

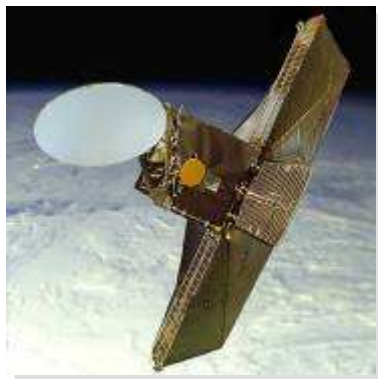


Att verifiera komplexa autonoma system utanför sin målmiljö

**Mikael Björklund
Swedish Space Corporation
"Rymdbolaget"**



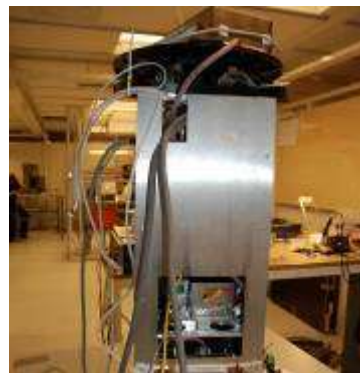
Projects since 1972



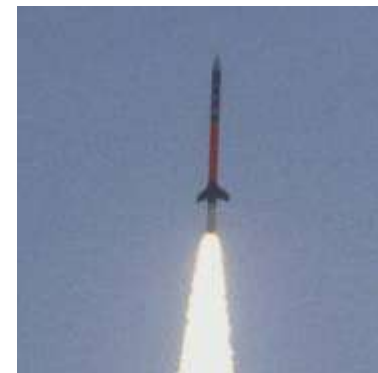
6 scientific satellites



60 rocket systems



60 experiment modules



500 rocket launches



550 balloon launches



60 maritime surveillance systems



communication with more than 100 satellites



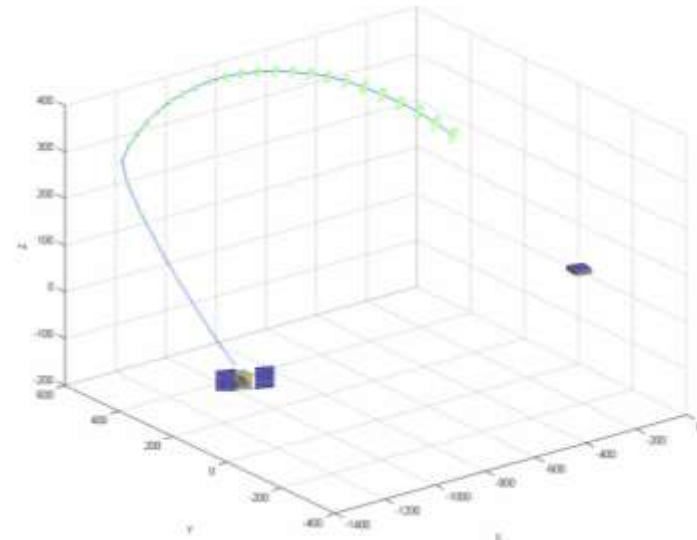
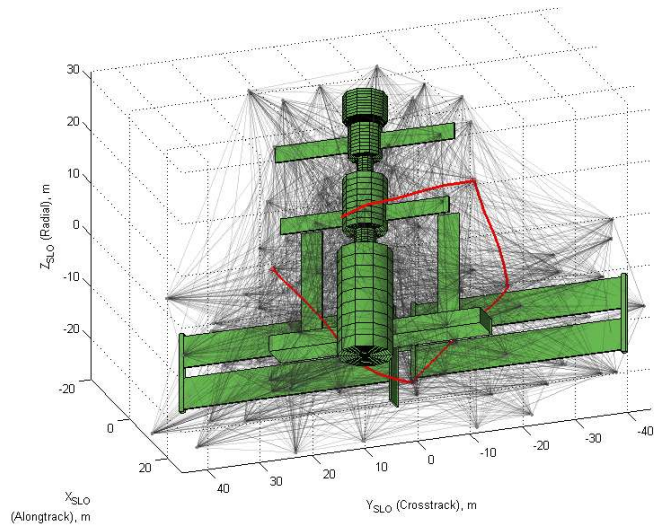
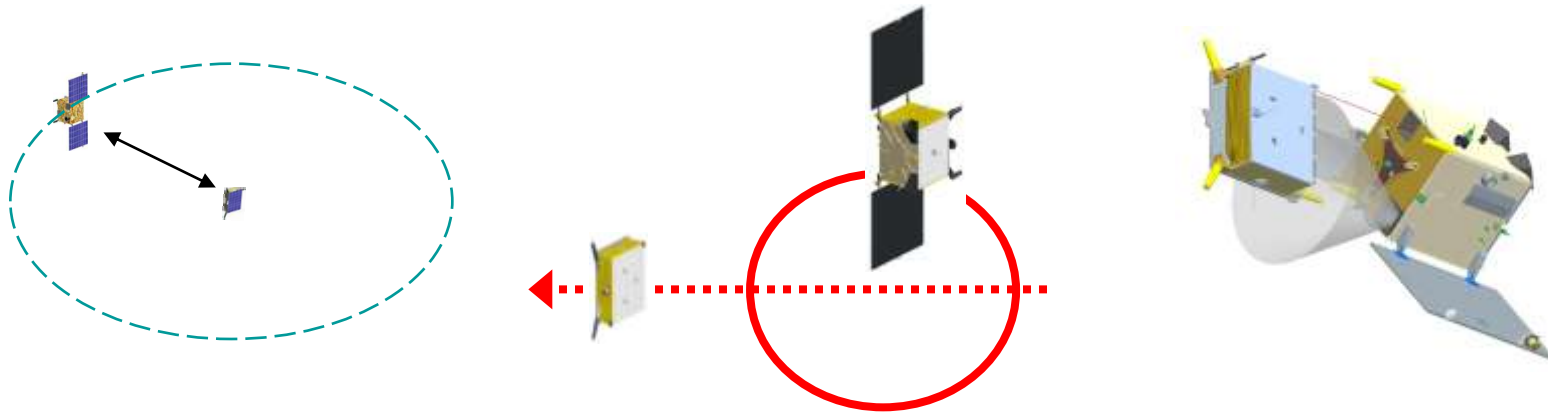
Prisma



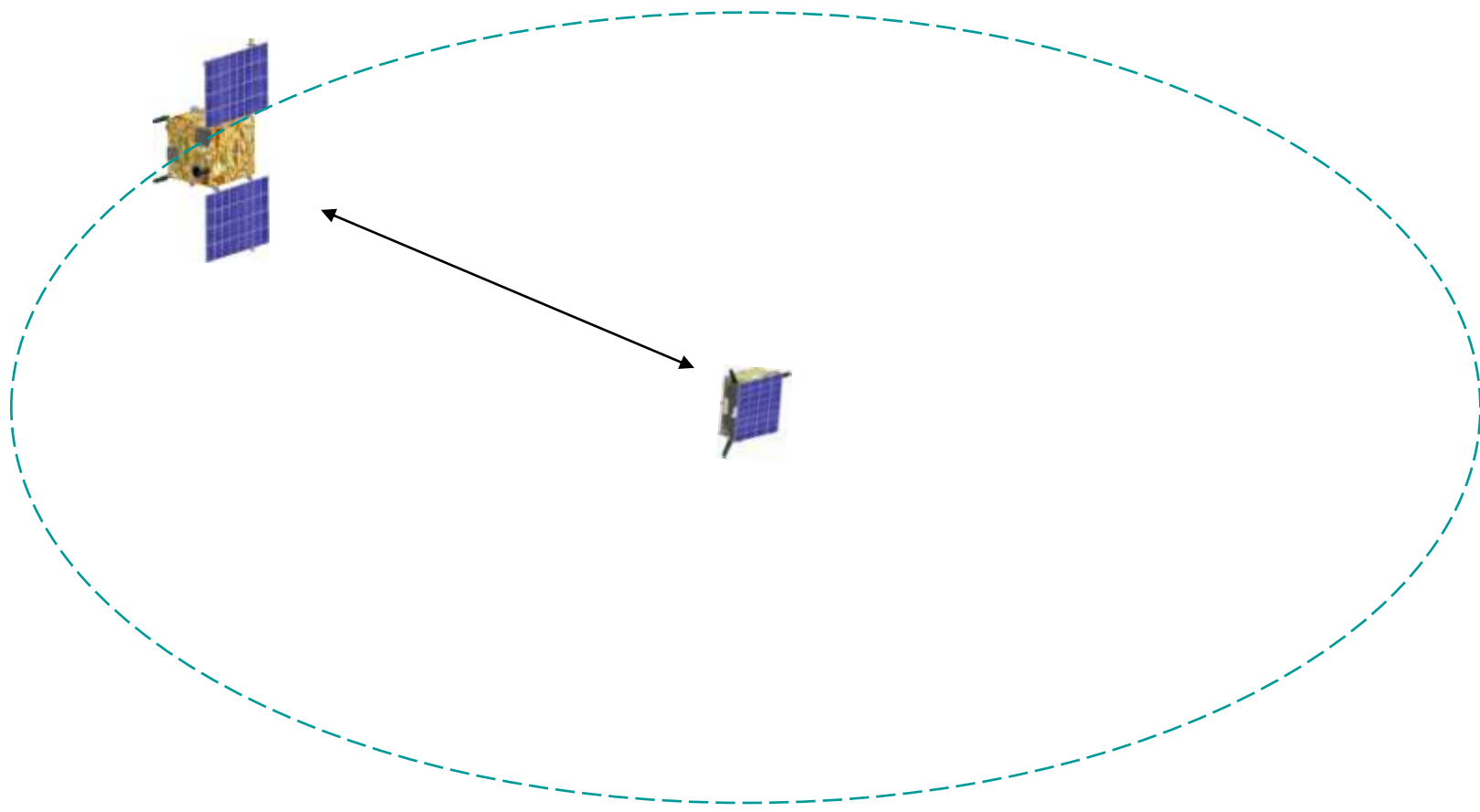
- **Två satelliter (Mango och Tango)**
- **Demonstration av nyutvecklade sensorer för formationsflygning**
- **Test av ny teknik för rymdbruk**
- **Internationellt samarbete mellan Sverige, Frankrike, Tyskland och Danmark**
- **Uppskjutning 2010 ifrån Ryssland**



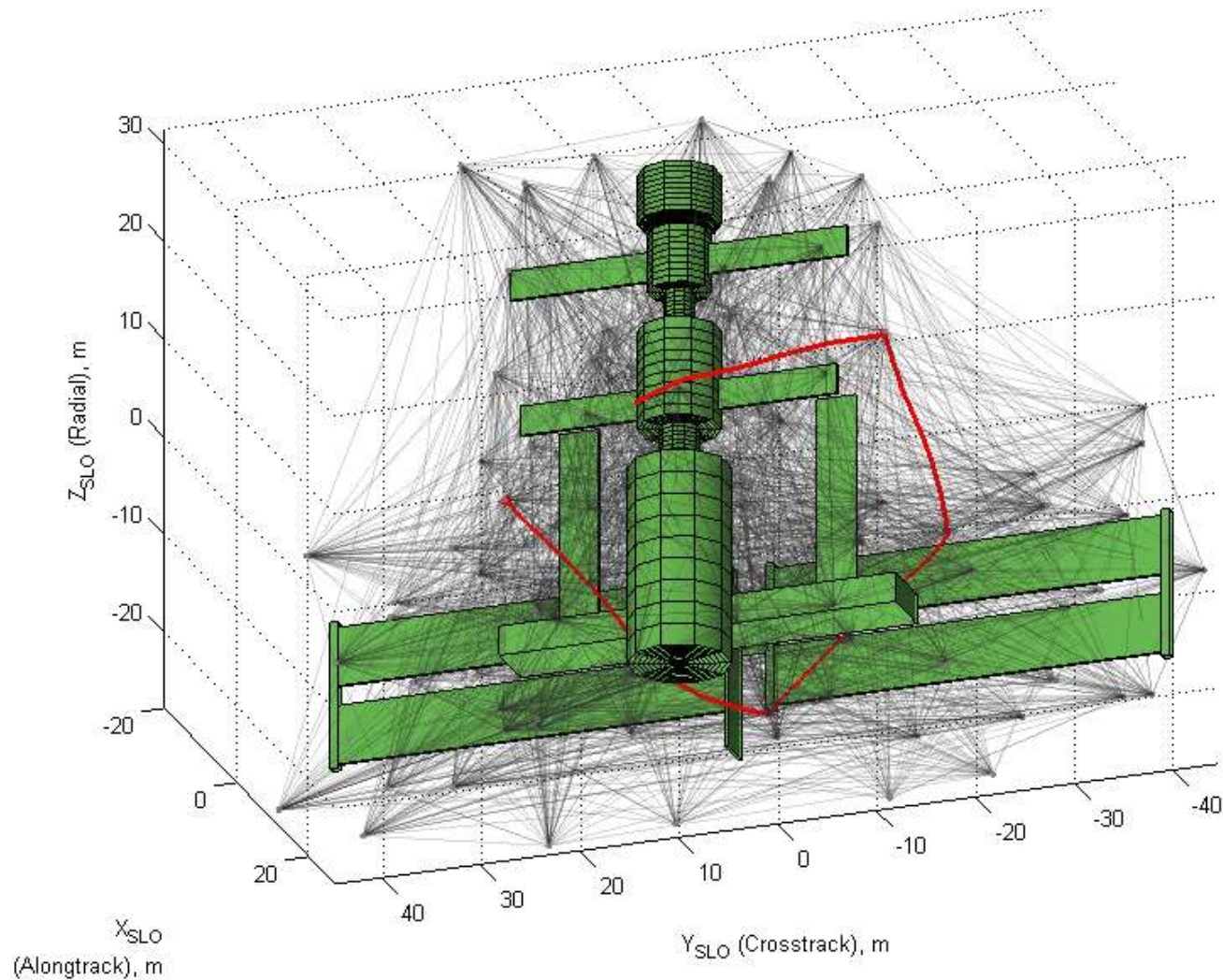
Autonom formationsflygning



Autonom formationsflygning



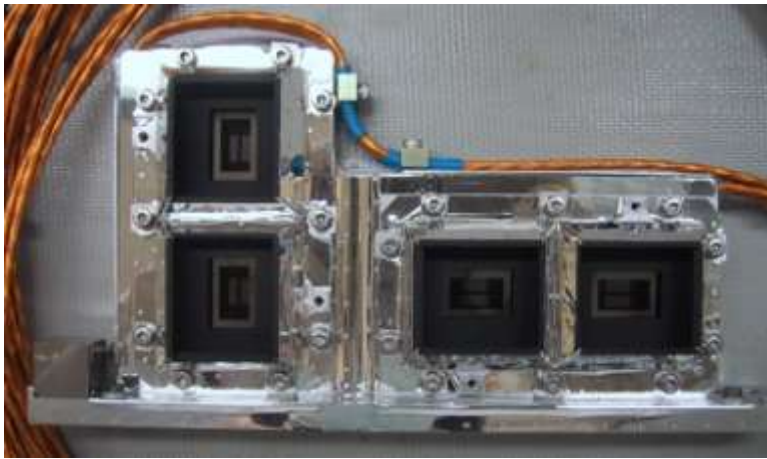
Autonom formationsflygning



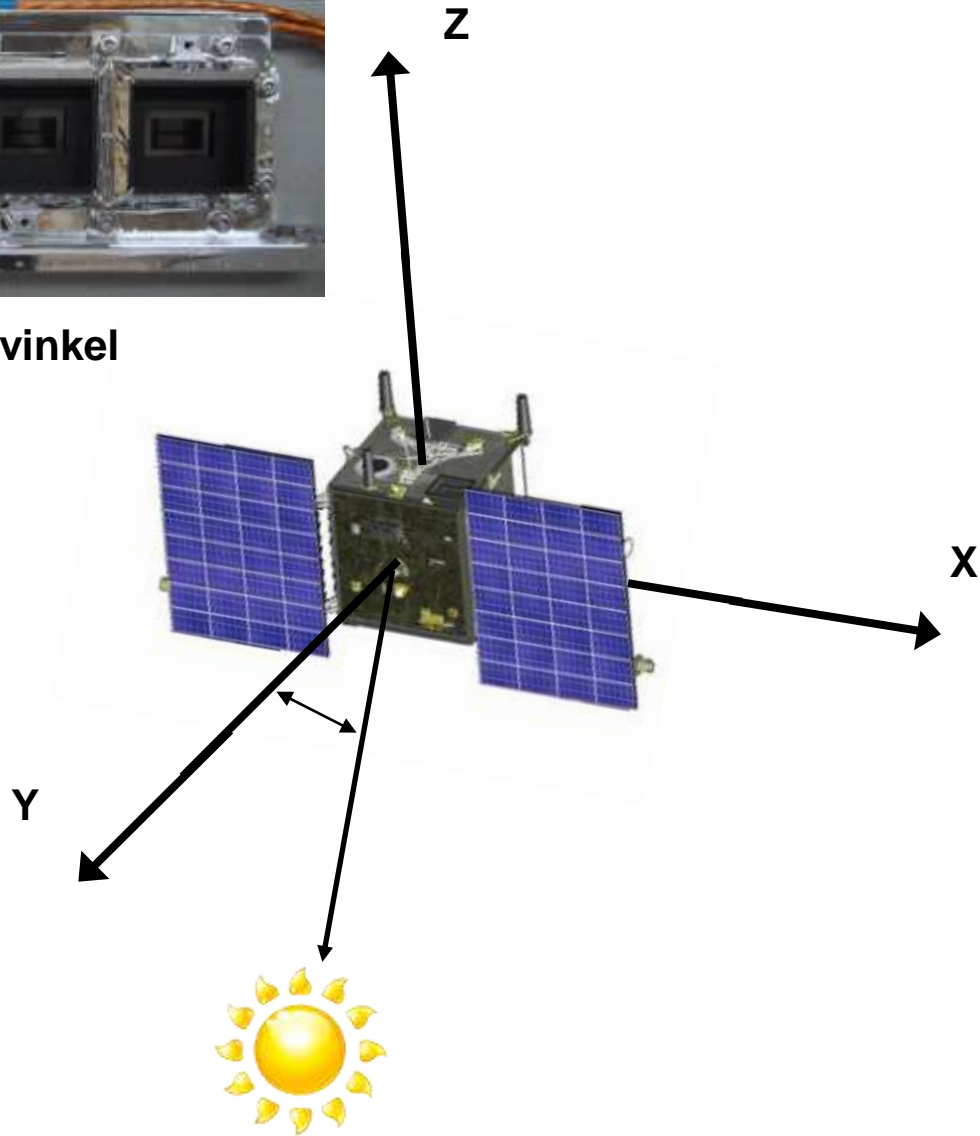
Utanför sin målmiljö

Det går inte att skapa en representativ testmiljö för alla sensorer i systemet



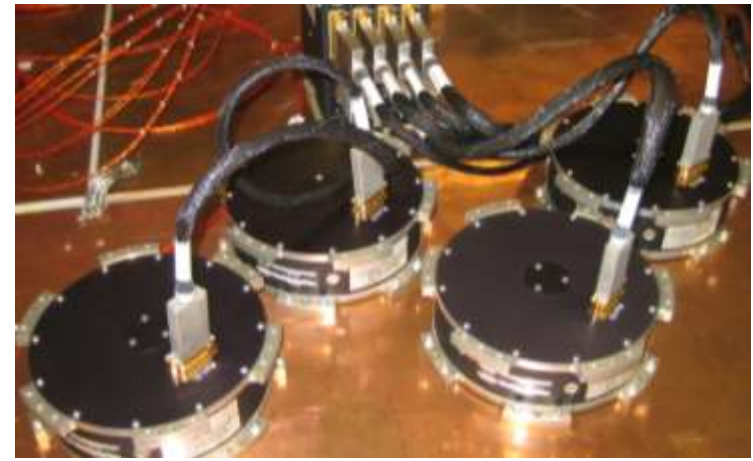


Sensorer för solvinkel

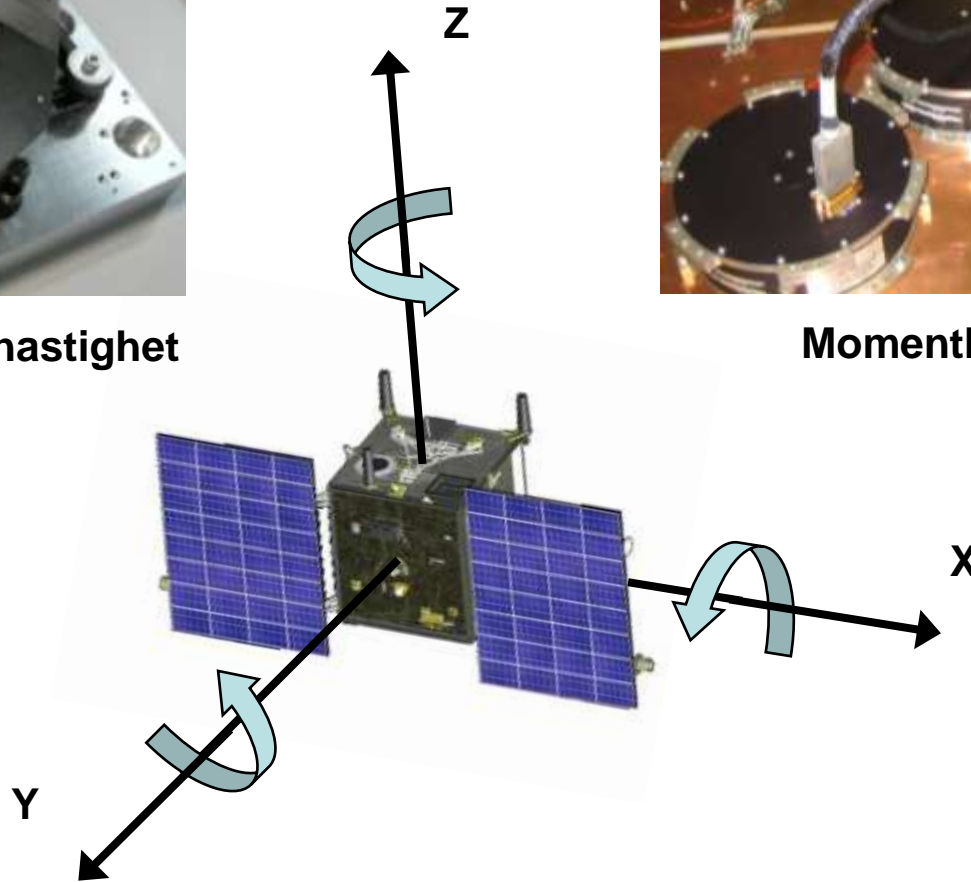




Sensorer för vinkelhastighet



Momenthjul för styrning

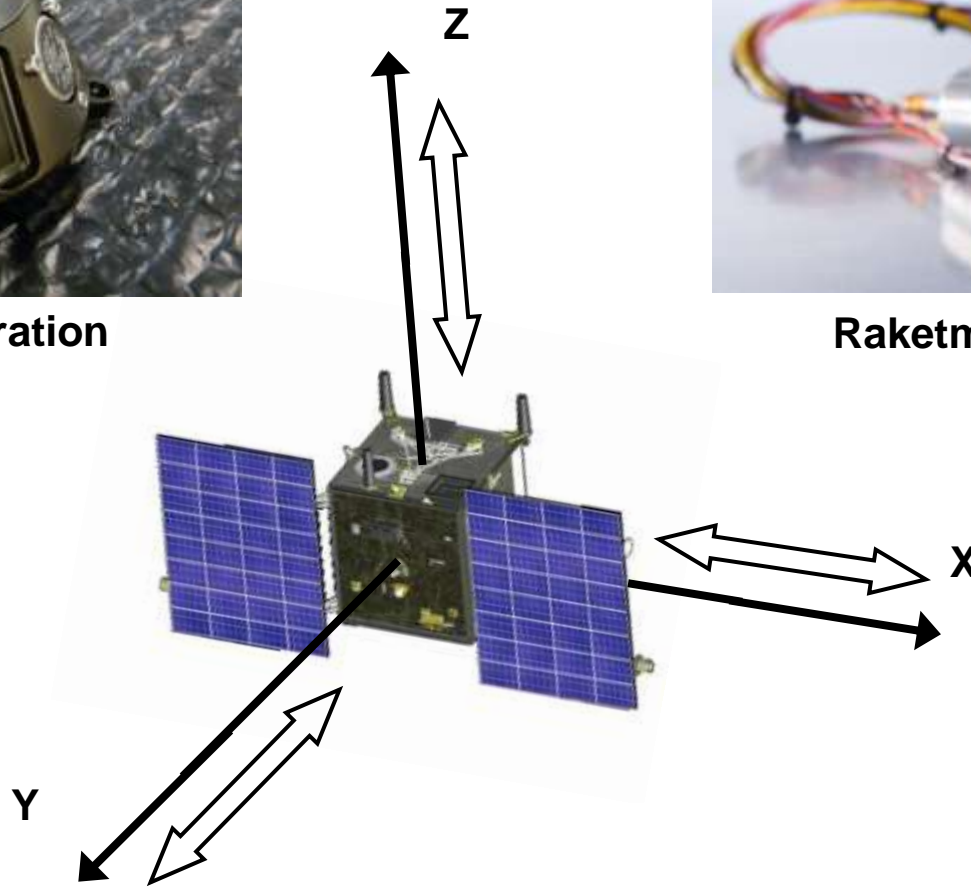


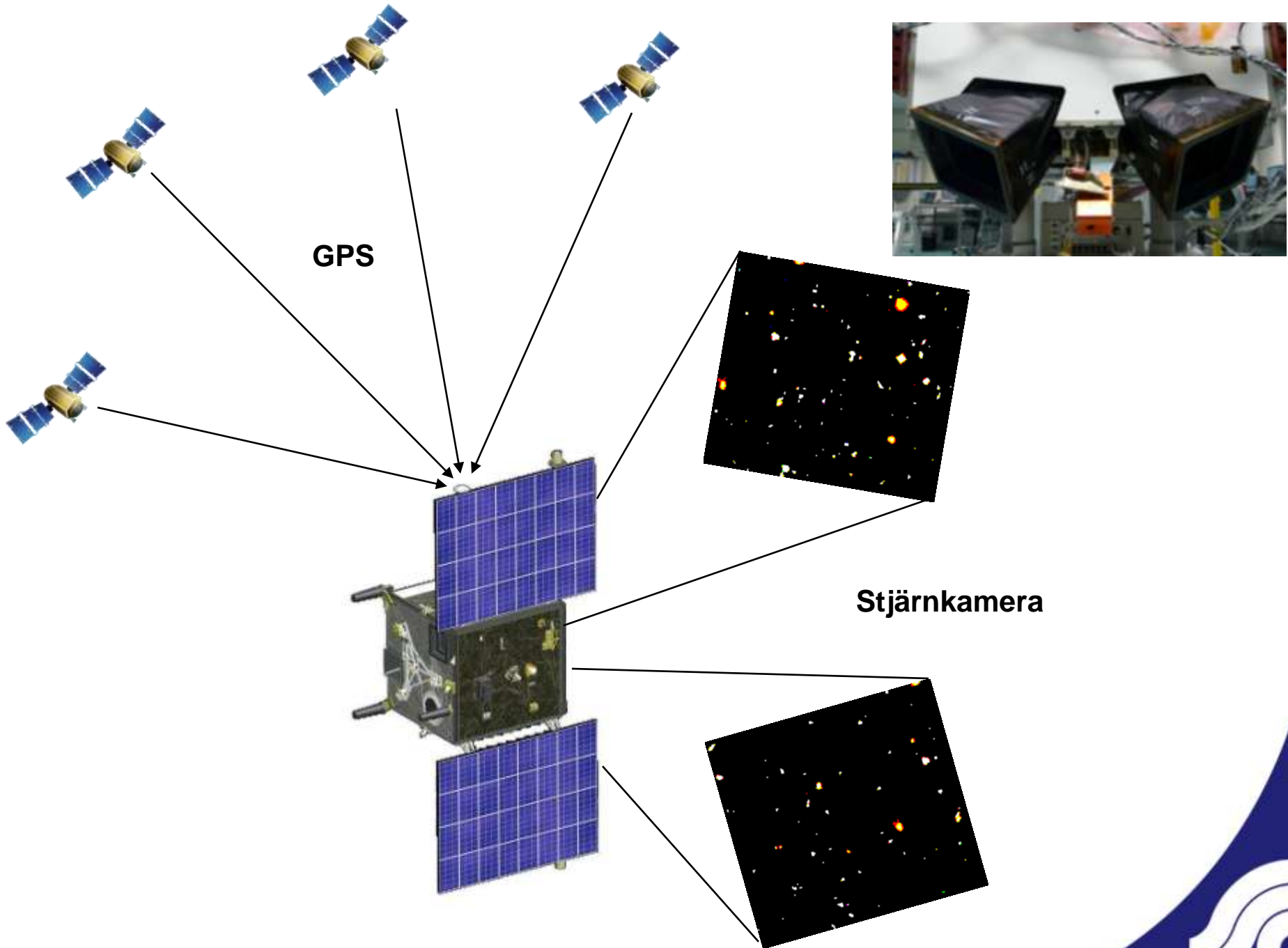


Sensorer för acceleration



Raketmotorer (0.1kg)





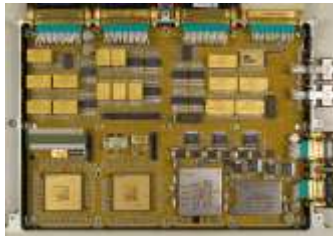
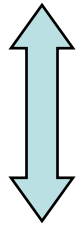
GPS

Stjärnkamera

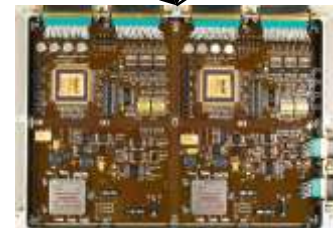
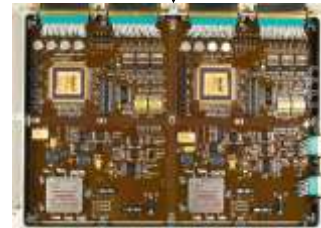
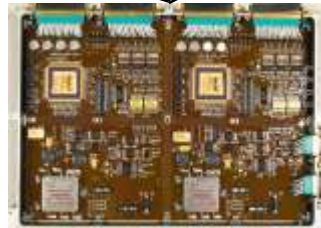
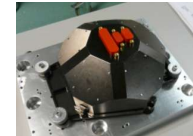
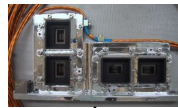


Datahantering ombord

Kommunikation
med marksystem



Omborddator

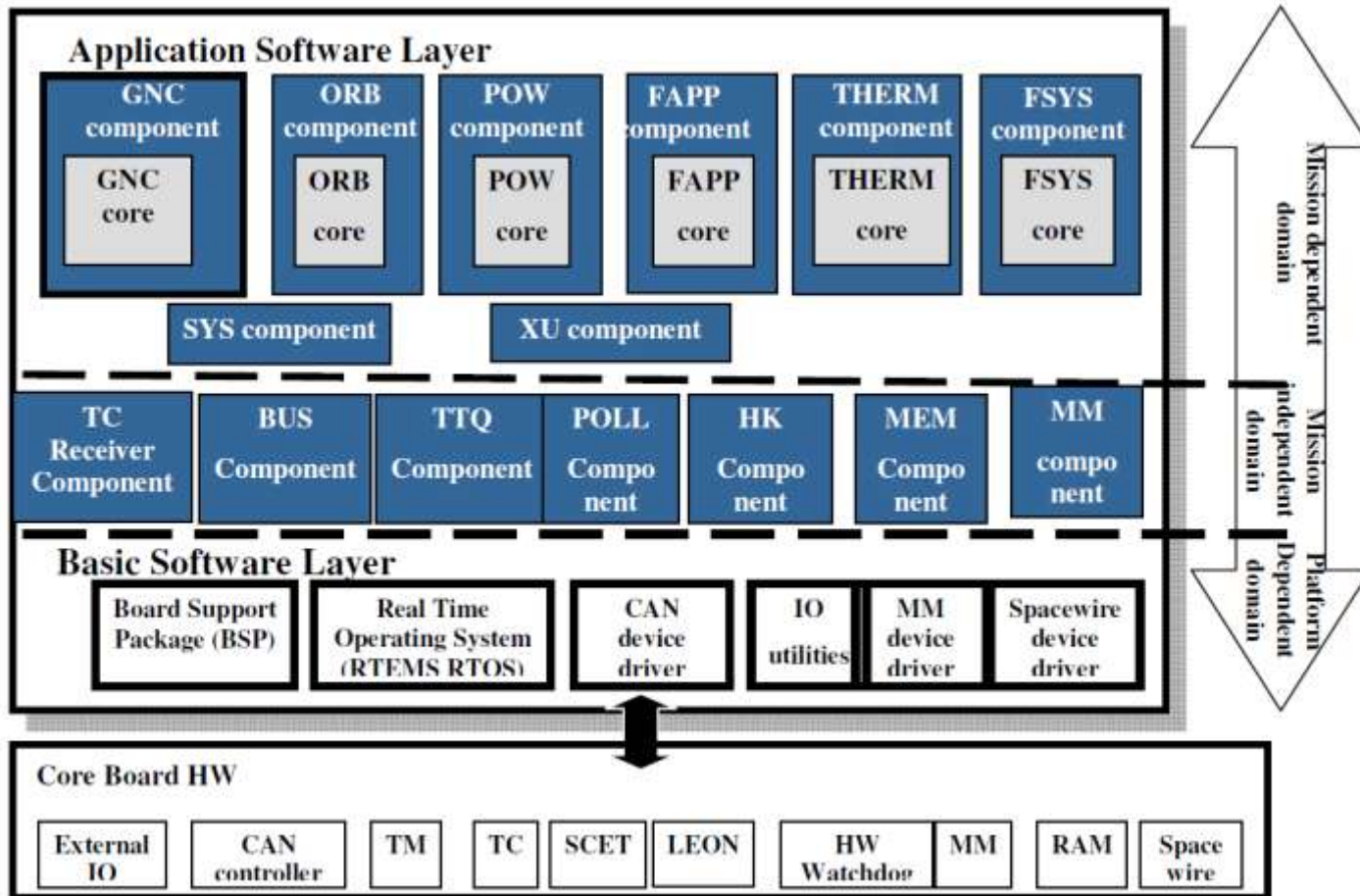


Datainsamling och styrning

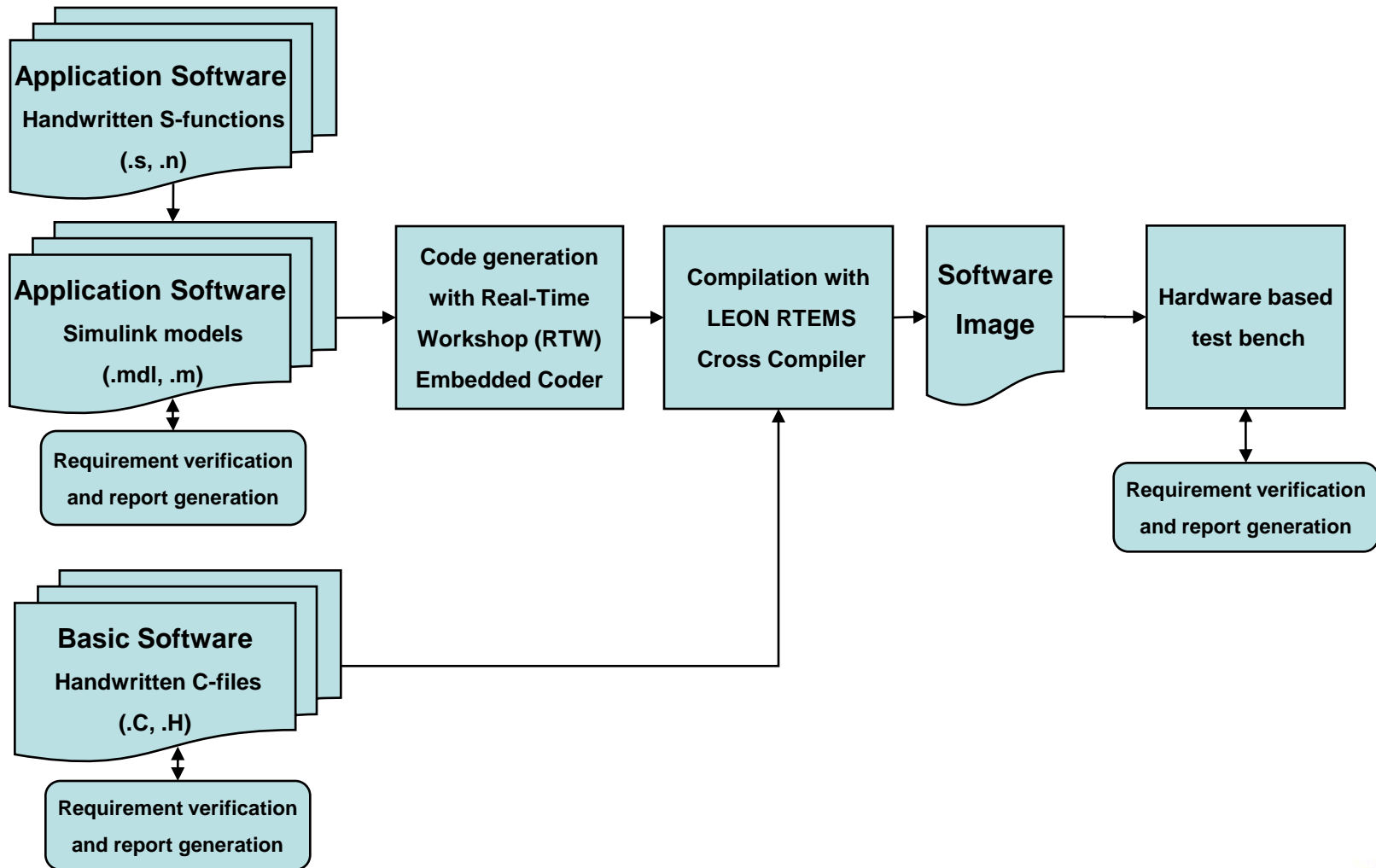
CAN bus



Ombordmjukvara

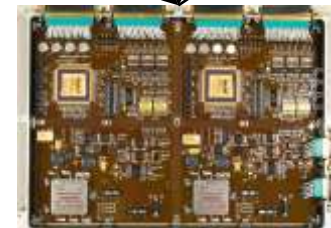
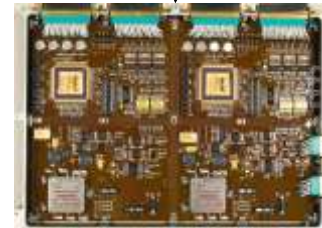
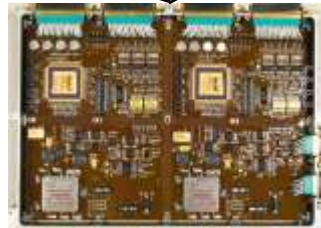
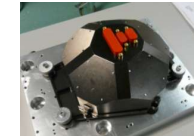
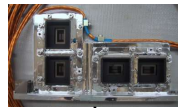
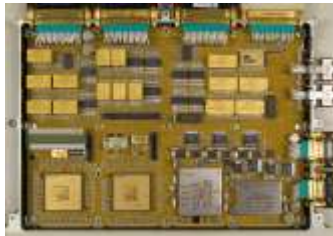
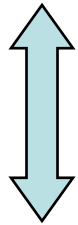


Mjukvaruflöde



Datahantering ombord

Kommunikation
med marksystem



Omborddator

Datainsamling och styrning

CAN bus

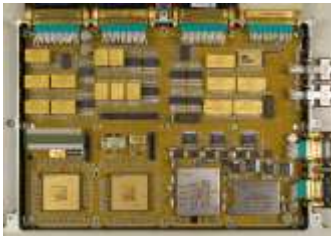
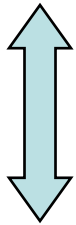


Testmiljö för mjukvaruverifiering innan leverans till systemet

Simulering

- Databasinsamling och styrenheter
- System som kan påverka satellitens position eller attityd i bana.
- Alla sensorer

Kommunikation
med marksystem



Omborddator



SATSIM
xPCtarget

CAN bus



Flygsimulatore "SATSIM"

Omgivningens dynamik

- Jordens magnetfält
- Solen, jorden och månens position
- Solens och atmosfärens påverkan

Satellitens position och dynamik

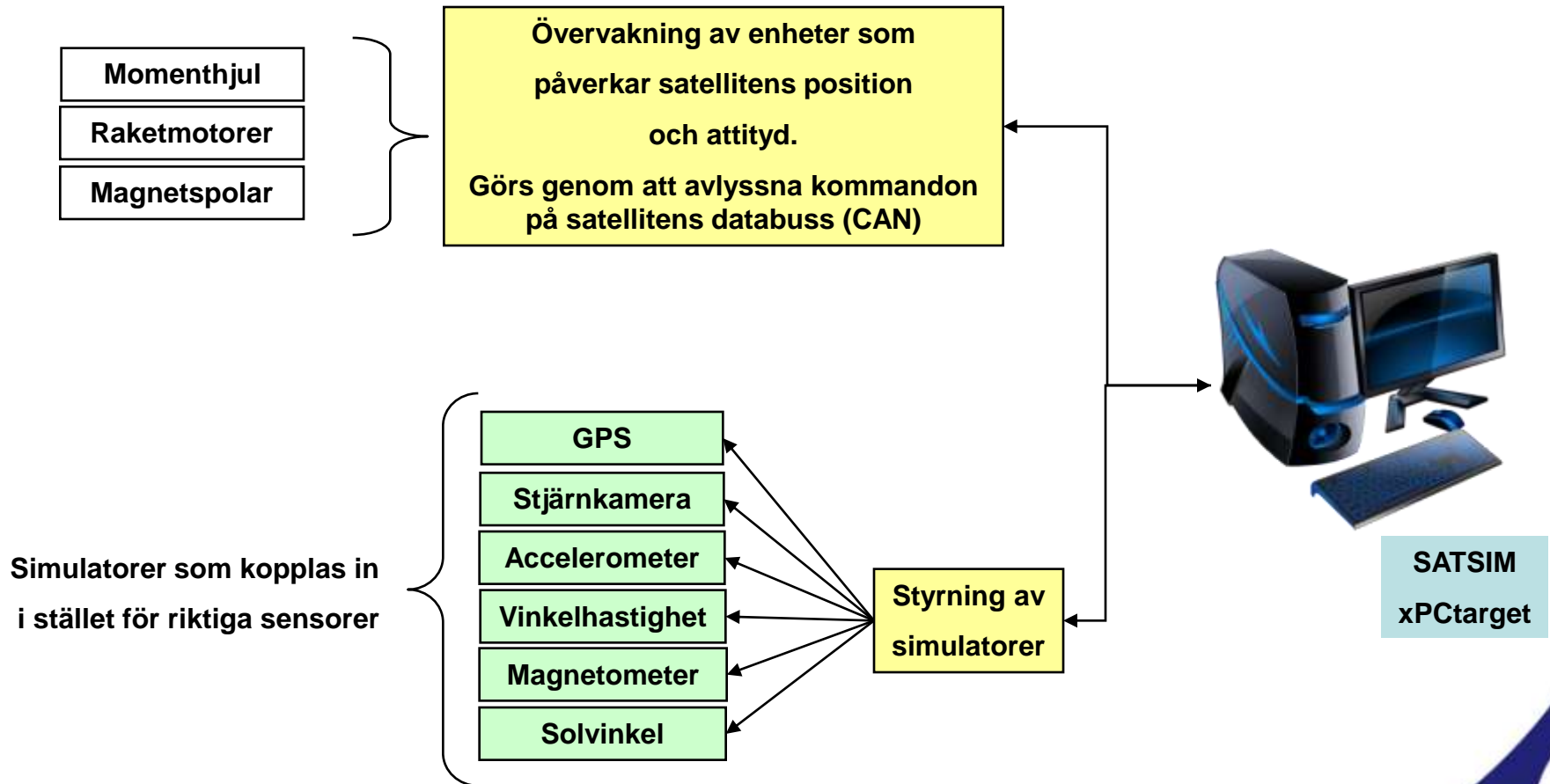
- Position i banan
- Attityd i banan
- Tröghetsmoment



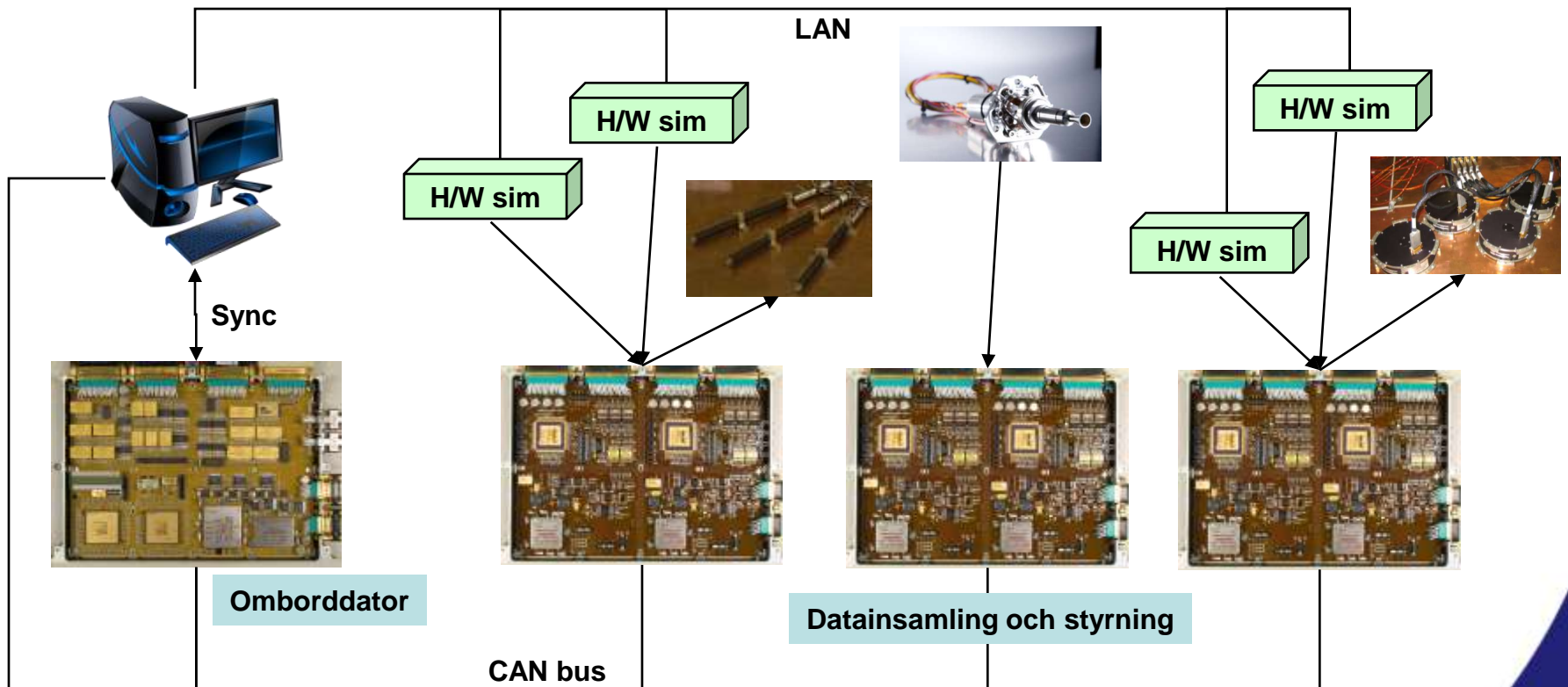
SATSIM
xPCtarget



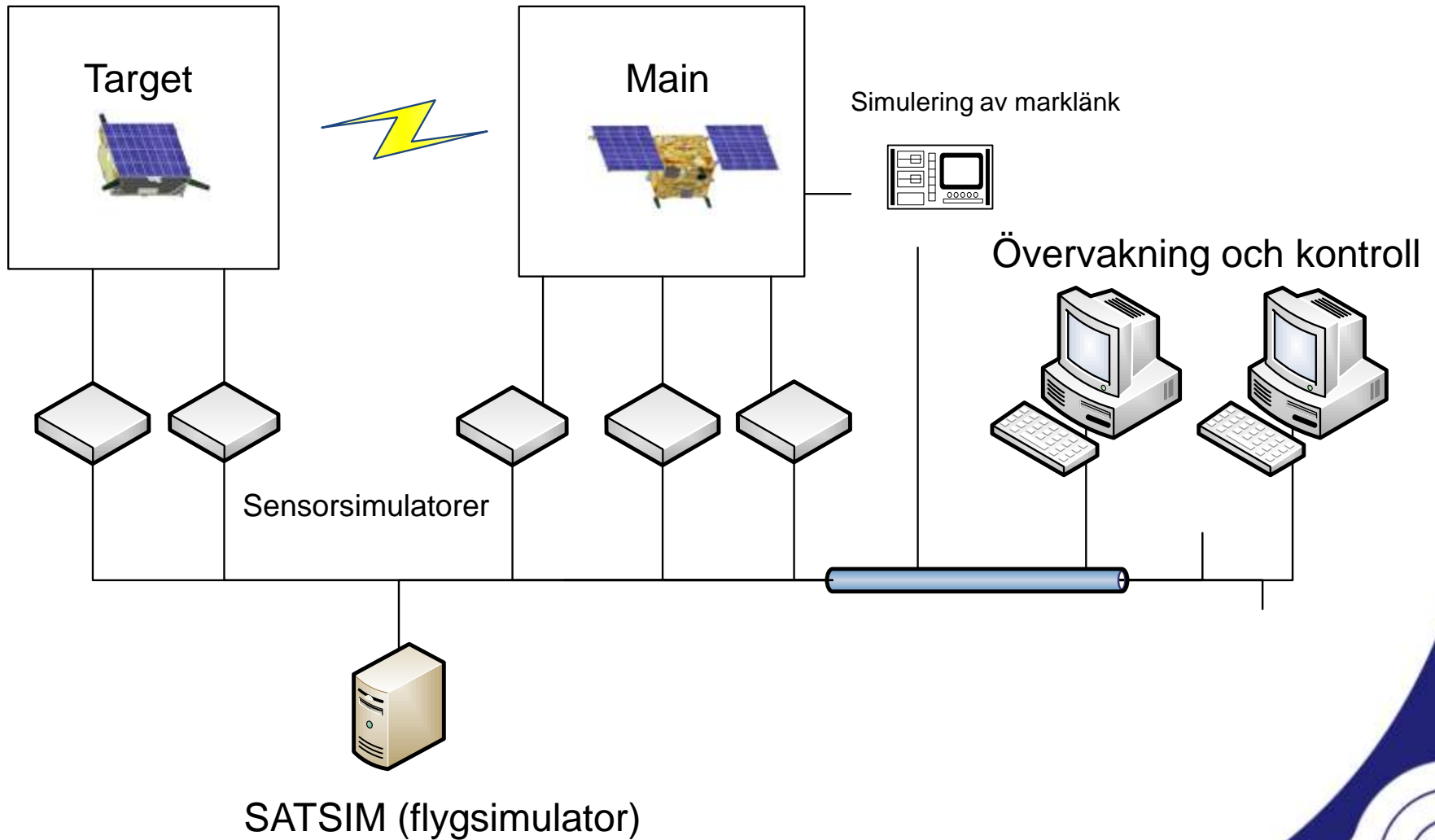
SATSIM under systemtester



SATSIM under systemtester



Testuppställning "hardware in a closed loop"







Tack för mig!

www.ssc.se



