AsiaSat

Reaching Further, Bringing You Closer

UHD with AsiaSat

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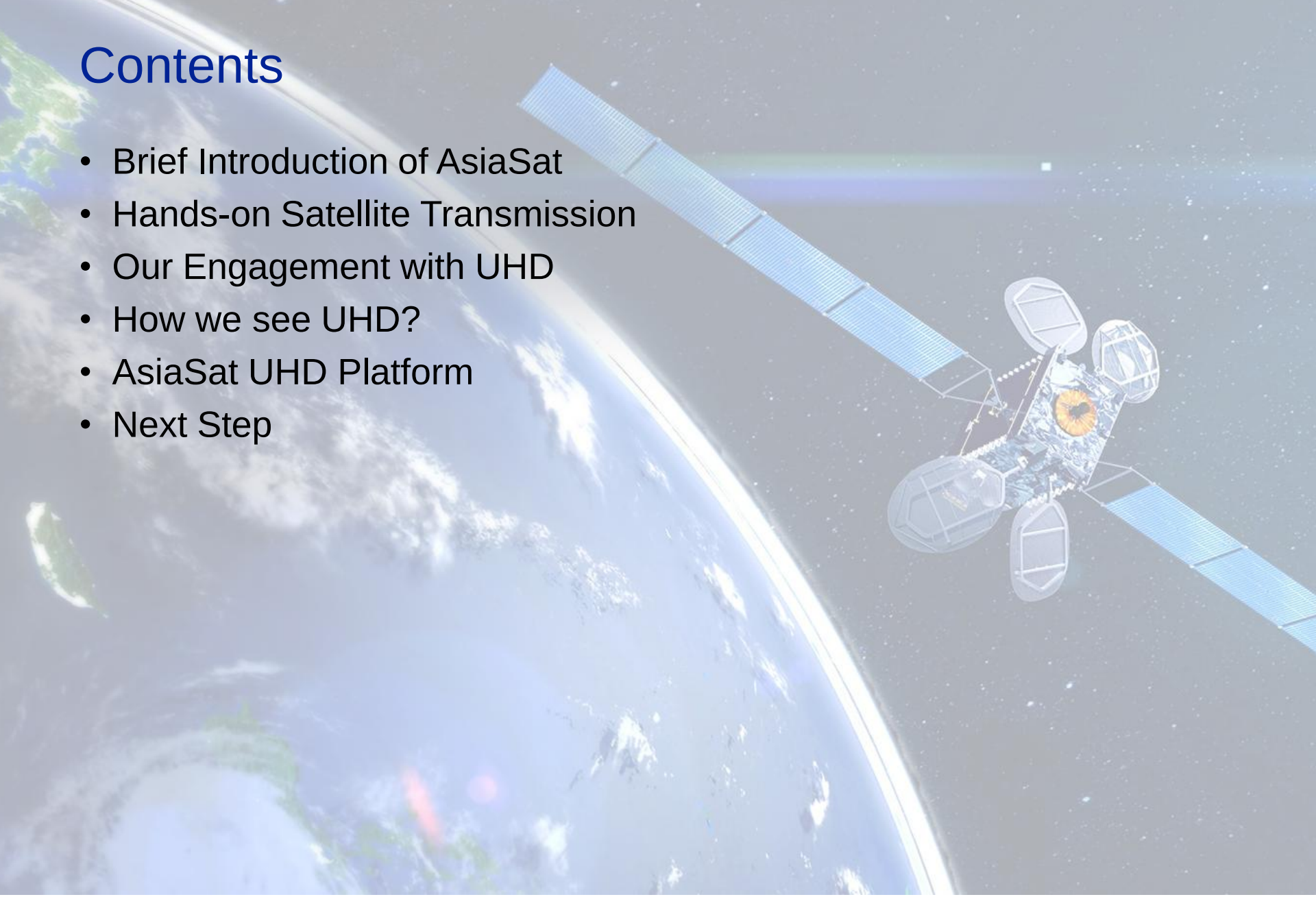
Manager, Sales Solutions

23 Jun 2016

4K-SAT 4K-SAT 2

Contents

- Brief Introduction of AsiaSat
- Hands-on Satellite Transmission
- Our Engagement with UHD
- How we see UHD?
- AsiaSat UHD Platform
- Next Step



AsiaSat

Brief Introduction of AsiaSat

Our Background
Our Satellite Fleet
Our Facilities
Our People

Reaching Further, Bringing You Closer

AsiaSat Corporate Video

Our Background

Head-quartered in Hong Kong

Established in 1988

Listing in Hong Kong Stock Exchange

Regional Satellite Operator

- Asia's leading satellite operator, aiming to provide highest quality satellite communications services in the region

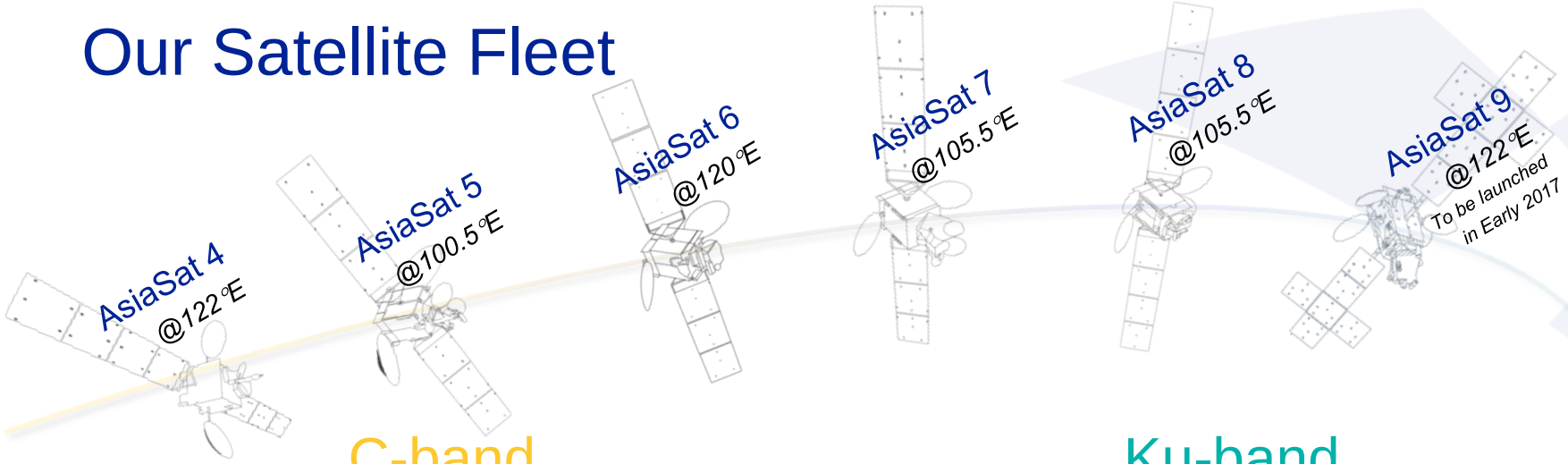
Coverage

- Across 50 countries in Asia-Pacific
- Reaching 2/3 of world's population

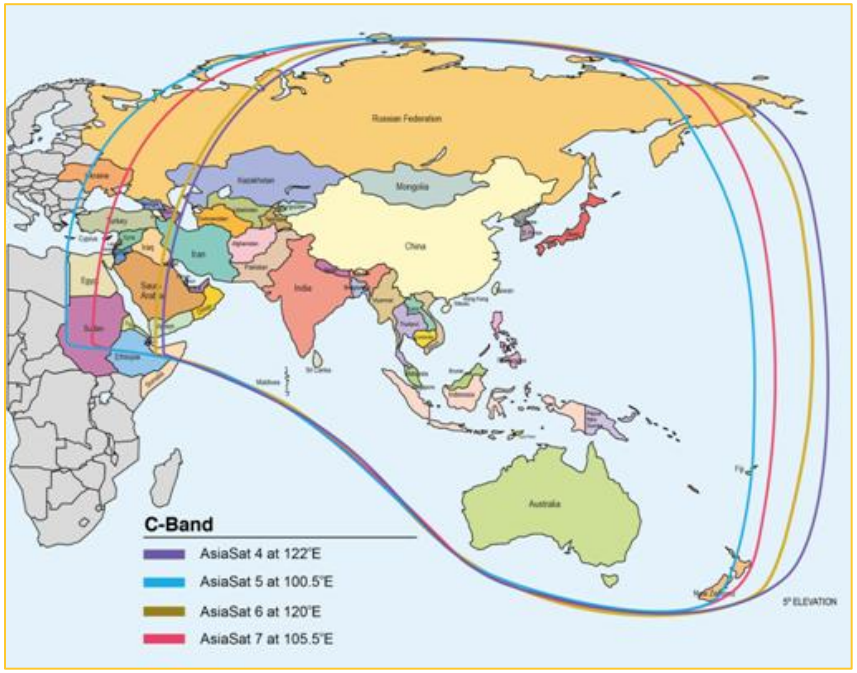
Customer Profile

- International and Regional TV Broadcasters
- Telecommunications Service Providers
- News Agencies
- Corporations and Governments

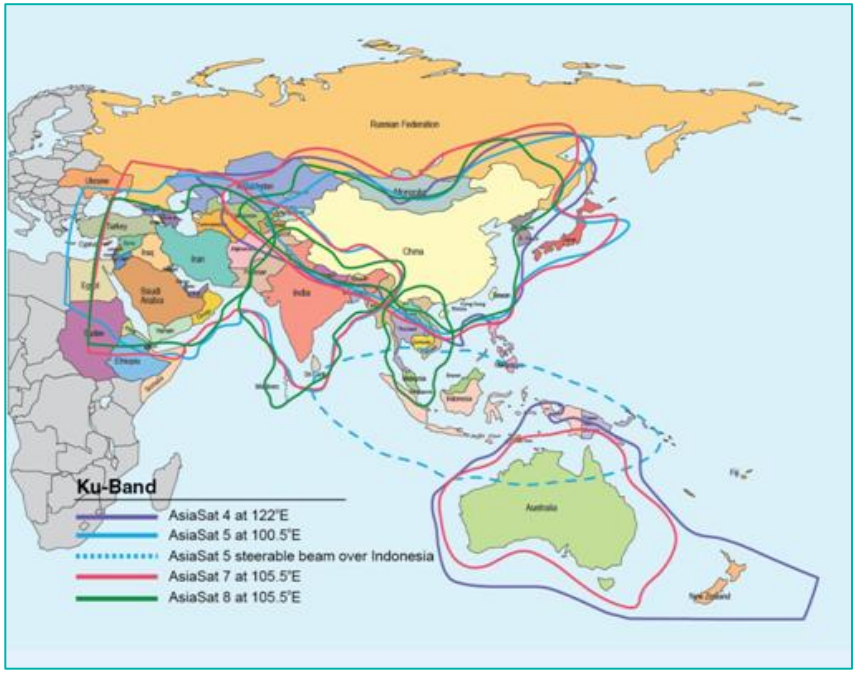
Our Satellite Fleet



C-band



Ku-band



For more details of our satellite fleet, please visit our web site (http://www.asiasat.com/technology/satellite-fleet).

Our Earth Stations

Tai Po Earth Station

Stanley Earth Station

For more details of our facilities, please visit our web site (http://www.asiasat.com/aboutus/facilities).

Tai Po Earth Station

AsiaSat Tai Po Earth Station is located at the Tai Po Industrial Estate in the New Territories, Hong Kong.

The Station is a two level building of 5,551 sq.m. built on a 13,638 sq.m. site.

Besides supporting the Telemetry, Tracking and Control (TT&C) activities of AsiaSat's satellite fleet, the earth station also provides a broad range of value added services to customers in the broadcast and telecommunications industries.

Antennas

- 1x 1.3m (C)
- 2x 9.0m (C)
- 3x 7.3m (C)
- 2x 6.3m (C)
- 1x 6.1m (C)
- 4x 7.3m (Ku)
- 2x 6.3m (Ku)
- 1x 4.9m (Ku)
- 1x 4.8m (Ka)

International Fibre Service Providers

- British Telecom
- PCCW Global
- Tata Communications
- Telstra Global

Local Telecom Service Providers

- HGC
- HKBN
- New World T&T
- Wharf T&T
- PCCW
- Towngas Telecom

Services

- Uplink Service
- Downlink Service
- Occasional Service
- Conditional Access Service
- Compression Service
- Playout Service
- Monitoring Service
- Hosting Service
- Fibre / Internet Connectivity Service
- DVB-S2/S MCPC Platforms
- Broadway® Connectivity Service
- Disaster Recovery Facilities
- Satellite Transfer Orbit Service

Stanley Earth Station

AsiaSat Stanley Earth Station is located on Hong Kong's Stanley Peninsula and serve as the backup of satellite control facilities to the Tai Po Earth Station via connections of fully redundant leased circuits.

The station consists of six antennas with sufficient redundancies and flexibility.

- 2x 11.0m (C)
- 1x 9.0m (C)
- 1x 5.0m (C)
- 2x 6.1m (Ku)

The redundant facility is fully controlled by Tai Po and attuned with the Satellite Operations Centre (SOC), enabling backup TT&C services to ensure high reliability and integrity.

Our People


Crossroads
foundation
where need meets resource


AsiaSat


AsiaSat

Organisational Structure

President and CEO
William WADE

Vice President, Sales and Business Development	Vice President, Marketing and Global Accounts	Vice President, Engineering and Operations	Vice President, Finance and Chief Financial Officer	Vice President, China	General Counsel
Philip BALAAM	***Sabrina CUBBON***	***Roger TONG***	***Sue YEUNG***	***ZHANG Yan***	***Catherine CHANG***



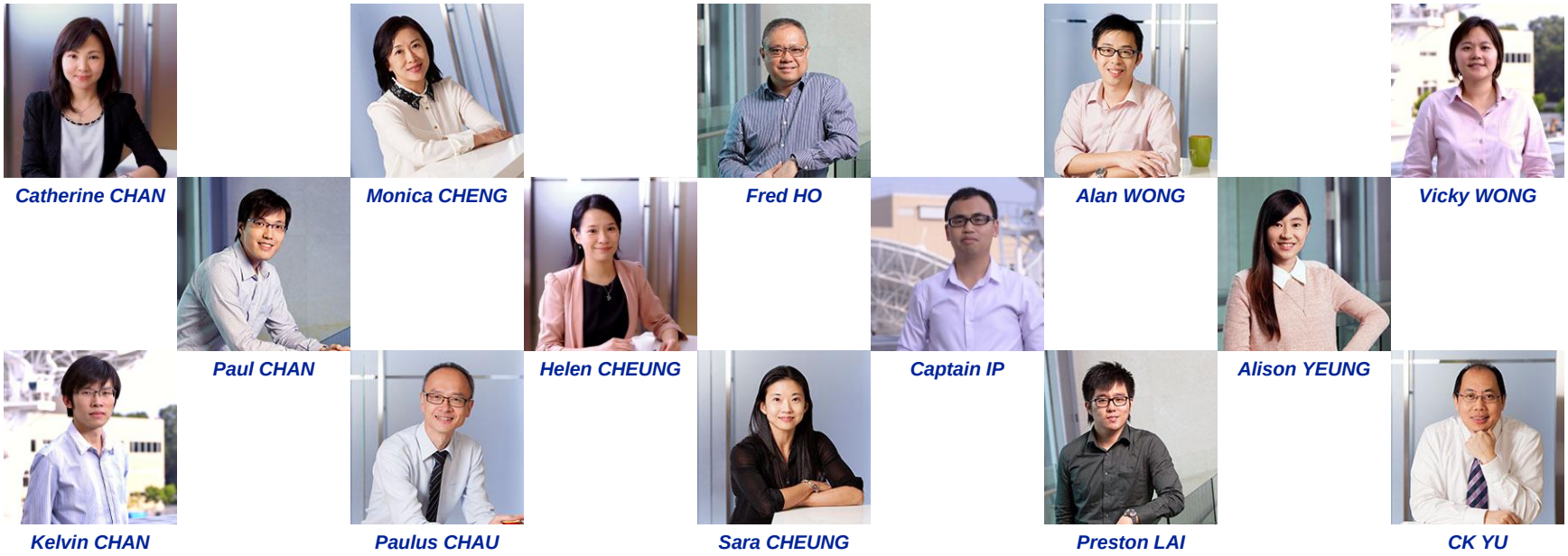



Meet Our People

We have over 130 staff in our organisation.

We are all committed to support your success in satellite transmission as your success is our success.

Please visit to our web site (http://www.asiasat.com/aboutus/meet-our-people) for more about our staff interesting stories.



AsiaSat

Hands-on Satellite Transmission

Reaching Further, Bringing You Closer

Where are the Satellites?

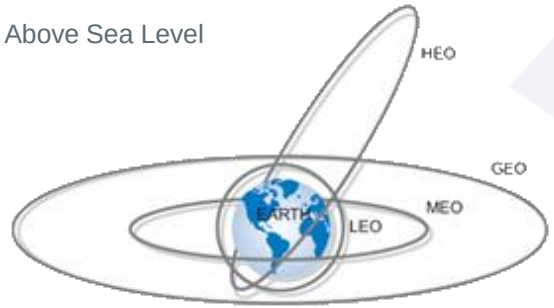
International Space Station (ISS):340km

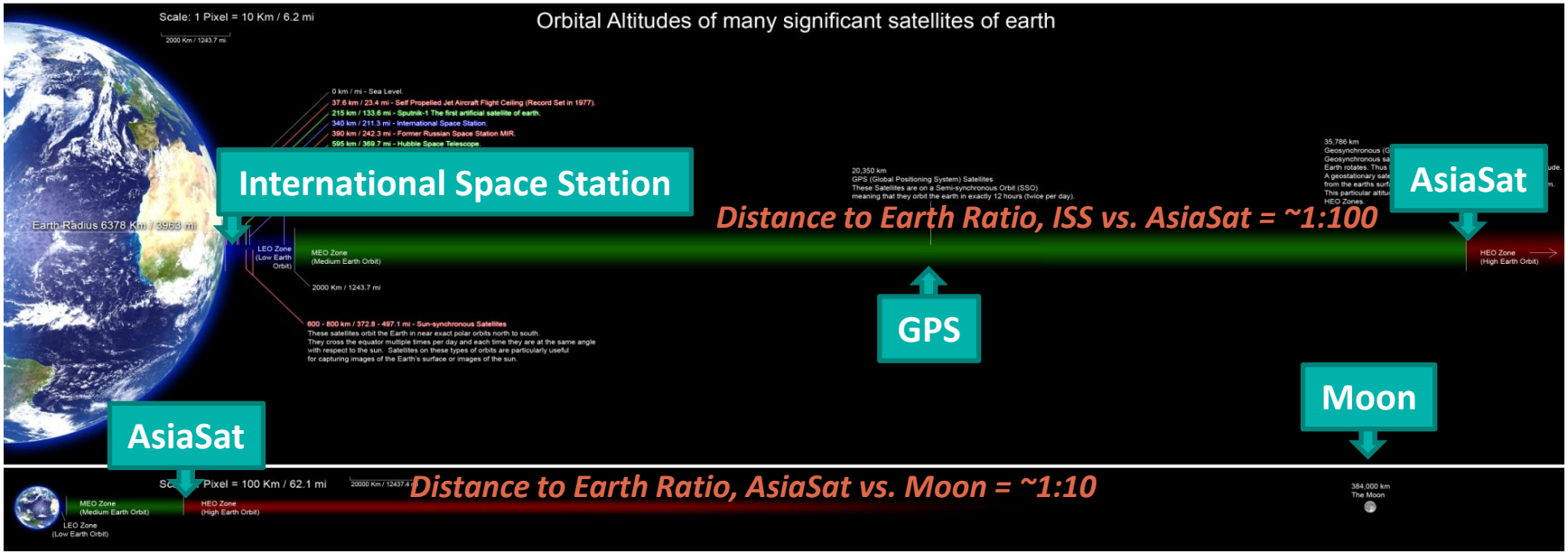
GPS Satellites: 20,350km

AsiaSat (Geostationary Satellites): 35,786km

Moon: ~384,000km

Above Sea Level

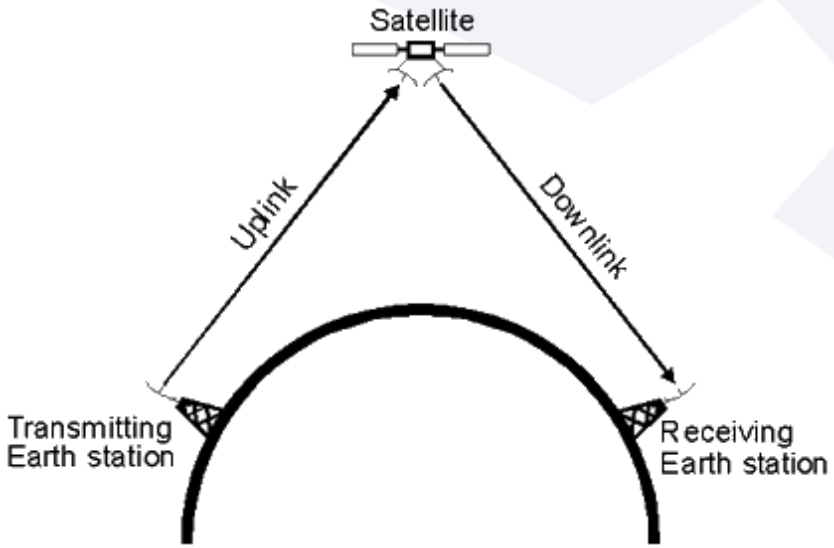




Source: http://commons.wikimedia.org/wiki/File:Orbitalaltitudes.jpg

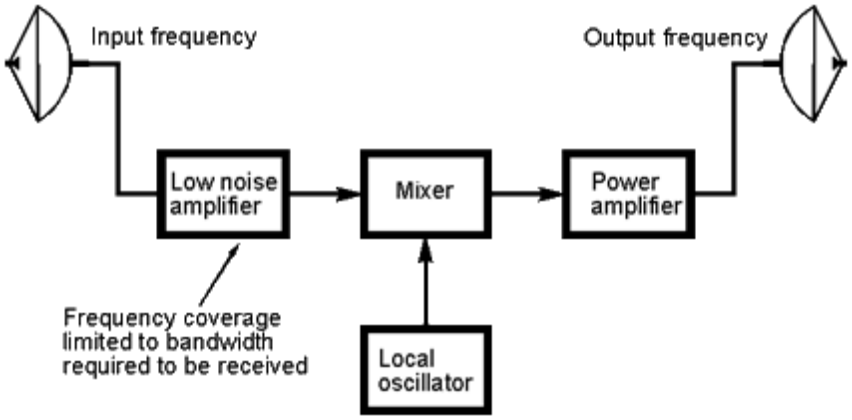
How does Satellite Transmission work?

1. Tx Earth Station to sends SIGNAL (Uplink)
2. Satellite receive and retransmit the SIGNAL
3. Rx Earth Station to receive SIGNAL (Downlink)
4. Using different frequency bands for Uplink and Downlink



Frequency Bands

- L-band: 1 to 2 GHz
- S-band: 2 to 4 GHz
- **C-band: 4 to 8 GHz**
- X-band: 8 to 12 GHz
- **Ku-band: 12 to 18 GHz**
- K-band: 18 to 27 GHz
- Ka-band: 27 to 40 GHz

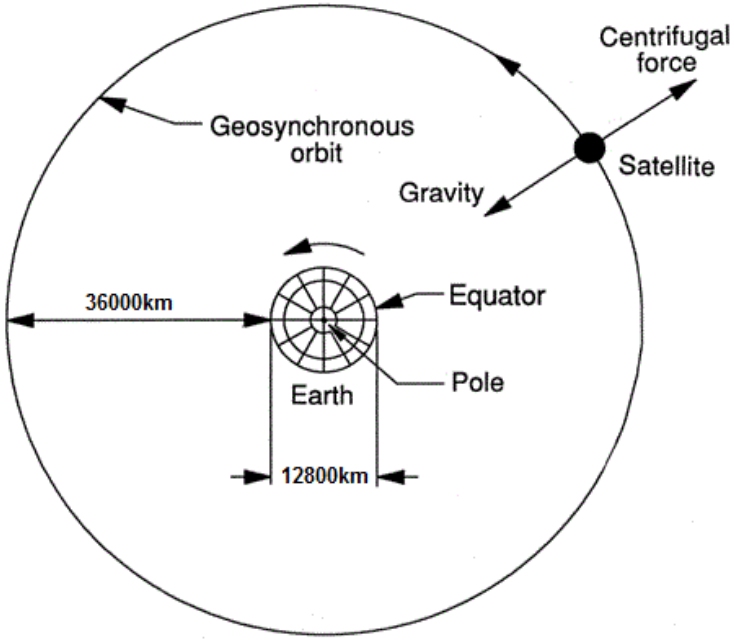


Satellite Transponder block diagram

How does Satellite stay in orbit?

Satellite stays in orbit due to the balance of two factors

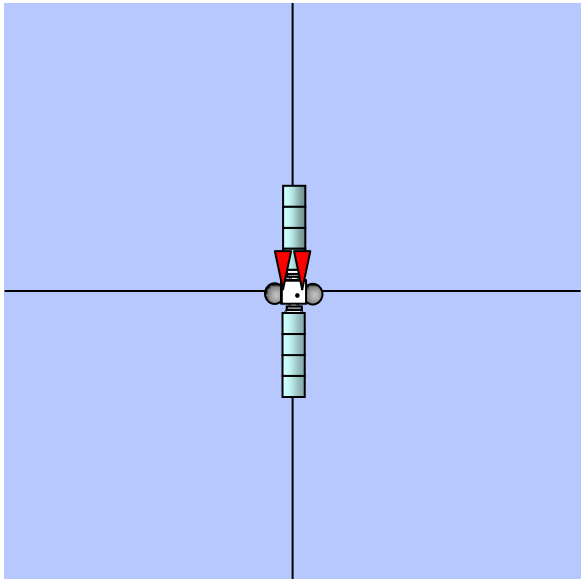
1. Its **Velocity** (or the speed at which it would travel in a straight line)
   - The higher the orbit, the less velocity is required. The nearer the orbit, the faster it must move to ensure that it does not fall back to Earth.
   - Geostationary Satellite is moving at 3.075 km/s (3 x max. speed of a rifle bullet).
2. The **Gravitational Pull** between the Earth and the Satellite itself.

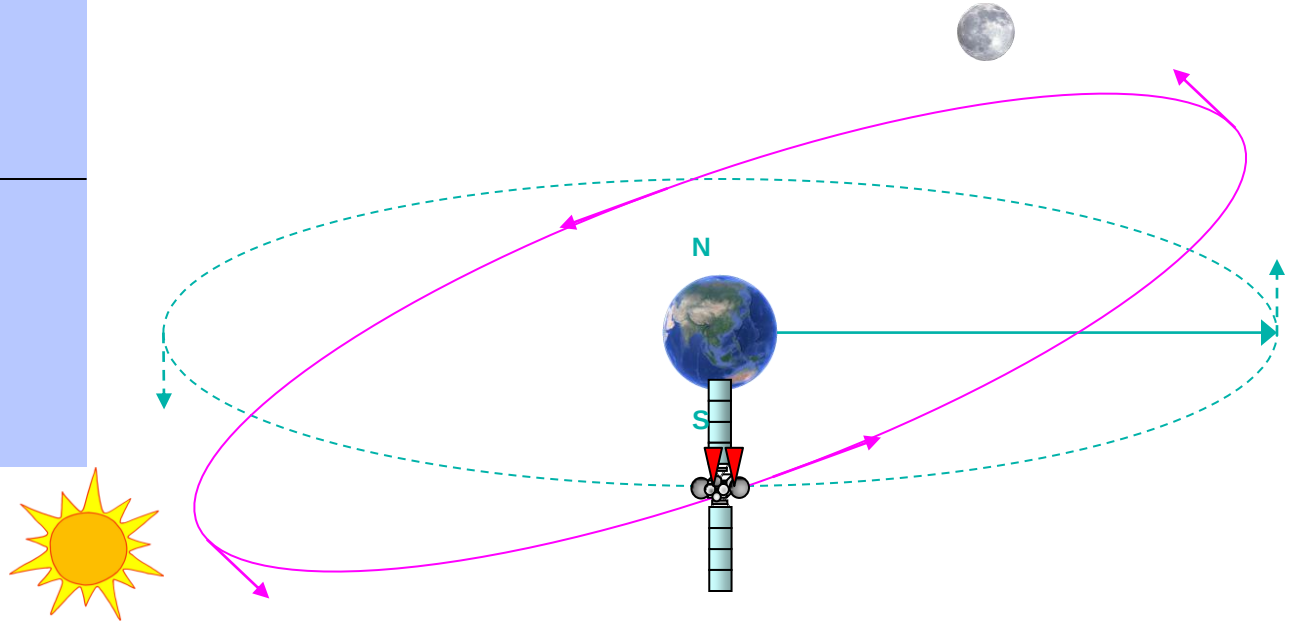


Does Satellite keep where they are Forever?

Forces act on satellite to change its orbit over time

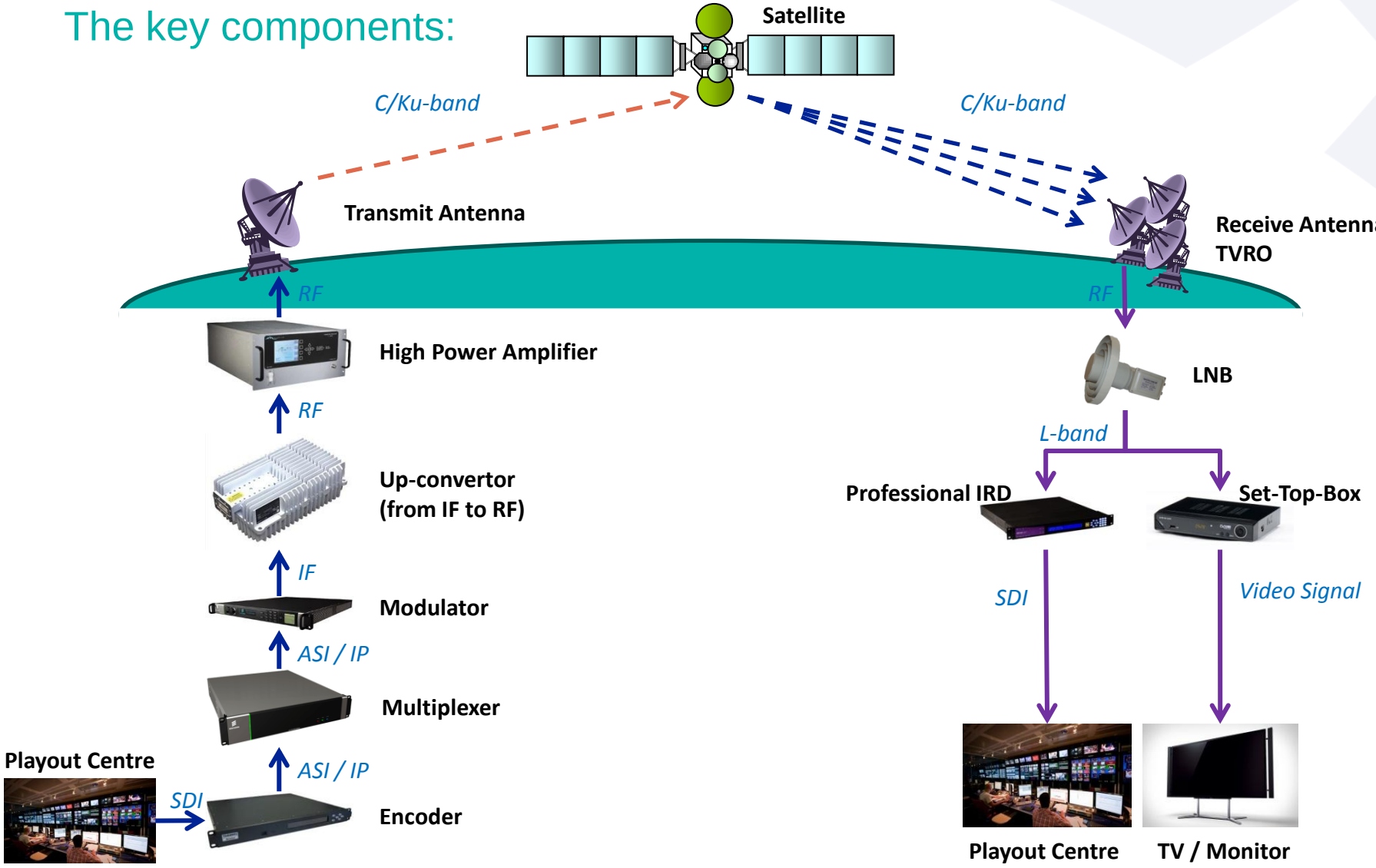
- Gravitational Pull from Sun & Moon
- Slight Asymmetries in Earth's Gravitational Field
- Solar Radiation Pressure





How to Broadcast a TV Signal through Satellite?

The key components:



AsiaSat

Our Engagement with UHD

Reaching Further, Bringing You Closer

What have we done?

January
Partnered with Cyberport HK for a UHD via Satellite live demo.
- *79Mbps*
- *DVB-S2, 16APSK*
- *MPEG-4*
- *8-bit*
- *30fps*

CYBERPORT 數碼港

August
AsiaSat UHD project was initiated to evaluate the UHD solution. AsiaSat UHD Team was formed.

2014 → 2015

June - July
Supported EBU to put three FIFA World Cup matches (inc. Final) on **AsiaSat 5**
- *83Mbps*
- *NS3, 8PSK*
- *MPEG-4*
- *8-bit, p60*

EBU

FIFA WORLD CUP Brasil

October
AsiaSat UHD Research Lab was established to review UHD solution from Playout, Compression, to Satellite Tx & Rx.

What have we done?

January
Confirmed to proceed w/ **DVB-S2**

and **HEVC** solution.

February - May
Started to evaluate various HEVC solutions on both off-air transcode and real time encoding with solutions vendors.

June
Announced the launch of AsiaSat UHD platform on AsiaSat 4 with extensive C-band coverage in Asia Pacific region.

August
Released the white paper – The Evolution and Impact of Ultra HD (by Mr. Captain IP)

October
Partnered with ROHDE&SCHWARZ to launch AsiaSat first UHD channel 4K-SAT in 10-bit/50fps

Initial content line up:
1. AsiaSat
2. Rohde & Schwarz
3. Fashion TV
4. Cyberport

December
Announced logo of 4K-SAT.

2015 — 2016

What have we done?

January
Partnered with Harmonic to launch 4K-SAT2/HVN channel officially on on 1 March with NASA TV UHD content.

March
Launched exclusive 4K original content of Love Nature on 4K-SAT, via MCA

May
Premium general entertainment content from 4KUNIVERSE launched on 4K-SAT

More are Coming!

2016 — 2017

February
Trial run 4K-SAT2 at 10-bit/60fps with NASA TV Content.

April
Announced the first UHD live sport event via satellite on AsiaSat 4 with EBU.

May
Broadcasted two UHD live European Finals matches on AsiaSat 4.

AsiaSat UHD Demo with Cyberport HK (23 Jan 2014)

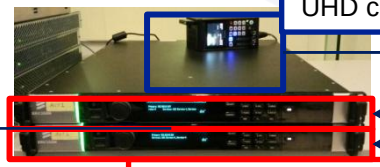
Transmission Parameters
Downlink Frequency: 4100MHz
Downlink Polarisation: V-pol
Symbol Rate: 30MSps
Data Rate: 79.11Mbps
Type: DVB-S2
Modulation: 16APSK
FEC: 2/3

AsiaSat Uplink System

DVB-S2 Modulator

RF *ASI*

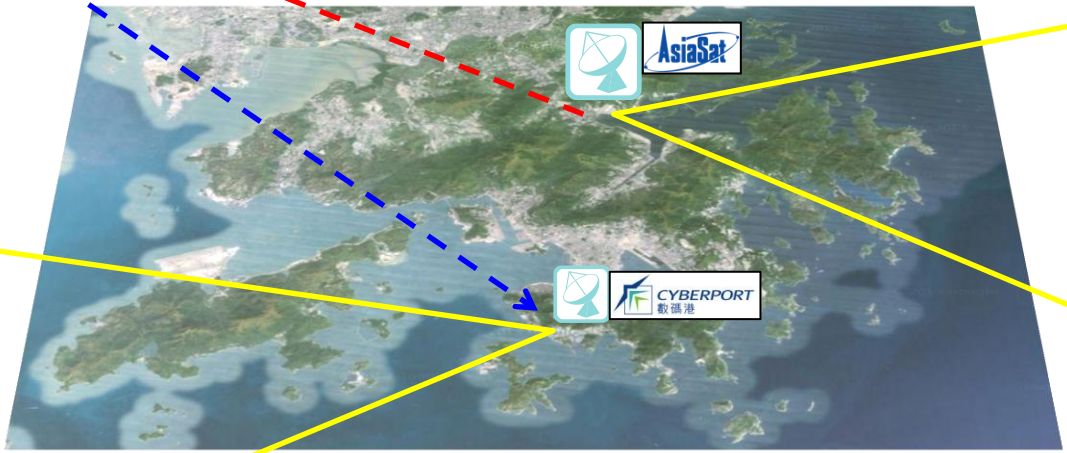
78Mbps MPEG-4 8-bit p30



Playback System
UHD content playout

HD-SDI x4

Encoders x2 (2x2 HD-SDI interfaces)
for compressing the UHD content



RF (L-band)

Cyberport TVRO

Professional IRD x4

Chain Loop

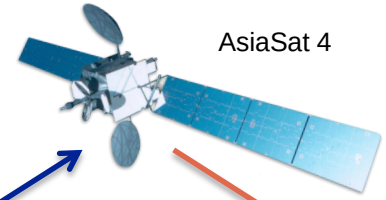
HD-SDI x4

HDMI

HD-SDI to HDMI Convertor

84" UHD TV in Cyberport MCC

HEVC Solution for UHD Broadcast



AsiaSat 4

DVB-S2 Modulator

DVB-S2 HEVC STB

UHD Live Source

HEVC Live Encoder

Multiplexer

UHD Source File

Off-Air Transcoder

Video Server

NAS

FTP	
IP	
RF	
HDMI	
3G-SDI	

AsiaSat

How we see UHD?

Reaching Further, Bringing You Closer

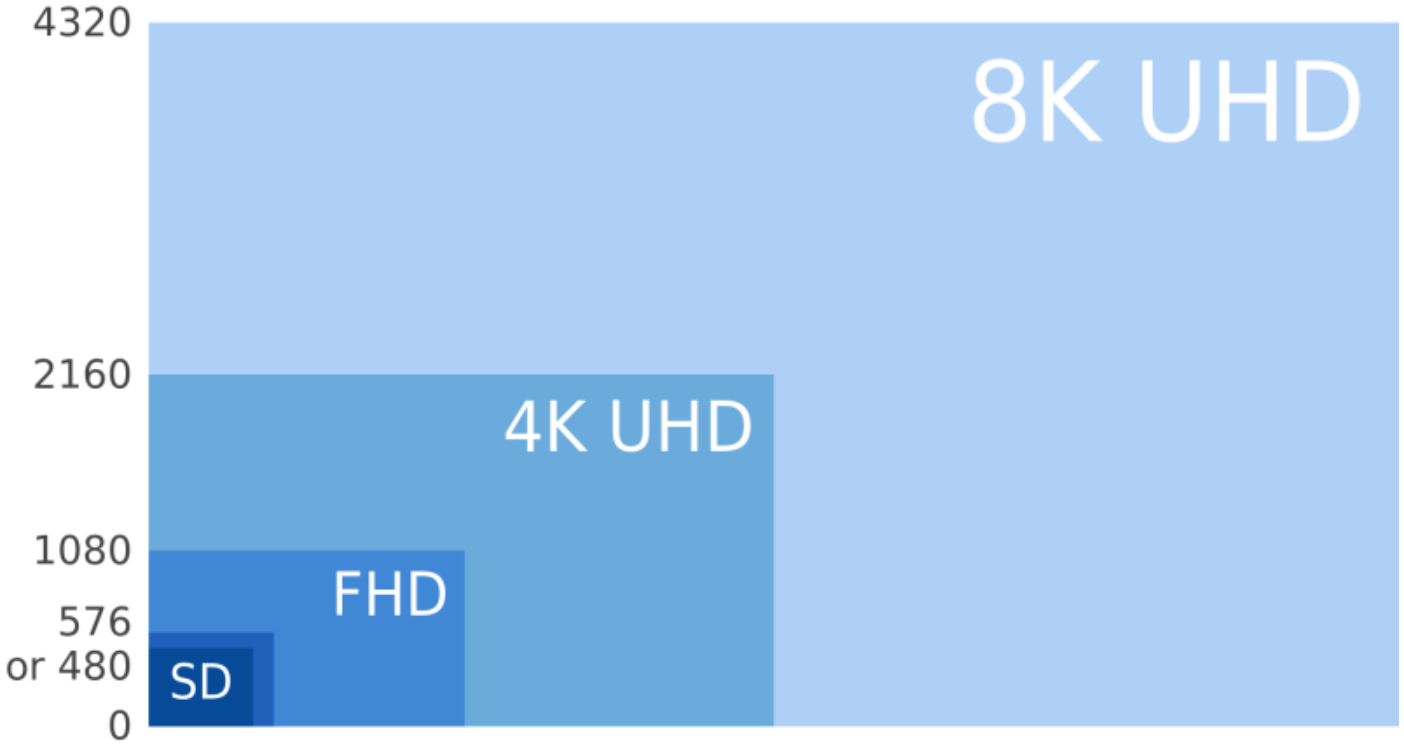
Much Better Viewing Experience / Quality

It is a lot more than just pixels and pictures!

Higher Resolutions

4K/UHD: 3840x2160 (= 4x Full HD screens)

8K/UHD: 7680x 4320 (= 4x 4K/UHD screens or 16x Full HD screens)



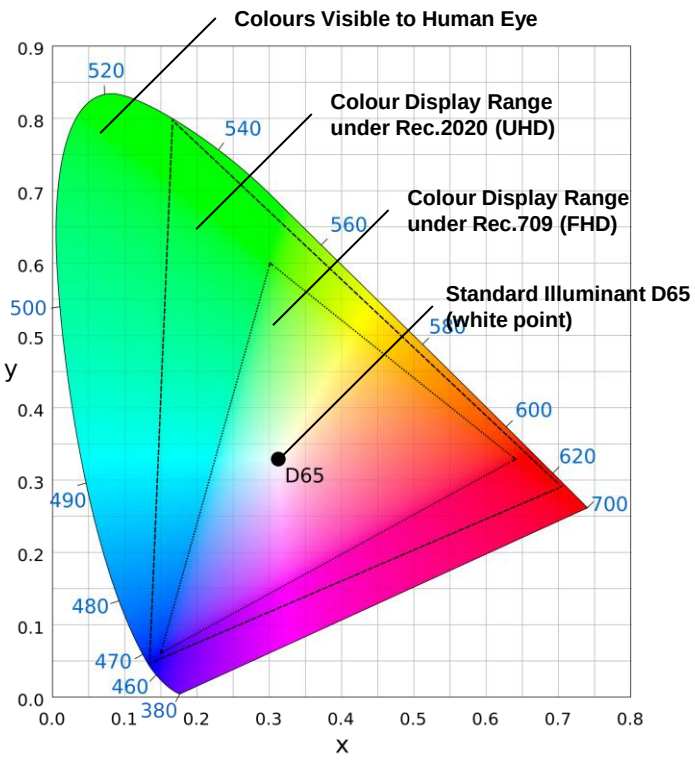
Much Better Viewing Experience / Quality

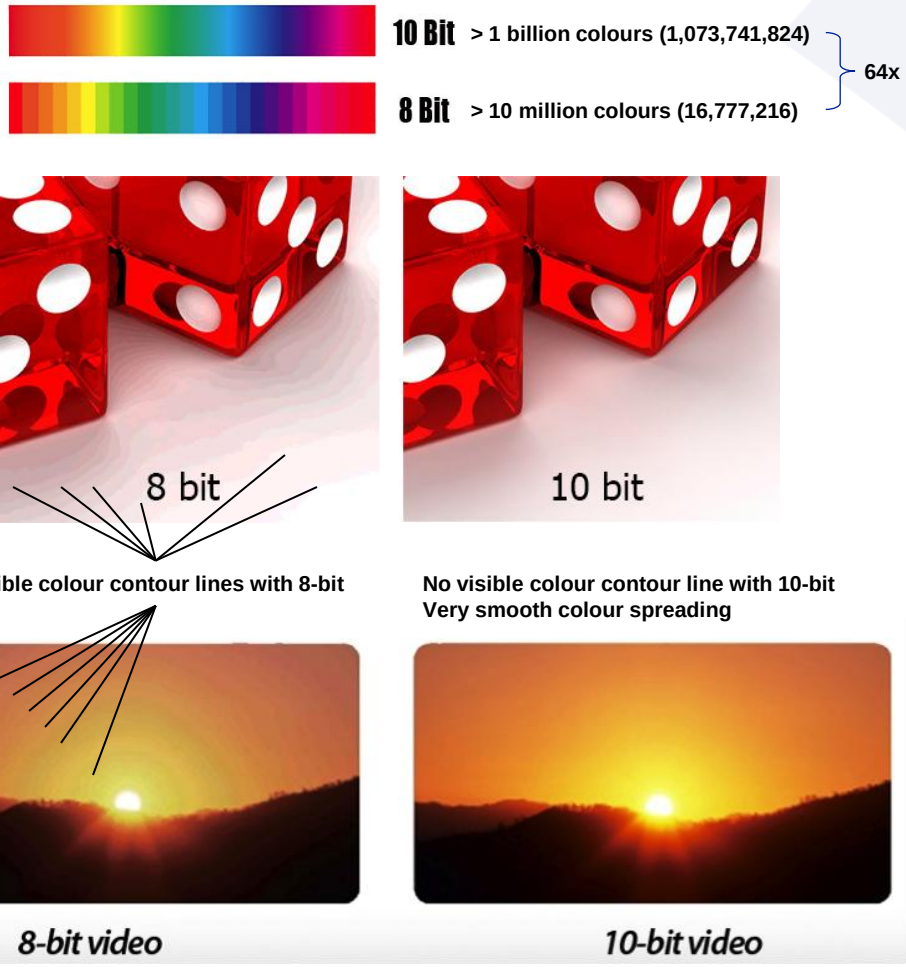
It is a lot more than just pixels and pictures!

Higher Resolutions

Higher Colour Bit Depth

More colours can be seen in UHD video





Much Better Viewing Experience / Quality

It is a lot more than just pixels and pictures!

Higher Resolutions

Higher Colour Bit Depth

Higher Dynamic Range

Video with HDR, not just with still-picture only

Real Bright and Dark can be seen on the same screen

Much Better Viewing Experience / Quality

It is a lot more than just pixels and pictures!

Higher Resolutions

Higher Colour Bit Depth

Higher Dynamic Range

Higher Frame Rate

SD and HD videos are using 25fps or 30fps

UHD videos need to use 50fps or 60fps for smooth video on big screen

100fps and 120fps are the next standard of frame rate for even higher quality video

Much Better Viewing Experience / Quality

It is a lot more than just pixels and pictures!

Higher Resolutions

Higher Colour Bit Depth

Higher Dynamic Range

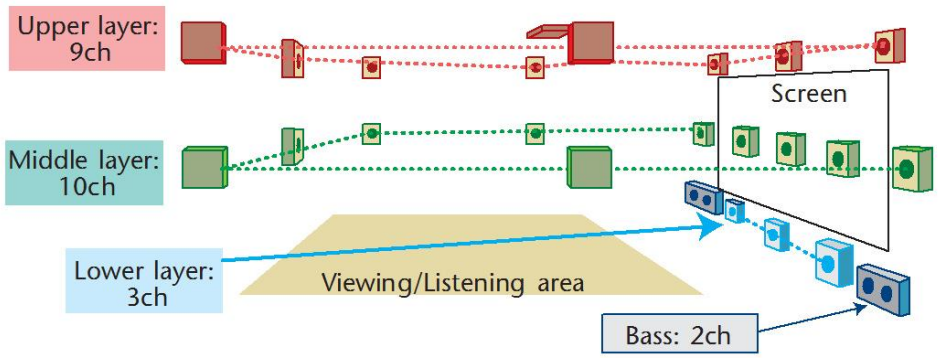
Higher Frame Rate

Significantly Enhanced Audio System

Quality enhanced from Channel-based 5.1 or 7.1 to Object-based 16.2 or 22.2.

Multidimensional sound experience – make you feel like you're truly inside the story, with sound coming from all directions, including overhead.

A sound object can be precisely specified where it should originate and it should move.



Speaker Arrangement for 22.2 Channel Audio System

Much Better Viewing Experience / Quality

It is a lot more than just pixels and pictures!

Higher Resolutions

Higher Colour Bit Depth

Higher Dynamic Range

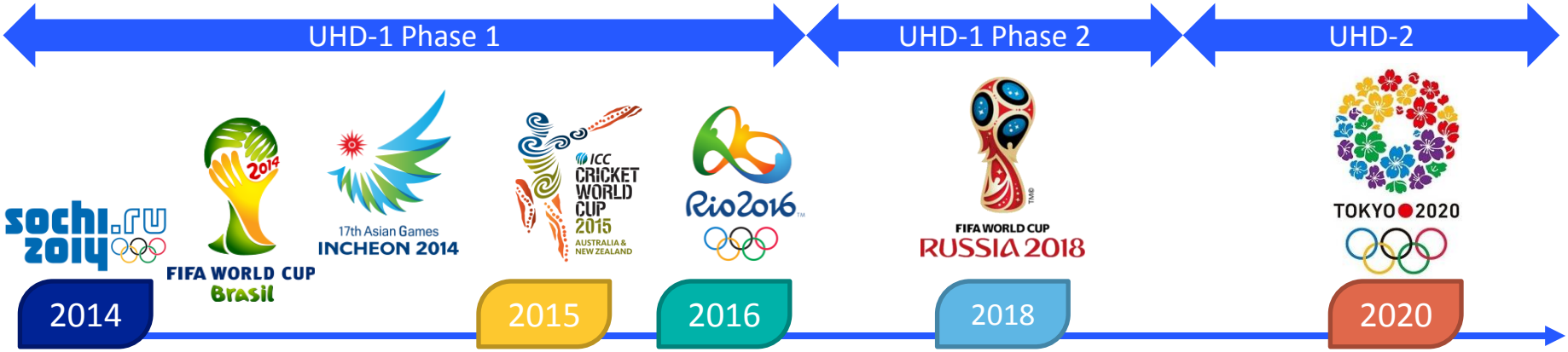
Higher Frame Rate

Significantly Enhanced Audio System

All the above are for **IMMERSIVE EXPERIENCE**

UHD Standards & Roadmap

Category	UHD-1 Phase 1	UHD-1 Phase 2	UHD-2
Deployment	2015	2018	2020
Resolution	3840x2160	3840x2160	7680x4320
Frame Rate	p50 / p60	p100 / p120	p100 / p120
Dynamic Range	HDR preferred	HDR mandatory	HDR mandatory
Colour Space	Rec.709	Rec.709 or Rec.2020	Rec.2020
Colour Sampling	4:2:0 / 4:2:2	4:2:0 / 4:2:2	4:2:0 / 4:2:2 / 4:4:4
Colour Bit Depth	10 bits	10 / 12 bits	10 / 12 / 14 bits
Video Encoding	HEVC Main 10	HEVC Main 10	HEVC Main 10
Audio Format	5.1	Beyond 5.1	Object Based
Audio Codec	Open	TBD	Next Generation Audio Codec
Viewing Angle	66 degrees	66 degrees	100 degrees
Viewing Distance	1.5H	1.5H	0.75H



Requirements for Efficient UHD Satellite Transmission

Higher Satellite Throughput

Satellite Transmission Technology

DVB-S (1993)

DVB-S2 (2003)

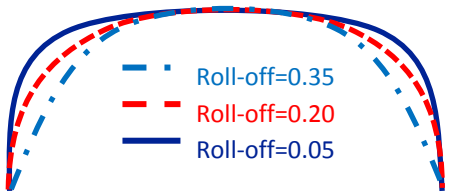
DVB-S2X (2014)

To Utilize the Spectrum Efficiently

Improvement in roll-off

New Enhanced Modulation & Coding Techniques

	DVB-S	DVB-S2	DVB-S2X
Roll-off	35%	20%	5%
Modulation	QPSK	8PSK	16APSK
No. of Bits per Hz	2	3	4
Expected Throughput Improvement	-	Min. 30%-40%	Min. 30%-40%



Advanced Compression Technology

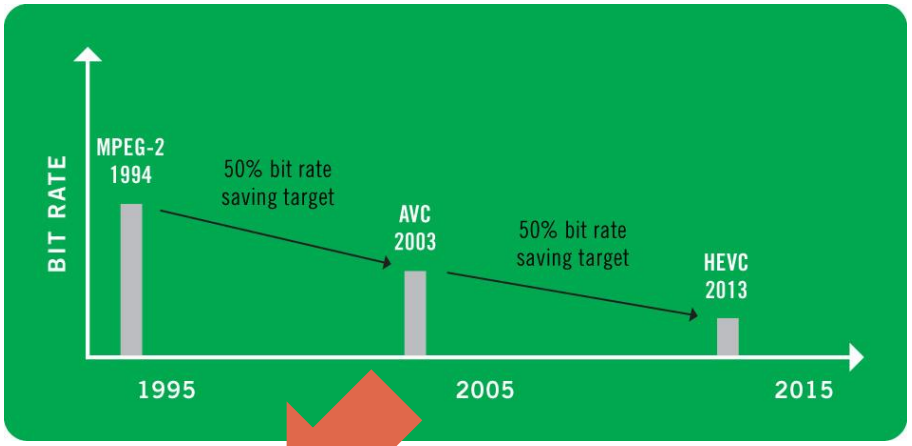
Compression Technology

H.262 / MPEG-2 (1994)

H.264 / MPEG-4 AVC (2003)

H.265 / HEVC (2013)

Save the Bit Rate of a channel



More Bits per Hertz !
More Channels per Transponder !

Number of Channels per Transponder

Estimated Bit Rate (Mbps) [1]	Compression	SD (p25/p30)	HD (p25/p30)	UHD (p50/p60)
	H.262 / MPEG-2	3 – 5	-	-
	H.264 / MPEG-4 AVC	2 – 3	8 – 10	75 – 85
	H.265 / HEVC	-	4 – 5	15 – 25

Satellite Transmission [2]	Carrier Data Rate	Target TVRO Size [3]	SD (p25/p30)	HD (p25/p30)	UHD (p50/p60)
DVB-S QPSK FEC 3/4	38Mbps	2.4m+	7 – 12 channels in **MPEG-2**	4 – 5 channels in **MPEG-4**	-
DVB-S2 8PSK FEC 5/6	72Mbps	2.4m+	24+ channels in **MPEG-4**	7 – 9 channels in **MPEG-4** 14 – 18 channels in **HEVC**	2 – 5 channels in **HEVC**
DVB-S2 16APSK FEC 2/3	79Mbps	3m+	-	7 – 9 channels in **MPEG-4** 15 – 19 channels in **HEVC**	1 channel in **MPEG-4** 3 – 5 channels in **HEVC**
DVB-S2X 16APSK FEC 114/180	83Mbps	3m+	-	8 – 10 channels in **MPEG-4** 16 – 20 channels in **HEVC**	1 channel in **MPEG-4** 3 – 5 channels in **HEVC**
DVB-S2X 16APSK FEC 135/180	99Mbps	4m+	-	9 – 12 channels in **MPEG-4** 19 – 24 channels in **HEVC**	1 channel in **MPEG-4** 3 – 6 channels in **HEVC**

Assumptions:

1. Estimated Bit Rate range is for reference only.
2. Symbol Rate: 27.5MSps (DVB-S, 35% roll off); 30.0MSps (DVB-S2, 20% roll off); 34.285MSps (DVB-S2X, 5% roll off)
3. TVRO size at beam centre region in C-band.

UHD Challenges

UHD Standards => high throughput requirement!

- Much more details (High Resolution & High Colour Space)
- Much better viewing experience (High Frame Rate & High DR)

Cost of making the UHD content, expensive!

- Limited UHD studios available
- UHD recording equipment, most are up to 30fps only
- Editing at 50fps or 60fps takes a long time

Evolution of SDI

- UHD-SDI, Electrical or Optical Physical Layer?

UHD storage file format is to be finalized with HEVC enable

- The industry has not yet fixed the UHD source file format
- Aim at reducing storage size
- Existing formats are all in MPEG-4 compression
  - Apple ProRes 50mins UHD 60fps clip need 700GB storage! (14GB/min)

Spectrum/Bandwidth limited in Terrestrial / Satellite

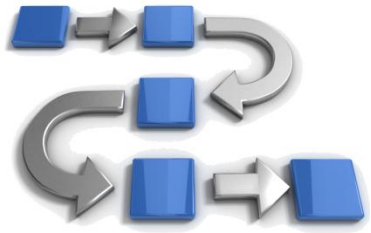
- Occupied by mobile applications

End to End UHD

What needs to be upgraded besides the TV set?

Studio Interconnection Standards

- HD p50 needs 3Gbps
- 3G-SDI cable support up to 3Gbps
- UHD 1 p60 needs 10.5 Gbps,
- 4x 3G-SDI for UHD 1 at p60
- UHD 2 will need multiple 10 Gbps or over 100 Gbps
- Change of Physical Layer for UHD?
  - Electrical (Coaxial or Ethernet) **or**
  - Optical (Multimode Fibre)



Transitional workflows

- UHD & 4K production formats (ProRes, DPX, XAVC, etc.).
- Needs to support existing HD and UHD post production workflows and conversion.
- UHD Recording equipment

Domestic interconnection standards

- HDMI (ver. 1.4) => 4K p30
- HDMI (ver. 2.0) => UHD-1 p60

Studio

Compression Codec

Broadcast standards

Spectrum

Domestic

Workflows

HEVC

High Effecieny Video Coding

Video and Audio Codec Development

- The higher bitrate of UHD TV development needs increased performance from Codecs and compression algorithms

DVB S2

DVB S2X

Broadcast standards

- UHD for Satellite, Cable, Terrestrial transmission and Internet connections.

Spectrum

- Spectrum is limited in Terrestrial / Satellite

AsiaSat

AsiaSat UHD Platform

Reaching Further, Bringing You Closer

AsiaSat UHD Platform

Satellite
- AsiaSat 4 @122 E

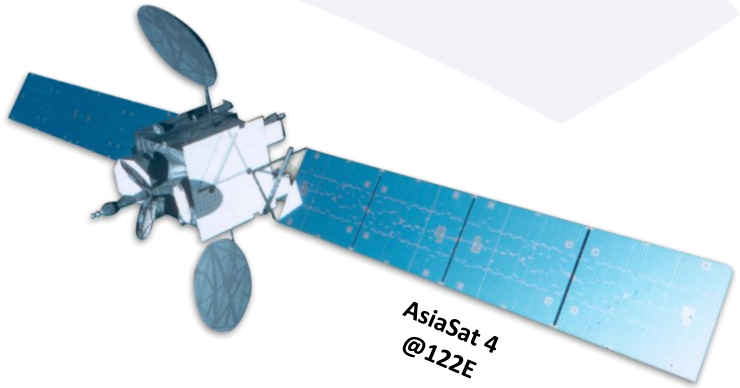
Transponder
- A4-C13H

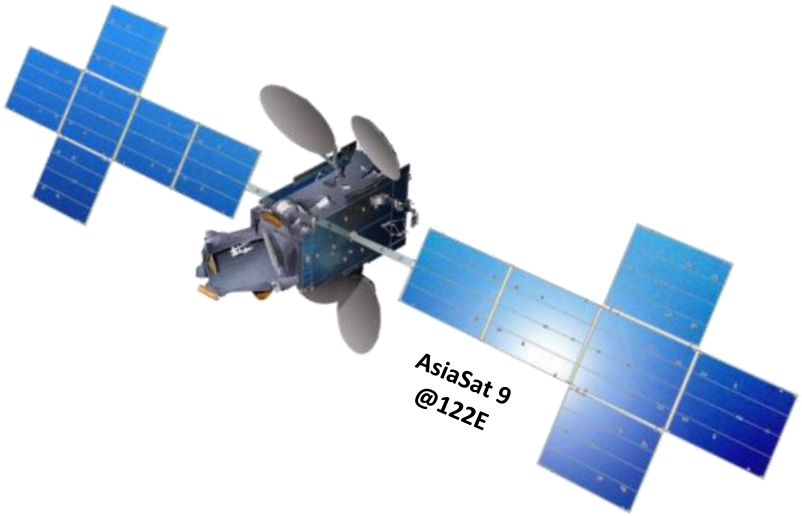
Downlink Frequency
- 4120MHz

Downlink Polarization
- Horizontal

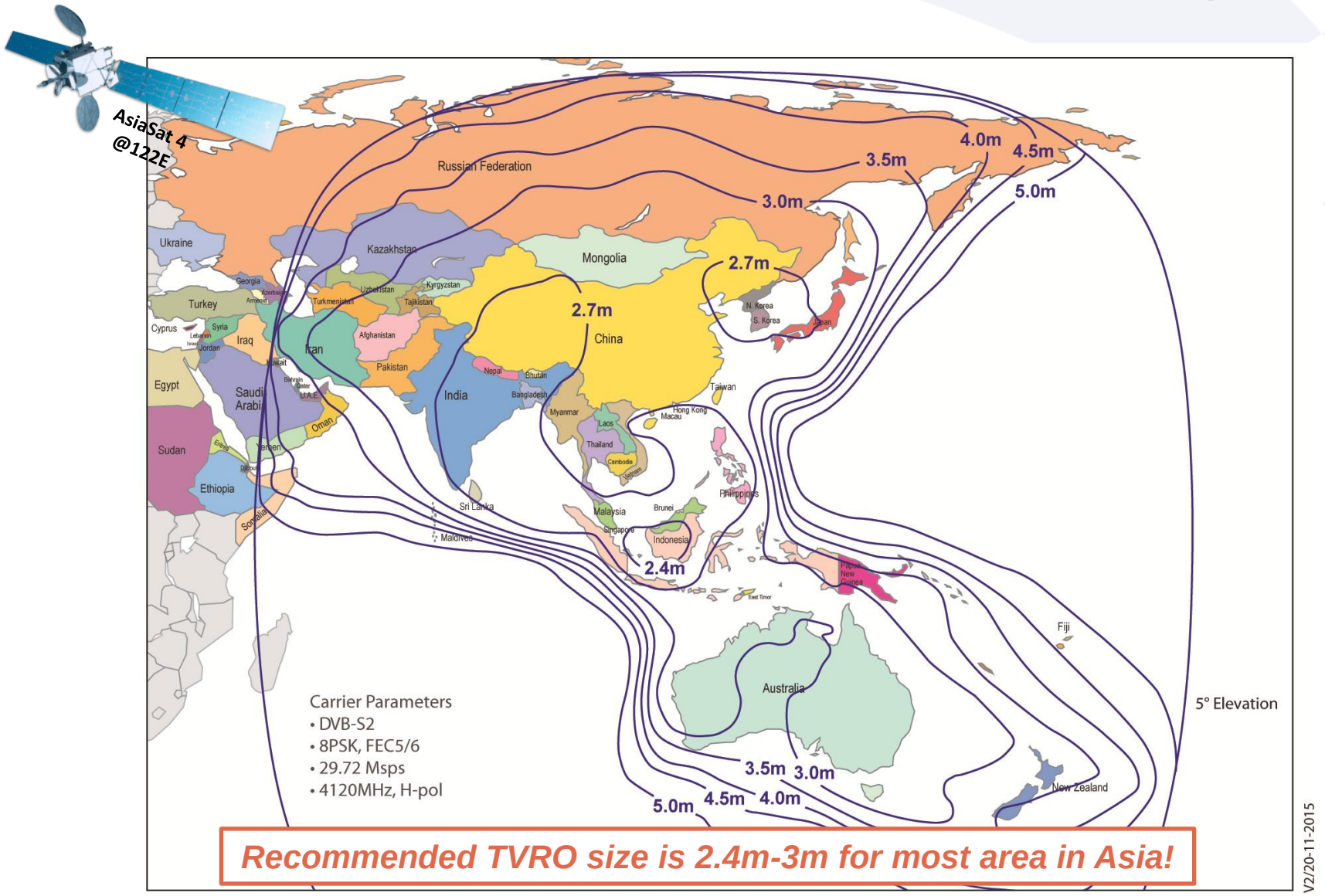
Carrier Parameters
- DVB-S2
- 8PSK, FEC 5/6
- 29.72MSps

Max. Throughput
- 71.99Mbps





A4-C13H DVB-S2 MCPC Platform TVRO Map



Recommended TVRO size is 2.4m-3m for most area in Asia!

AsiaSat

Next Step

Reaching Further, Bringing You Closer

Next Step

AsiaSat is the advocate for UHD broadcasting.

- For our UHD lab details, please visit http://www.asiasat.com/technology/UHDlab

Standardize the HDR solution

- camera > studio > compression > TV set

Standardize the workflow of producing UHD content

- Physical infrastructure, file format/container, etc.

More high quality UHD content is required, especially live sports

AsiaSat

Reaching Further, Bringing You Closer

Thank You

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www.asiasat.com