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A SURVEY ON SATELLITE DIGITAL TRANSPARENT PROCESSOR

Abstract

Since last decade Digital Transparent Processor (DTP) has attracted a great deal of considerations among satellites payload manufacturers and system operators. This is because compared with traditional transparent bent-pipe satellites, satellite with DTP could provide better space-terrestrial communications performance in terms of transmissions delay and connections flexibility. Both benefits are obtained since DTP supports any-to-any onboard connections between any input and any output sub-channels. Therefore, DTP has shown considerable applications prospects and many in-orbit HTS (High Throughput Satellite) and mobile communications satellites have adopted DTP as their core payloads.

Considering the booming applications, this survey examines DTP's research and development (RD) activities all around the world, and further introduces its key techniques and KPIs (Key Performance Indicators) for engineering implementations.

Firstly, the global research groups are categorized into payload manufacturers and prototype developers, and their contributions are reviewed respectively. With regarding to the payload manufacturers, three companies' DTP products are introduced, namely ADS (Airbus Defense and Space), TAS (Thales Alenia Space), and Boeing. The RD activities of both ADS and TAS are consistently supported by ESA's (European Space Agency) ARTES program, in which ADS focuses on mobile applications and TAS aims at broadband applications. With regarding to the prototype developers, the contributions of NICT (National Institute of Information and Communications Technology) in Japan and SAC (Space Applications Centre) in India are reviewed respectively.

Then, several typical in-orbit satellites with DTP are introduced including WGS, Alphasat (Inmarsat-XL), and Intelsat-29e. Their respective payload structures, capabilities, KPIs and applications are briefly reviewed and compared. All those examples have verified the suitability and effectiveness of DTP for broadband and mobile applications, hence DTP is becoming a standard digital payload for communications satellites.

Next, the key techniques in DTP implementations are summarized, and KPIs of DTP products are introduced. The most difficult implementation issue is how to realize onboard broadband signal processing with cost-effective power consumption and mass, subject to satellite platform limitations. Hence the key techniques for DTP engineering development include high-speed ADC/DAC, optical interconnections between digital processing boards, and advanced ASIC (Application Specific Integrated Circuit) technology. With regarding to KPIs, some important parameters such as sub-channel filter response, NPR (Noise-to-Power Ratio) and switching capabilities are introduced to illustrate DTP's conception and mechanism, and simulation-based performance analysis proposed by University of L'Aquila and CNIT is reviewed.

Finally, the survey concludes the DTP development directions and highlights the future issues.