ATSC 3.0, Convergence, and Spectrum Efficiency

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NEXTGENTV

POWERED BY ATSC 3.0

Advanced Television Systems Committee

- Standards development organization for digital terrestrial broadcasting
  - Founded in 1983 by CTA, IEEE, NAB, NCTA, and SMPTE
  - Focused on digital terrestrial broadcasting including television
- ATSC is an open, due process organization
  - Approximately 140 member organizations
  - Broadcasters, broadcast equipment vendors, cable and satellite systems, consumer electronics and semiconductor manufacturers, universities
- ATSC Mission Statement:
  - To create and foster implementation of voluntary Standards and Recommended Practices to advance terrestrial digital television broadcasting, and to facilitate interoperability with other media.


abc
AGOS
Advanced Technologies
AIRCODE
air communication developer's group
alticast
amazon web services
AMERICAN TOWER
ANTENNAS DIRECT
ANTOP
Digital HDTV Antennas
APTS
America's Public Television Stations
ARK MULTICASTING
atbs
ateme
AVATEQ
technology + innovation
BitPath
BROADCAST DATA NETWORK
BitRouter
Cast.era
CAVELL MERTZ & Associates, Inc.
CBC
CBS
CLEVERLOGIC
COBALT
Coherent Logix
COMARK
Communications
comcast
CRC
Consumer Technology Association
CONTRALY
COXMEDIA GROUP
CROWN CASTLE
Dektec
DigiCAP
Digital Alert Systems
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Now part of the AT&T family
dish
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Drew Nelson Research L.L.C.
DS BROADCAST
dts LISTEN
DTV AUDIO GROUP
dtv INNOVATIONS
EDGE NETWORKS
EIDEN
ETRI
Electronics and Telecommunications Research Institute
ENENSYS Technologies
eurofins
Digital Testing
FINCONS GROUP
FOX
Fraunhofer IIS
GAIAN
GATESAIR
GlennReitmeierTV LLC
Google
GRAHAM MEDIA GROUP
gray
harmonic
HEARST corporation
Hewlett Packard Enterprise
HUMBER
IBM
BTS
IEEE Broadcast Technology Society
IEEE
CONSUMER ELECTRONICS SOCIETY
Imagination
immersion
INTERDIGITAL
ion MEDIA
KaiMedia
Korean Broadcasters Association
LG Electronics
LowaSIS
LTN GLOBAL
Massachusetts Institute of Technology
MediaKind
mediaproxy
MEDIATEK
meredith
Mstar semiconductor
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NATIONAL ASSOCIATION OF BROADCASTERS
NAGRA
KUDELSKI GROUP
NBC UNIVERSAL
ncta
THE INTERNET & TELEVISION ASSOCIATION
NERC DTV
National Engineering Research Center
NPG
News-Press & Gazette Company
Nexstar
MEDIA GROUP, INC.
NHK
nielsen
NOVATEK
ONEMedia
OPEN NETWORK ENABLED
OSBORN ENGINEERING
PBS
pearl
PHILIPS
PIXTREE
PRO TELEVISION TECHNOLOGIES
PSY[X]
PUBLIC MEDIA GROUP
A PUBLIC BENEFIT CORPORATION
PUBLIC MEDIA VENTURE GROUP
PMVG
Qualcomm
QUINCY
RF Notifications
ROHDE&SCHWARZ
Saankhya Labs
SAMSUNG
SCRIPPS
SHARP
SBG
SINCLAIR BROADCAST GROUP
SK telecom
SBE
SMPTE
SONY
s&t
Synamedia
Technology Advisors
TEGNA
TTA
telestream
Televisa
Telos Alliance
THOMSON
BROADCAST
TITAN TV INC
triveni DIGITAL
Ubilinx
Ubilinx Technology, Inc.
UniSoft
Universidad del País Vasco
Euskal Herriko Unibertsitatea
UNIVISION
V-NOVA
VERANCE
VideoFlow
WIDEORBIT
zenith

A World of Experts behind ATSC 3.0

370+ active contributors

- Many others work “behind the scenes” on 3.0 development efforts

140 organizations

- Broadcasters
- Consumer Technology Manufacturers
- Professional Equipment Manufacturers
- R&D Laboratories
- Universities

International Participation

- Canada
- China
- Europe
- Japan
- South Korea
- United States

ATSC 3.0 Summary – Broadcasting in the Internet Age

- Physical Layer – flexible, configurable, world's most efficient one-to-many DTT system
- Transport – IP-based protocol via MMPT and ROUTE/DASH
- Video – UHD, HDR, WCG, HFR, scalable video coding via HEVC H.265
- Audio – immersive audio, personalization via Dolby AC-4, MPEG-H Audio
- Apps – web-based interactivity via HTML5, CSS, JavaScript and Websocket APIs
- Accessibility – new capabilities for visually and hearing-impaired audience
- Advanced Emergency Messaging – new rich media capabilities and receiver "wake-up"
- Datacasting – ability to deliver data to IoT, e.g., cars, agriculture, signage, smart cities, etc.
- Convergence Ready – designed to easily interoperate with other IP data delivery networks

Innovative Technologies Implemented in ATSC 3.0

Low Density Parity Check (LDPC) code, up to 64k-bit code length;

Non-Uniform Constellation (NUC) Modulation with up to 4096NUC-QAM modulation;

Layered-Division-Multiplexing (LDM) that can efficiently combine robust mobile and high data rate fixed services in one TV channel;

Robust Bootstrap (synchronization/signaling sequence) that combines time and frequency domain signalling technologies (PN + Zadoff-Chu sequence);

System Sampling frequency F(s) = N x 384,000 Hz, same as 5G for easy convergence (384,000 Hz is 1/10 the 3G WCDMA chip rate).

IP-based transport system, same as many global data network standards for easy convergence

ATSC 3.0 is a Platform

Unlike previous DTT standards, ATSC 3.0 is a Platform that evolves

ATSC 3.0 must continually develop so that broadcasting can serve the changing market demands

ATSC members maintain and develop the ATSC 3.0 Platform

ATSC Committee Structure

Planning
Teams
- recommendations

Technology
Groups
- draft standards

Implementation
Teams
- build solutions

Active ATSC Committees

Planning Team 4 – Future Broadcast Ecosystem Technologies

Planning Team 5 – Automotive Applications

Planning Team 6 – Global Recognition of ATSC 3.0

Planning Team 8 – Core Network Technologies for Broadcast

Technology Group 3 – ATSC 3.0

- 7 Specialist Groups, 2 Ad Hoc Groups are active under the TG3 umbrella

Conformance Implementation Team

India Implementation Team

DEPLOYMENTS

SOUTH KOREA DEPLOYMENTS

South Korea literally paved the road to ATSC 3.0, adopting its Next Gen TV standard in 2016 and launching 4K Ultra High Definition ATSC 3.0 broadcasts in May 2017. Momentum continues to build since the landmark UHD broadcasts of the Winter Olympics, and ATSC 3.0 services now reach over 70% of the population.

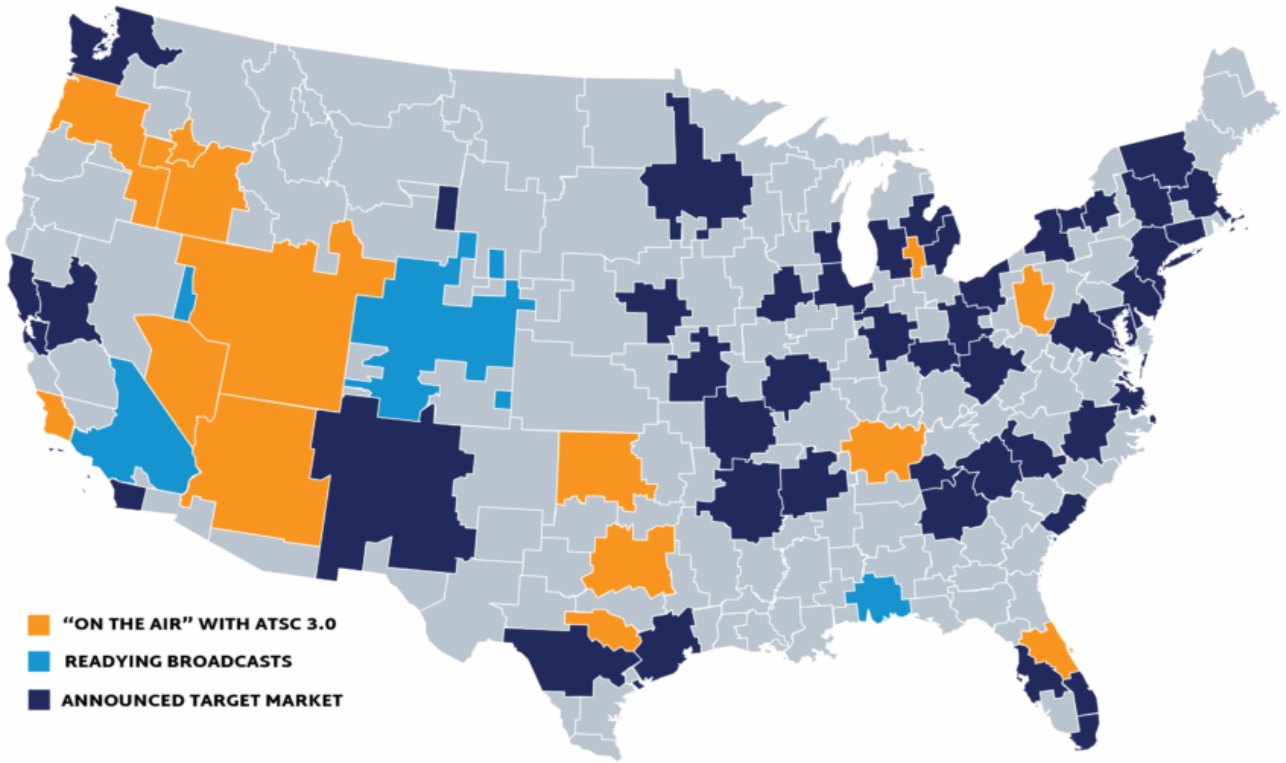
In addition to UHD, broadcasters in South Korea continue developing new services on the country's ATSC 3.0 service roadmap.

- "On the Air" with ATSC 3.0

DEPLOYMENTS

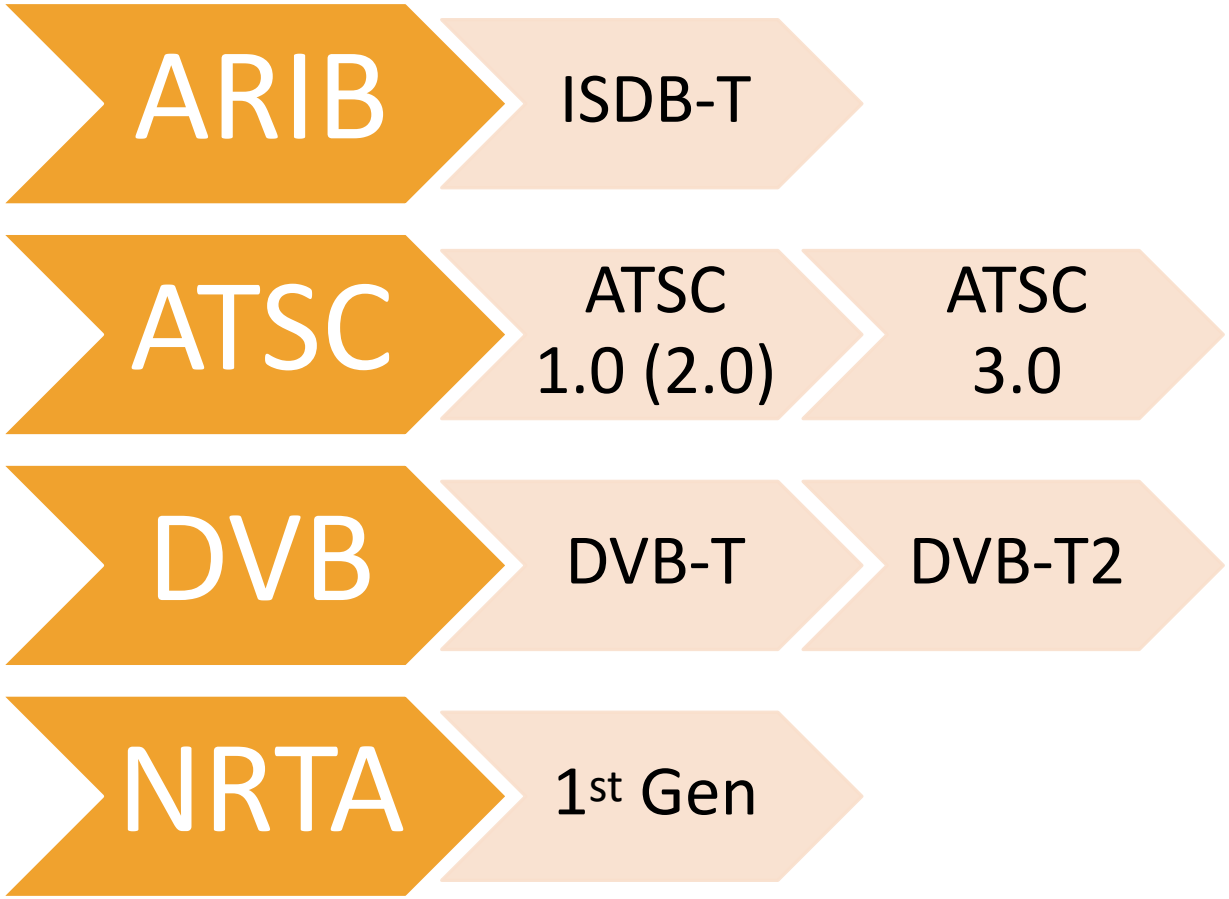
Broadcasters have announced that they are working together to bring ATSC 3.0 first to 62 markets across the country, which collectively would mean next-generation TV reception by more than 75% of all viewers. Those 62 "First Markets" are indicated on this map. Each "first market" (in dark blue) will transition to readying broadcasts (in light blue) and then on-the-air with ATSC 3.0 (in orange.)

UNITED STATES DEPLOYMENTS



On Air or Announced
Austin
Boise
Dallas-Ft. Worth
Denver
Las Vegas
Los Angeles
Medford-Klamath Falls
Mobile-Pensacola (Ft Walt)
Nashville
Oklahoma City
Orlando-Daytona Bch-Melbrn
Phoenix (Prescott)
Pittsburgh
Portland, OR
Salt Lake City
SantaBarbra-SanMar-SanLuOb

Two Generations of Digital Terrestrial Broadcast Standards



3GPP Broadcasting Sub-System

1. Multimedia Broadcast Multicast Services (MBMS) is a point-to-multipoint (P2MP) communication system designed for 3G cellular network (Release 6, Q4 2004);
2. *Evolved* MBMS (*e*MBMS, also called LTE-Broadcast) was an upgrade for 4G/LTE (Release 9 & 12, Q4 2008 & March 2015);
3. *Further Evolved* MBMS (*fe*MBMS, also called enTV) is a further enhanced system (Release 14, mid-2017). Specify options for broadcasting to ***4G/LTE*** terminals;
4. 3GPP did not address "5G broadcast" in Release 16. (i.e., *fe*MBMS is not based on 5G NR; it is a 4G-based system)

Converged Networks and Spectral Efficiency

Different networks and different frequency bands excel at different use cases

The ability to dynamically steer, switch or share data sessions across different data networks allows optimal usage of spectrum

A key use case for convergence is to intelligently and dynamically choose one-to-one (P2P) networks vs. one-to-many (P2MP) networks according to the current need

Large data sessions intended for a large number of devices can be most efficiently carried by a PTMP network

- Map updates to cars
- Popular media content
- If storage is available on the receive device, a PTMP network can be used for time-shifted consumption

International Trends on Convergence

CRC Canada
- Initiated and on-going research Broadcast-Broadband convergence project in 2015

Europe
- EU 5G PPP X-Cast project 2017-2019
- Demonstrated SDR feMBMS in 2019

China
- National Broadcaster granted a 5G carrier license June 2019, using 700 MHz and mid-band to deploy 5G, while keeping broadcast TV services

U.S.
- Proposal to ATSC on Convergence of 5G and Broadcast Core Networks (OneMedia)
- Cable TV and 5G core network convergence by Cable Labs

India
- National Standard Body studied OTA broadcast for LTE traffic off-loading. ATSC 3.0 and LDM favored. Plan to propose to 3GPP.

Korea
- Demonstrated ATSC 3.0 & 4G/LTE-A field trial.
- ATSC-5G convergence project underway.
- Continue collaboration with CRC Canada.

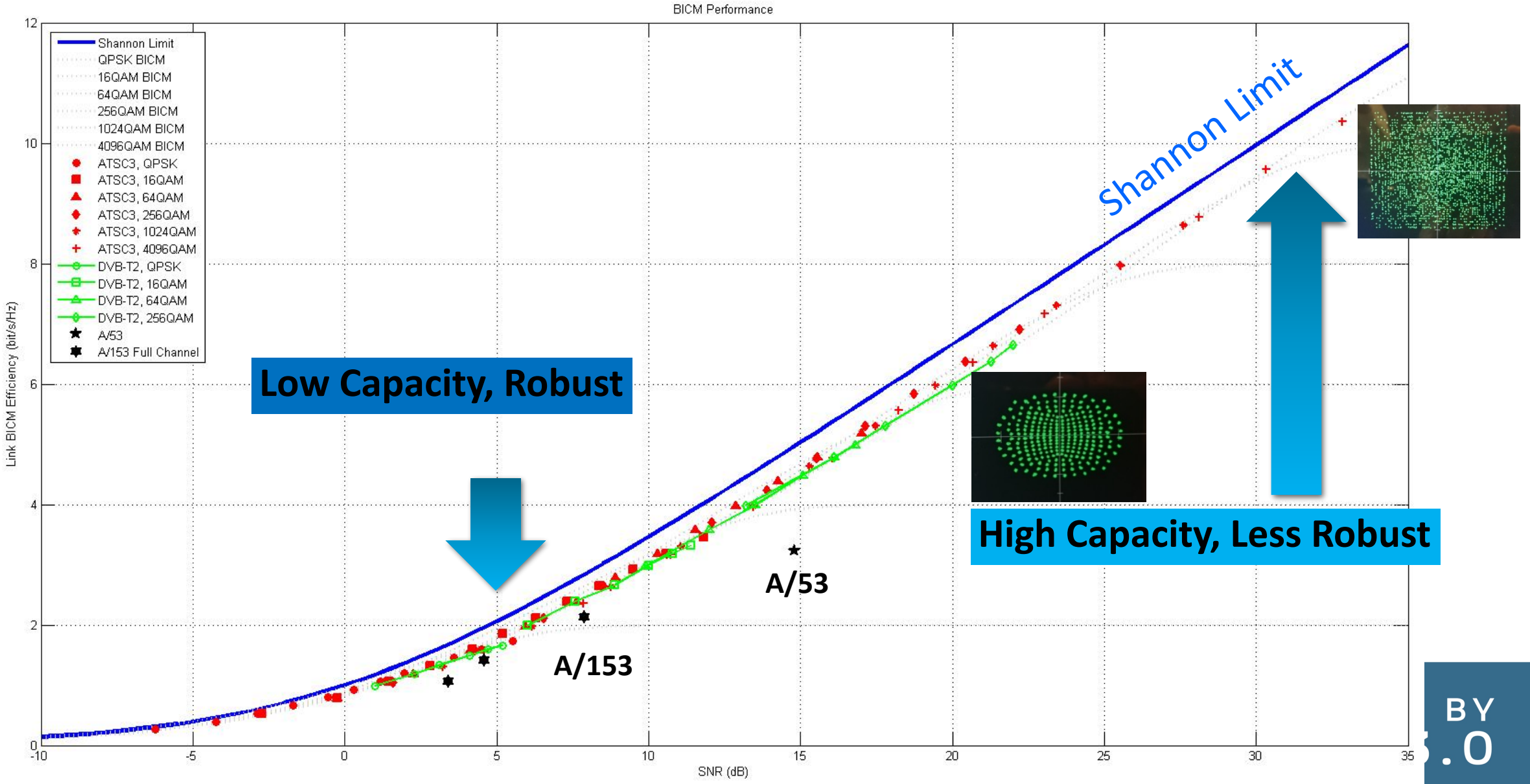
3GPP Envisions Convergence

1. 5G will be an ecosystem that includes many different standards, operating on different spectrum bands, providing different services;
2. 3GPP has defined methods for Steering, Switching and Splitting data sessions across heterogeneous networks

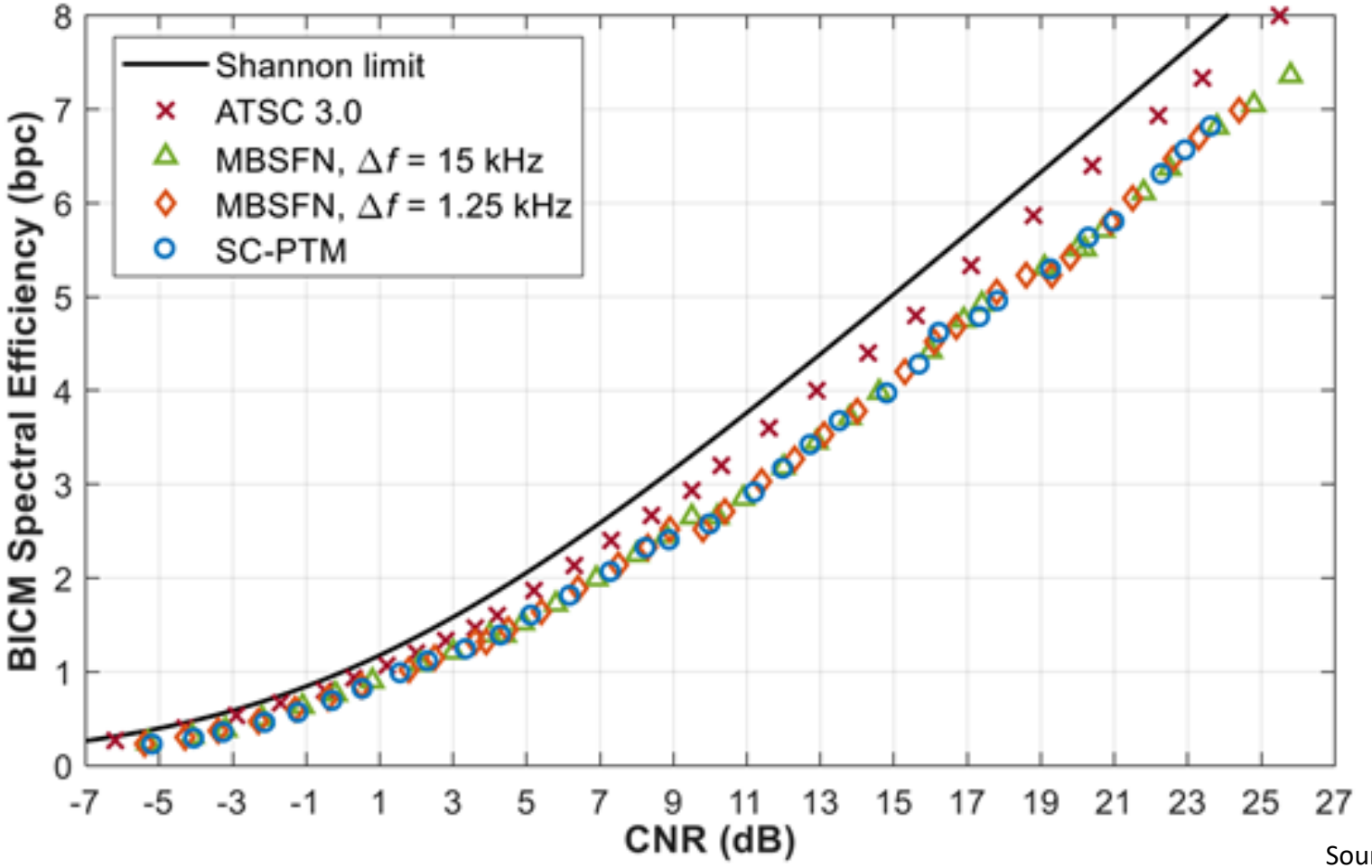
ATSC Envisions Convergence

1. ATSC 3.0 is 5G ready and could be part of the 5G ecosystem as part of the wireless connected world;
2. ATSC 3.0 and 5G share many common components (IP transport, HTML5/JavaScript, Audio/Video, etc.);
3. ATSC 3.0 can deliver Audio/Video/Data to mobile and fixed terminals in large geographical areas, i.e., one-to-many communications to large amount of terminals simultaneously (P2MP Wide Area Network).

Physical Layer Capacity



Comparison of ATSC 3.0 and 3GPP Broadcast Mode



BICM Spectral Efficiency as a function of CNR for BLER=0.1% (SISO AWGN Channel)

ATSC3.0 Performance is closest to Shannon Limit

Source: TSDSI 5000 v1.0.0 Technical White Paper Broadcast Offload

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Planning Team 8 – Core Network Technologies Background

Background:

A core network that enables broadcast towers to be efficiently connected to form one or more service networks may be important or even necessary to fulfill myriad use cases, such as datacasting to the Internet of Things, Broadcast Traffic Offload, datacasting to moving vehicles, and others.

A broadcast core network may further enable convergence and interoperability with other heterogeneous networks.

Planning Team 8 – Core Network Technologies Scope

Scope:

PT8 will study the core network concept and consider how it may apply to ATSC 3.0 digital terrestrial broadcasting, including identifying specific use cases and commercial benefits of broadcast core network technology. The group will also investigate the applicability of other industry standards, analyze "gaps" and identify what new technical work might be undertaken by ATSC in this area, considering the guidance for new work as stated in the Bylaws. PT8 will report the results of this work to the Board.

Preliminary ATSC 3.0 Core Network Design Concepts

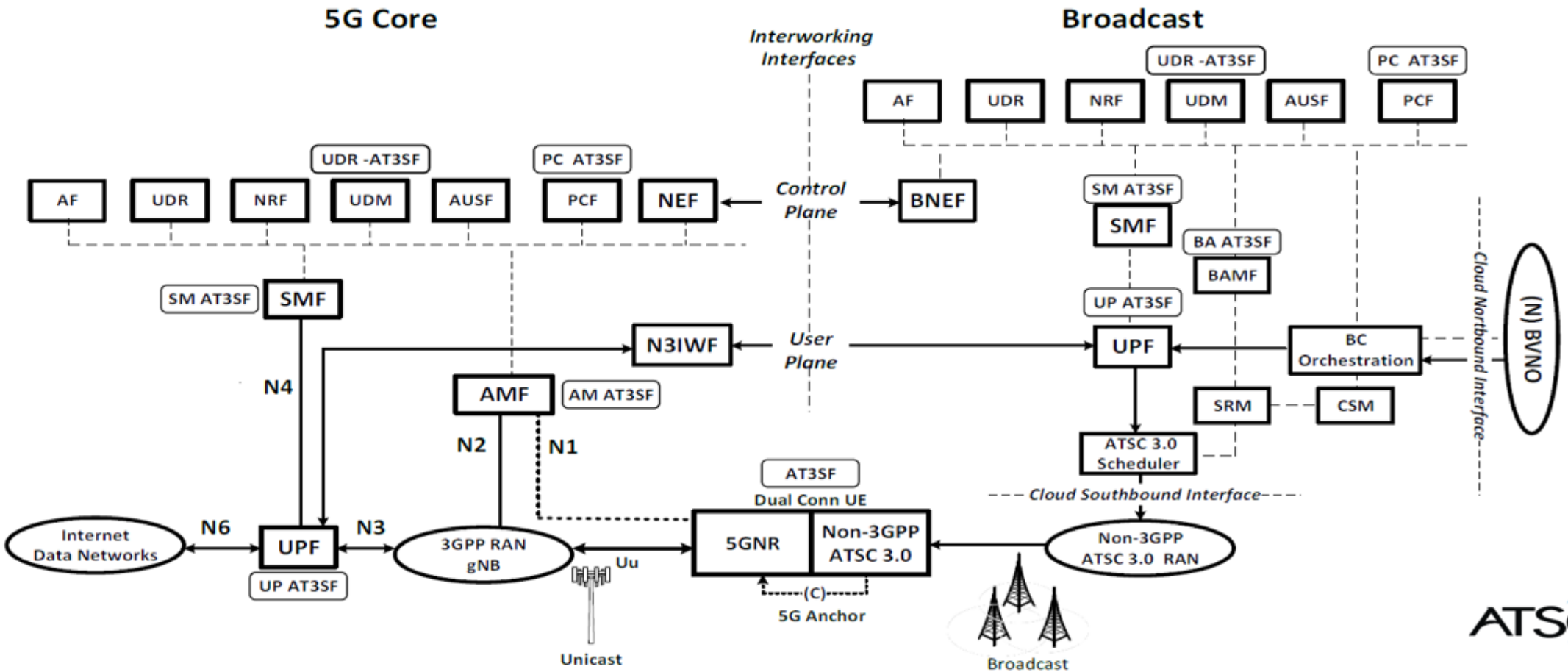
ATSC core network should be designed for standalone operation

ATSC core network should be designed for converged operation with other data delivery networks, e.g., 5G.

ATSC core network should be designed for cases where an uplink is not available, as well as for cases when an uplink is always or sometimes available.

5G Core and ATSC intersection

Telco Meeting Broadcasting



Source: ATSC 3.0 Broadcast 5G Unicast Heterogeneous Network Converged Services Starting Release 16, Transactions on Broadcasting BTS-19-205

Summary

DTT broadcasters are operating in a global ecosystem of converging networks

Data session steering, switching, and sharing across heterogeneous networks can improve spectrum usage efficiency

- Use the most appropriate network(s) for each given data session in a dynamic fashion

ATSC 3.0 specifies the most efficient physical layer for one-to-many data delivery in the world today

- Designed for TV and non-TV uses
- Designed for fixed and mobile uses
- Designed for one-to-many downlink
- Designed for convergence with other data delivery networks, e.g., Internet, LTE/5G

A core network for broadcast enables broadcasters to efficiently participate in a global converged network ecosystem

ATSC Planning Team 8 is studying broadcast core network design

ATSC 3.0 is a platform that can be developed as market demands change, and technology groups await the outcome of PT-8's findings

Thank You!

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