DS-FTP: Deep Space File Transfer Protocol

Presented by:
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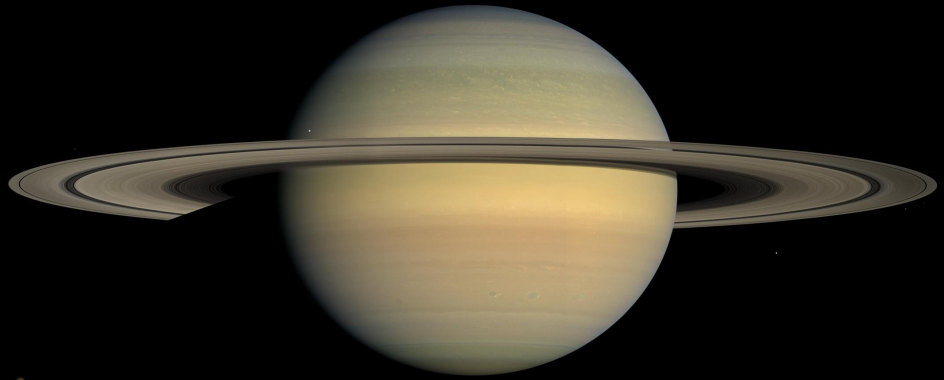
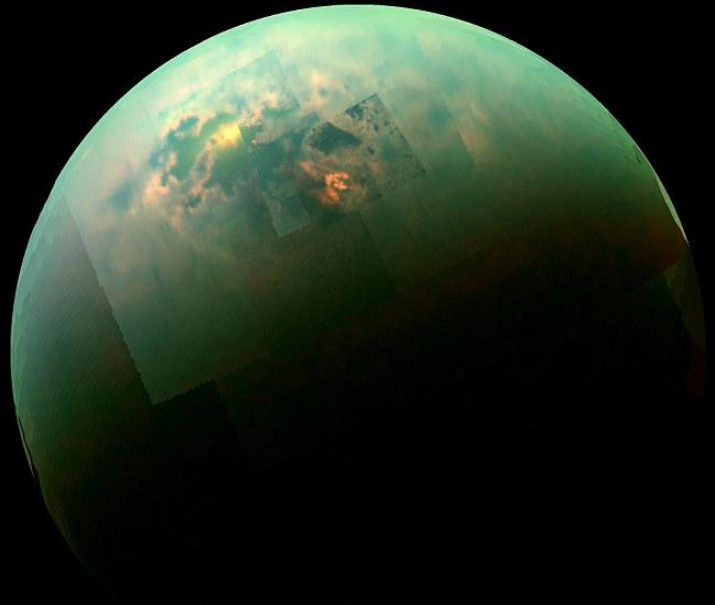
Overview

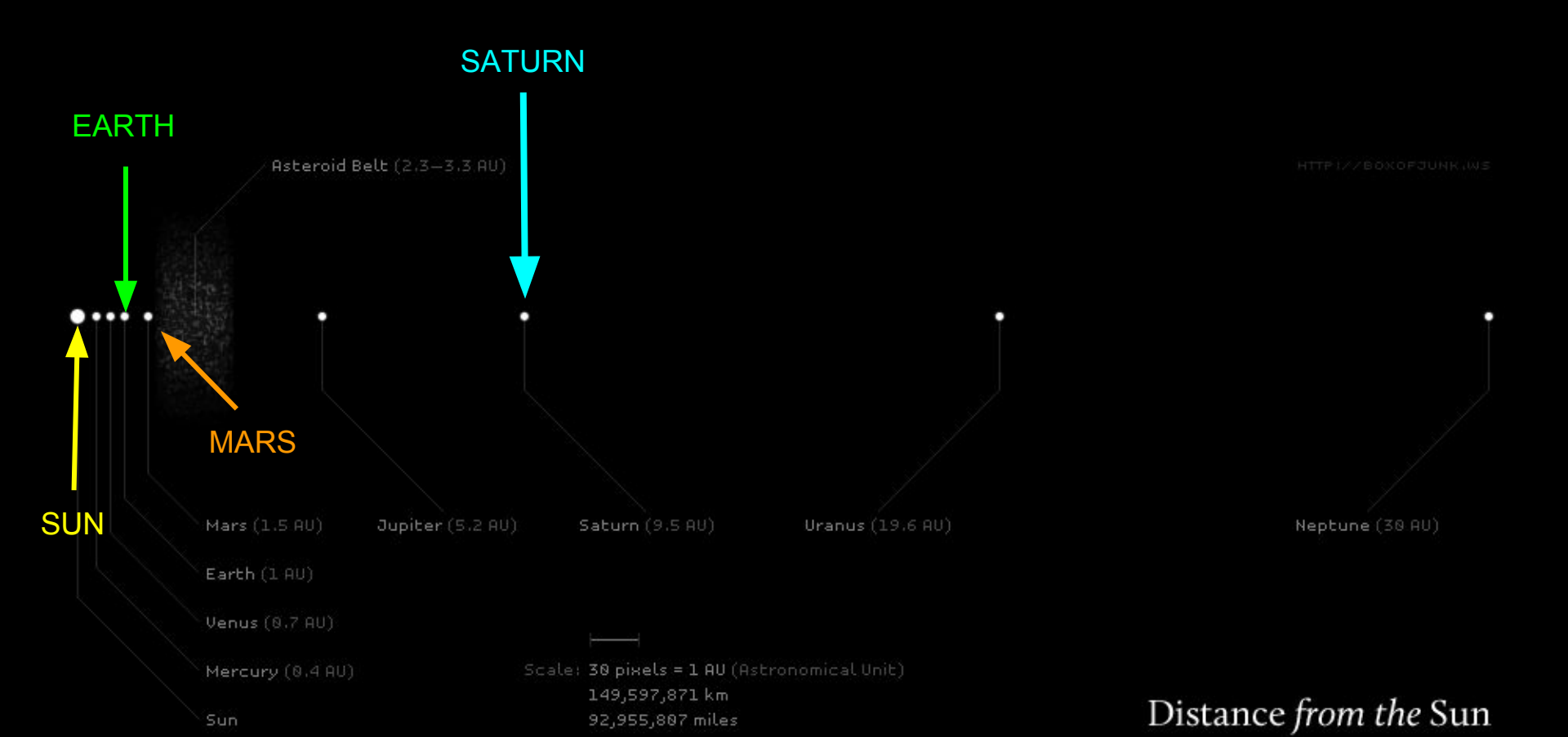
- Motivations
- Related Work
- Data Structures & Messages
- Sending and Receiving Algorithm
- Conclusions & Future Work



Saturn, as seen by the Cassini craft in 2008



Saturn’s second-largest moon, Titan. Solid surface, lakes of methane (rocket fuel) and nitrogen-atmosphere


SATURN
EARTH
Asteroid Belt (2.3–3.3 AU)
HTTP://BOXOFJUNK.WS
MARS
SUN
Mars (1.5 AU)
Jupiter (5.2 AU)
Saturn (9.5 AU)
Uranus (19.6 AU)
Neptune (30 AU)
Earth (1 AU)
Venus (0.7 AU)
Mercury (0.4 AU)
Sun
Scale: 30 pixels = 1 AU (Astronomical Unit)
149,597,871 km
92,955,807 miles
Distance from the Sun

Introduction and Motivation

The year is 2563, and "*Fast and Furious 482: Asteroid Drift*" just came out back on Earth. You're working as a space pilot on Titan. You want to watch it, but how do you get a copy?

- Saturn is 4,260 light-seconds (~71 light-minutes) away from the earth
- Propagation delay = 4,260 seconds
- RTT = 8,520 seconds (2 hours 22 minutes)
- How do we send an IP-based message back and forth?
- Special case of Delay Tolerant Networking (DTN)

Related Work

"*Deep Space Transport Protocol: A novel transport scheme for Space DTNs*", Papastergiou, Psaras, Tsaoussidis

"*A Reconfigurable Context-Aware Protocol Stack for Interplanetary Communication*", Peoples, Parr, Scotney, Moore

"*Space for Internet and Internet for Space*", Burleigh, Cerf, Crowcroft, Tsaoussidis

"*The Interplanetary Internet implemented on a terrestrial testbed*", Mukherjee, Ramamurthy

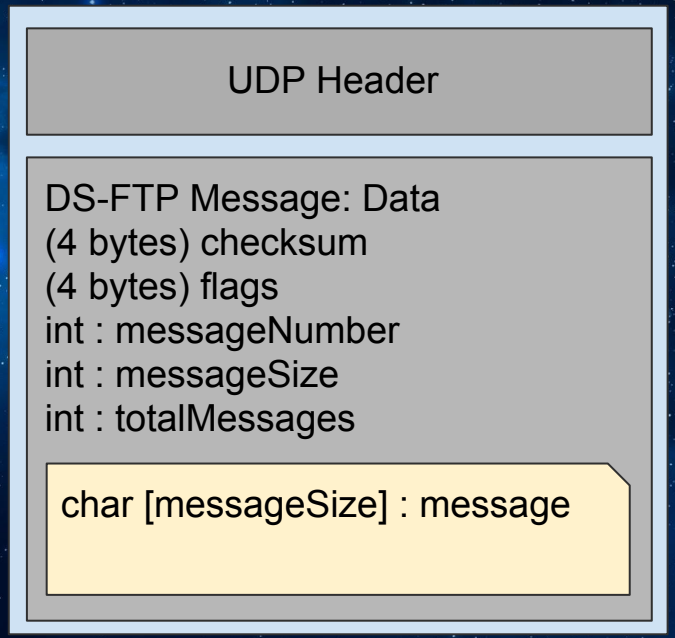
"*Communication Technologies and Architectures for Space Network and Interplanetary Internet"*, Mukherjee, Ramamurthy

Related Protocols

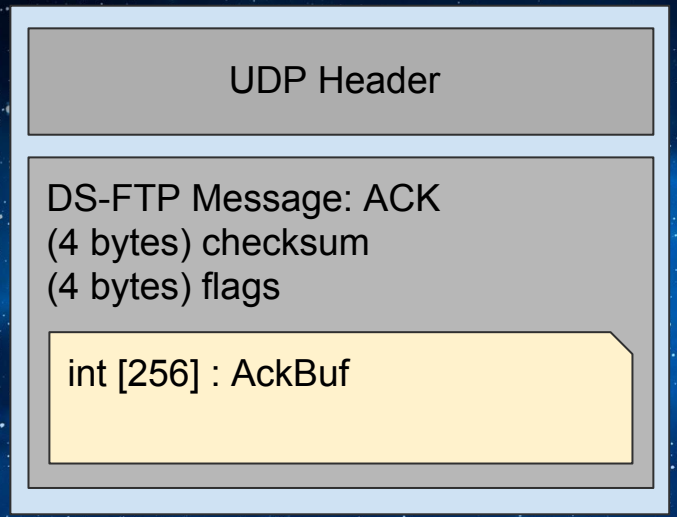
- TP-Planet - AIMD Congestion detection protocol
  - Most space communications occur over dedicated circuits, so congestion is irrelevant
- SCPS-TP - Space Comm. Protocol Standards, Transport Protocol
  - Based on TCP Vegas
  - Incorporates SNACKs (Selective Negative ACKnowledgements)
  - Allows identification of more than one missing message in receive buffer
- CCSDS - File Delivery Protocol
- Saratoga - UDP/IP file transfer protocol (Surrey Satellite Technology)
- LTP - Licklider Transmission Protocol; DTN convergence, data blocks

Data Structures + Messages

Message Block



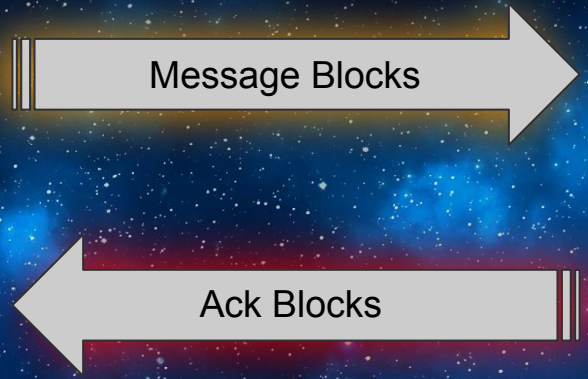
Ack Block



Sending and Receiving

Client (Sender)

1. Read data from file and create messages
2. Send messages into link with dynamic redundancy
3. Wait for Ack packets and re-requests



Server (Receiver)

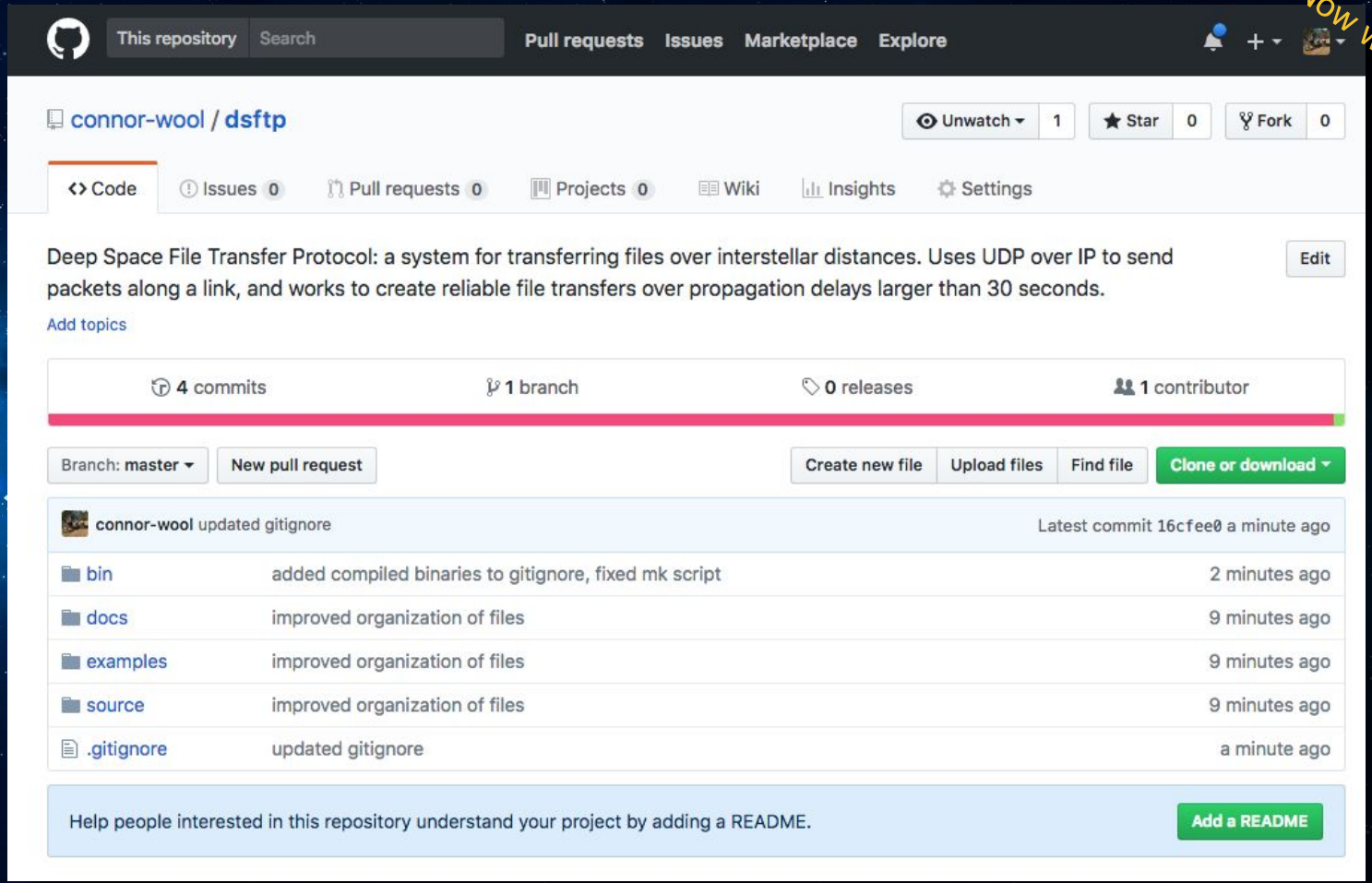
1. Listen for incoming messages
2. Write messages to file and mark in “messageTrackingTable”
3. Create AckBlock messages and send once 256 messages recieved or no messages recieved for 10 seconds

Predictive Re-sending

- The biggest enemy is dropped packets
- Instead of waiting for server to re-request packets, preemptively resend packets based on available bandwidth of link
- Could be implemented with NAT on the server side to cause extra packets to be dropped once connection is complete and server has closed port
- Server tracks message number associated with each packet, can identify duplicates

File Management

- Uses the <fcntl.h> library for binary-level read/write to files
- All messages except final message are of MSG_BLK_MAX_SIZE
  - Allows server-side process to seek through output file and arbitrarily write messages to their proper location in the final output file
- All messages have a “message size” field as a safeguard, server side uses this value to control # of bytes written to file



Now with GPL3!

Internet vs. Galaxy-net

- What does this mean for the future of the Internet?
- Internet
  - A group of interconnected hosts running the IP protocol, for which the propagation delay from any host A to any host B is at most 30 seconds
  - Allows for high-orbit spacecraft and nearby objects (moons, satellites, Imperial Star Destroyers) to be a part of the local planet's Internet system
- Galaxy-net
  - A group of Internets connected by EM/Optical long-distance transmission links
  - Communicate via file-transfer
  - Replicate important files across links and store cache files locally in each Internet
  - Large-scale case of distributed computing

Conclusions + Future Work

- Currently checksums are un-implemented (relies on link-level CRC)
- Current system only allows transfer of single file per connection
  - Add field for tracking which file a message is attached to, for constant stream of data between client and server
  - Add “-q <queueFile>” optional parameter to a group of filenames, dsftp will transport all files between client and server, and ensure correct delivery