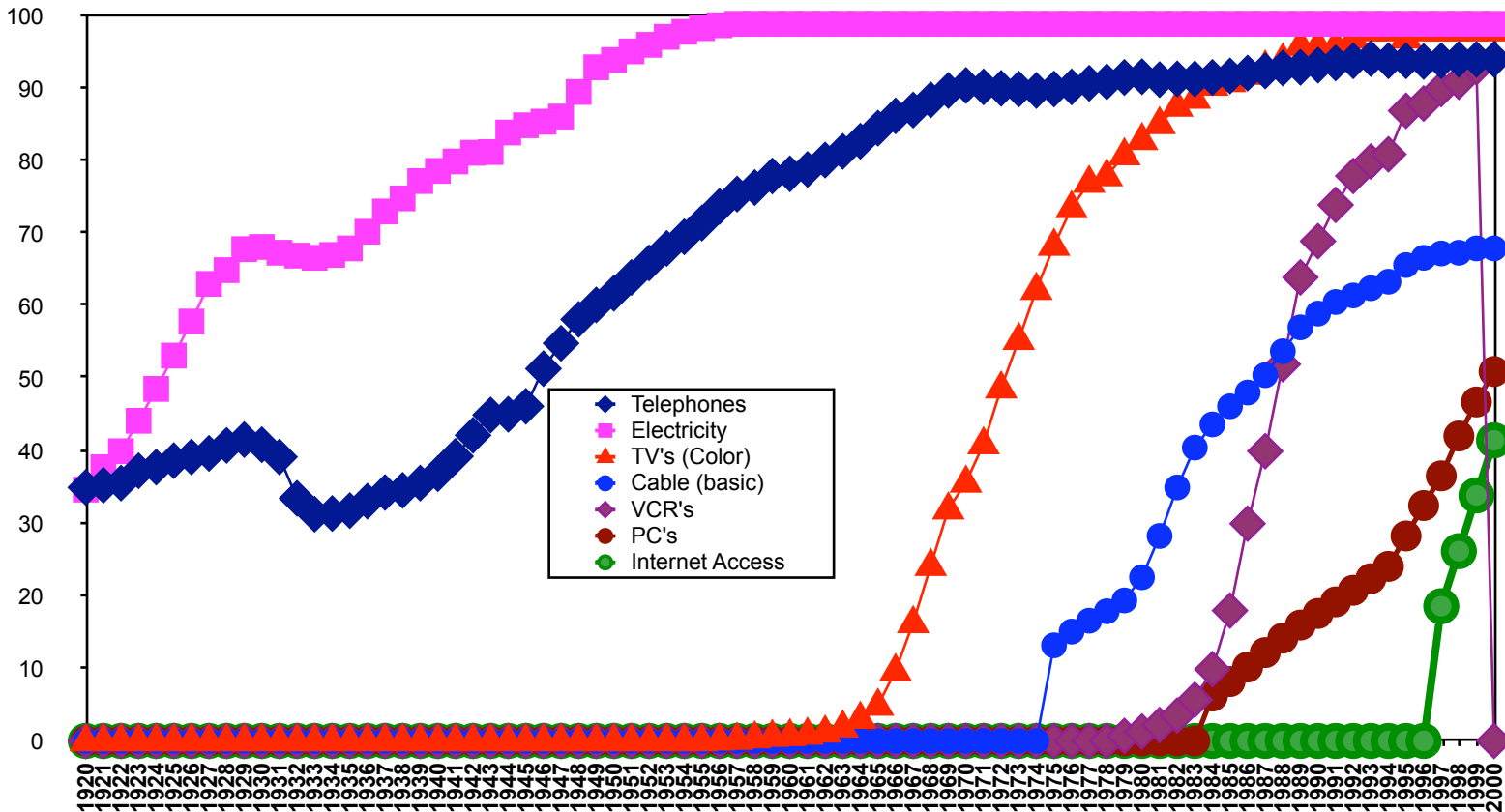
“CLOCKSPEED” TODAY IS 36 TIMES FASTER THAN IN 1995, BUT USERS WANT FEATURES SUCH AS A LONGER BATTERY LIFE, SURROUND SOUND, AND MULTIPLE FUNCTIONS

EACH NEW CHIP HAS ON THE ORDER OF 2 MILLION TRANSISTORS

GENERIC “S-CURVE”



“S-CURVES” FOR VARIOUS TECHNOLOGIES



GLOBAL DIGITAL MOBILE AND INTERNET S-CURVES

