ITU Symposium and Workshop on small satellite regulation and communication systems

Prague, Czech Republic, 2-4 March 2015

Status of ITU-R studies related to small satellites

Wouter Jan Ubbels (ISIS – Innovative Solutions In Space BV)

Martin Buscher (Technische Universität Berlin)

WRC-15 agenda item 9 – issue 9.1.8

Following proposals from 12 CEPT members, WRC-12 decided to put on the WRC-18 preliminary agenda the issue of nanosatellites and picosatellites. WRC-18 agenda item 2.2 reads:

"2.2 to consider the appropriate regulatory procedures for notifying satellite networks needed to facilitate the deployment and operation of nanosatellites and picosatellites, in accordance with Resolution 757 (WRC-12)"

Resolution 757 (WRC-12) invites ITU-R to undertake the relevant studies and furthermore instructs the Director of the Radiocommunication Bureau to report to WRC-15 on the results of these studies.

Results of the work go in the report of the Director → as such it is an issue under WRC-15 agenda item 9

ITU-R Resolution 757 (WRC-12)

Regulatory aspects for nanosatellites and picosatellites

invites ITU-R

to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics

instructs the Director of the Radiocommunication Bureau

to report to WRC-15 on the results of these studies

Applicable regulatory procedures:

*RR Articles **9**, **11:** Advance Publication, Coordination and Notification*

*RR Appendix **4**: technical characteristics to be used for Advance Publication, Coordination and Notification*

ITU-R study question 254/7

Characteristics and spectrum requirements of satellite systems using nano and pico satellites

1. What are the distinctive characteristics of nanosatellites and picosatellites and satellite systems in terms of their use of the radio spectrum as defined by data rates, transmissions time and bandwidths?
2. Taking into account such distinctive characteristics, what are the spectrum requirements for nanosatellite and picosatellite systems?
3. Under which radiocommunication services can satellite systems using nanosatellites and picosatellites operate?

This question was assigned to ITU-R Study Group 7

ITU Study Group 7 & Working Party 7B

- Part of ITU Radiocommunication sector (ITU-R)
- Study Group 7 – science services, consists of:
  - Working Party 7A (WP7 A): Time signals and frequency standard emissions
  - **Working Party 7B (WP7 B): Space radiocommunication applications**
  - Working Party 7C (WP7 C): Remote sensing systems
  - Working Party 7D (WP 7D): Radio astronomy
- The study group meets twice a year for a 5 day meeting

WP7B work related to AI9 issue 9.1.8

- Answer study Question 254/7:

  Report ITU-R SA.2312 Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites

- Respond to invitation to ITU-R to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites (RES 757):

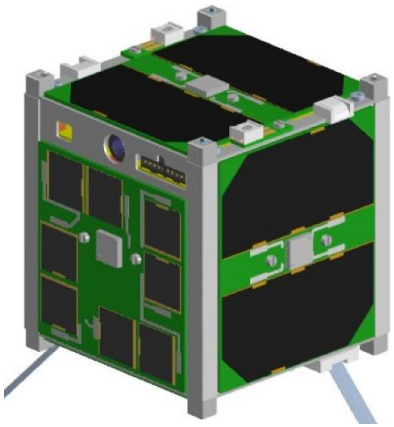
  Report ITU-R SA.[NANO PICOSAT CURRENT PRACTICE]

  This report is under development (hence the […]), and expected to be finished at the May 2015 meeting of WP 7B

What are the characteristics of nano- and picosatellites?

Typical Mission:

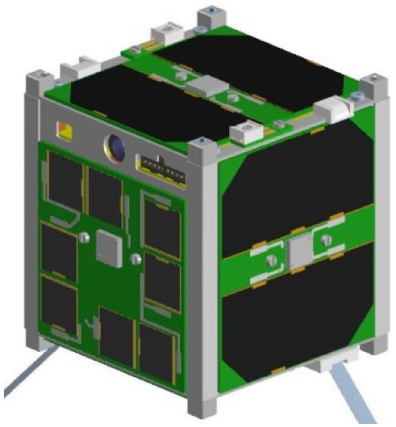
Mass	**< 10 kg**
Edge length	**< 30 cm**
Development time	**< 3 years**
Mission lifetime	**< 2 years**



What are the characteristics of nano- and picosatellites?

Typical Mission:

Mass	**< 10 kg**
Edge length	**< 30 cm**
Development time	**< 3 years**
Mission lifetime	**< 2 years**

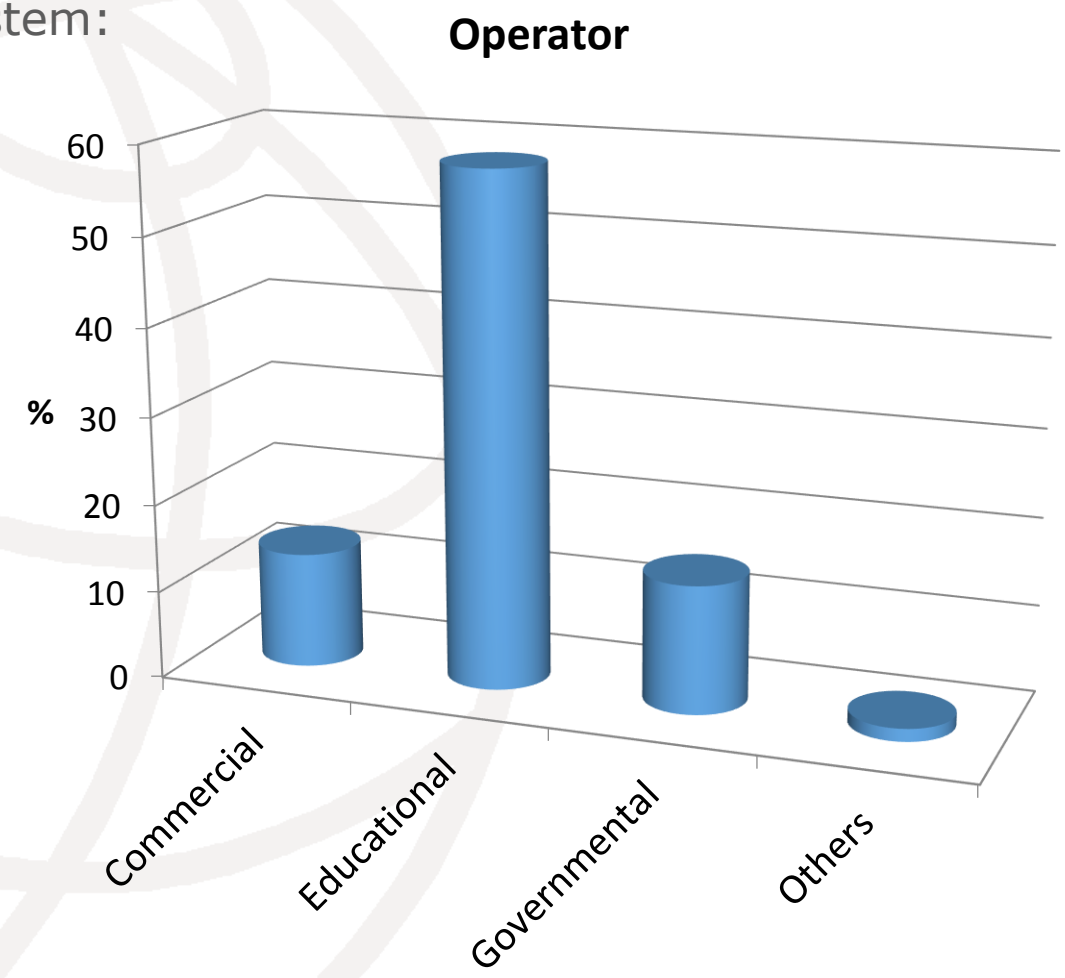


But which characteristics are relevant from a frequency management perspective?

TUB Small Satellite Database

Various parameters per system:

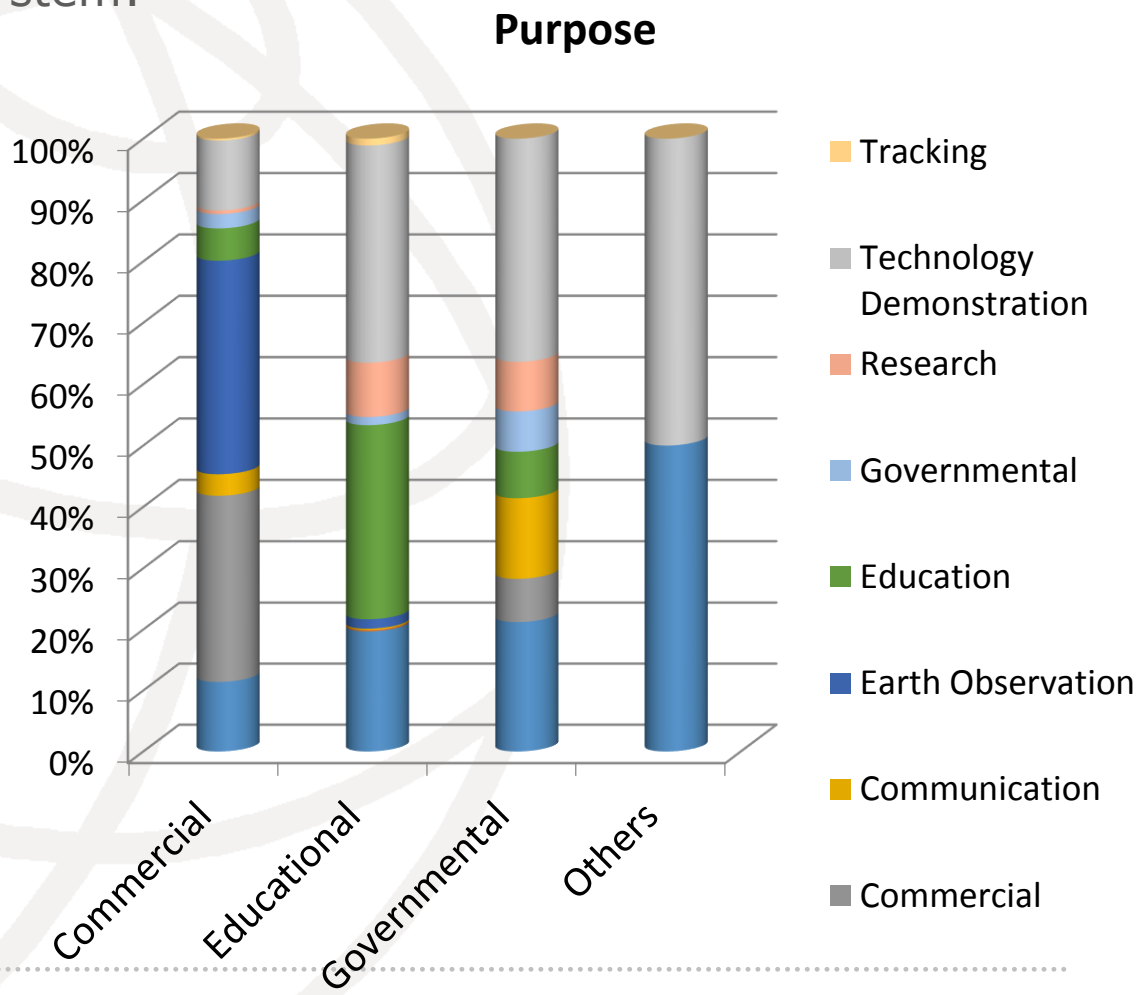
- **Name & operator**
- Mass & dimensions
- Purpose
- Communication
- Orbital parameter
- Timelines
  - Development timeline
  - Mission lifetime
  - …



TUB Small Satellite Database

Various parameters per system:

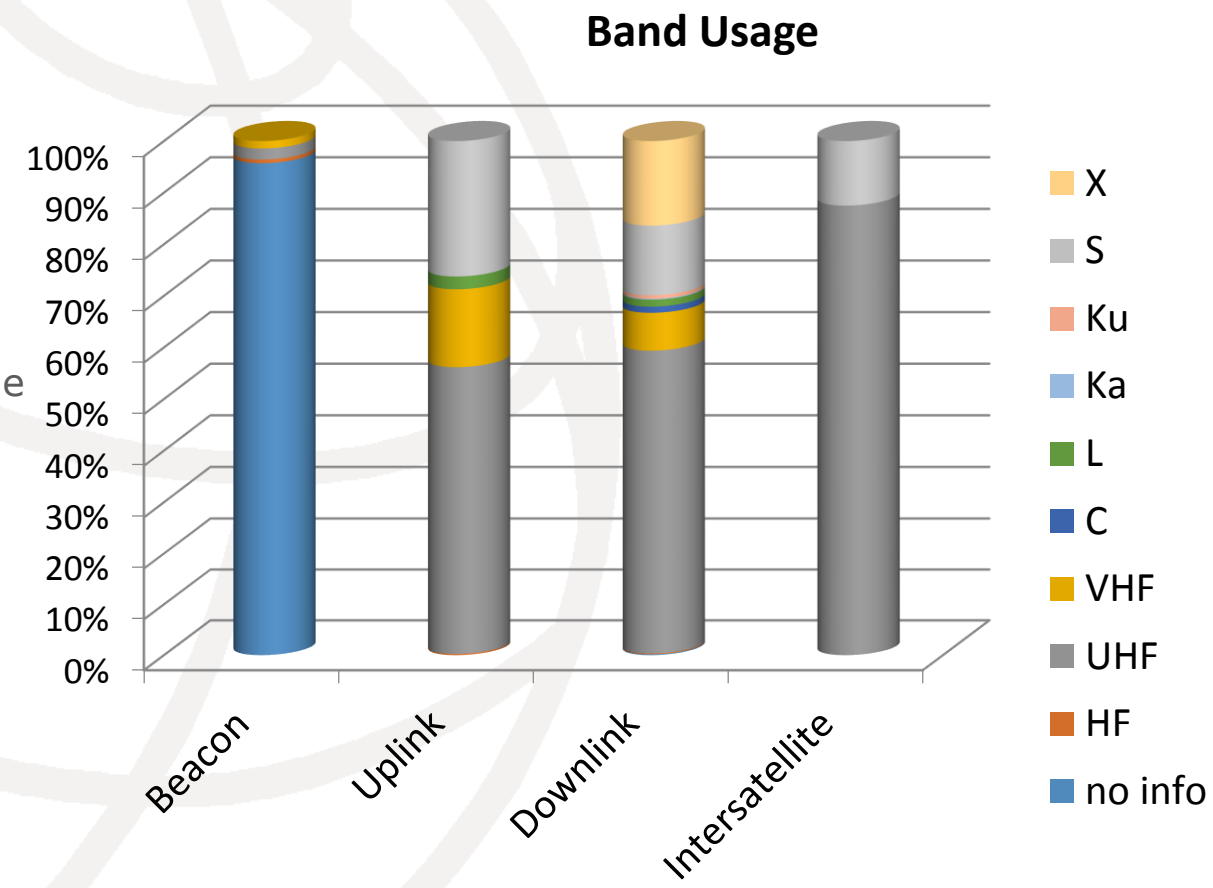
- Name & operator
- Mass & dimensions
- **Purpose**
- Communication
- Orbital parameter
- Timelines
  - Development timeline
  - Mission lifetime
  - …



TUB Small Satellite Database

Various parameters per system:

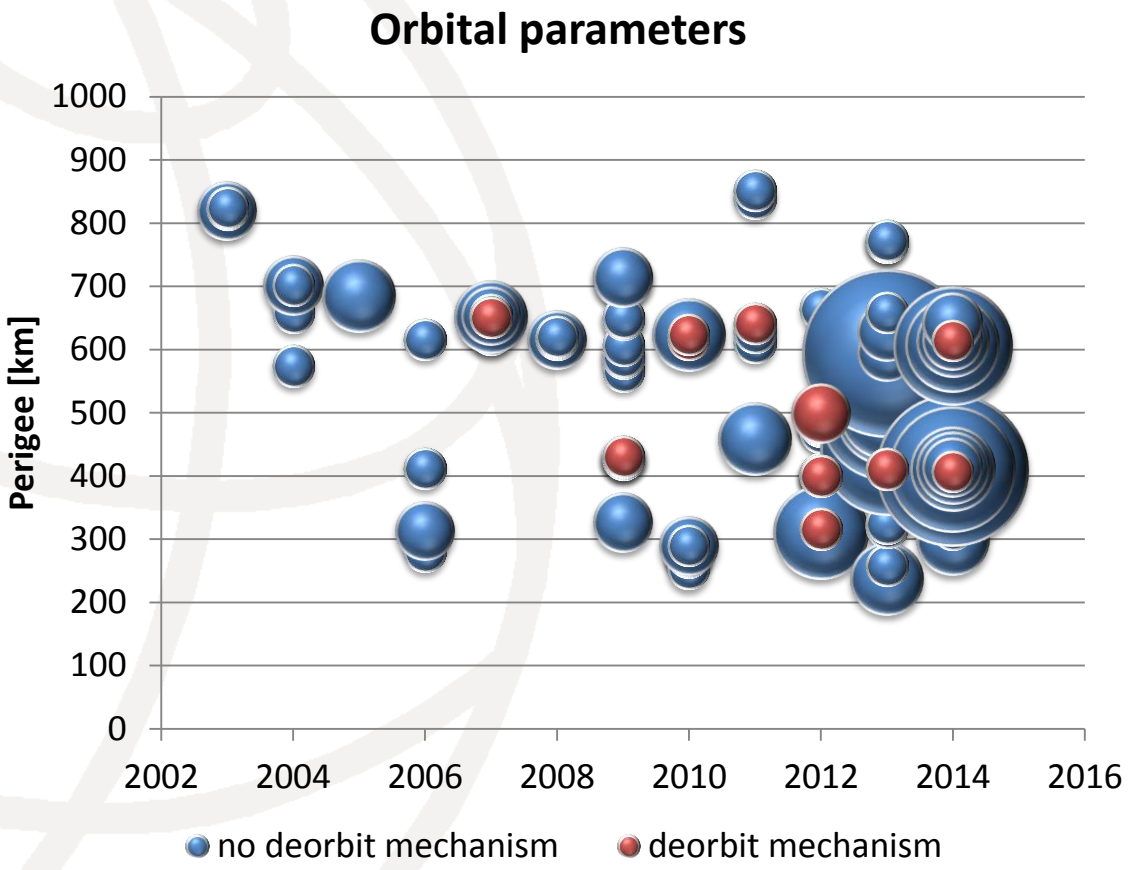
- Name & operator
- Mass & dimensions
- Purpose
- **Communication**
- Orbital parameter
- Timelines
  - Development timeline
  - Mission lifetime
  - …



TUB Small Satellite Database

Various parameters per system:

- Name & operator
- Mass & dimensions
- Purpose
- Communication
- **Orbital parameter**
- Timelines
  - Development timeline
  - Mission lifetime
  - …



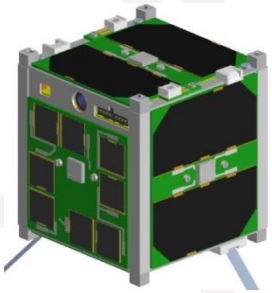
TUB Small Satellite Database

Various parameters per system:

- Name & operator
- Mass & dimensions
- Purpose
- Communication
- Orbital parameter
- Timelines
  - Development timeline
  - Mission lifetime
  - …

What are the characteristics of nano- and picosatellites?

- Mass, size
- Orbital parameters / launch arrangements



[AMSAT-UK]

However, characteristics which are relevant from a frequency management perspective are not so distinctive!

What are the spectrum requirements for nano- and picosatellite systems?

- Nanosatellites and picosatellites as a distinct satellite class can not be defined from a spectrum requirements / frequency coordination perspective

- It is (at the moment) not possible to answer this question both for current and for upcoming missions since technology and therefore spectrum requirements can rapidly change

Under which radiocommunication services can systems using nano- and picosatellites operate?

- First "beep-sats" used amateur-satellite service
  - Amateur-satellite: radiocommunication service for selftraining, intercommunication and technical investigations carried out by amateurs
- More and more small satellite systems use other services
  - Space research service
  - Space operation service
  - …

→ Nanosatellites and picosatellites are not bound to any radiocommunication service!

ITU-R study question 254/7

Characteristics and spectrum requirements of satellite systems using nano and pico satellites

1. What are the distinctive characteristics of nanosatellites and picosatellites and satellite systems in terms of their use of the radio spectrum as defined by data rates, transmissions time and bandwidths? answered

2. Taking into account such distinctive characteristics, what are the spectrum requirements for nanosatellite and picosatellite systems? answered

3. Under which radiocommunication services can satellite systems using nanosatellites and picosatellites operate? answered

Examine the procedures for notifying space networks and consider possible modifications

Step 1:

Examination of

- ITU Radio Regulations
  - Article 5
  - Article 9
  - Article 11
  - Appendix 4
- Development time of small satellites
- Mission Lifetime
- Problems & Needs of small satellite developer

Examine the procedures for notifying space networks and consider possible modifications

Results:

- Changes in Article 9 & 11 should not be undertaken
- Frequency allocations can only be arranged for a satellite service – not for a satellite class

- Small satellite developers need training and assistance in the application of regulatory procedures

Examine the procedures for notifying space networks and consider possible modifications

Step 2:

Deeper analysis of small satellite developers' difficulties in frequency coordination

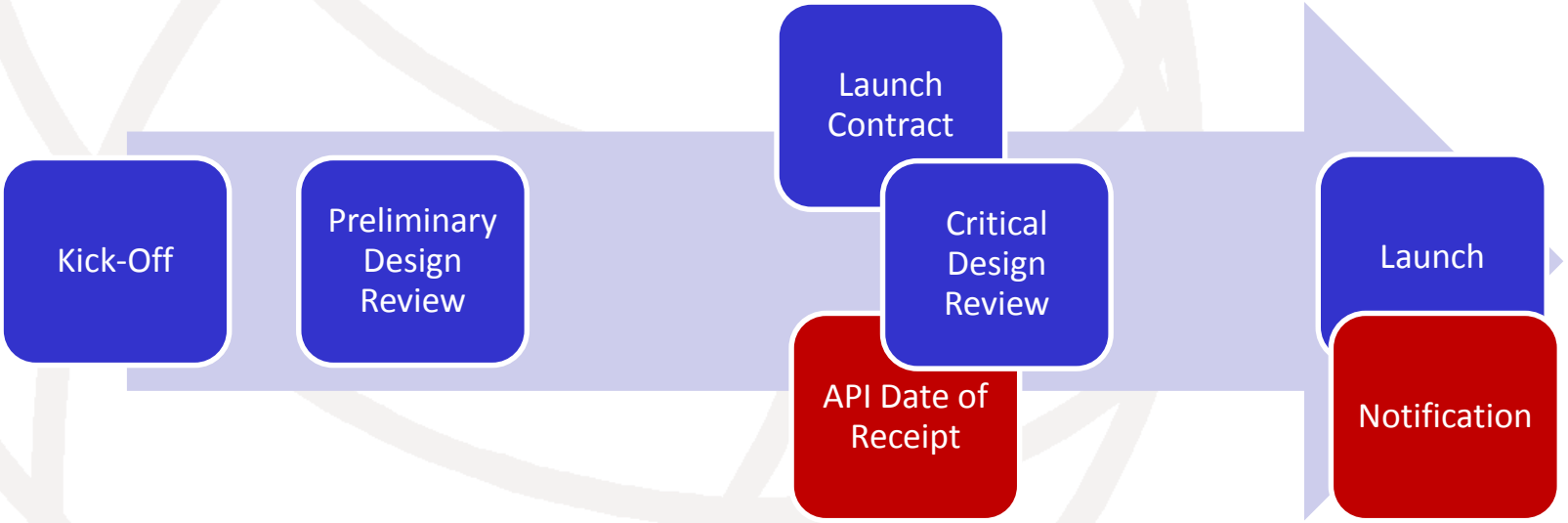
Examine the procedures for notifying space networks and consider possible modifications

Results:

1. Lack of knowledge of frequency coordination
2. Late knowledge of orbit parameters

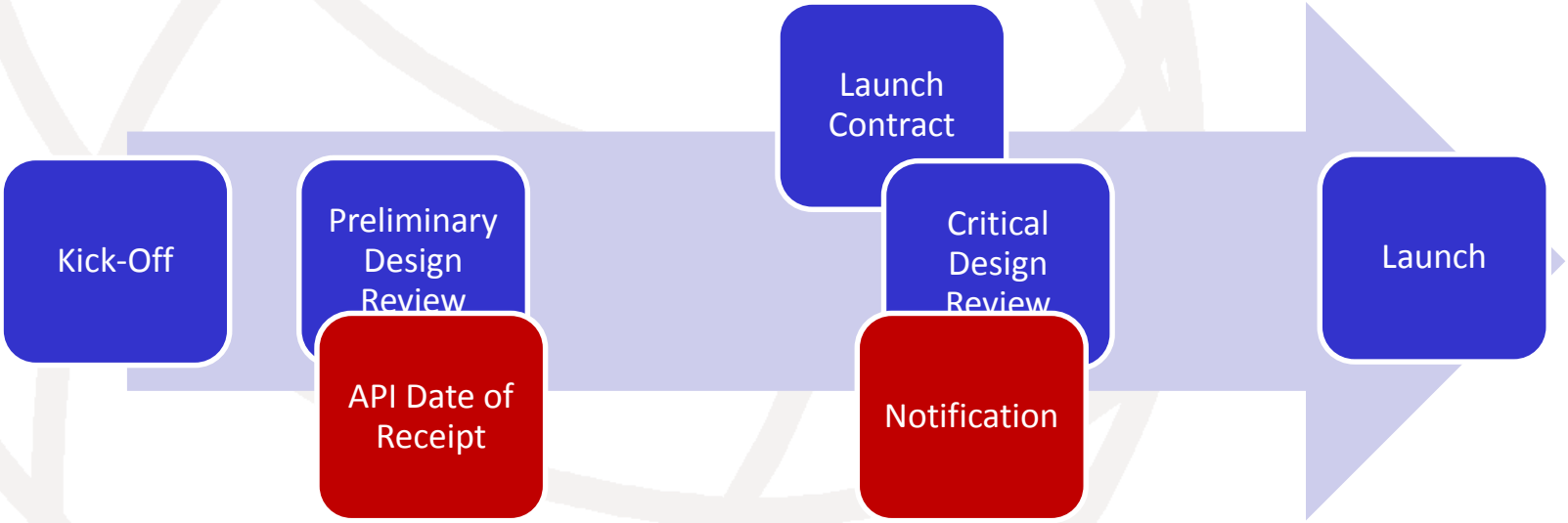
Examine the procedures for notifying space networks and consider possible modifications

Typical mission design timeline for a small satellite



Examine the procedures for notifying space networks and consider possible modifications

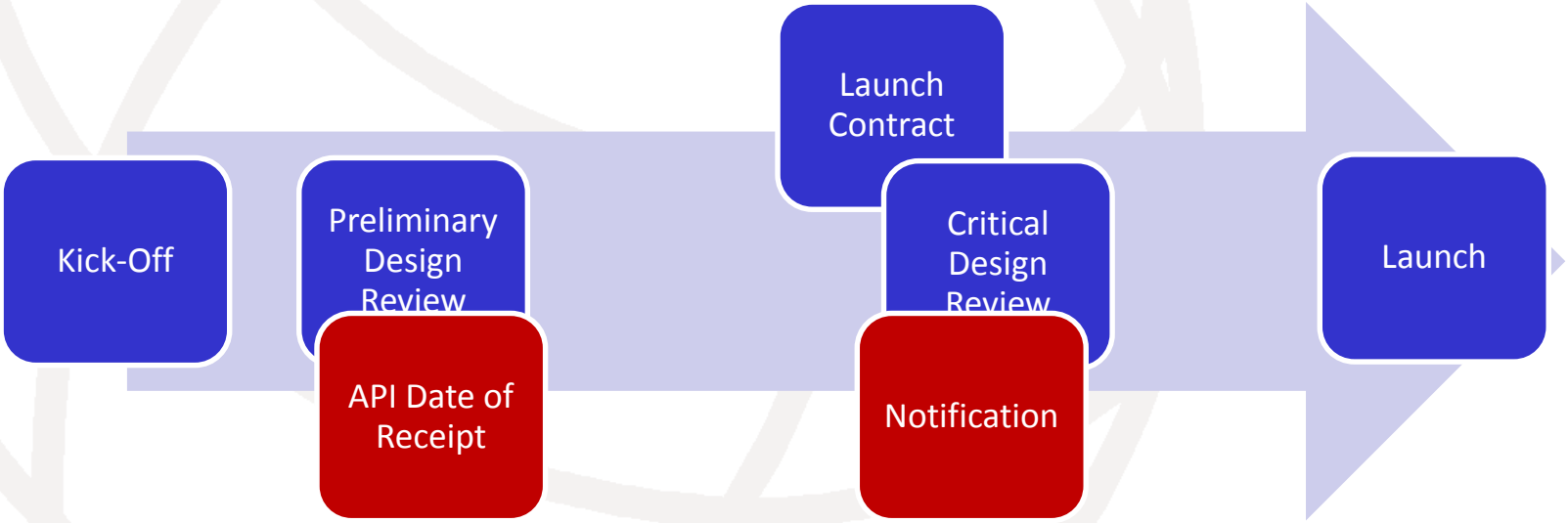
Optimized mission design timeline for a small satellite



Examine the procedures for notifying space networks and consider possible modifications

Optimized mission design timeline for a small satellite

- Early API without exact knowledge of orbital parameters is possible!



Conclusions

- No definition of picosatellites and nanosatellites that can be used in regulatory procedures
- ITU Radio Regulations (Article 9 & 11) remain untouched
- Dissemination of knowledge among small satellite developers is much-needed & will be further promoted
- Current regulatory procedures are applicable for small satellite developers, if all steps are undertaken on time and in due form
  - This does not take into account the growth in the amount of small satellites

Thank you for your attention!