



TIQXMMI

Тошкент Ирригация ва Қишлоқ Хужалигини
Механизациялаш Муҳандислари Институтини



YRB

YER RESURSLARINI
BOSHQARISH FAKULTETI



GVA GI

GEODEZIYA VA
GEOINFORMATIKA

“Замонавий геодезик асбоблар” фанидан

7-мавзу: GPS сунъий йўлдош навигаторлари ва уларнинг ишлаш принципи



Маърузачи: доцент Инамов Азиз Низамович

Reja:

- GPS va GNSS haqida tushuncha
- Pozitsion haqida tushuncha
- GPS s'yomkasi, texnika va aniqligi
- Navigasiya tizimlari
- Qo'llanilish sohalari

Kartografiya va geodezik syomka tarixi

- Klassik uslublari: triangulatsion, trilaterasion va poligonometrik tarmoqlar
- “chiziq va ko’rinish” bilan chegaralangan.
- Qo’llanilgan uskunalar :Po’lat sim, Theodolit, Kompas, Nivelir, Taxiometr, va GPS



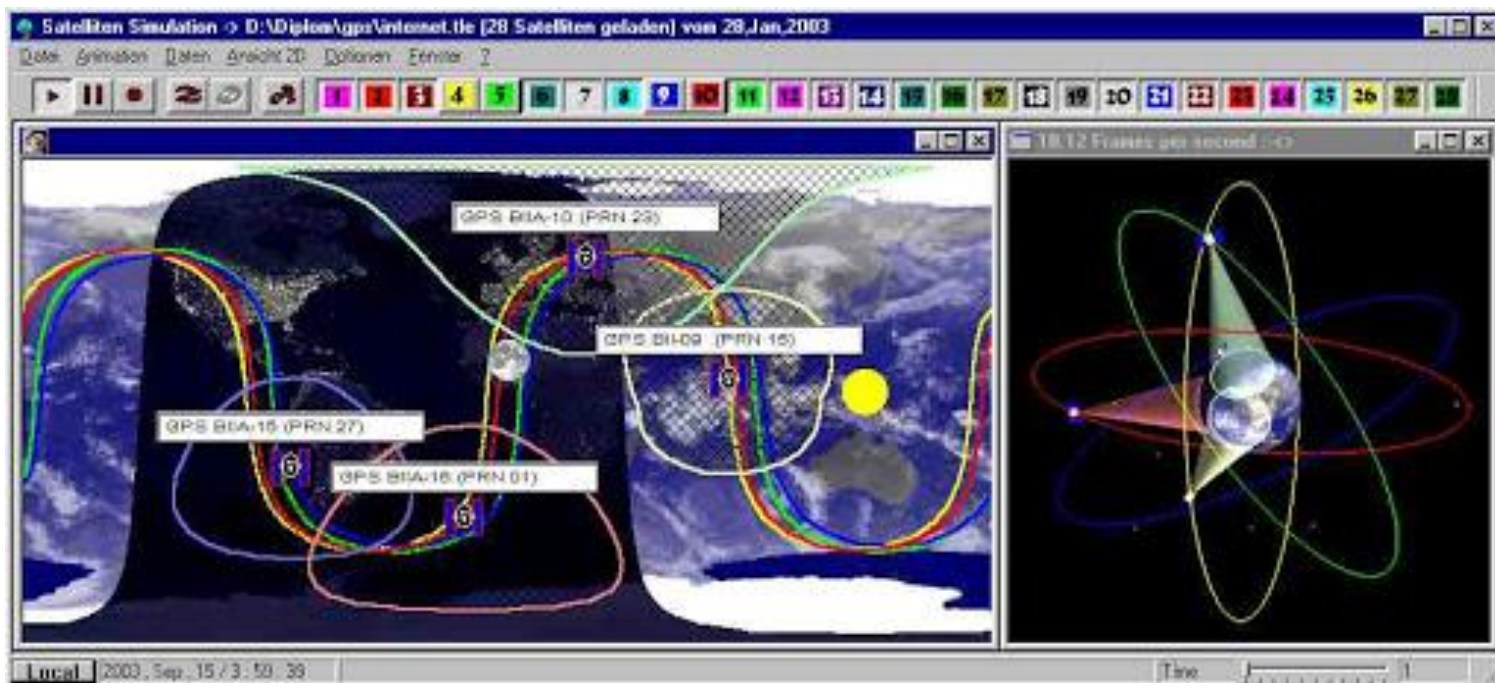
Navigatsiya tarixi

- **An'anaviy usul: Quyosh Navigatsiyasi**
 - **Kenglik uchun etarli bulsada uzoqlikni aniqlashda juda noaniq bo'lgan (1760 aniq soatlar ixtiro qilingunga qadar)**
- **13- ASR: Magnit Kompas**
- **1912 yilda: Radio to'lqinlar**
- **1930 yilda: Radar**
- **1940 yilda: Loran-A**
- **1960 yilda: Omega va Navy Transit (SatNav)**
- **1970 yilda: Loran-C**
- **1980 yilda: GPS**

Samoviy navigatsiya vs. Yer navigatsiya

- Yuqori chastotali (short wave-length) radio signallar
- Yerdagi navigatsiyalar rel'ef bilan chegaralangan

□ **Birinchi GPS sun'iy yoldoshi PRN 4 Fev.22, 1978 da samoga uchirilgan**



Bu qanchalik yaxshi ishlaydi?

GPS- 15m

LORAN sistemasi C- 180m

Transitli- 200m

TACAN- 400m

Operativ Havо Navigatsiyasi

Inersiyali- 1 km

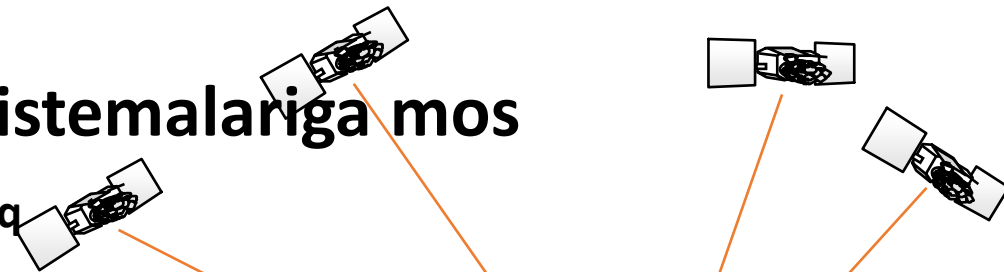
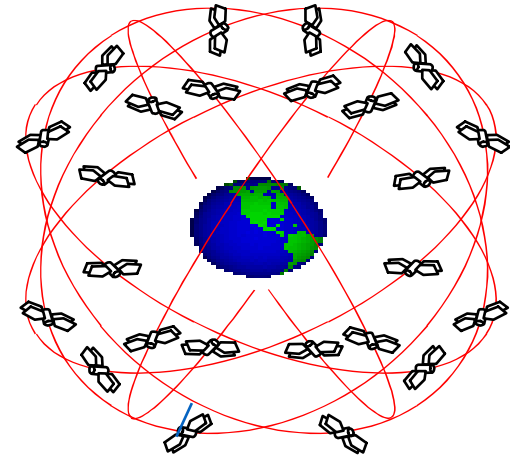
Omega- 2 km



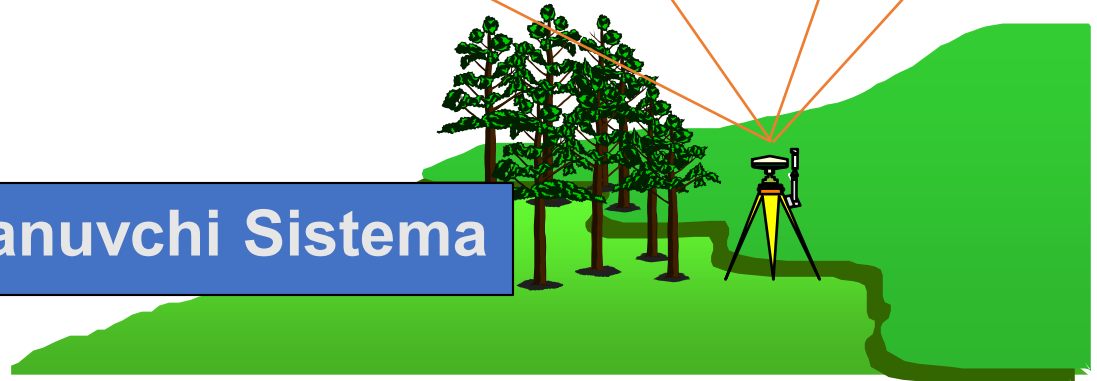
Navigatsiya aniqliklarini solishtirish

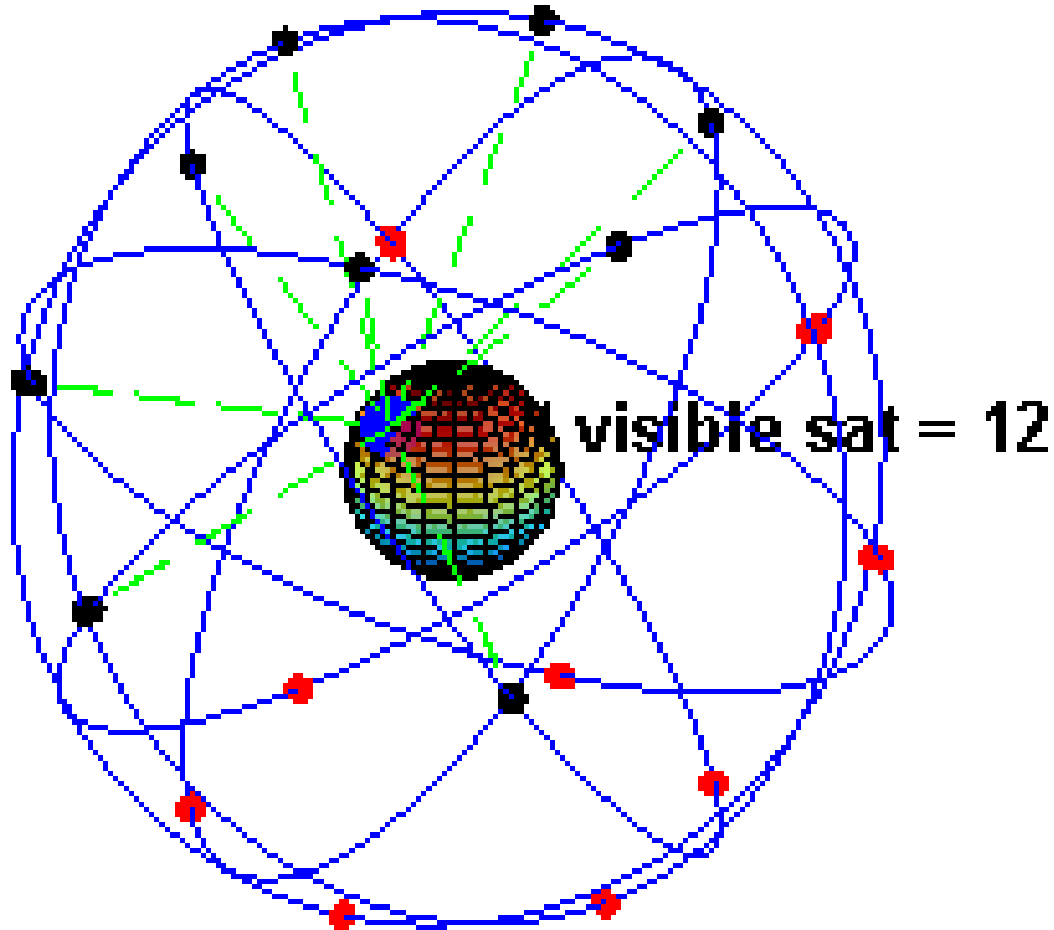
GPS ning umumiy xarakteristkaları

- AQSH tomonidan ishlab chiqilgan
- Ta'minoti
 - Aniq Navigatsiya
 - 10 - 20 m
 - Butun dunyoni qoplagan
 - 24 soat ishlaydi
 - Umumiy Koordinata sistemalariga mos
 - Harbiy va xalq xo'jaligi uchun ochiq

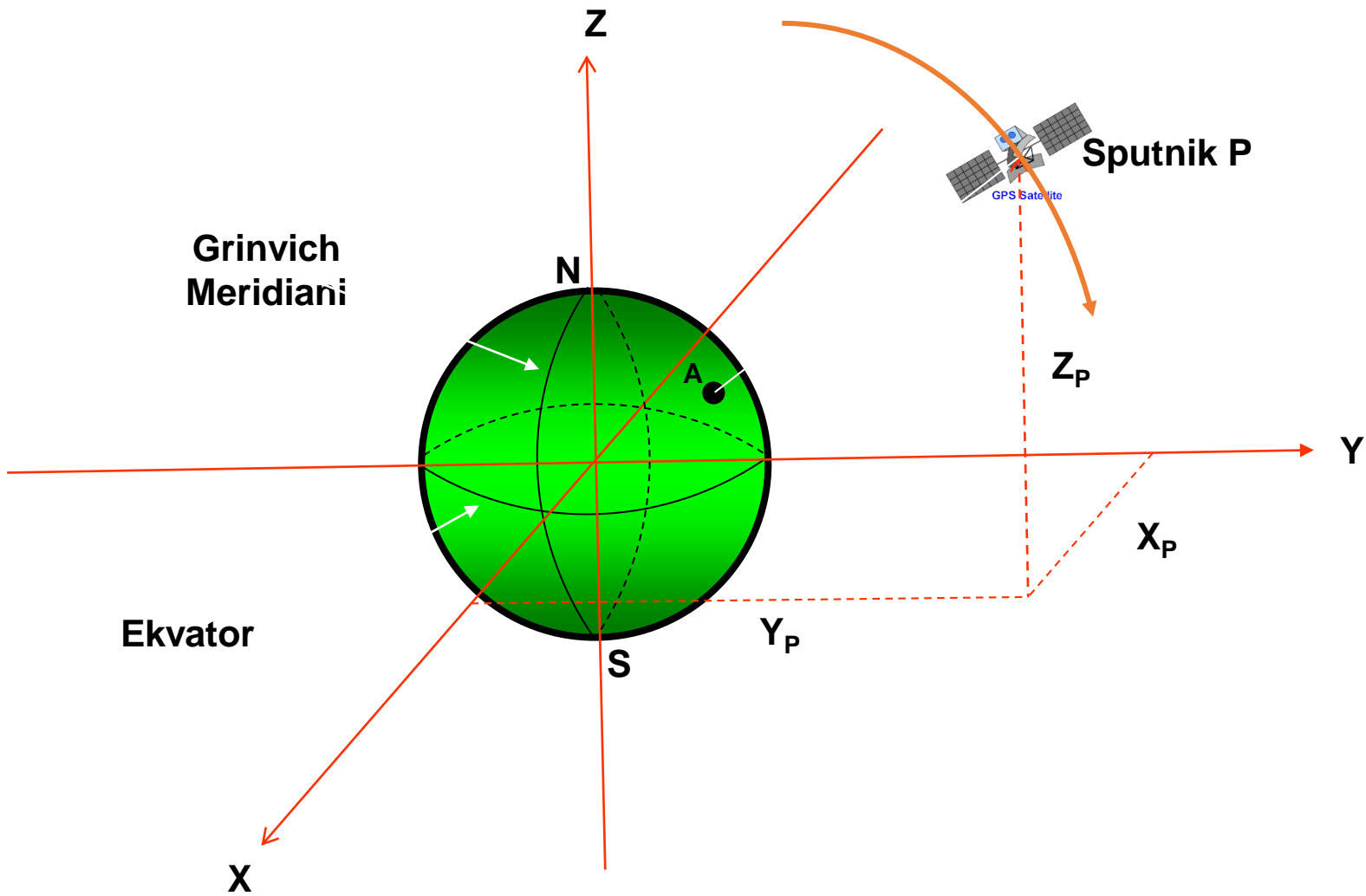


Butun dunyo bo'ylab aylanuvchi Sistema





GPS tizimi



$$AP = \sqrt{(X_P - X_A)^2 + (Y_P - Y_A)^2 + (Z_P - Z_A)^2}$$

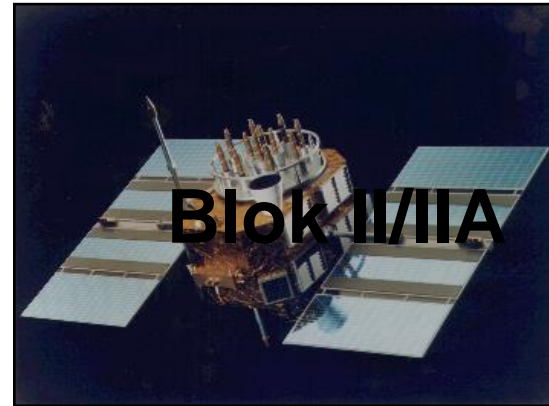
Geosentrik Fazo Kordinata sistemasi

Fazoviy Segment



Blok I

cc22 Fev 78(78-85)
Orbitada: Yo'q, Jami=11



Blok III/IIA

Suniy yo'ldoshning 1- uchishi :
14 Apr 89(89-97) Jami: 28



Blok IIR / IIR-M(L2C fuqaroviy signal va yangi milliy kod M ikki yo'nalishga ham L1& L2)

Suniy yo'ldoshning 1- uchishi: v: 22 Jul 1997/25
Sentyabr 2005 Jami=21/8



Blok IIF

Suniy yo'ldoshning 1- uchishi : 2009

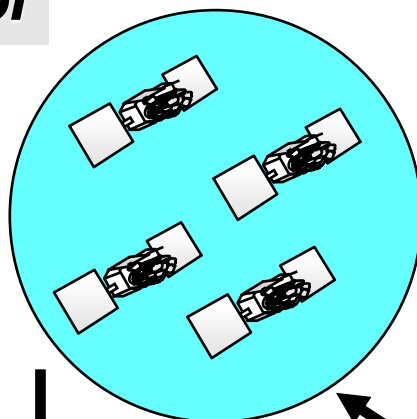
Blok III



GPS to'g'risida ma'lumot

- **Umumiy harajatlari ~\$12 milliard**
- **Yillik harajatlari ~\$400 million**
- **3 Segment:**
 - **Fazoviy: Sputniklar**
 - **Foydalanuvchi: Qabul qiluvchilar**
 - **Kontrol: Monitor & Kontrol stansiyalari**
- **Kordinata tizimi: WGS-84**
- **Tashkillashtiruvchi: AQSH Samoviy izlanishlar kuchlari**
(US Air Force Space Command (AFSC))

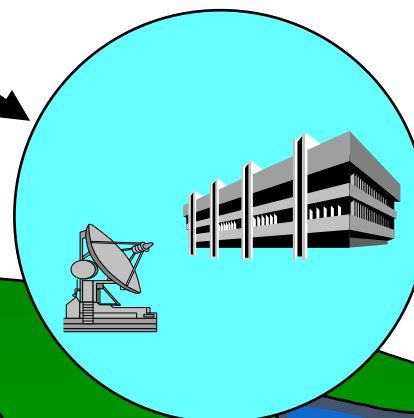
GPS tizim tarkibi



Fazoviy Segment
NAVSTAR : NAVigasiya
24 Sputniklar (30)



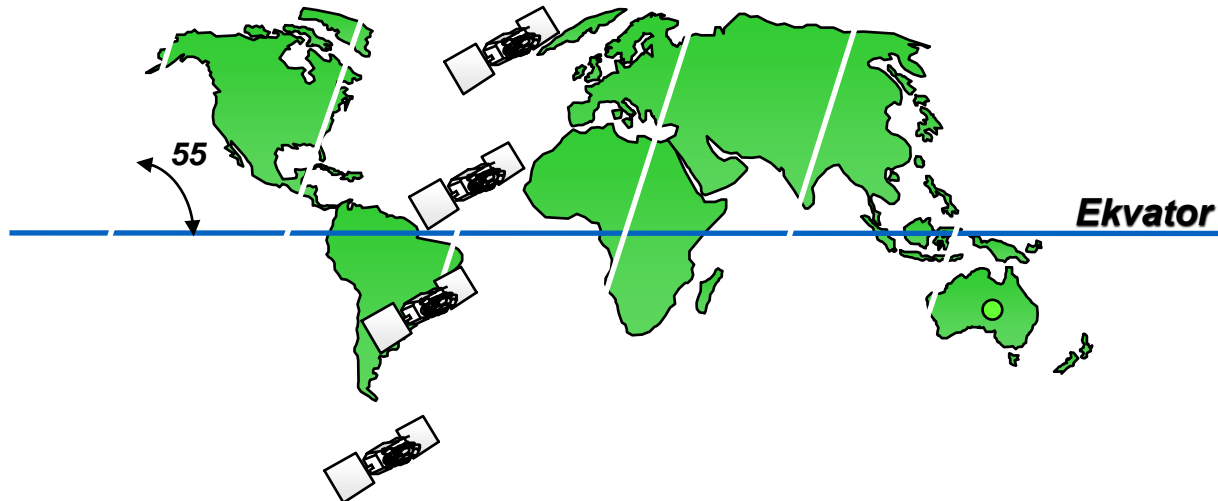
Foydalanuvchi Segmenti



Kontrol Segmenti

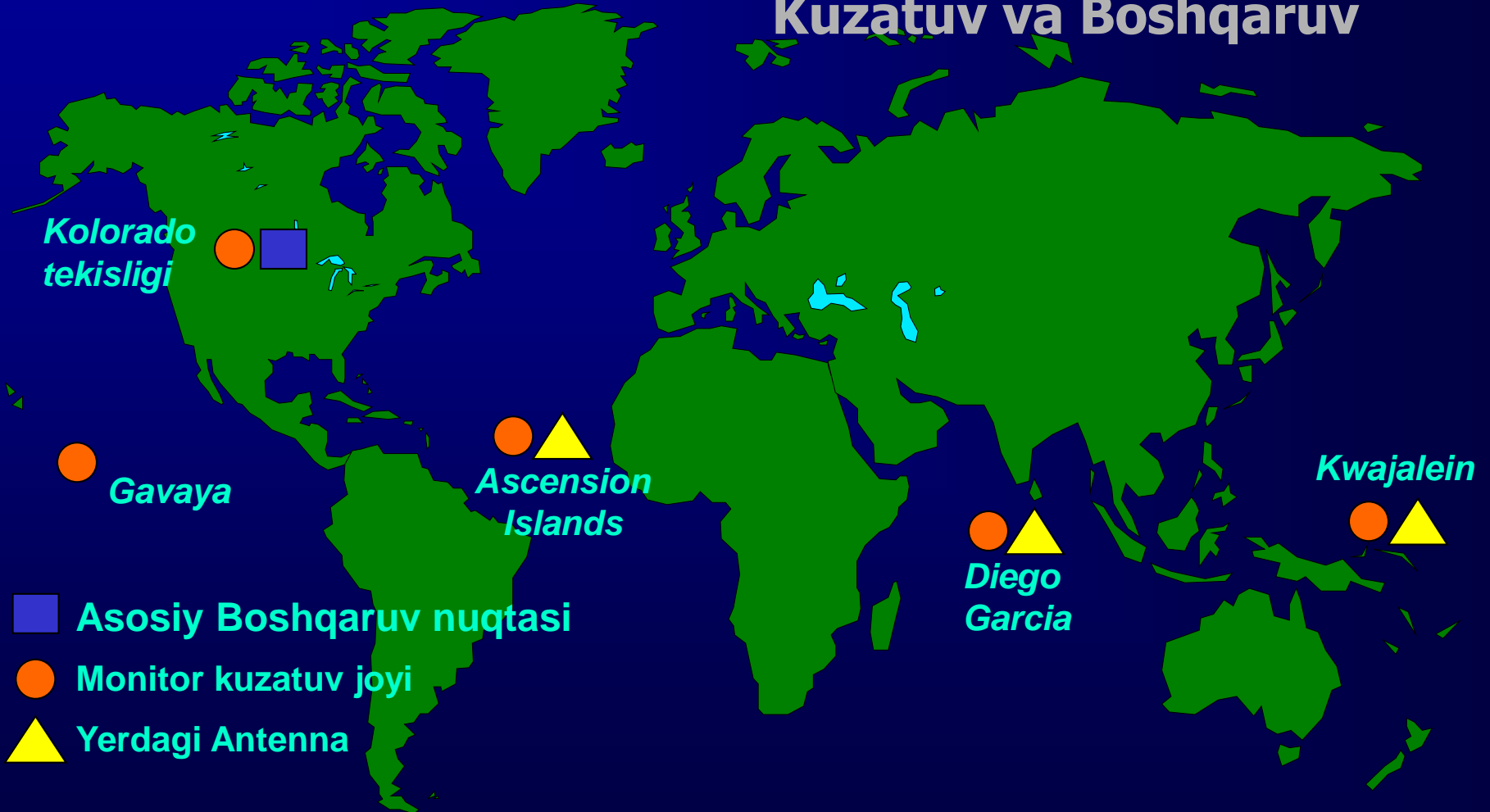
Fazo Segmenti

- 24 Suniy Yoldosh
 - 4 Sputnik har 6 Orbitada (55 Grad)
- 20-200 Km Yer sathidan
- 12 soatli orbitalar
- 7.5 yil muddatli
- Har xil sinflari
 - Block 1, 2, 2A, 2R & 2 F

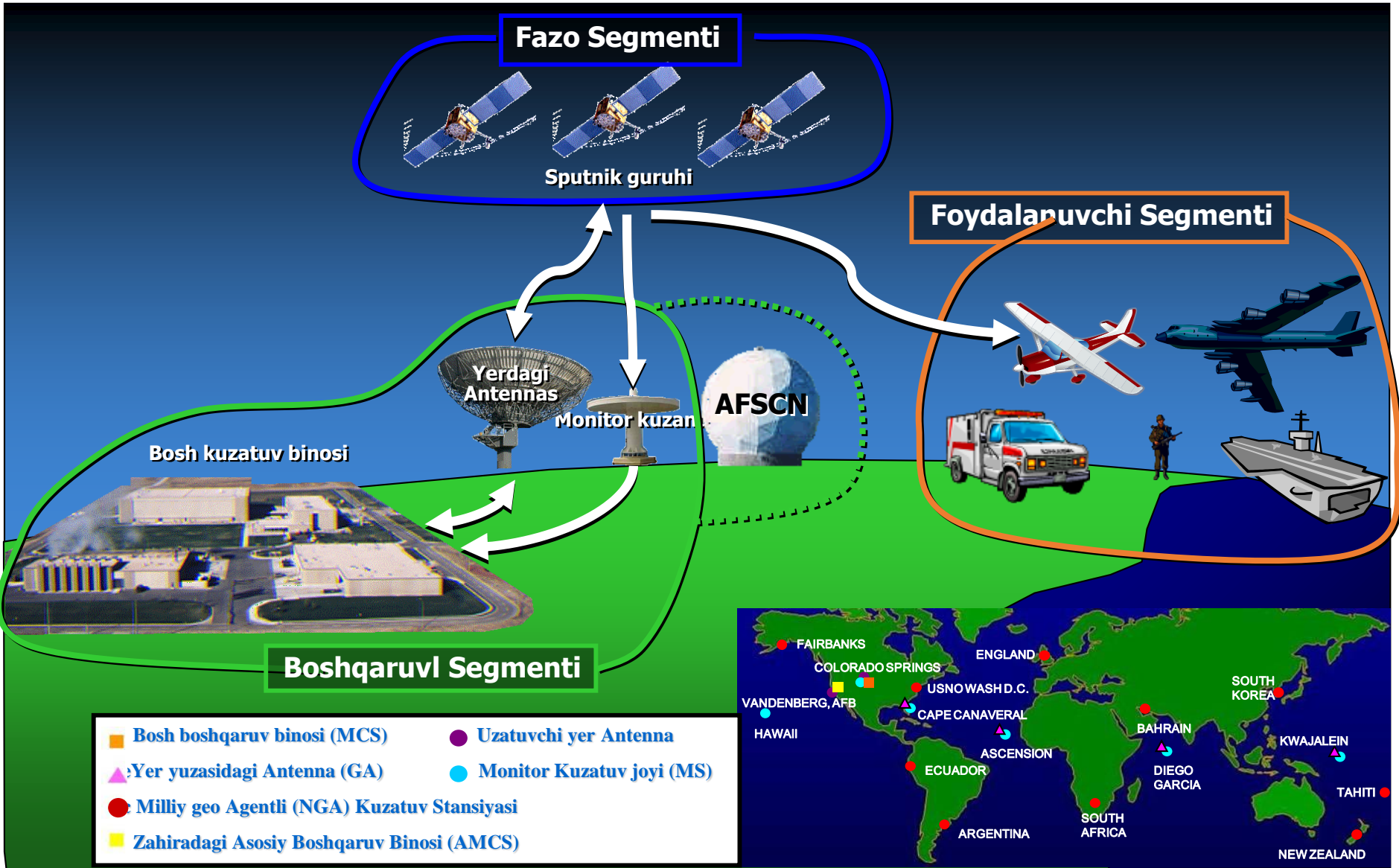


Kontrol Segmenti

Kuzatuv va Boshqaruv



GPS Segmenti



IIR-15 M (25 Sentyabr 2006 y.)

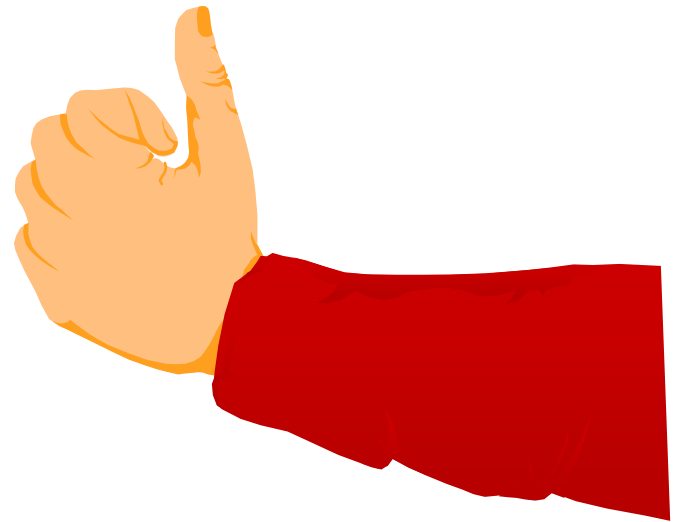


Kimlar foydalanishadi?

- HAMMA!
- Dengiz, havo kuchlari
- Havo Yollari
- Geodezistlar
 - Bu sohada revolyutsiya desa ham bo'ladi
- Tranzit yuk tashuvchilar
- Alpinist, turistlari
- Avtomobillari
- Media sputniklari
- Aniq vaqtni talab etuvchi har qanday tizim

Nega GPS ?

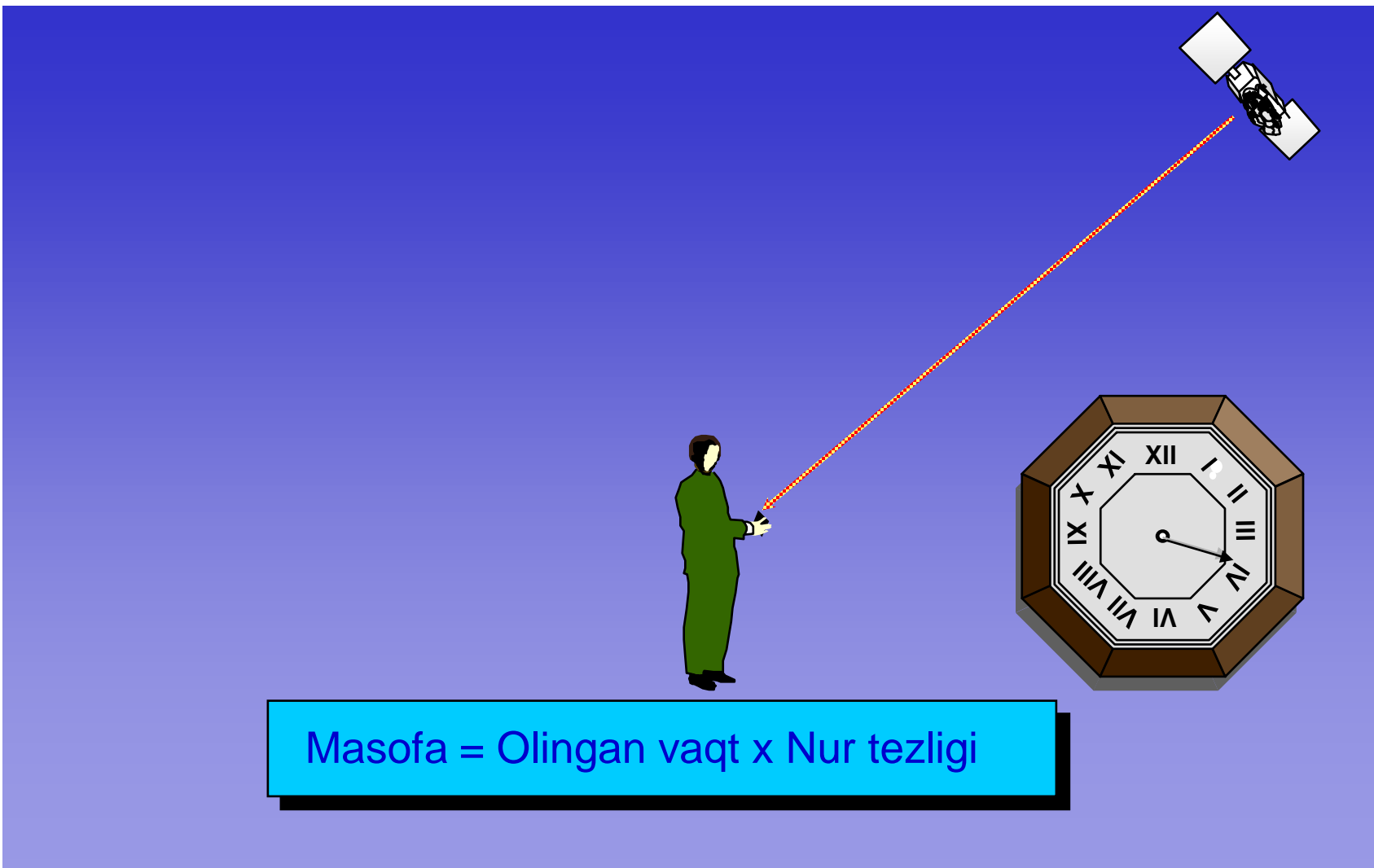
- Obi-havoga bog'liq emas
- Ko'rish chizig'i talab e'tilmaydi
- Yuqori geodezik aniqlik
- Tunu-kun ishlay oladi
- Tez va oson
- Iqtisodiy samarali
- Umumiy kordinata tizimi
- Qo'llanilish sohalari juda keng
- Raqobatbardosh



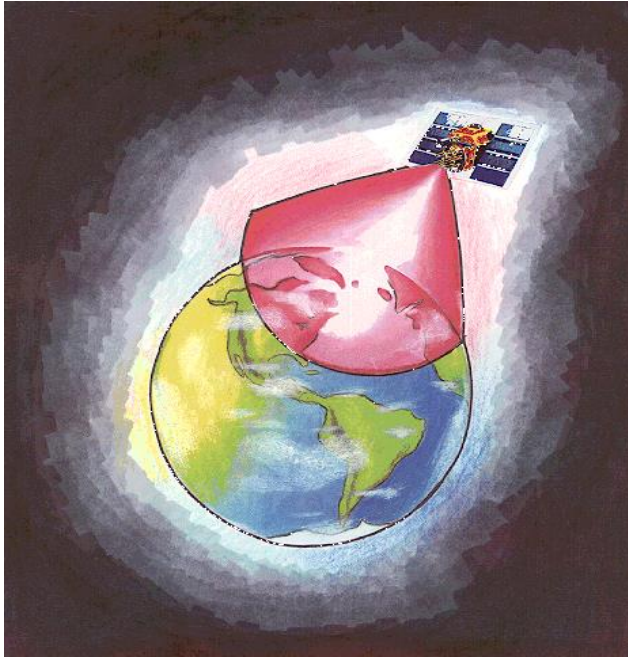
Qanday ishlaydi? (5 bosqich)

- **GPS bu *uzluksiz* tizim (triangulatsiya)**
 - **Sputniklar 4 km/s tezlikda harakatda**
- 1. A GPS antenasi bir necha sputnikdan 1 tomonlama signal oladi**
 - **Har bir signal vaqtdan iborat**
 - **Har bir signal sputnik pozitsiyasini bildiradi**
- 2. Signal vaqti sputnik vaqti bilan solishtiriladi**
- 3. delta-T nur tezligiga ko'paytiriladi ($\Delta T * c$) (Masofani topish uchun)**
- 4. Har bir masofa sputniklarning qaysi joyda ekanligini ko'rsatadi**
- 5. Bunday masofalar yig'indisi joy koordinatasini beradi**

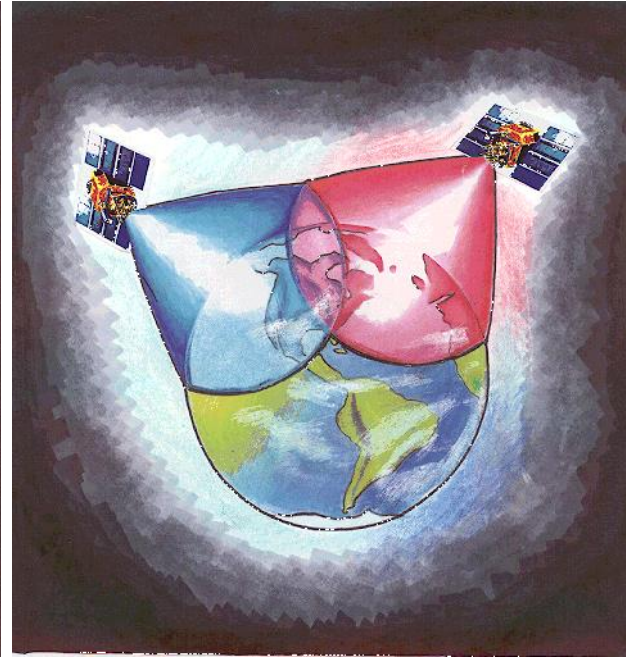
Ishlash Prinsipi : Masofa



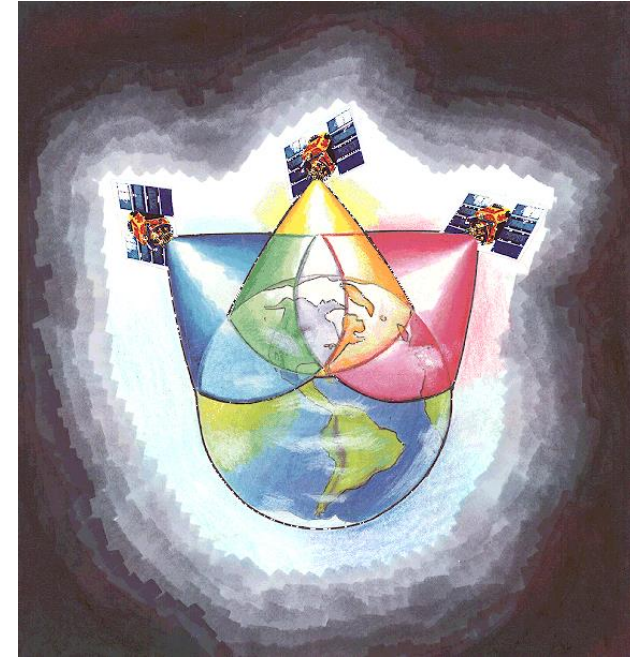
Bir necha sputnik masofalari



1 diapazon konus yuzaning sferik yuza joylashuvini ko'rsatadi.



2 ta diapozon kesishuvi natijasida kuzatuvchi yumaloq gumbazli forma yuzani ko'rishni mumkin



3 diapozon 1 va 2 chi natijani ushlab umumiy ko'rinishni beradi

Prinsip tuzilmasi: Masofa

- **Masofalar vaqtlar farqlarini hisoblash orqali olinadi**
- **Oddiy GPS larda oddiy soatlar o'rnatiladi va ular sputnik soatlaridan aniqliklari kam**
- **Nur tezligi 300 000 km soatida harakat qiladi**
 - **(Masofa = Nur tezligi x Vaqt)**
- **GPS soati xatoligi**
 - **1/10 ikkinchi xatolik = 30,000 Km xato**
 - **1/1,000,000 ikkinchi xatolik = 300 m xato**

Masofa tenglamalari

$$P_1 = \sqrt{(X - X_1)^2 + (Y - Y_1)^2 + (Z - Z_1)^2} + b$$

$$P_2 = \sqrt{(X - X_2)^2 + (Y - Y_2)^2 + (Z - Z_2)^2} + b$$

$$P_3 = \sqrt{(X - X_3)^2 + (Y - Y_3)^2 + (Z - Z_3)^2} + b$$

$$P_4 = \sqrt{(X - X_4)^2 + (Y - Y_4)^2 + (Z - Z_4)^2} + b$$

Bu erda:

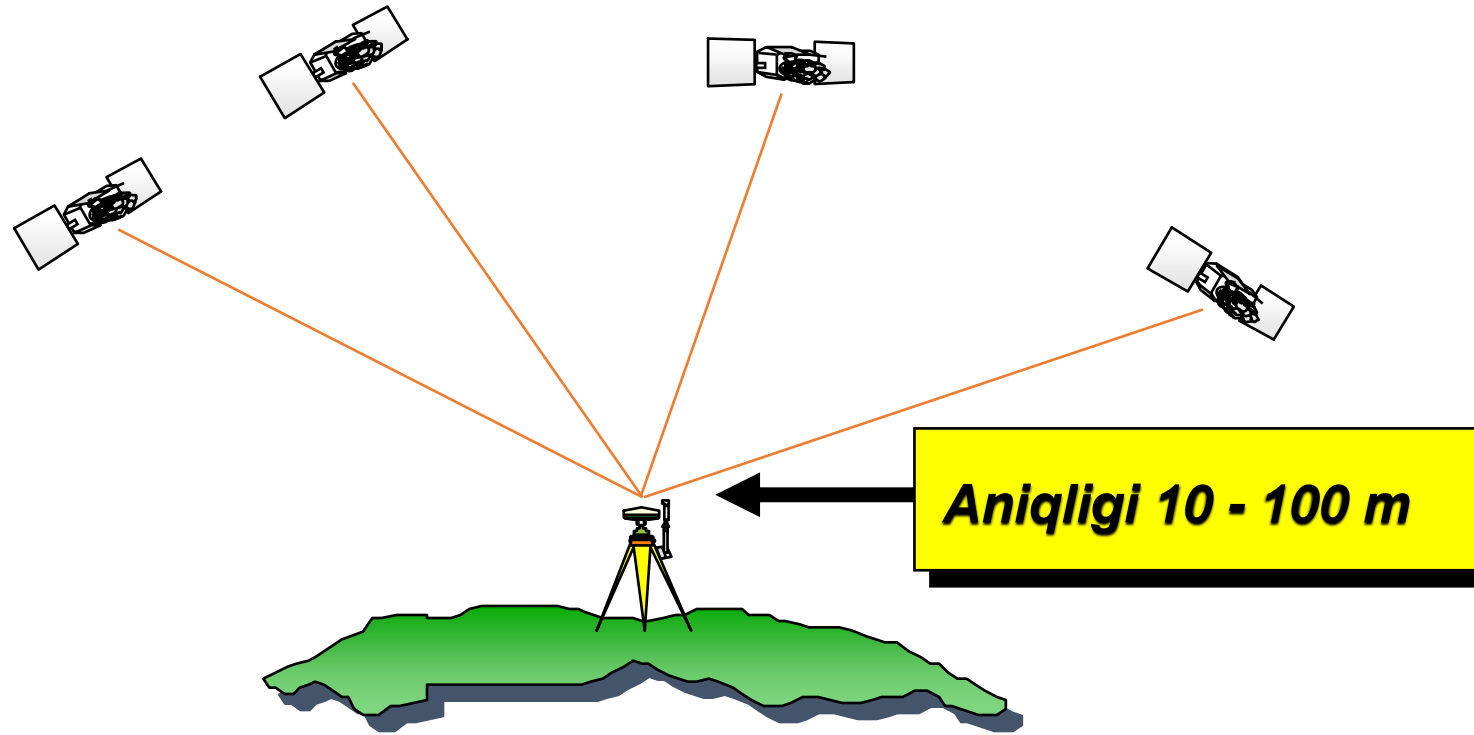
P_i = O'lchamli Noaniq Diapozon (Nosimmetrik diapozonlar) i^{th} SV

X_i, Y_i, Z_i = i^{th} SV Masofasi, Kartizan Kordinatalari

X, Y, Z = Masofa belgisi, Kartizan Kordinatalari

b = Foydalanuvchi vaqt

Joylashuv nuqtalari



Oddiy xollarda GPS 10 dan 100 m gacha xatolikka yo'l qoyadi

GPS vaqti

- GPS vaqti 6 Yanvar 1980 da, 00:00:00 ga keltirilgan
 - Yanvar 6 = 1- shanba 1980 yilda
- Sputnik GPS vaqtlari xalqaro Atom Vaqtiga keltirilgan (*Xalqaro atom vaqti -TAI*)
 - TAI esa Umumiy Vaqt Koordinatasiga asos bo'lib xizmat qiladi (Grinvich vaqti-UTC)
 - $GPS\ vaqti = TAI + 13^s$
 - 13 sekundlik o'zgarish 1/6/1980 yildan beri mavjud

Kod Modellari

L1 CARRIER 1575.42 MHz



C/A CODE 1.023MHz



NAV/SYSTEM DATA 50 Hz



P-CODE 10.23 MHz



L2 CARRIER 1227.6 MHz



L1 SIGNAL

L2 SIGNAL



Mixer

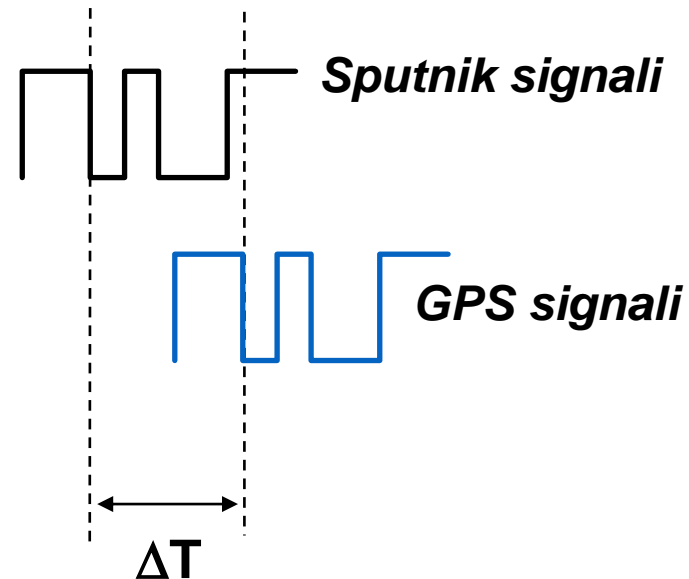


Modulo 2 Sum

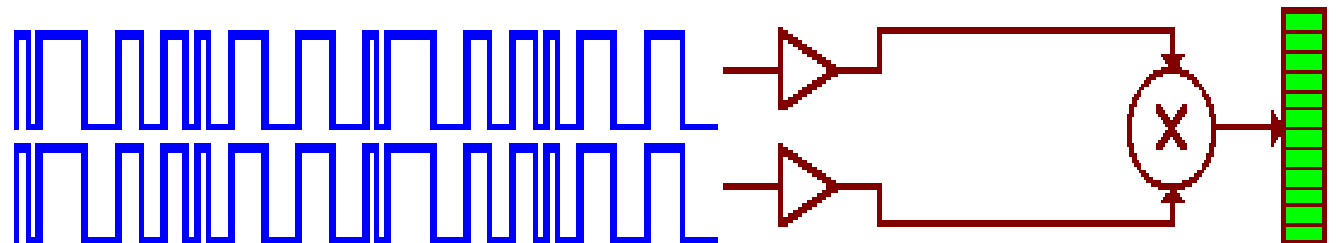
GPS SPUTNIK SIGNALLARI

Kod analizi orqali vaqtni hisoblash

- Faza (Kod)
 - Har bir sputnik yagona signal yuboradi ,1 msec oraliqda
 - GPS esa bu signalni o'z signali bilan taqqoslaydi
 - Vaqtlar farqidan (ΔT) masofa hisoblab olinadi

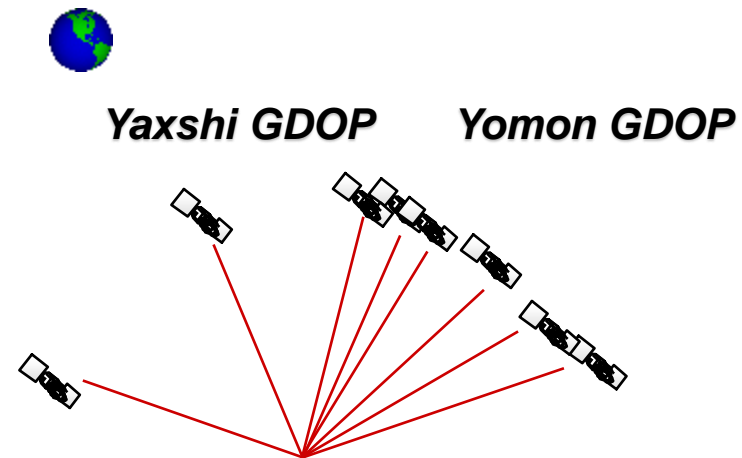


$$D = V (\Delta T)$$



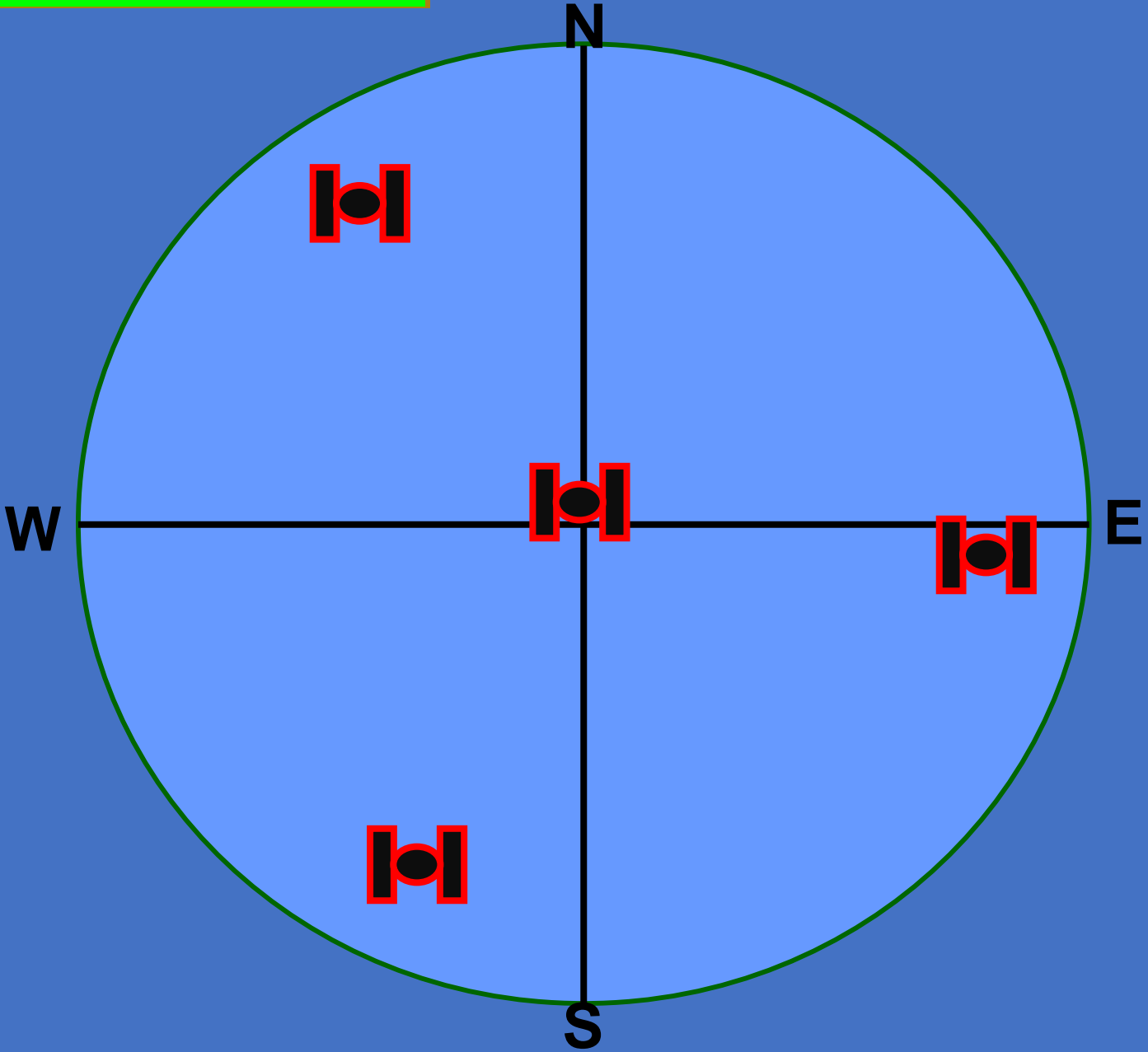
Ravshanlikning xiralashishi (DOP)

- **GDOP** (Geometrik)
 - Kenglik, Uzoqlik, Balandlik va Vaqt
- **PDOP** (Pozitsional)
 - Kenglik, Uzoqlik va Balandlik
- **HDOP** (Gorizontal)
 - Kenglik va Uzoqlik
- **VDOP** (Vertikal)
 - Balandlik

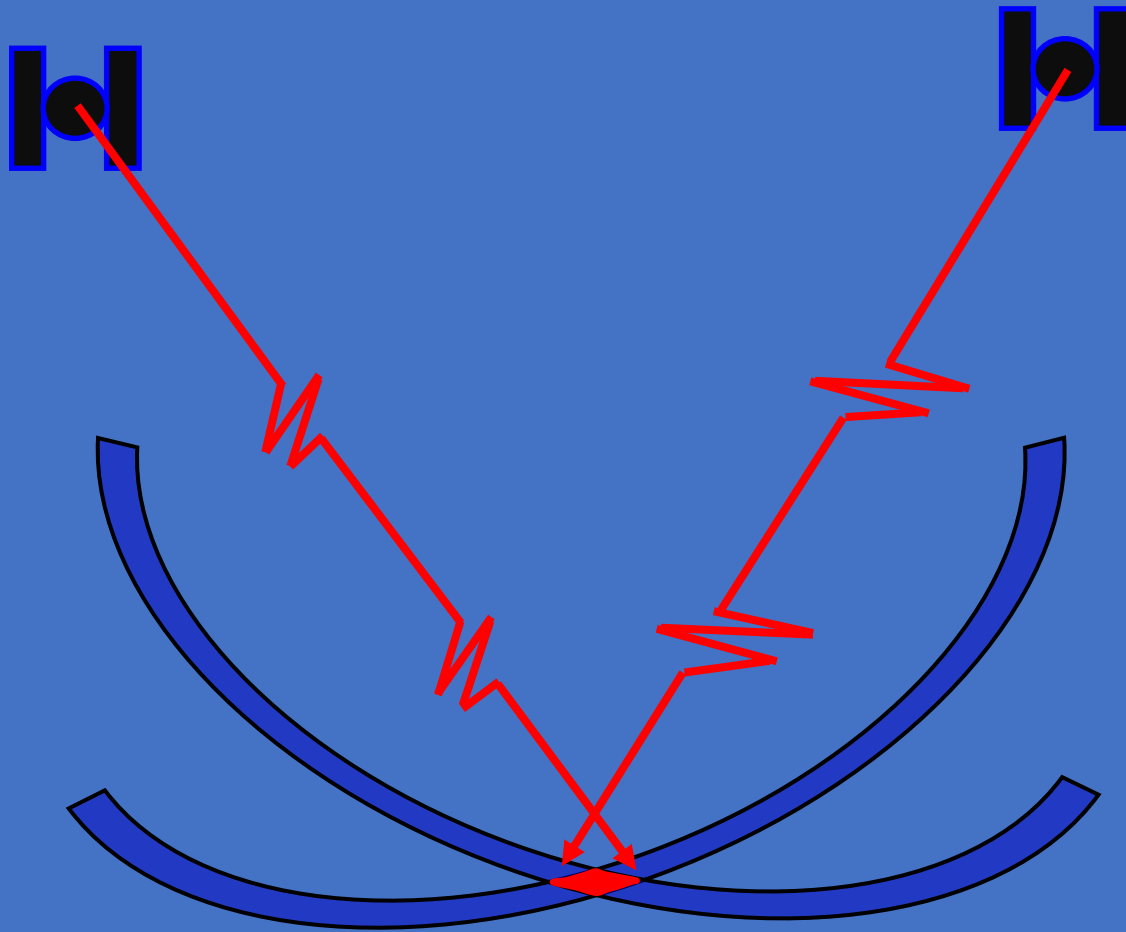


Sifati	DOP
<i>Juda yaxshi</i>	1-3
<i>Yaxshi</i>	4-5
<i>Qoniqarli</i>	6
<i>Qoniqarsiz</i>	>6

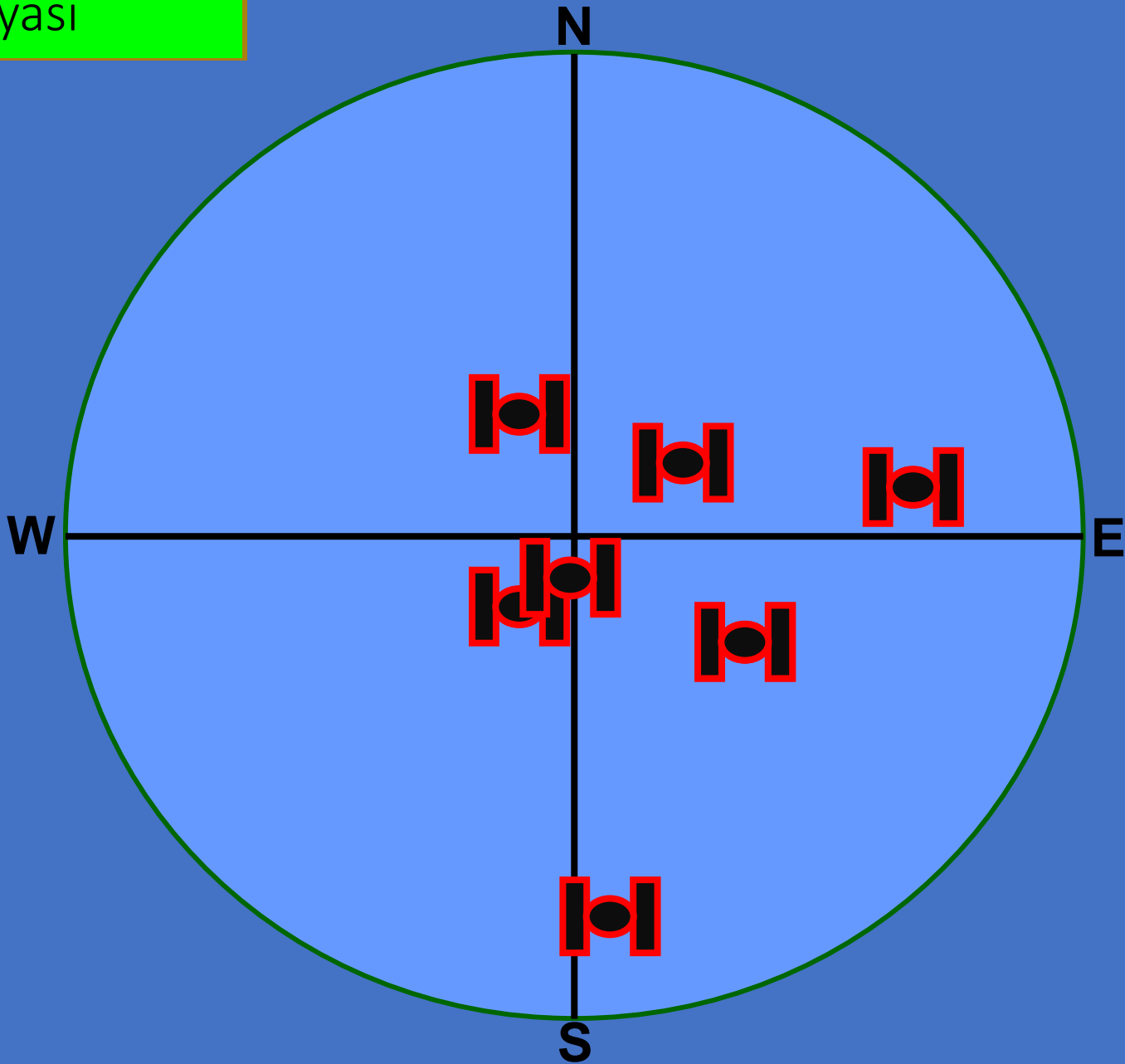
Ideal Sputnik Geometriyasi



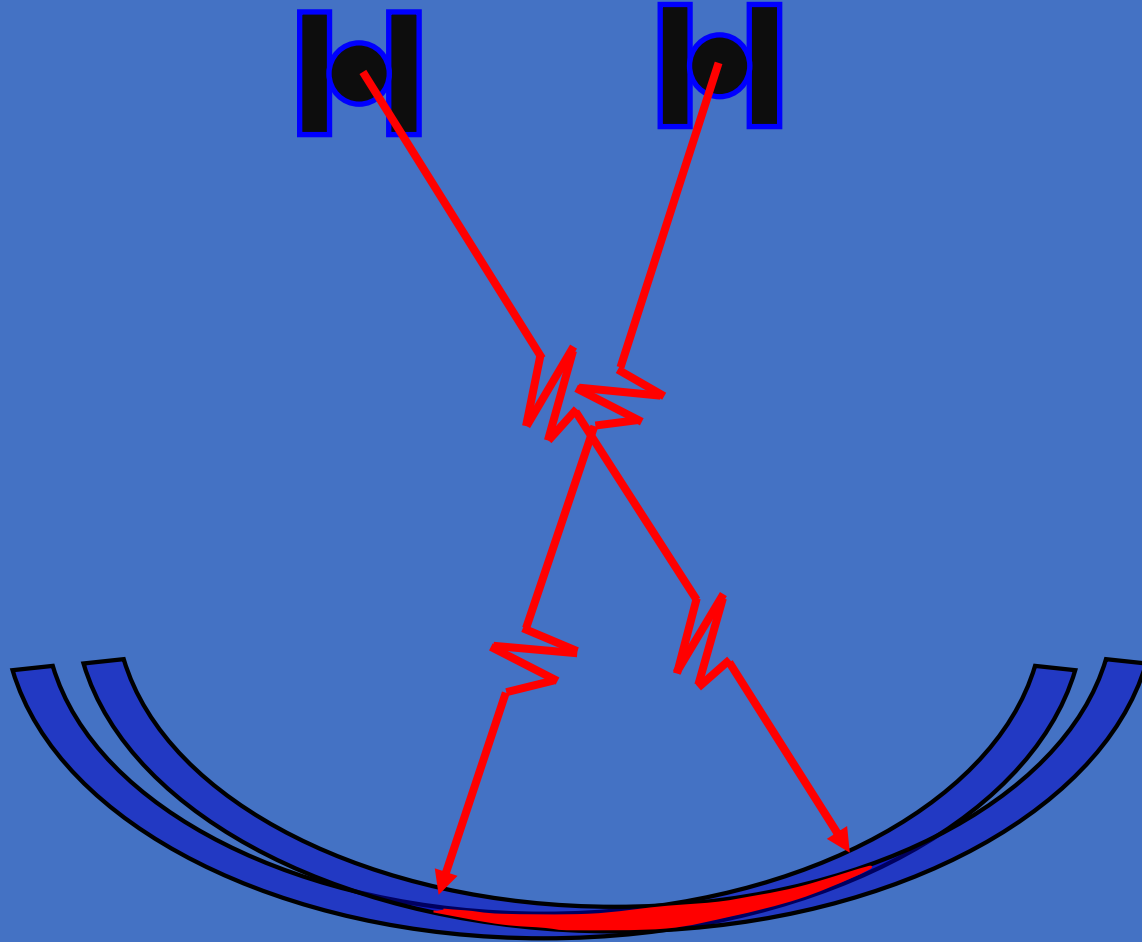
Yaxshi sputnik geometriyasi



Yomon sputnik geometriyasi



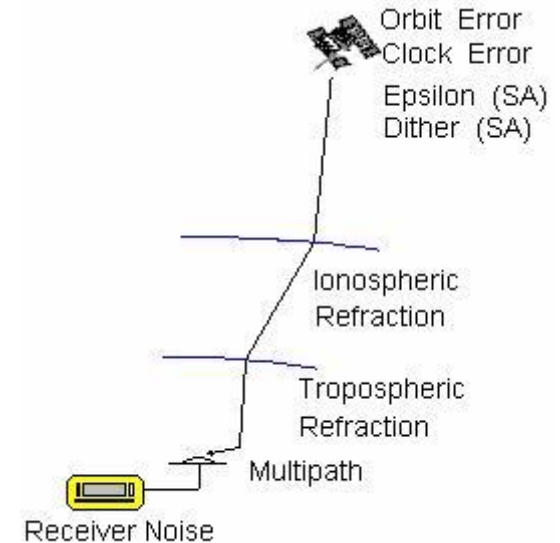
Yomon sputnik geometriyasi

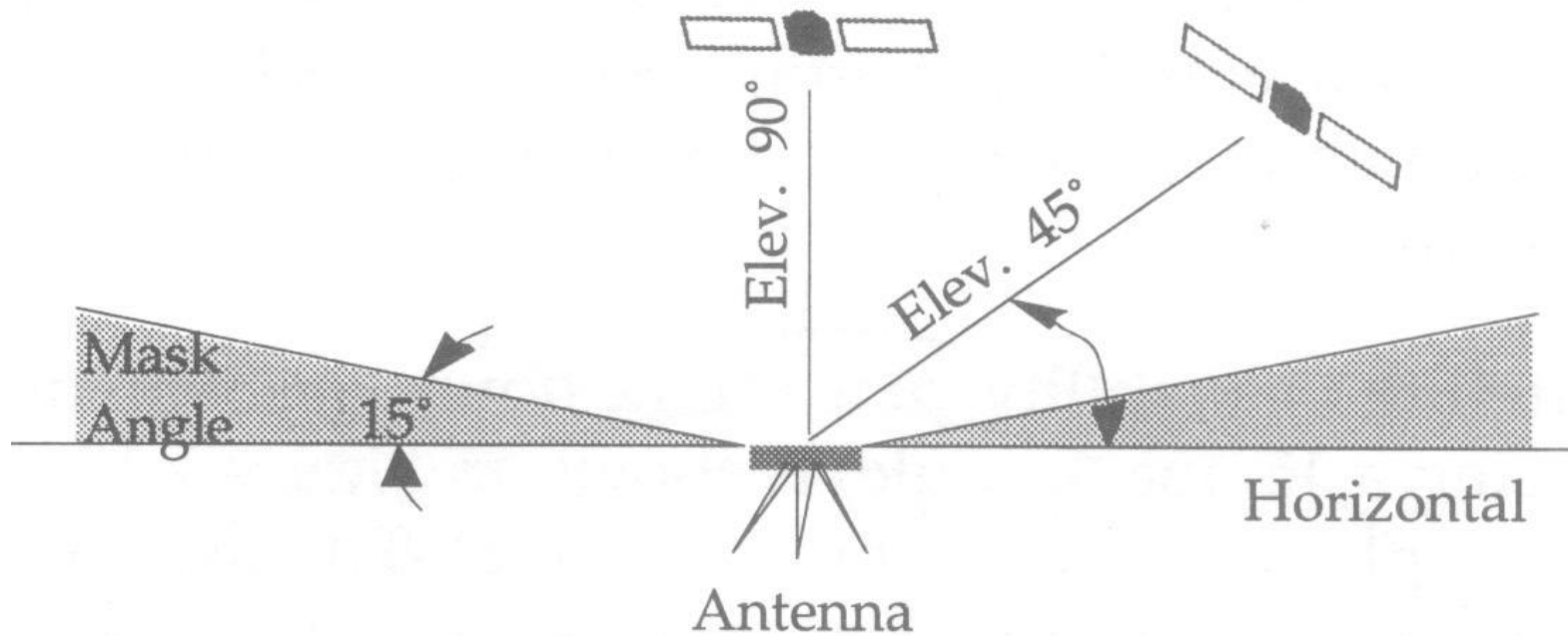


GPS ning xatoliklari manba'i

Standart Joylashuv Hizmati (SPS):

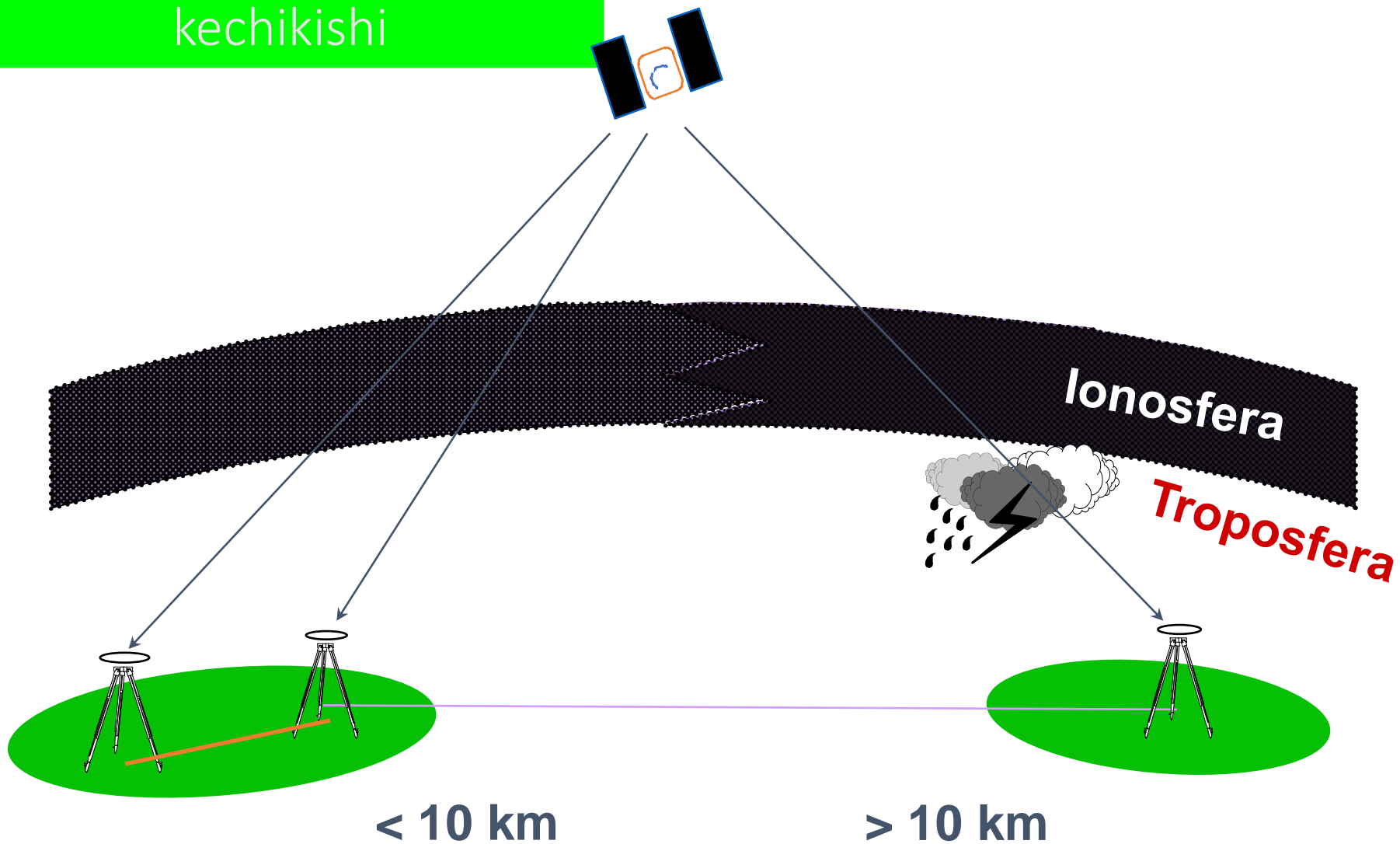
- Sputnik vaqtlari: < 1 to 3.6 m
- Orbiat xatolik: < 1 m
- Antena xatoligi: 0.3 to 1.5 m
- Ionosfera: 5.0 to 7.0 m
- Troposfera: 0.5 to 0.7 m
- Foydalanuvchi xatoligi: km yoki undan ham kop



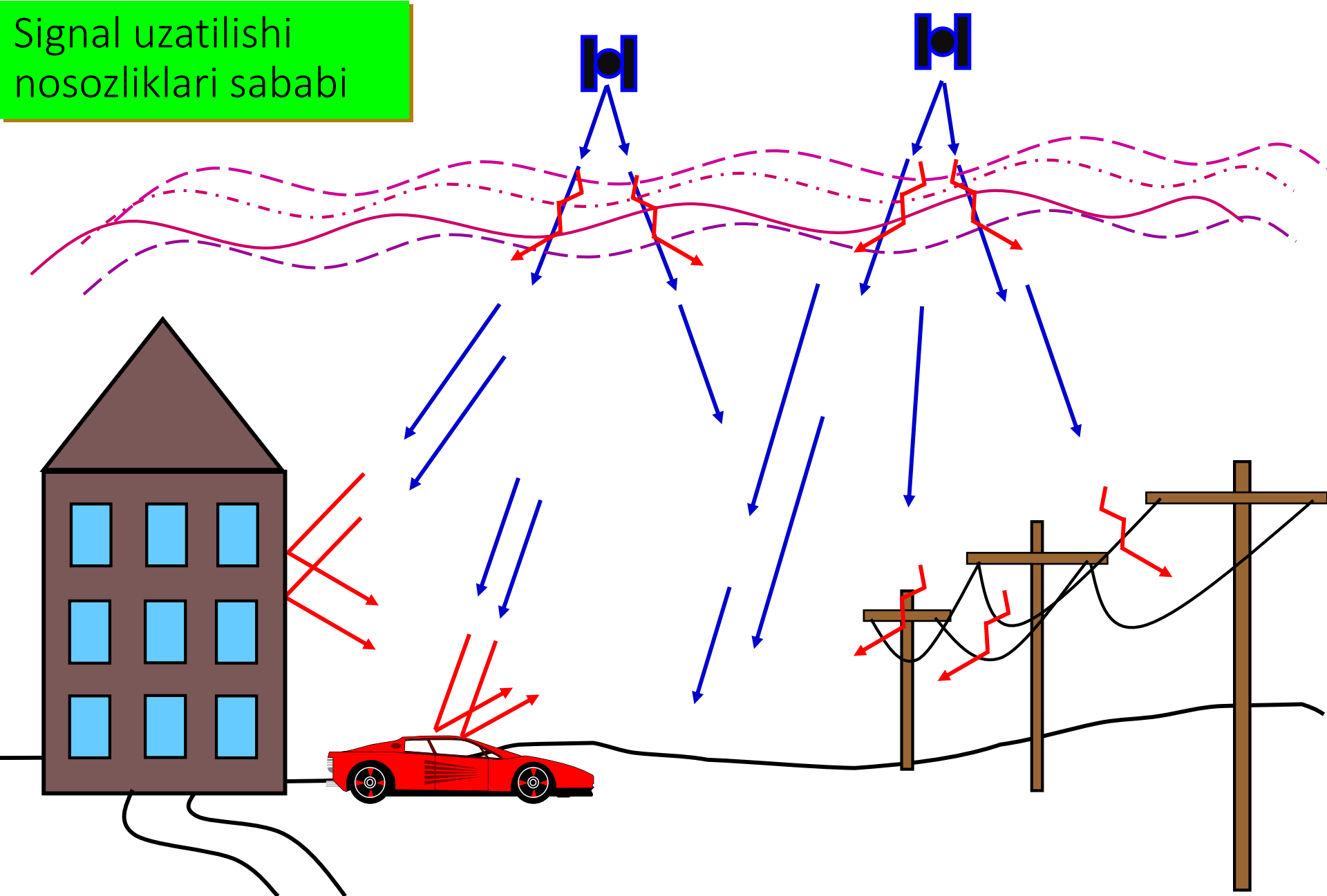


Rel'ef burchaklari

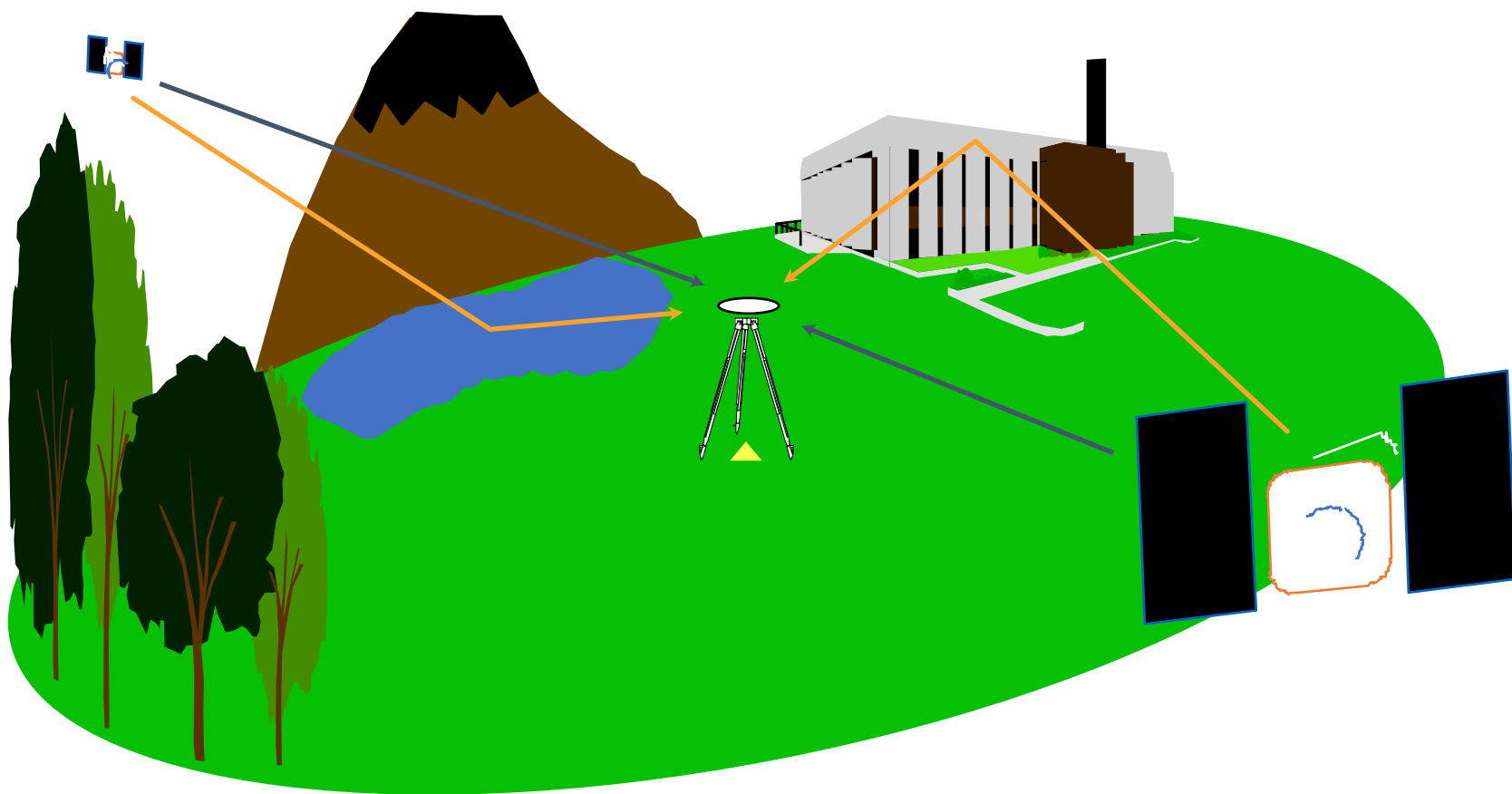
Atmosferadan signallar kechikishi



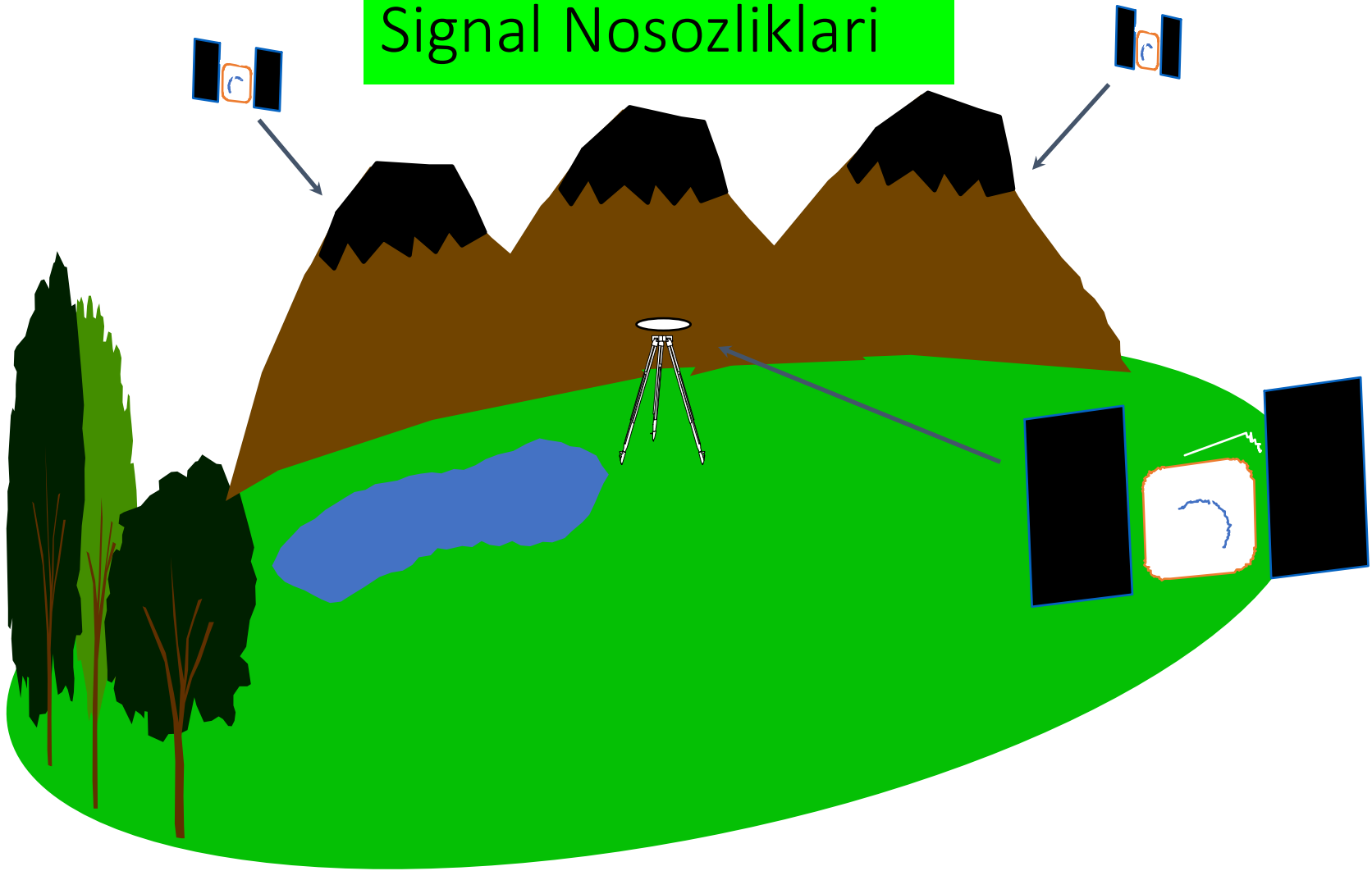
Signal uzatishi
nosozliklari sababi



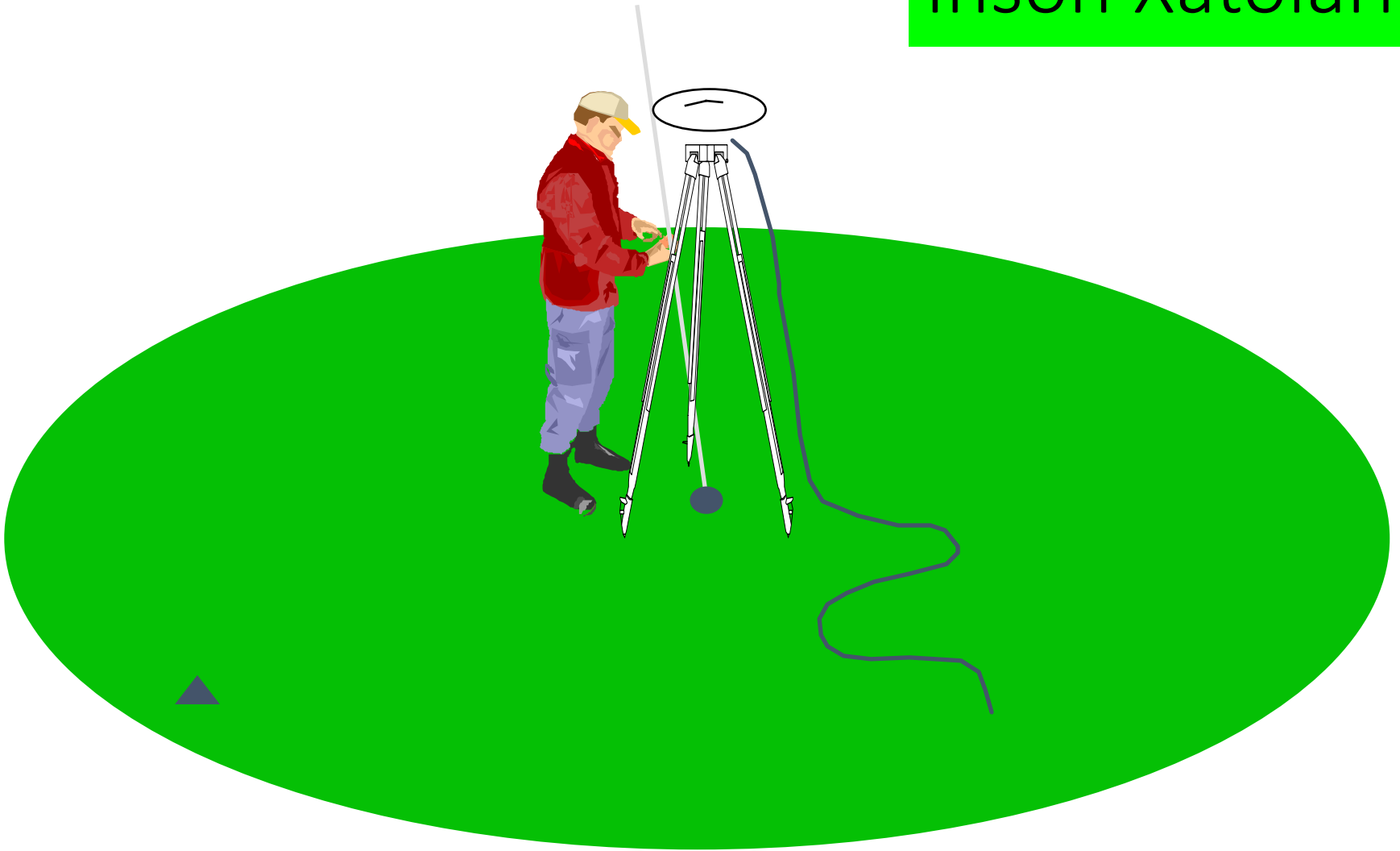
Ko'p nurli uzatish usuli hatoliklari



Signal Nosoziqlari



Inson Xatolari



GPS kimlar tomonidan ishlatiladi

Ma'lumot uzatish
strukturasi

Shaxsiy Navigatsiya

Yuk tashish

Yer o'lchash va
xaritashunoslik

Aviatsiya

Dam olish zonalari

A'loqa

Temiryo'llar

Baliqchilik va
kemachilik

Dengizshunoslikda



Dehqonchilikda
maydon o'lchash



Qishloq xo'jaligi mashinalari



AP

Transport:
Kemlar
Yuk moshinalar
Yengil
moshinalar!?!?!

Mobil Telefonlar



Uskunalar turlari:
Kenwood GPS markadagi uskunalar
Avtomatik GPS:
Garmin - Magellan
TomTom markadagi



Kuzatuv
Soatlari



Ma'lumot qayd
qiluvchi
uskuna



Cho'ntak
kompyuterlari

GPS sifrovoy
camera/video