



Recommendation ITU-R SM.2117-0
(09/2018)

**Data format definition for exchanging
stored I/Q data for the purpose
of spectrum monitoring**

SM Series
Spectrum management



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Foreword

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RA	Radio astronomy
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S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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Annex 1

Data format definition for exchanging stored I/Q data for the purpose of spectrum monitoring

1 General aspects

This annex provides the definition of a data format for exchanging stored I/Q data for radio monitoring purposes.

The data format provides:

- an easily understandable and implementable file format for I/Q data;
- a minimum set of characteristics to describe the data contained in the file;
- a data description suited for the exchange, analysis, and generation of signals on a spectrum analyser or for replay on a signal generator.

2 Description of I/Q data

2.1 Basics of I/Q data

The term I/Q data as used in the scope of this Recommendation describes a discrete time series of a complex valued baseband signal. With additional information like amplitude scaling and RF carrier frequency, a corresponding RF signal can be described.

In general, I/Q data describes a complex baseband signal $b(t)$ which can be transformed to or can be derived from a corresponding real valued RF signal $x(t)$. The “in-phase” component or real part of $b(t)$ is called $i(t)$. The “out-of-phase” component or imaginary part of $b(t)$ is called $q(t)$.

Thus, the corresponding RF signal $x(t)$ can be expressed as:

$$x(t) = i(t) \cdot \sqrt{2} \cdot \cos(2\pi f_0 t) - q(t) \cdot \sqrt{2} \cdot \sin(2\pi f_0 t) \quad (1)$$

It is evident that equation (1) can be used directly in a generator to synthesize the corresponding RF signal using $i(t)$ and $q(t)$ centred at a carrier frequency f_0 .

To obtain the corresponding complex baseband signal from a RF signal centred at a carrier frequency f_0 , equation (2) would be implemented in an ideal analyser. The symbol ‘ j ’ indicates the imaginary component and is equal to the square root of minus one. The symbol ‘ $*$ ’ indicates the convolution operation. The impulse response $h(\tau)$ defines a low pass filter (LPF) with a gain of one inside its pass band. The filtering with a LPF is necessary to attenuate signal components centred at twice the carrier frequency. The passband of the LPF must be selected wide enough to cover the bandwidth of the corresponding RF signal.

$$b(t) = i(t) + j \cdot q(t) = x(t) \cdot \sqrt{2} \cdot e^{-j \cdot 2\pi f_0 t} * h(\tau) \quad (2)$$

Usually, f_0 is chosen in such way that f_0 is equal to or greater than half the bandwidth of the corresponding RF signal. If a smaller value is chosen for f_0 aliasing is not avoidable. Equation (2) is sketched in Fig. 1. Baseband I/Q data $i(t) + jq(t)$ are obtained from an RF signal $x(t)$ by the use of a quadrature detector (Fig. 1), where the real part $i(t)$ and the imaginary part $q(t)$ are expressed by the in-phase component and the quadrature component, respectively.