

Arkhitektura Sputnikovogo Raspredeleniya T2-MI

Arkhitektura seti raspredeleniya signala DVB-T2 cherez sputnik

Opisanie blokovoy skhemy | Nauchnyy kommentariy | Ssylki na ETSI

Standarty: ETSI EN 302 755 V1.4.1 (DVB-T2) | ETSI EN 302 307-1 V1.4.1 (DVB-S2 Multistream)

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1. Vvedenie

T2-MI (T2 Modulator Interface) - eto spetsializirovanny transportnyy protokol, opredelyonny standartom ETSI EN 302 755 V1.4.1, kotoryy pozvolyaet raspredelyat polnyy multipleks DVB-T2 cherez sputnikovuyu svyaz (DVB-S2) ili IP-set k regionalnym nazemnym peredatchikam. Dannaya blokovaya skhema tochno otobrazhaet polnyuyu arkhitekturnuyu tsep sistemy raspredeleniya ot istochnogo multipleksa do konechnogo zritelya.

Kazhdyy element skhemy opredelyon sootvetstvuyushchim standartom ETSI, prichem vse soedineniya, napravleniya potokov signalov i oboznacheniya sootvetstvuyut deystvuyushchim tekhnicheskim spetsifikatsiyam.

2. Tsentralnyy DVB-T2 Multipleks

Tsentralnyy DVB-T2 multipleks yavlyaetsya istochnoy tochkoj vsej tsep raspredeleniya. On sodержit neskolko transportnykh potokov (Transport Streams - TS), sootvetstvuyushchikh otdelnym televizionnym sluzhbam (Sluzhba 1 do Sluzhby N). Kazhdaya sluzhba zakodirana kak standartnyy transportnyy potok MPEG-2 v sootvetstvii so standartom ISO/IEC 13818-1.

Multipleks takzhe sodержit tablitsy SI/PSI (Service Information / Program Specific Information):

- NIT (Network Information Table) - sodержit informatsiyu o fizicheskoy seti i transpondere
- PAT (Program Association Table) - sopostavlyaet programmy s znacheniyami PID
- CAT (Conditional Access Table) - sodержit informatsiyu ob uslovnom dostupe

Eti tablitsy yavlyayutsya obshchimi dlya vsekh sluzhb multipleksa i peredayutsya, soglasno ETSI EN 302 755, cherez Common PLP (sm. razdel 4.1).

3. T2-MI Packager / T2 Gateway

T2-MI Packager, takzhe izverstnyy kak T2 Gateway, yavlyaetsya tsentralnym elementom

obrabotki vsey sistemy. Eto ustroystvo vypolnyaet dve logicheskie funktsii, kotorye soglasno ETSI EN 302 755 integrirovany v odin apparatnyy blok - eto NE dva otdelnykh ustroystva:

- T2-MI Packager: inkapsuliruyut polnyuyu strukturu kadra T2 v protokol T2-MI
- PLP Multiplekser: multipleksiruyut vse PLP (Physical Layer Pipes) v odin potok

Element kadra T2	Opisanie i funktsiya
Simvol P1	Simvol sinkhronizatsii - identifikatsiya signala DVB-T2, rezhim Guard Interval
Simvol(y) P2	Nesyot signalizatsiyu L1-pre i L1-post - metadannye o strukture vsego kadra
Slyad Common PLP	PERVYY slayd dannykh neposredstvenno posle simvolov P2 - obshchiy SI/PSI dlya vseh sluzhb
Slyady Data PLP #1..N	Slyady dannykh otdelnykh sluzhb v poryadke ot #1 do #N
T2 Metka vremeni	Metka vremeni dlya sinkhronizatsii seti SFN (EN 302 755, §5.2.3)

KRITICHESKOE PRIMECHANIE (EN 302 755 §6):

Slyad Common PLP vsegda razmeshchaetsya kak PERVYY slayd dannykh kadra T2, neposredstvenno posle simvolov P2, sodержashchikh signalizatsiyu L1. Etot poryadok strogo opredelyn standartom i ne dolzhen byt izmenyon.

Opredelenie termina SLAYD (SLICE) soglasno ETSI EN 302 755 §6: Slayd - eto nepreryvnyy, ogranichenny vo vremeni blok yacheek dannykh v simvolakh OFDM dannykh kadra T2, vydelonnyy odnomu konkretnomu PLP i obrazuyushchiy nepreryvnuyu oblast v chasotno-vremennoy setke.

KRITICHESKOE PRIMECHANIE - IP-put:

IP-put raspredeleniya vykhodit NEPOSREDSTVENNO iz T2-MI Packager kak Vykhod #2. Eto NE sputnikovyy signal niz khodyashchey linii. IP i Sputnik - eto dva nezavisimyykh vykhoda iz Packager, a ne dva puti ot sputnika.

4. Voskhodyashchaya liniya DVB-S2 Multistream

Voskhodyashchaya liniya DVB-S2 Multistream predstavlyaet pervyy iz dvukh vykhodov T2-MI Packager. Potok T2-MI inkapsuliruyetsya v sputnikovye nesushchie signaly soglasno ETSI EN 302 307-1 V1.4.1 i peredayotsya na sputnik. CCM (postoyannoye kodirovaniye i modulyatsiya) yavlyaetsya obyazatelnyy i obespechivayut stabilnyy kanal peredachi dlya sinkhronizatsii SFN. ISI #0 naznachen Common PLP, ISI #1 do #N - otdelnym Data PLP.

Parametr DVB-S2	Znachenije / Spetsifikatsiya
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Standart	ETSI EN 302 307-1 V1.4.1
Modulyatsiya	DVB-S2
Kodirovaniye	CCM - Constant Coding & Modulation (obyazatelno)
FEC	Vneshnyy kod BCH + vnutrenniy kod LDPC
Inkapsulatsiya	BBFRAME (BaseBand FRAME)
Rezhim peredachi	MIS - Multi Input Stream (Multistream)
ISI #0	Nesyot Common PLP
ISI #1..N	Nesyot Data PLPs #1 do #N

5. Sputnikovaya svyaz i Stantsiya Priema Sputnika (SRS)

Sputnik Eutelsat 3B na geostatsionarnoy orbite na pozitsii 3,1° vostochnoy dolg. sluzh it tochkoy retranslyatsii dlya raspredeleniya T2-MI v Afriku, Evropu i prilezhashchie regiony. Stantsiya priema sputnika (SRS) - eto professionalnoe oborudovaniye s parabolicheskoy antennoy i demodulatorom DVB-S2. Ona vypolnyaet sled uyushchuyu tsep obrabotki signala soglasno ETSI EN 302 307-1:

- Demodulatsiya DVB-S2 sputnikovogo nesushchego signala
- Dekodirovanie FEC: vneshniy BCH + vnutrenniy LDPC
- Dekodirovanie CCM
- Demultipleksirovaniye ISI - razdeleniye Multistream na otdelnye potoki T2-MI
- De-inkapsulatsiya BBFRAME
- Izvlecheniye potoka T2-MI dlya dalney shey obrabotki

6. Regionalnyy Peredatchik DVB-T2

Regionalnyy peredatchik DVB-T2 prinimayet potok T2-MI ot stantsii priema sputnika i preobrazuyet ego obratno v nazemnyy radiocha stotnyy signal DVB-T2, kotoryy mogut prinimat standartnye domashnie priomniki (STB). On podderzhivayet SFN/MFN i vossozdayot polnuyu strukturu kadra T2.

VAZHNOE PRIMECHANIE dlya posetiteley portala:

Obychnyy domashniy priomnik DVB-T2 (STB) NIKOGDA ne prinimayet signal T2-MI neposredstvenno. Domashniy zritel prinimayet tolko konechnyy nazemnyy radiochastotnyy signal DVB-T2 ot anteny. T2-MI - eto professionalnyy transportnyy format, prednaznachenny isklyuchitelno dlya raspredeleniya mezhdru professionalnym oborudovaniyem.

7. IP-put Raspredeleniya (Vykhod #2 iz T2-MI Packager)

IP-put raspredeleniya - eto vtoroy alternativnyy put raspredeleniya potoka T2-MI. On idyot NEPOSREDSTVENNO iz T2-MI Packager v IP-set - bez kakoy-libo svyazi so sputnikom. On ispolzuetsya dlya raspredeleniya na nazemnye stantsii SFN/MFN headend.

KRITICHESKOE PRIMECHANIE:

IP-put vykhodit NEPOSREDSTVENNO iz T2-MI Packager (Vykhod #2). Eto NE sputnikovy signal niskhodyashchey linii. IP i Sputnik - dva nezavisimyykh vykhoda iz Packager.

8. Professionalnyy Priyomnik DVB-T2 s Dekoderom T2-MI

Professionalnyy priyomnik DVB-T2 s dekoderom T2-MI - eto spetsializirovannoe izmeritelnoye i monitoringovoye ustroystvo, prednaznachennoe ISKLYUCHITELNO dlya professionalnogo ispolzovaniya. Eto ustroystvo NE prednaznacheno dlya domashnykh zriteley. Ono trebuyet demodulator DVB-S2 v kachestve vkh odnogo frontenda a i programmnyy dekodek T2-MI.

KRITICHESKOE PRIMECHANIE:

Obychnomu domashnemu zritelyu NIKOGDA ne nuzhen dekodek T2-MI. Domashniy priyomnik (STB) prinimayet tolko nazemnyy radiochastotnyy signal DVB-T2 ot anteny. Dekodek T2-MI trebuyetsya tolko v professionalnom oborudovanii.

9. Rezyume - Polnyy Potok Signala

Sleduyushchaya tablitsa obobshchayet polnyy potok signala v arkhitekture raspredeleniya T2-MI ot istochnika do konechnogo zritelya:

S h a g	Blok / Ustroystvo	Opisaniye protsessa / Standart
1	Tsentrallyy DVB-T2 Multipleks	Istochnaya tochka - TS potoki sluzhb + tablitsy SI/PSI
2	T2-MI Packager / T2 Gateway	Inkapsulatsiya T2-MI, sozdaniye kadra T2, PLP Mux (EN 302 755)
3 a	DVB-S2 Uplink (Vykhod #1)	Inkapsulatsiya DVB-S2 Multistream, CCM, ISI, BBFRAME (EN 302 307-1)
3 b	IP-set (Vykhod #2)	Pryamoe raspredeleniye T2-MI/UDP - alternativa sputniku
4	Sputnik Eutelsat 3B @ 3,1°E	Passivnaya tochka retranslyatsii - geostatsionarnaya orbita, DVB-S2 MIS
5	Stantsiya priema sputnika (SRS)	Demodulatsiya DVB-S2, demux ISI, izvlecheniye T2-MI (EN 302 307-1)

6	Regionalnyy peredatchik DVB-T2	Preobrazovaniye T2-MI v DVB-T2, modulyatsiya OFDM, SFN/MFN (EN 302 755)
7	DVB-T2 STB (domashniy priyomnik)	Standartnyy nazemnyy priyom DVB-T2 - konechnyy polzovatel

10. Normativnye Ssylki

Vse tekhnicheskiye dannye v etom dokumente verifirovany po sleduyushchim standartam:

Standart	Nazvaniye i sootvetstvuyushchiye razd.
ETSI EN 302 755 V1.4.1	DVB-T2: Struktura kadrov, kanaln. kodirovanie i modulyatsiya. Razd. 5, 6
ETSI EN 302 307-1 V1.4.1	DVB-S2: Struktura kadrov, kanaln. kodirovanie. CCM, Multistream, ISI
ISO/IEC 13818-1	MPEG-2 Sistemy: Spetsifikatsiya transportnogo potoka

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 Etot dokument byl podgotovlen isklyuchitelno na osnove standartov ETSI i proveryaemykh tekhnicheskikh istochnikov.