BEAM HOPPING
Maturing the Technology

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Director of System Engineering

Content

- SatixFy – Background
- Modern Satellite systems and Beam Hopping
- Beam Hopping principles and advantages
- Is Beam Hopping a mature technology?
- The new DVB-S2X Annex E Waveforms for Beam Hopping
- R&S Features supporting Beam Hopping

SatixFy

United States
Hellertown, PA
Analog IP center

United Kingdom
Farnborough **ESMA design center**
Manchester **Rad-Hard design center**

Bulgaria
Sofia
Antenna systems design center

Israel
Rehovot
Manof
Modem design centers

Global Activity

220
Employees

60
VLSI engineers

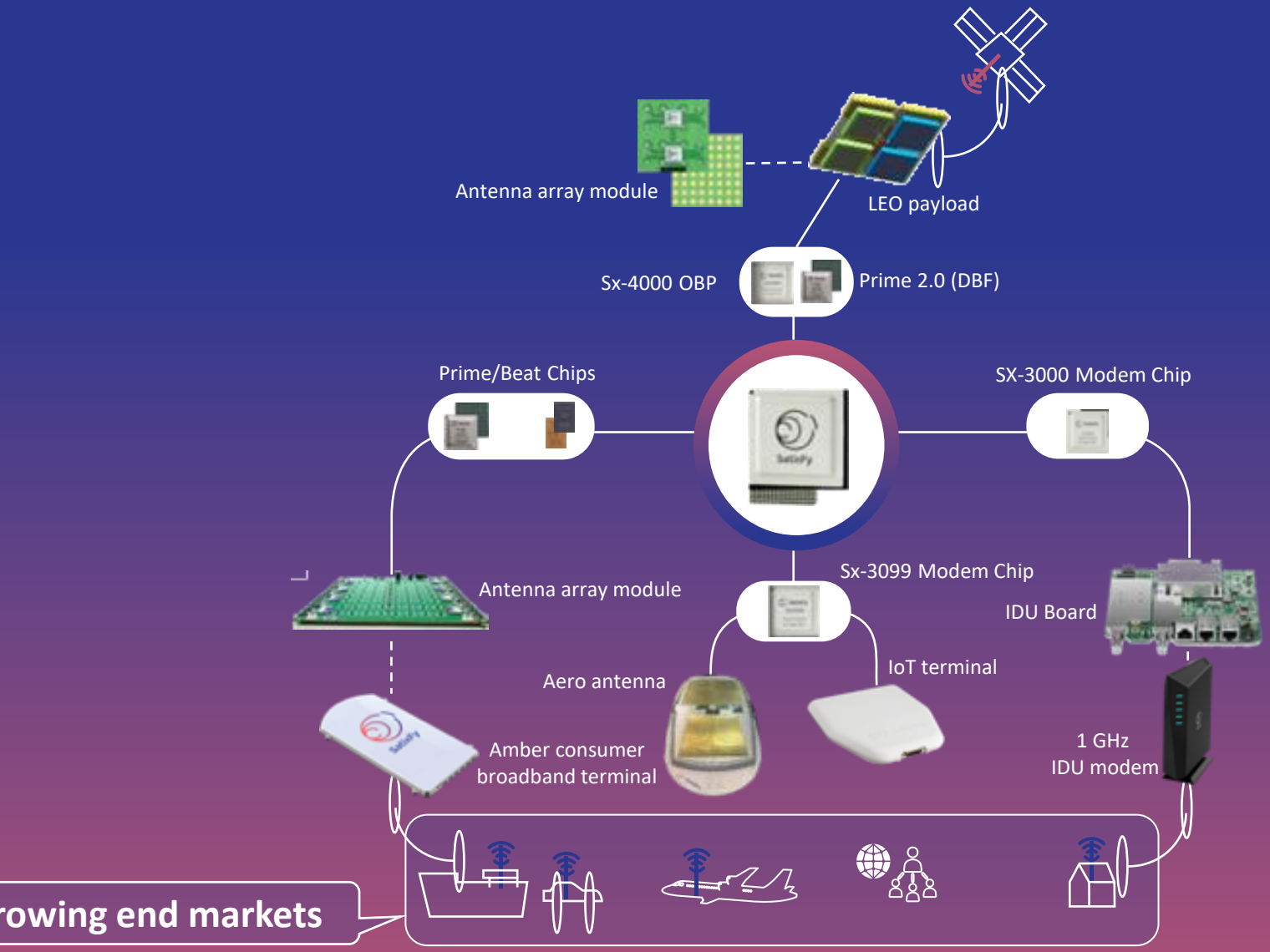
60
Hardware & software engineers

40
Product & antennas engineers

20
Algorithms & system

SatixFy – Who We Are

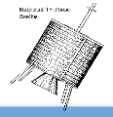
- The only **vertically integrated semiconductor chip** company providing **products** across entire SatCom value chain
- SatixFy designs its chips, builds its products, codes its software and designs end-to-end systems that use its technologies
- Satixfy's modems are **standard based**
- Revenue stage company with significant customers and growth rate



Rapidly growing end markets

SATCOM Evolution

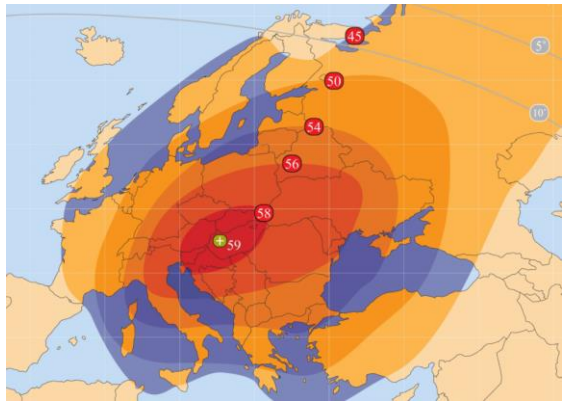
THEN

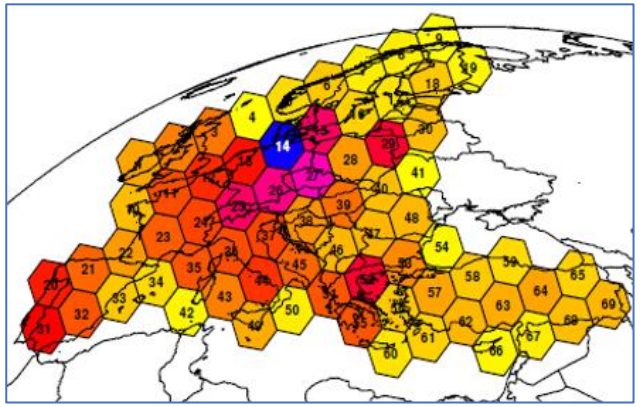


NOW

FUTURE

GEO- Wide Beams → **GEO HTS: Spot Beams** → **LEO Constellations**

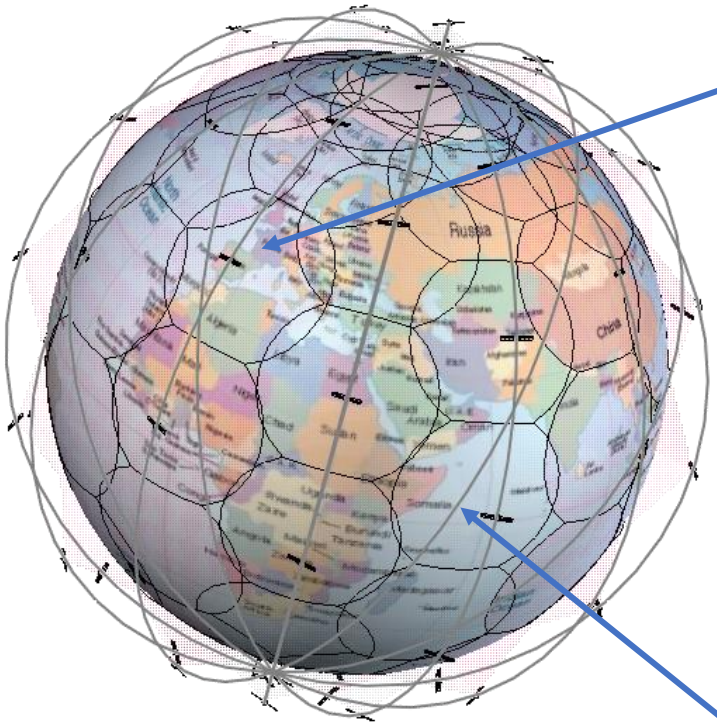




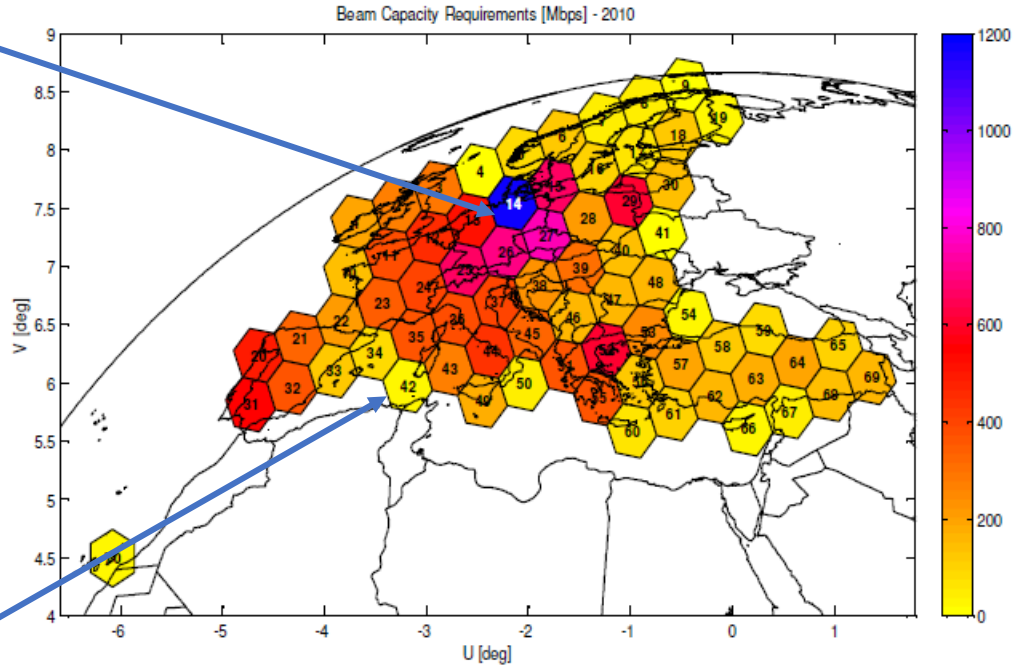
Maximize Spectrum Usage – More Mbps / MHz / W

Reduce latency, global coverage

Demand Variability Problem



High Demand



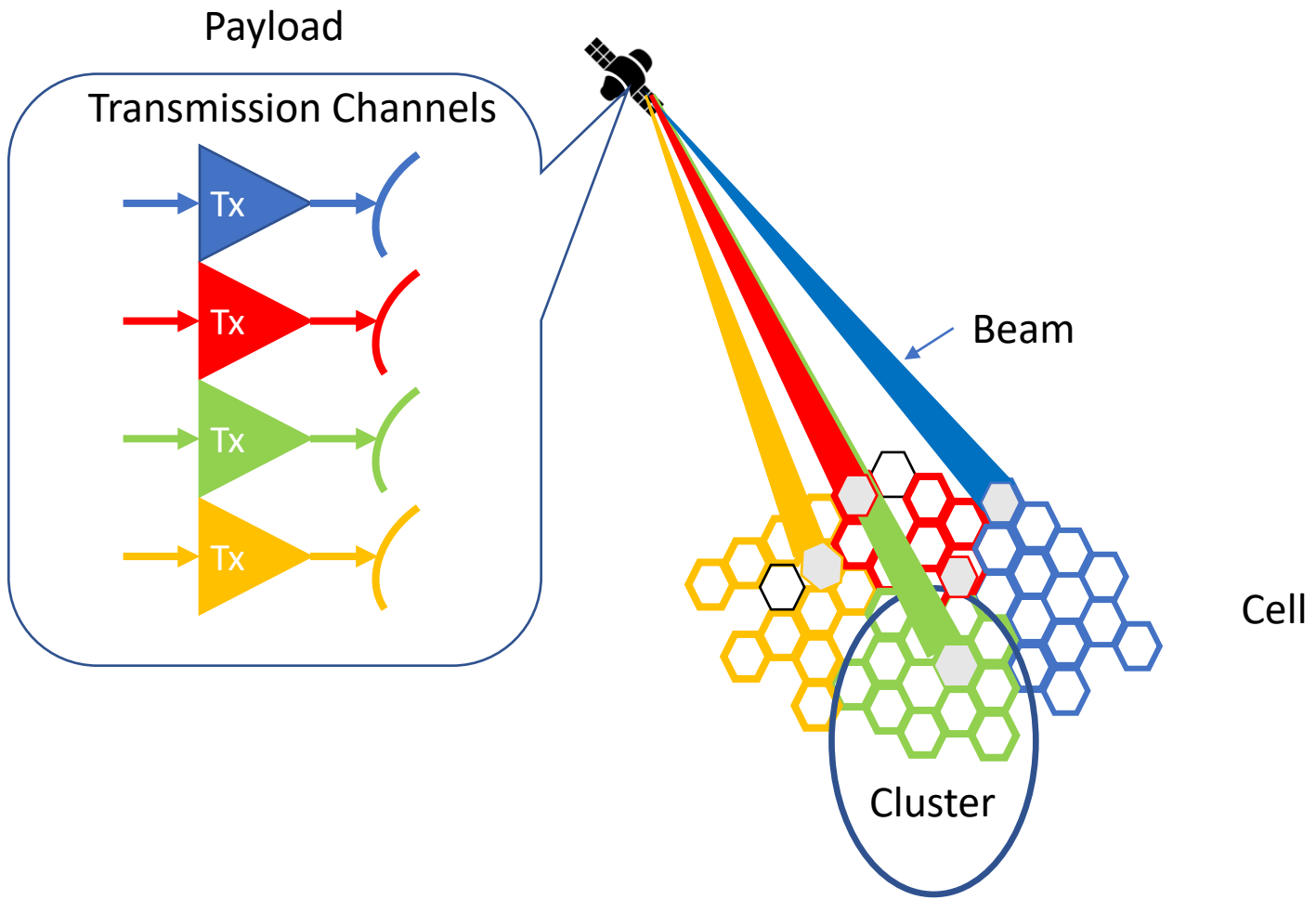
Low Demand

Problem: How to adapt the satellite resources to the demand in **place** and **time**

Dynamically

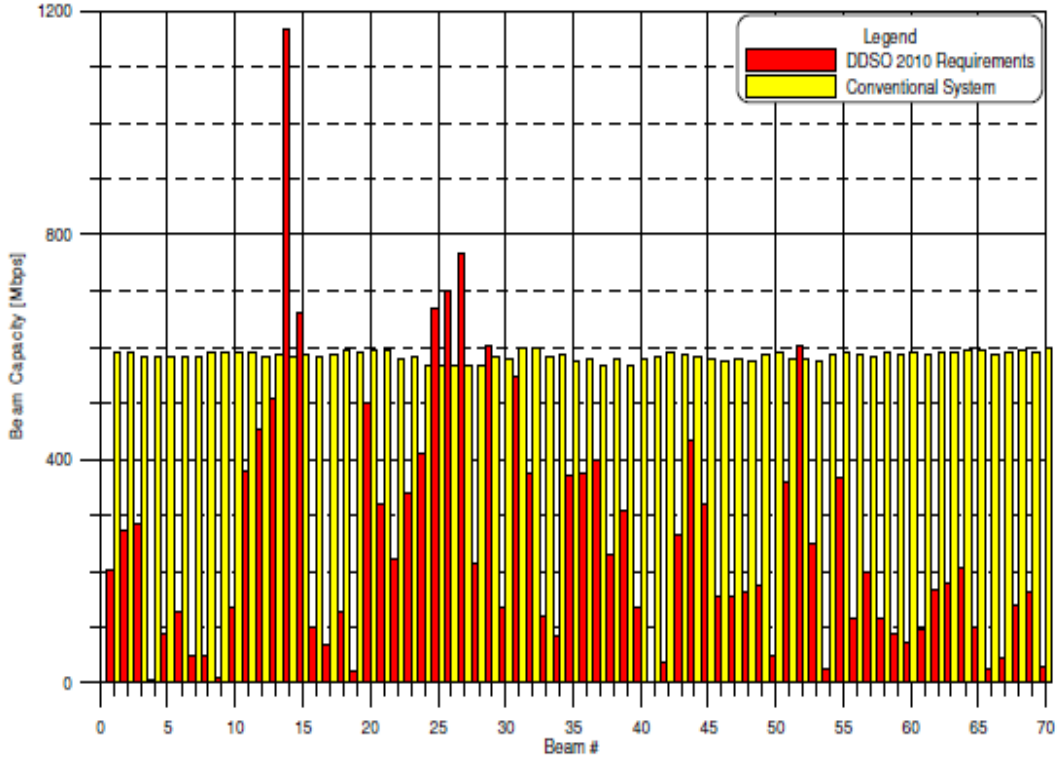
Solution: Beam Hopping

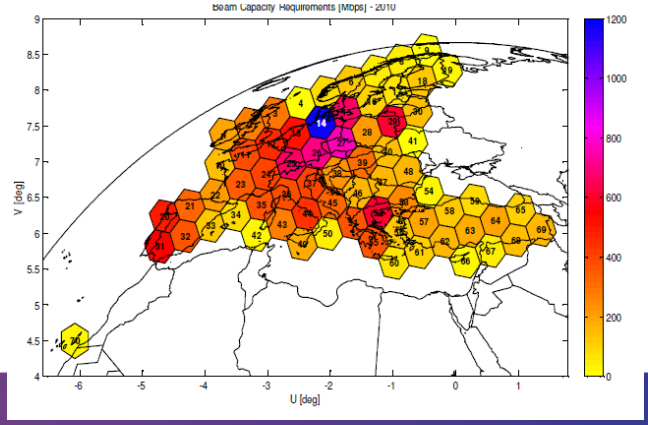
- **Beam Hopping** enables flexible allocation of satellite resources according to demand



Beam Hopping Advantages

- Beam Hopping provides best flexibility in allocating capacity to the beams with high traffic demand
  - Increased aggregate capacity by +15%
  - Reduction of the unmet and excess capacity by 20%
  - **Lower DC power consumption >50%**





ETSI TR 102 376-2 V1.2.1 (2020-01): Implementation guidelines for the second-generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 2: S2 Extensions (DVB-S2X). February 2020.

Is the Technology Mature ?

- Do we already have beam-hopping satellites in place?

- Can we expect wide deployments of beam-hopping systems in the future?

Market Approach Models

- Design, manufacturing, integration
  - System
  - Satellites
  - Satcom payload
  - Gateways
  - Terminals
- Licensing
- Launches
- Marketing
- System O&M
- Provision of service

Vertical

One company does it all

- *Tight Integration*
- *Optimized Solution*
- *Reduction of supply chains*
- *Close customer management*

Proprietary Solution

Open

Mutual Effort

- *Best of breed*
- *Multi-source*
- *Competition*
- *Various business models*

ECO-SYSTEM

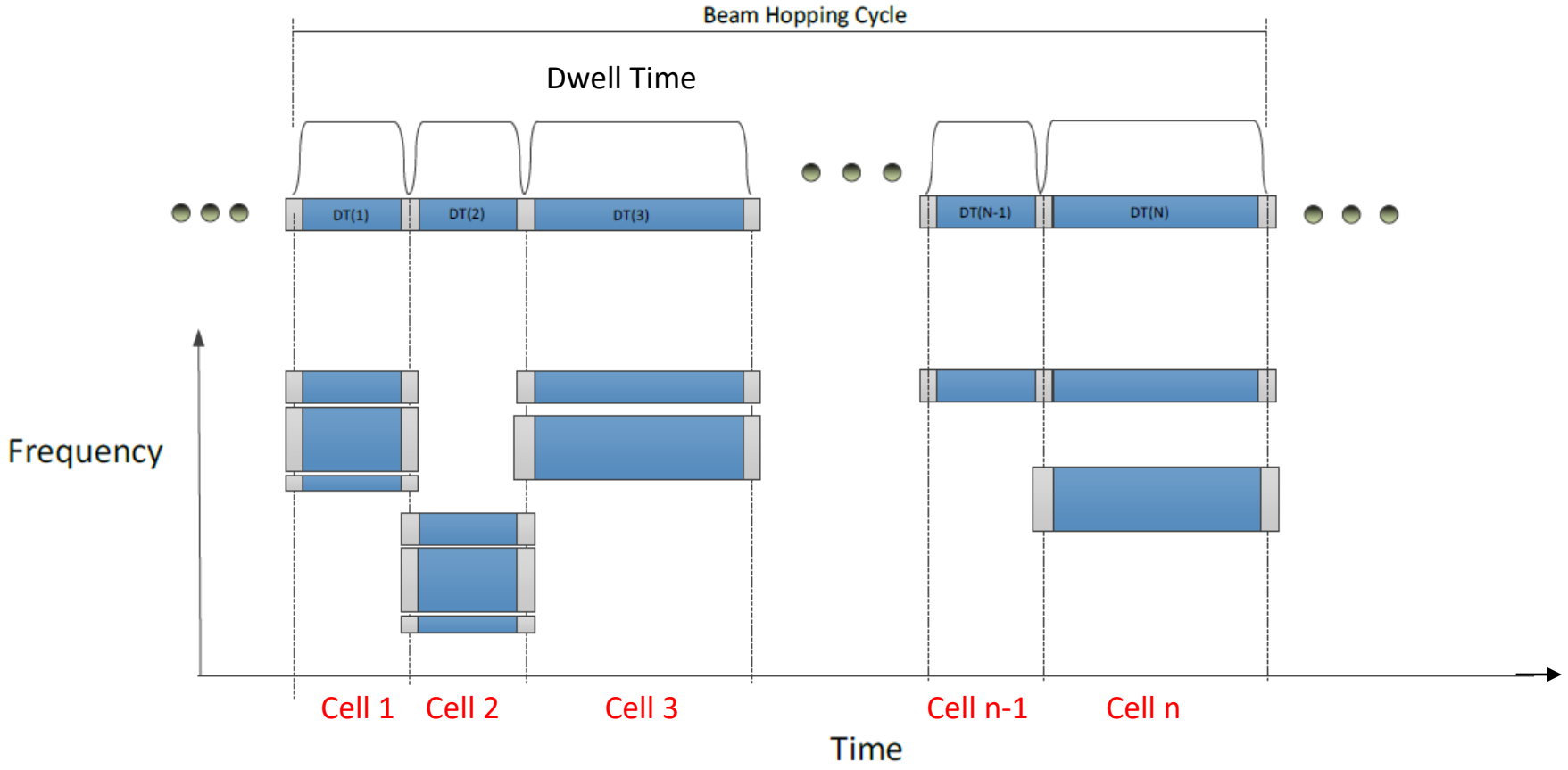
STANDARDS

STANDARDS

Common air interface

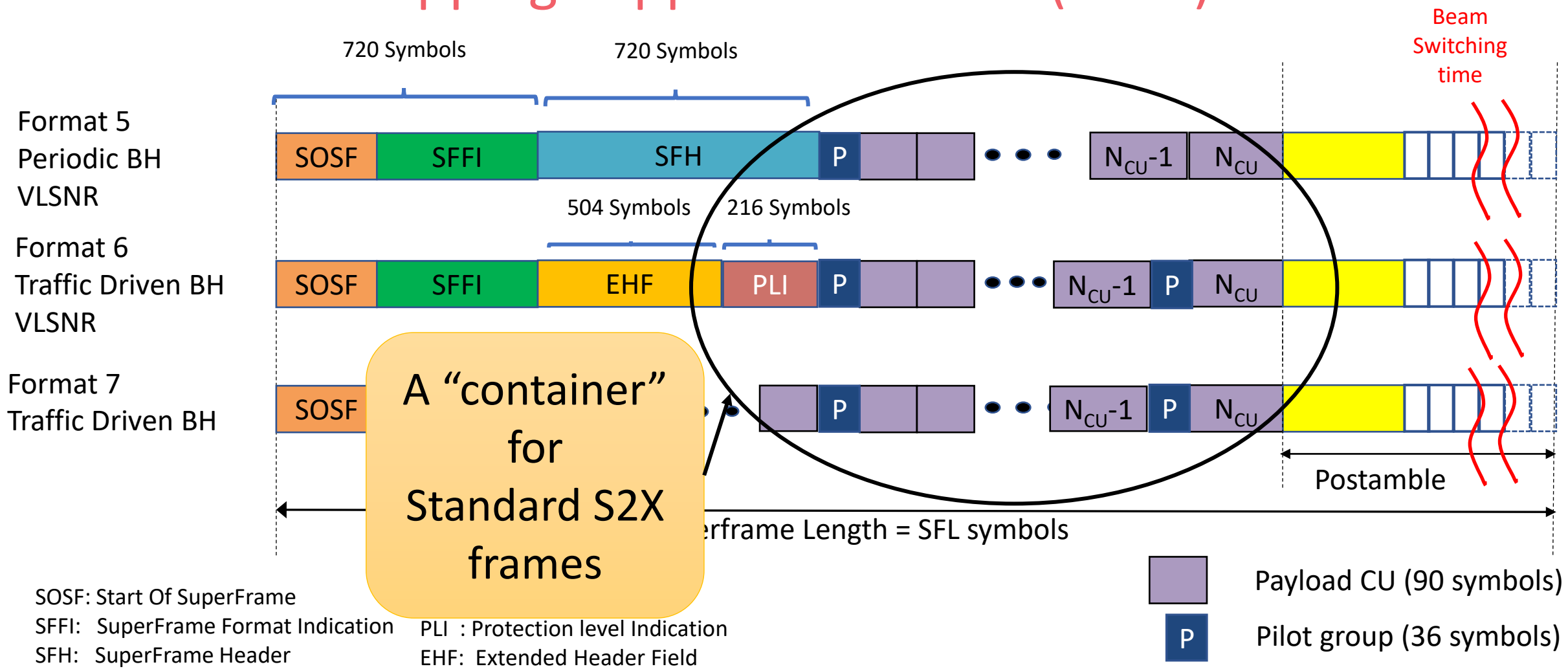
The Beam Hopping Signal

- A Cycle
  - Dwells
    - Carriers



A. Morello, N. Alagha: DVB-S2X Air Interface Supporting Beam Hopping Systems *25th Ka and Broadband Communications Conference,* (Ka-2019), Sorrento, Italy, Oct. 2019

DVB-S2X Waveforms for Beam Hopping Support – Annex E (2019)



SOSF: Start Of SuperFrame
SFFI: SuperFrame Format Indication
SFH: SuperFrame Header

PLI : Protection level Indication
EHF: Extended Header Field

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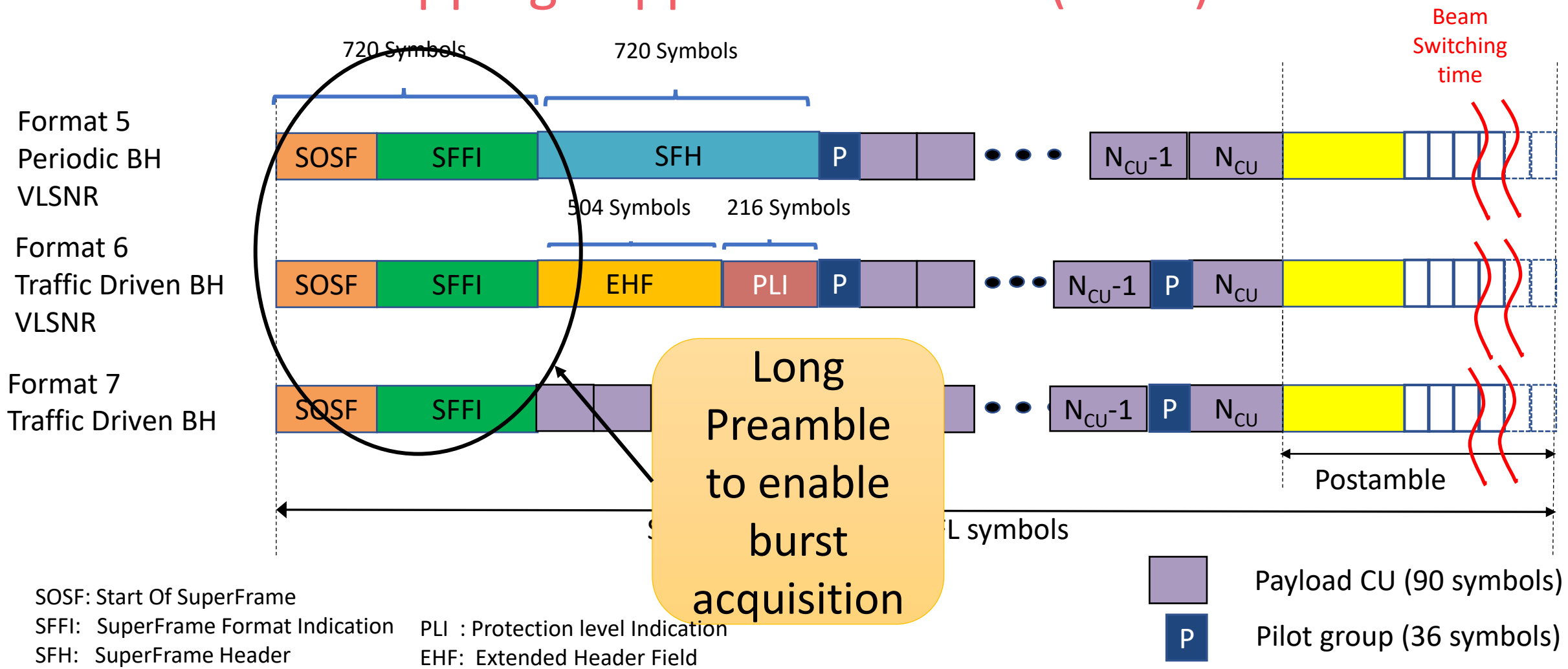

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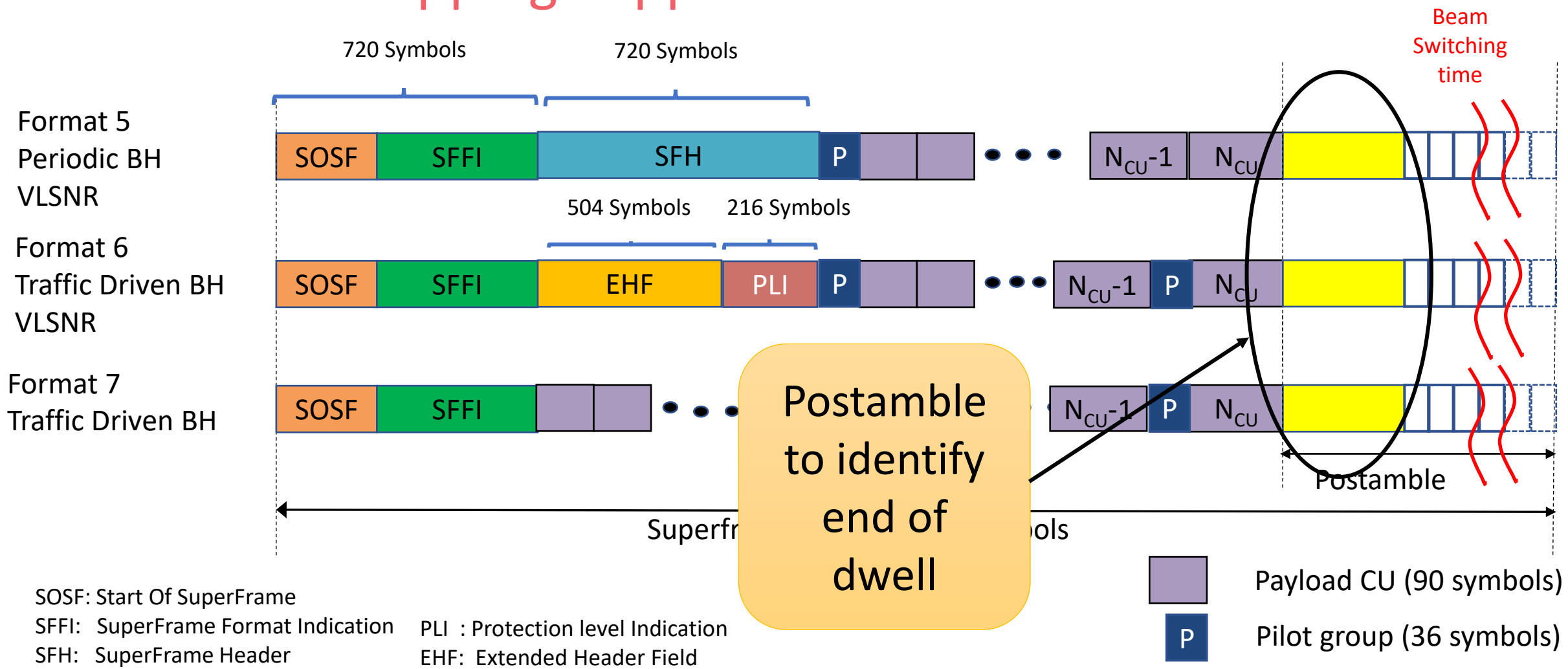

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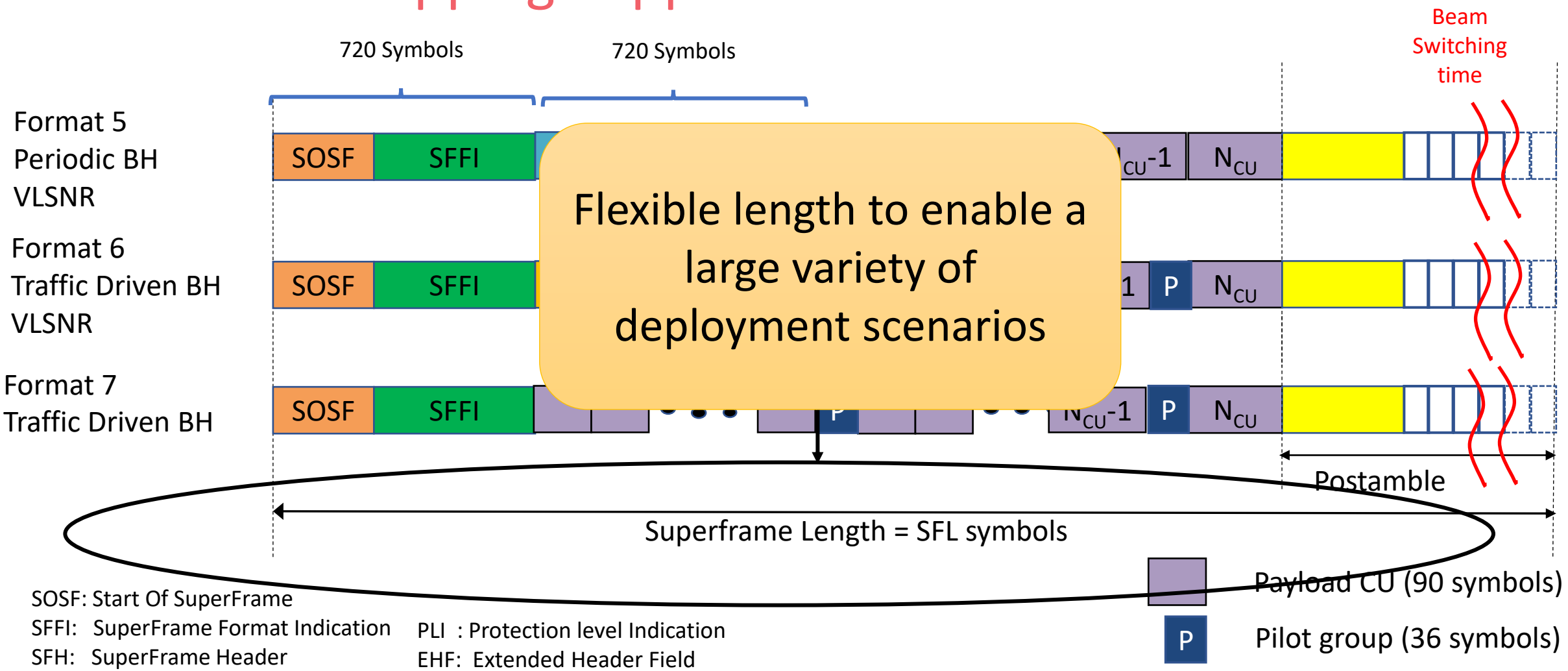

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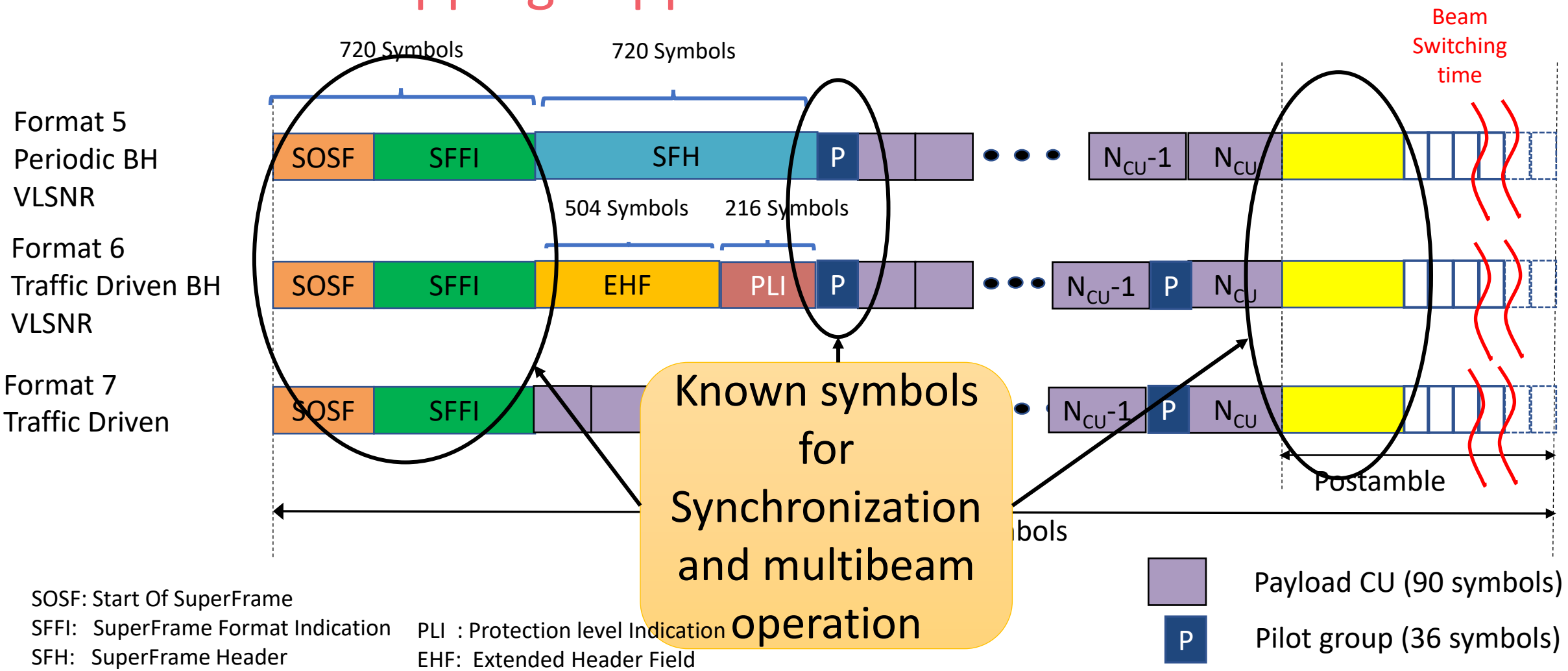

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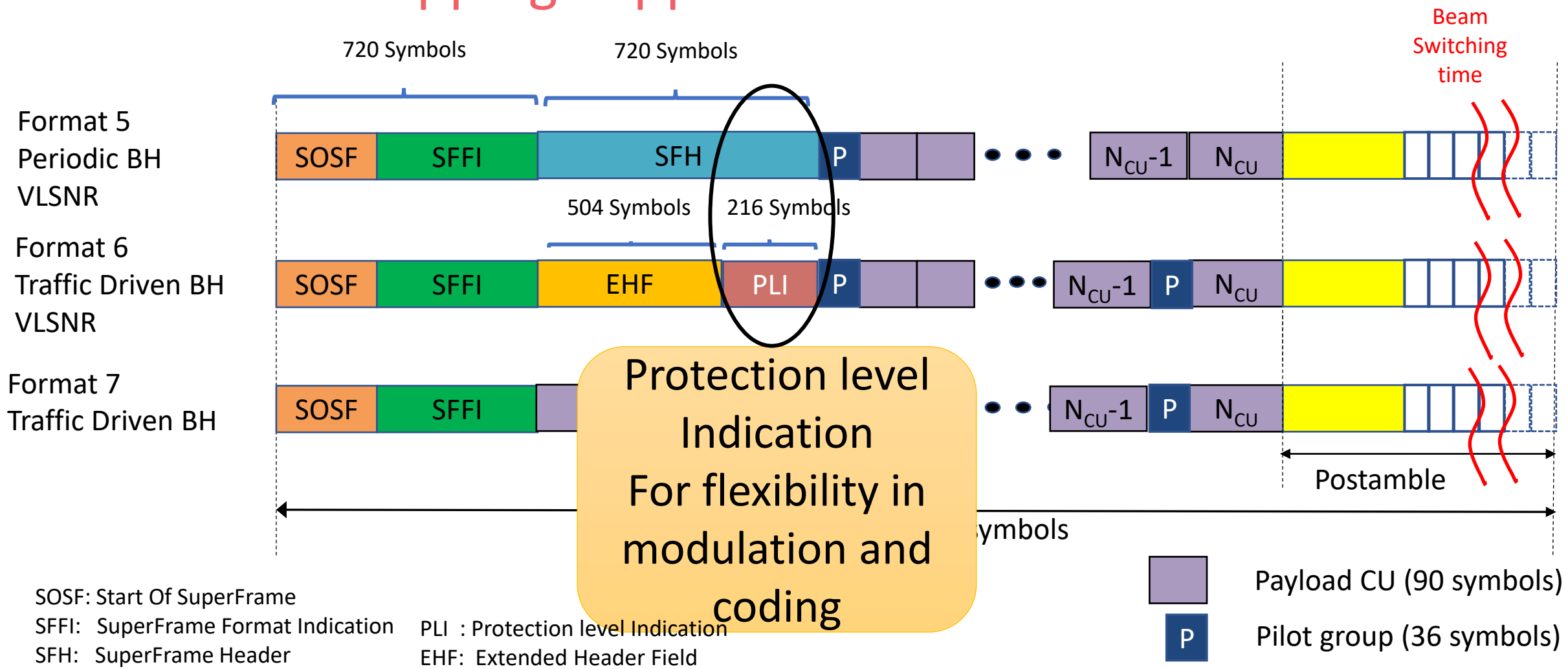

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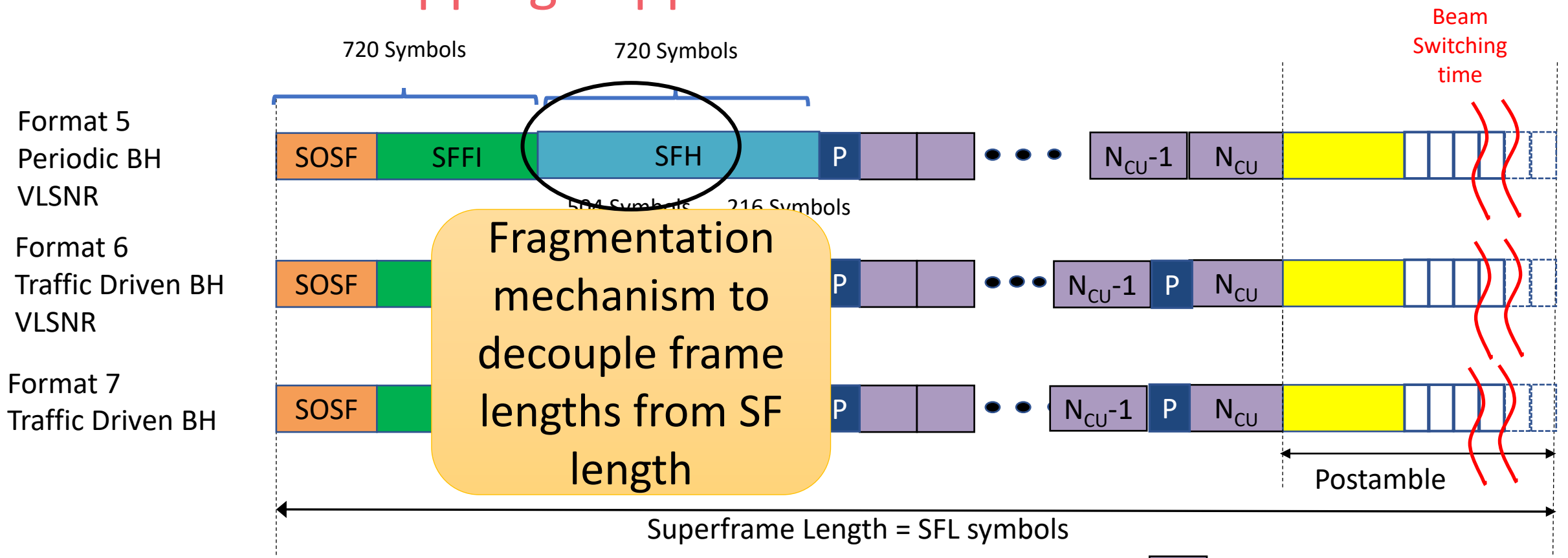

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ECO SYSTEM

TELESAT LIGHTSPEED™

Next-generation technologies provide unique benefits to users:

HYBRID ORBITS:

Satellites fly in an industry-first combination of polar and inclined orbits, resulting in complete global coverage, including polar areas, with higher capacity where most of the world's population lives

PHASED ARRAY ANTENNAS:

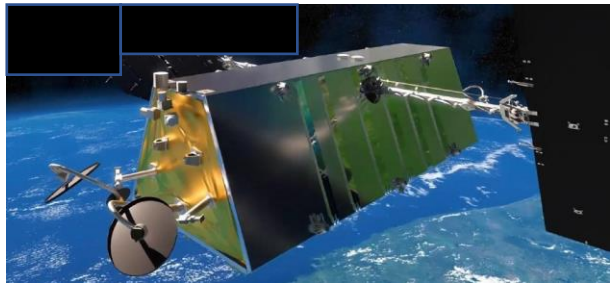
Sophisticated antennas on each satellite with hopping beams scan the earth to provide full coverage and can dynamically focus capacity precisely where users require it

DATA PROCESSING IN SPACE:

Full digital modulation, demodulation, and data routing occurs in space, resulting in higher capacity and flexibility

OPTICAL INTER-SATELLITE LINKS:

Data can travel at the speed of light from one satellite to another, resulting in a fully interconnected global mesh network that allows customers to access the Telesat Lightspeed Network no matter where they are

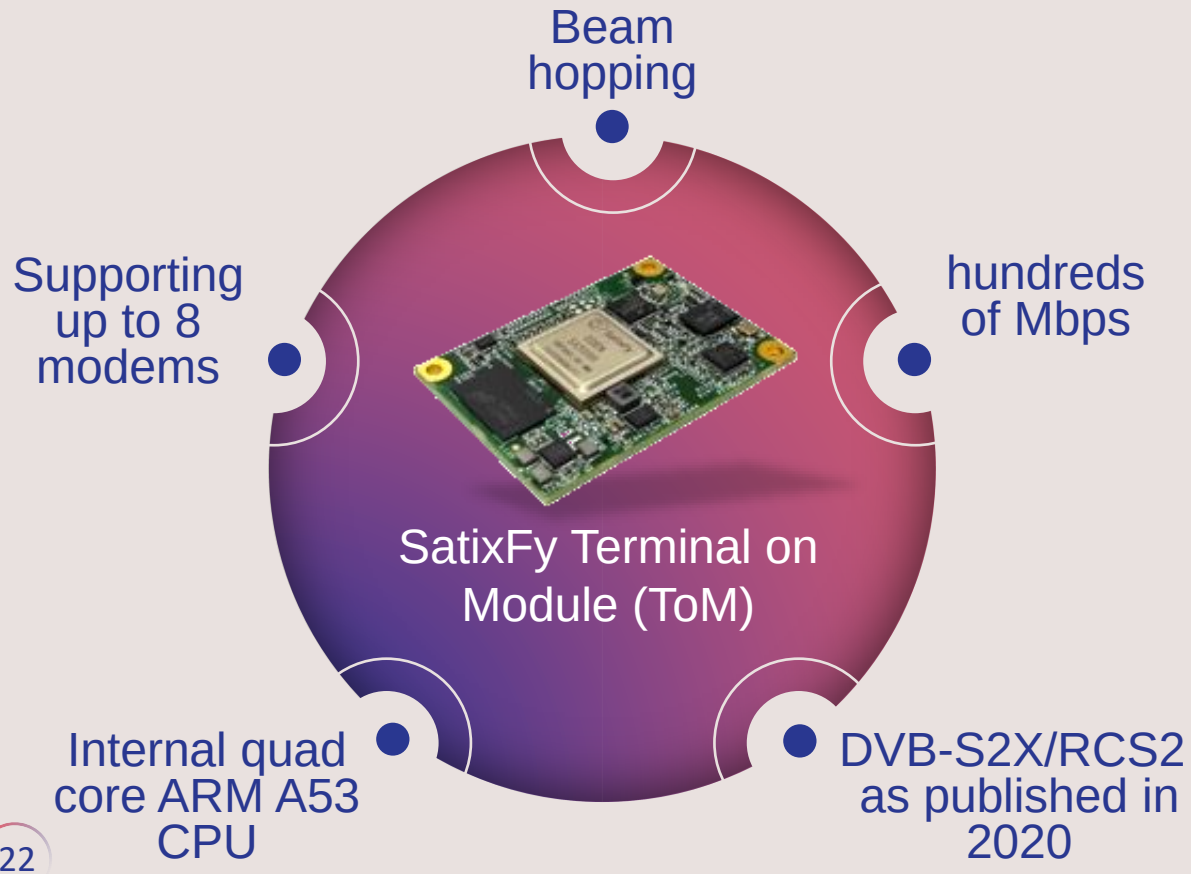


SatixFy to Develop Ground Infrastructure for Telesat

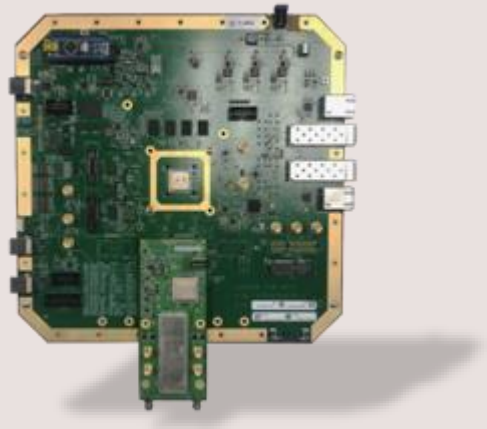
Landing Stations and User Terminal Modems

Incorporating SatixFy's Sx3099 Chip for the Telesat Lightspeed LEO Constellation

- The only chip that supports 1 GHz bandwidth



SatixFy's Sx3099 Evaluation Board



- SatixFy provides Telesat with Sx3099 evaluation boards for performance testing throughput and data processing capabilities

SatixFy's ToM carrier board

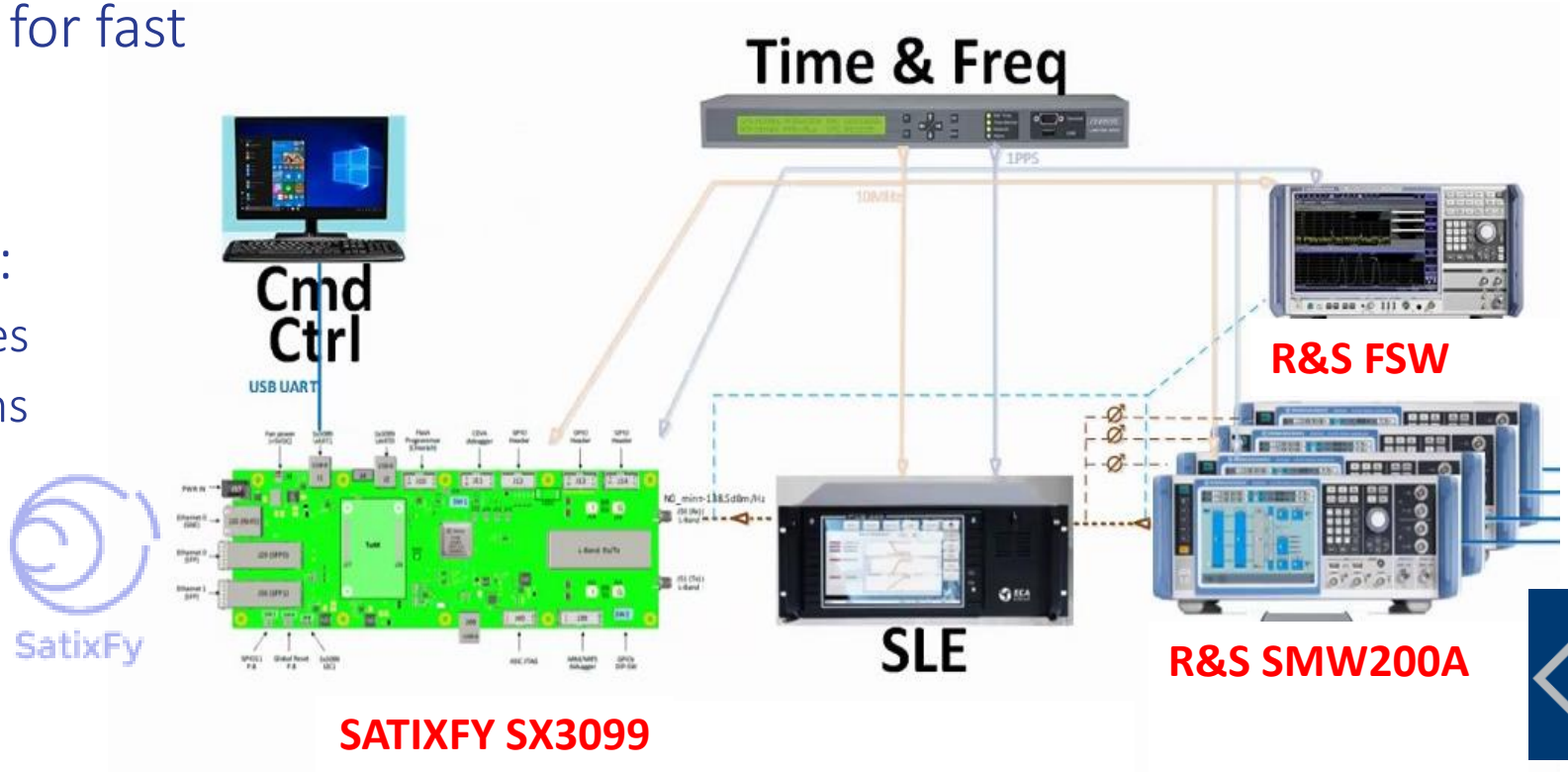
- SatixFy provides multiple ToMs with dedicated carrier boards for the performance assessment of both Landing Station and User Terminal modems

Landing Station hardware

- SatixFy delivers initial prototypes of Landing Station modems, based on its ToM carrier boards, for integration with Lightspeed antennas and data processing equipment

Test Instruments

- Common test setups for fast integration
- R&S (with Satixfy) develops support for:
  - DVB-S2X Superframes
  - DVB-RCS2 Waveforms



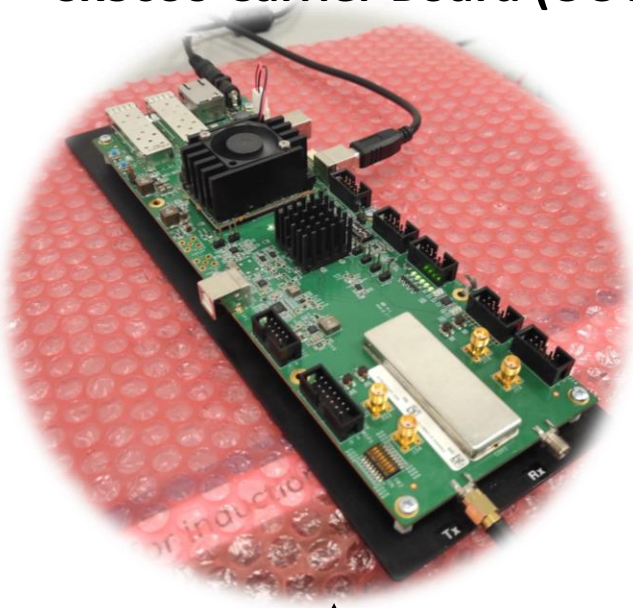
SATIXFY SX3099
Modem card

Test Instrument Support

Signal Generator: R&S SMW200A	Signal Analyzer: R&S FSW
DVB-S2X Annex E Beam Hopping	
• Waveform generation for almost all formats • User Interface for multi-superframe and bursty signals	• Synchronization to the superframe structure • Measurements of EVM of different modulations
DVB-RCS2	
• Support for all RCS2/ LM standard waveforms • Burst construction	• Synchronization to waveform preamble • Automated Configuration • Support of all waveforms

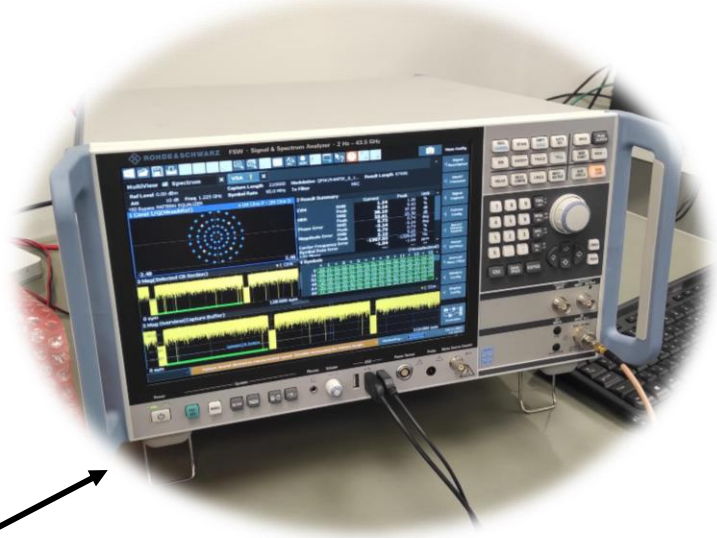
Testing Setup

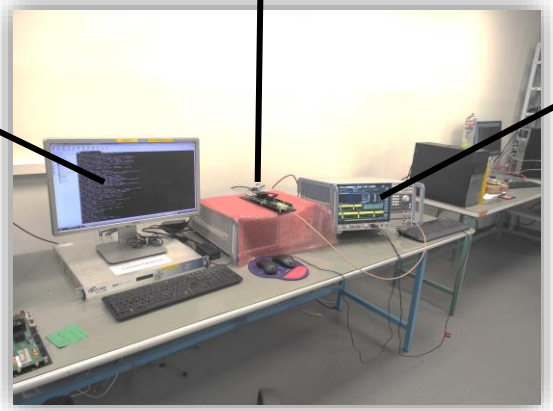
Sx3099 Carrier Board (UUT)



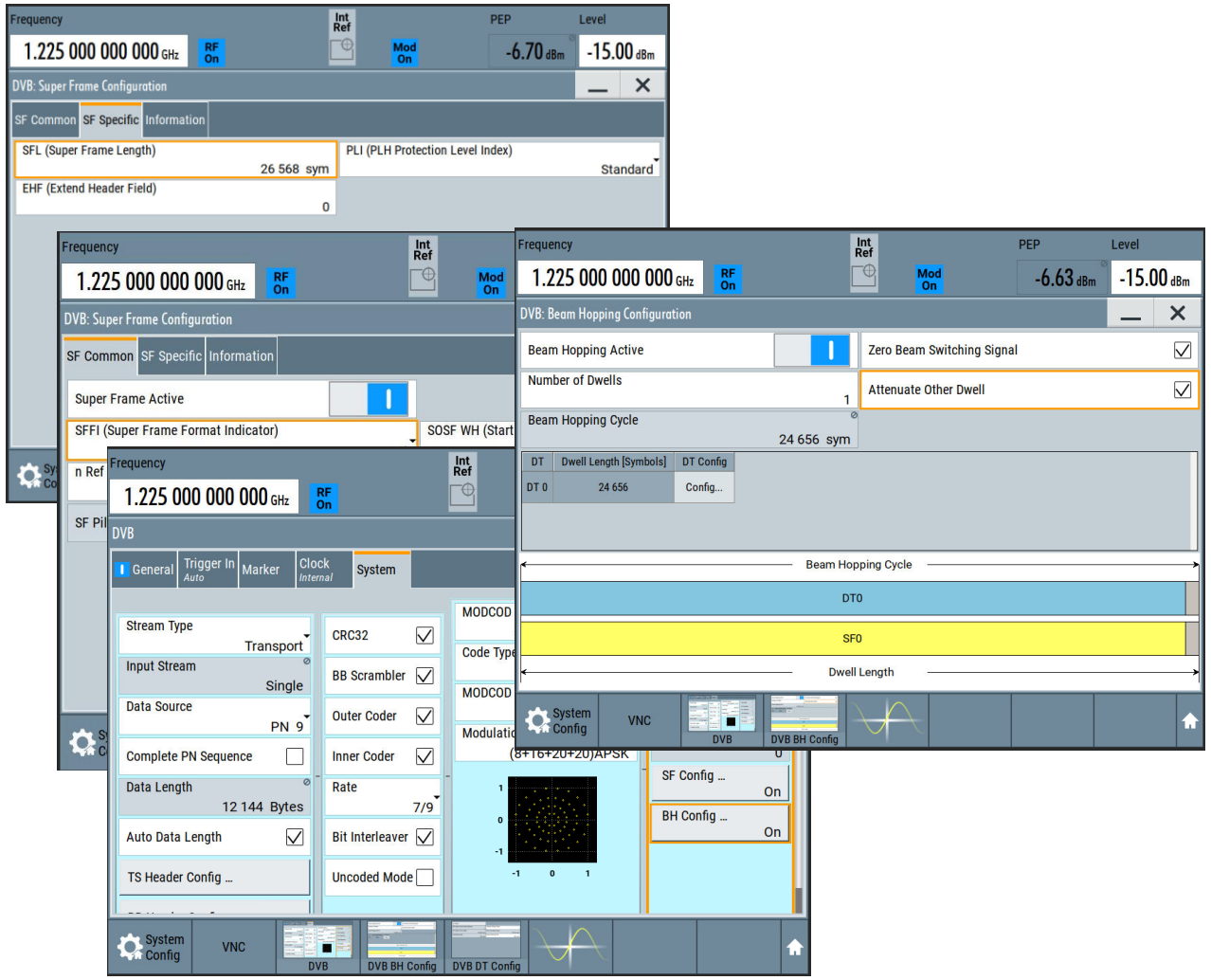
Control PC

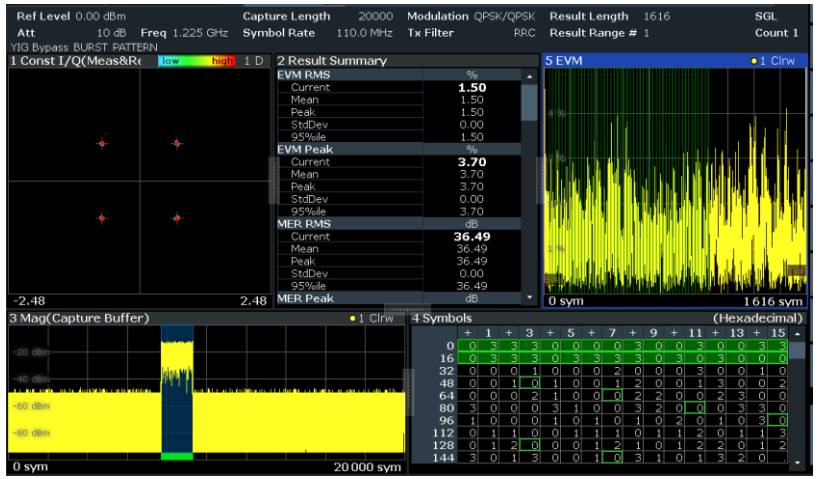
FSW Analyzer

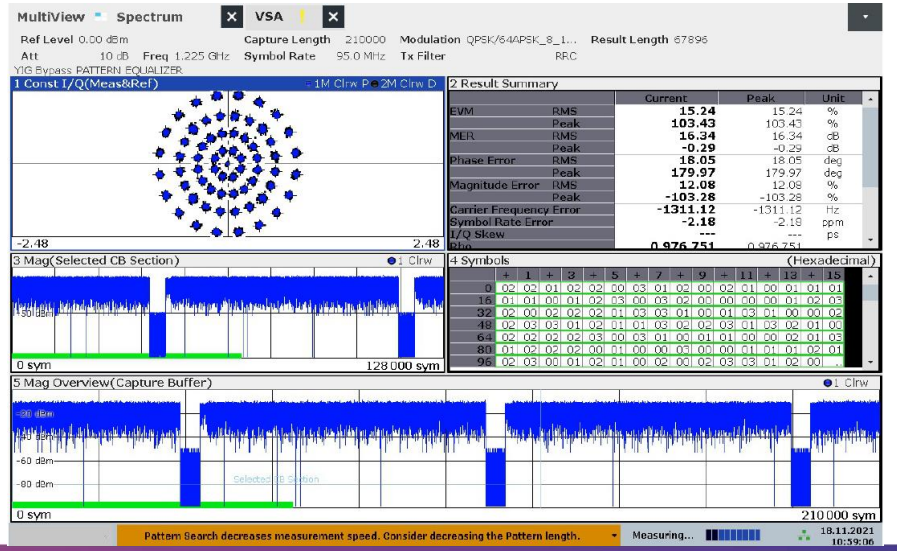




SMW and FSW Screens







Summary

- Beam Hopping provides a simple straightforward solution to the problem of adapting satellite resources to demand
- For full maturity there is a need for an Eco System including:
  - System operators
  - Equipment manufacturers
  - Test equipment suppliers
  - Standards to provide a common language
- R&S and SatixFy work together to develop test equipment for beam-hopping based on the DVB-S2X standard
- Another step towards technology maturity

THANK YOU

For Listening

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www.satixfy.com