

MPC & LSST

June 8th 2022

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Center for Astrophysics | Harvard & Smithsonian

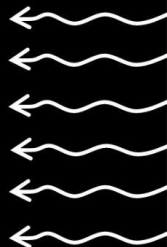
Overview

MPC : LSST Data Flow

High Level Operational Overview

Night

Real-time publication of all moving and variable sources



Observing

Ephemeris files for fast association

Newly collected tracklets passed on to MOPS for linking

Discover (link) new objects

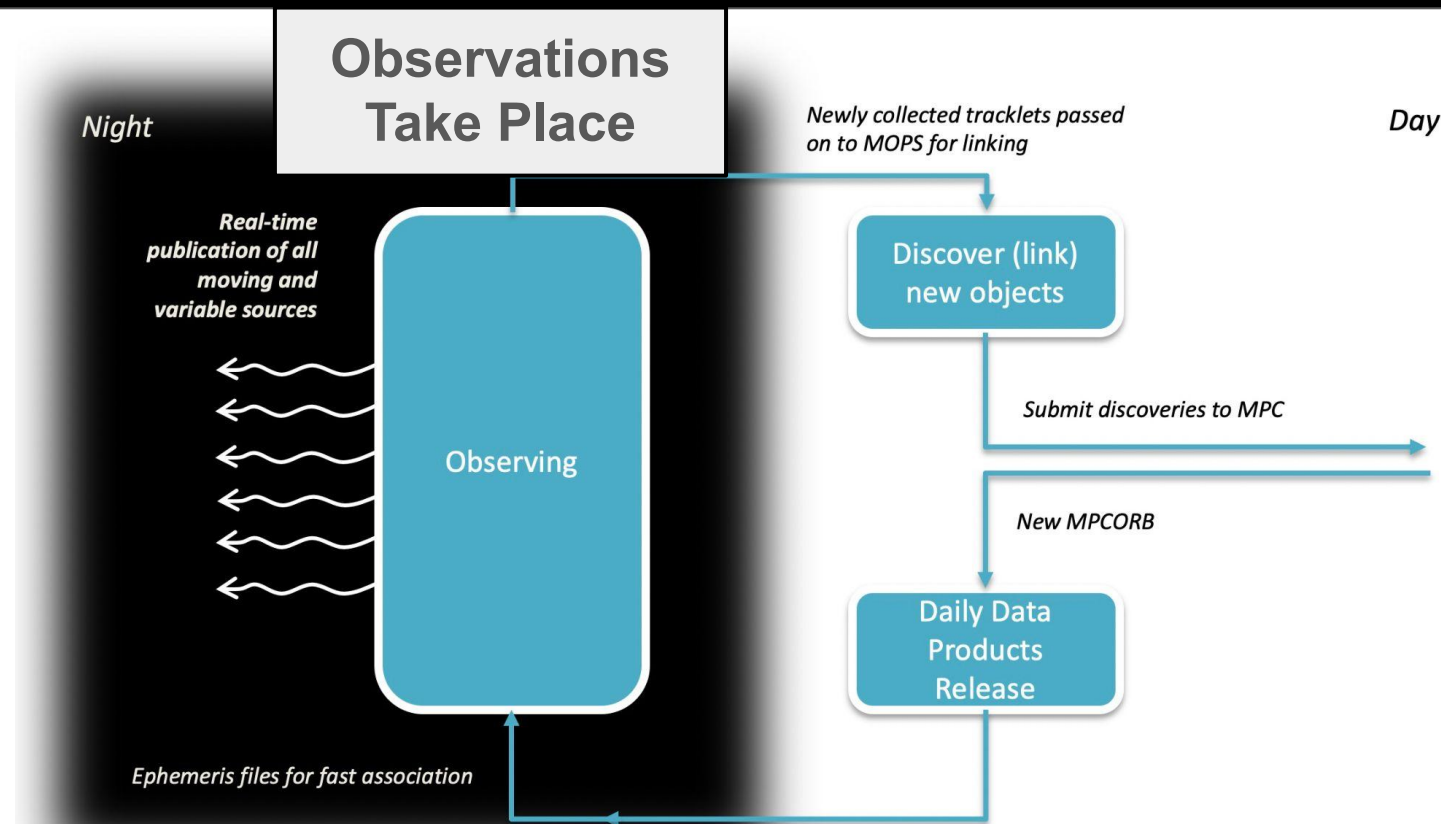
Submit discoveries to MPC

New MPCORB

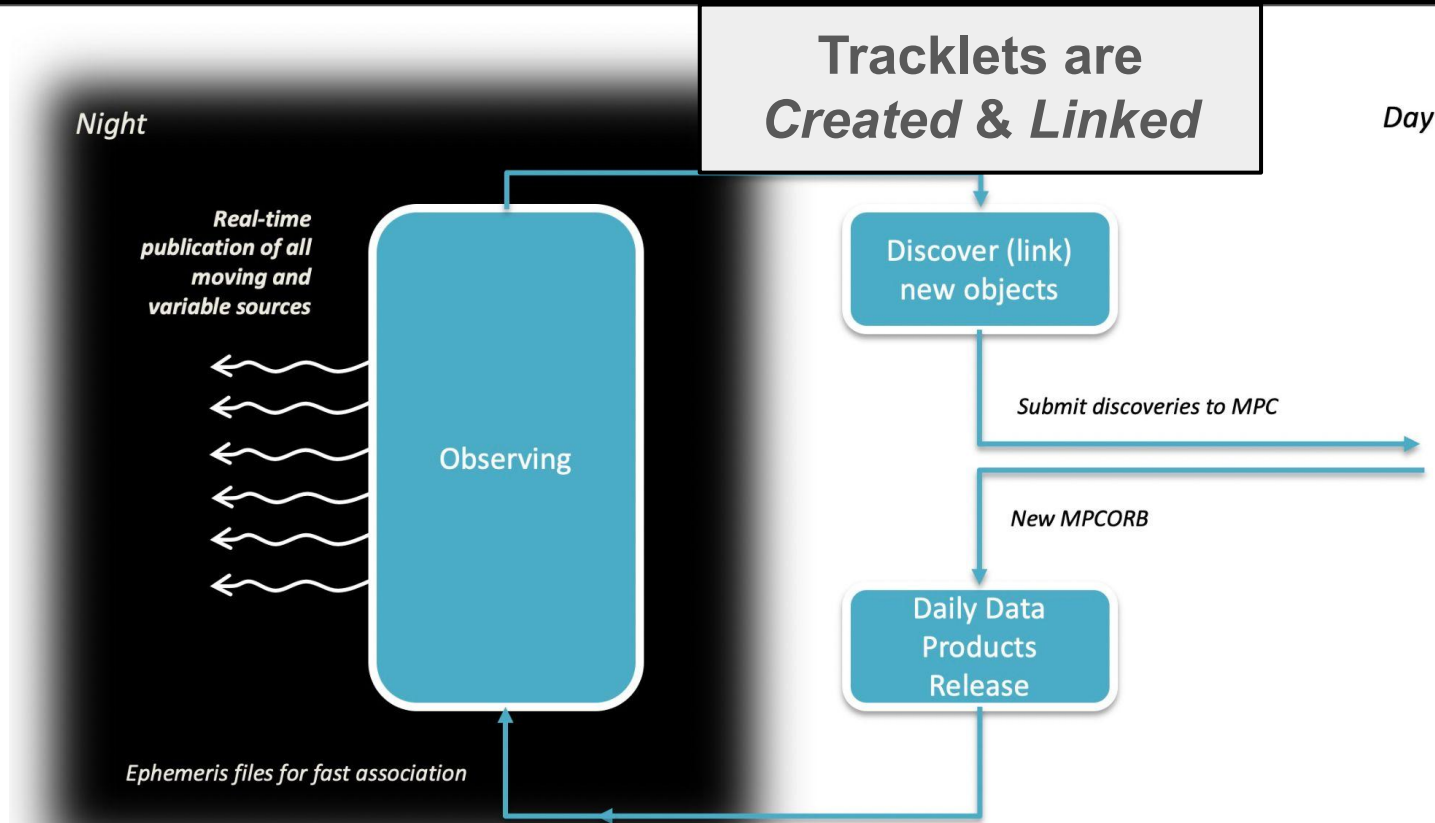
Daily Data Products Release

Day

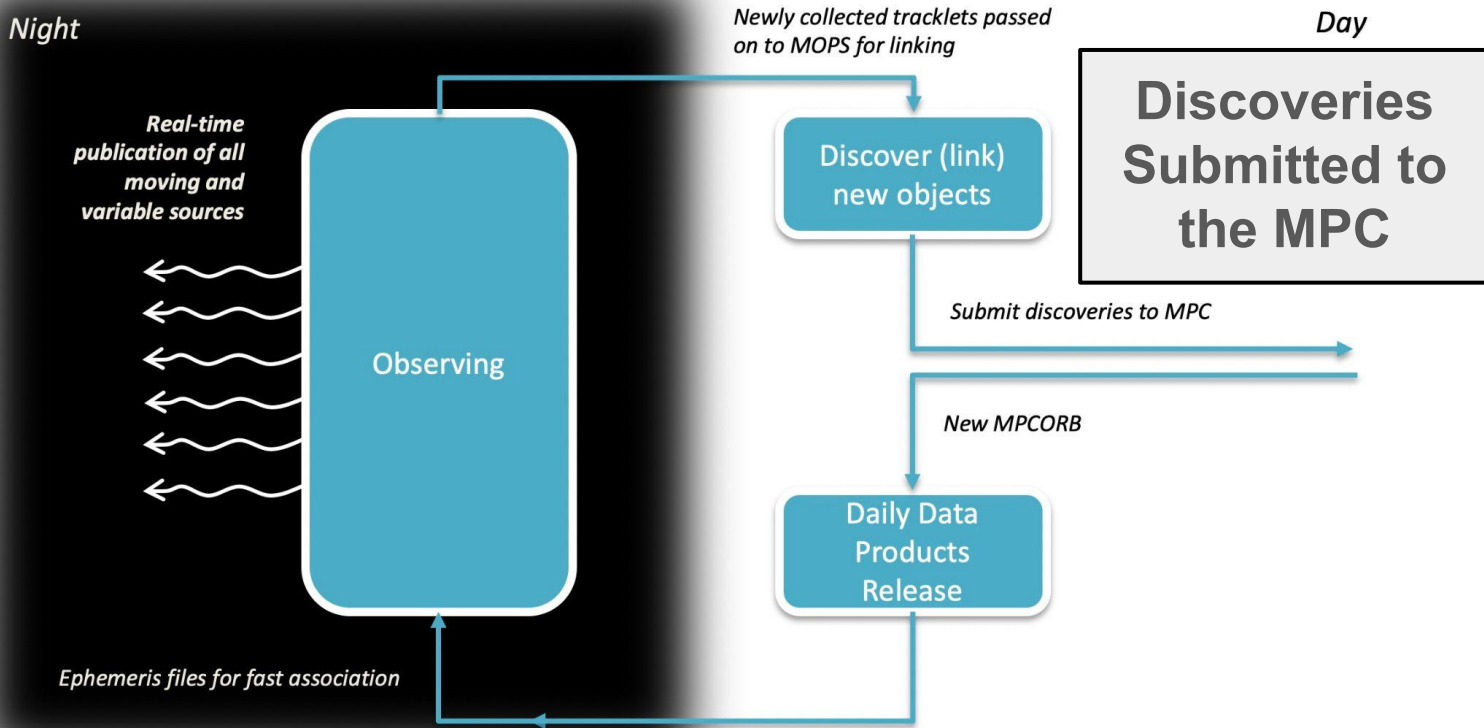
MPC : LSST Data Flow



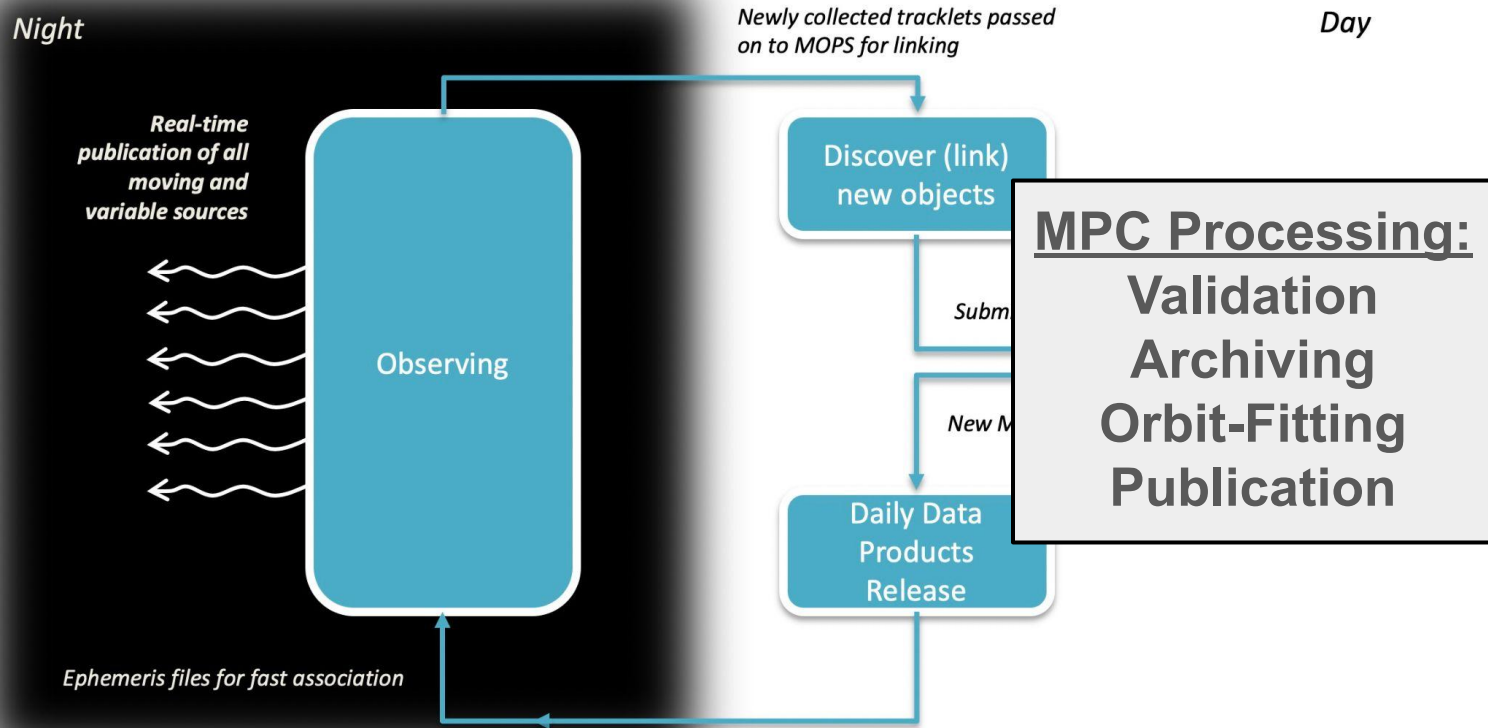
MPC : LSST Data Flow



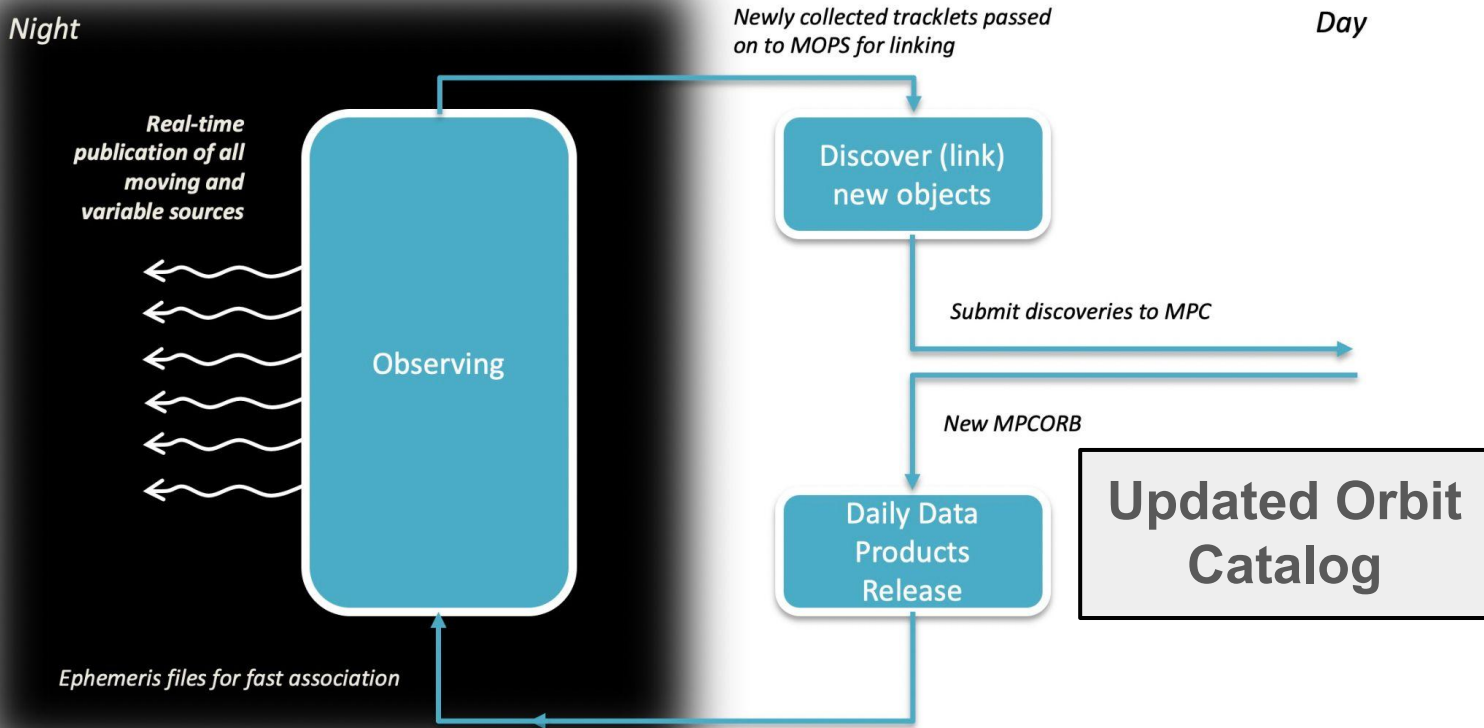
MPC : LSST Data Flow



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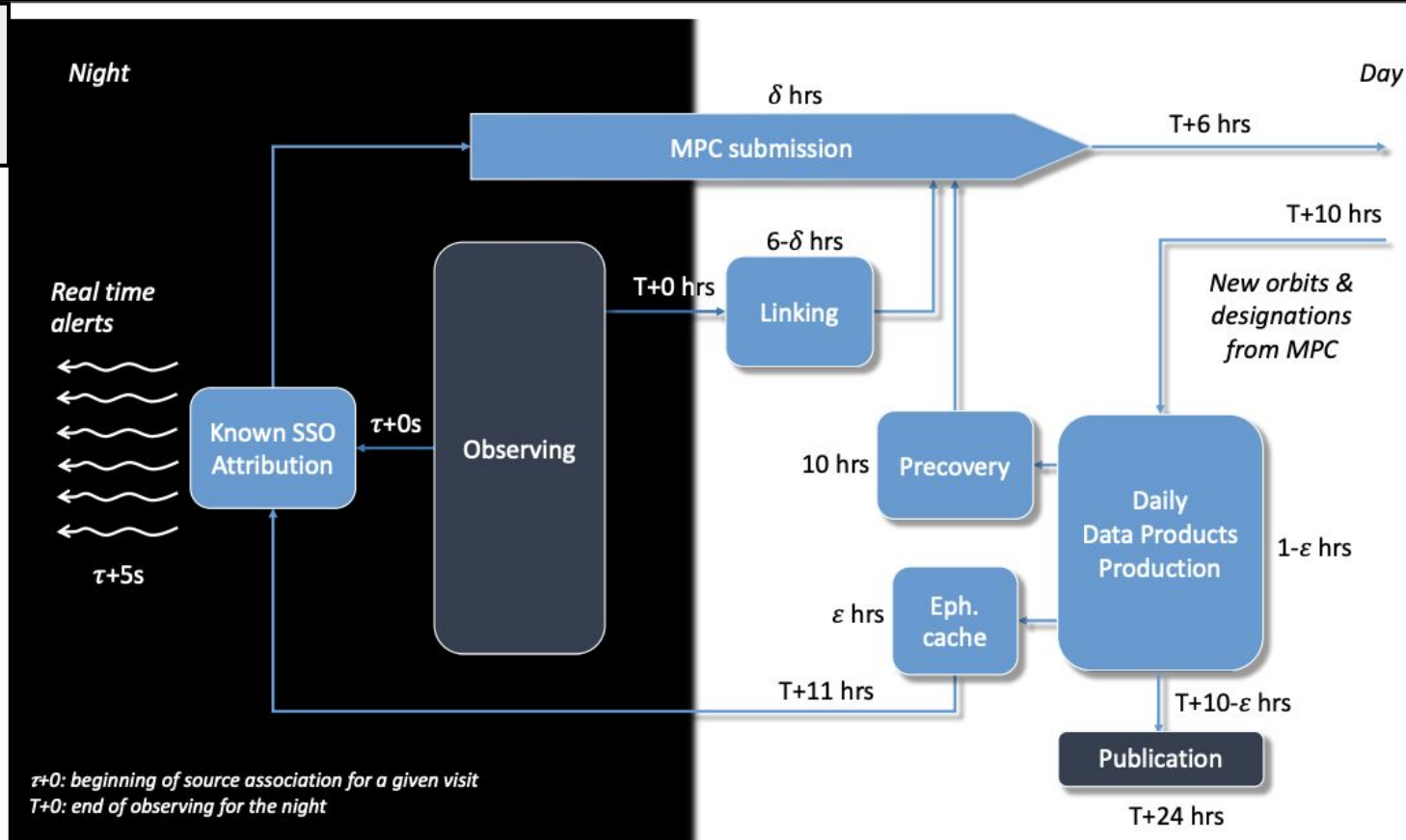


MPC : LSST Data Flow



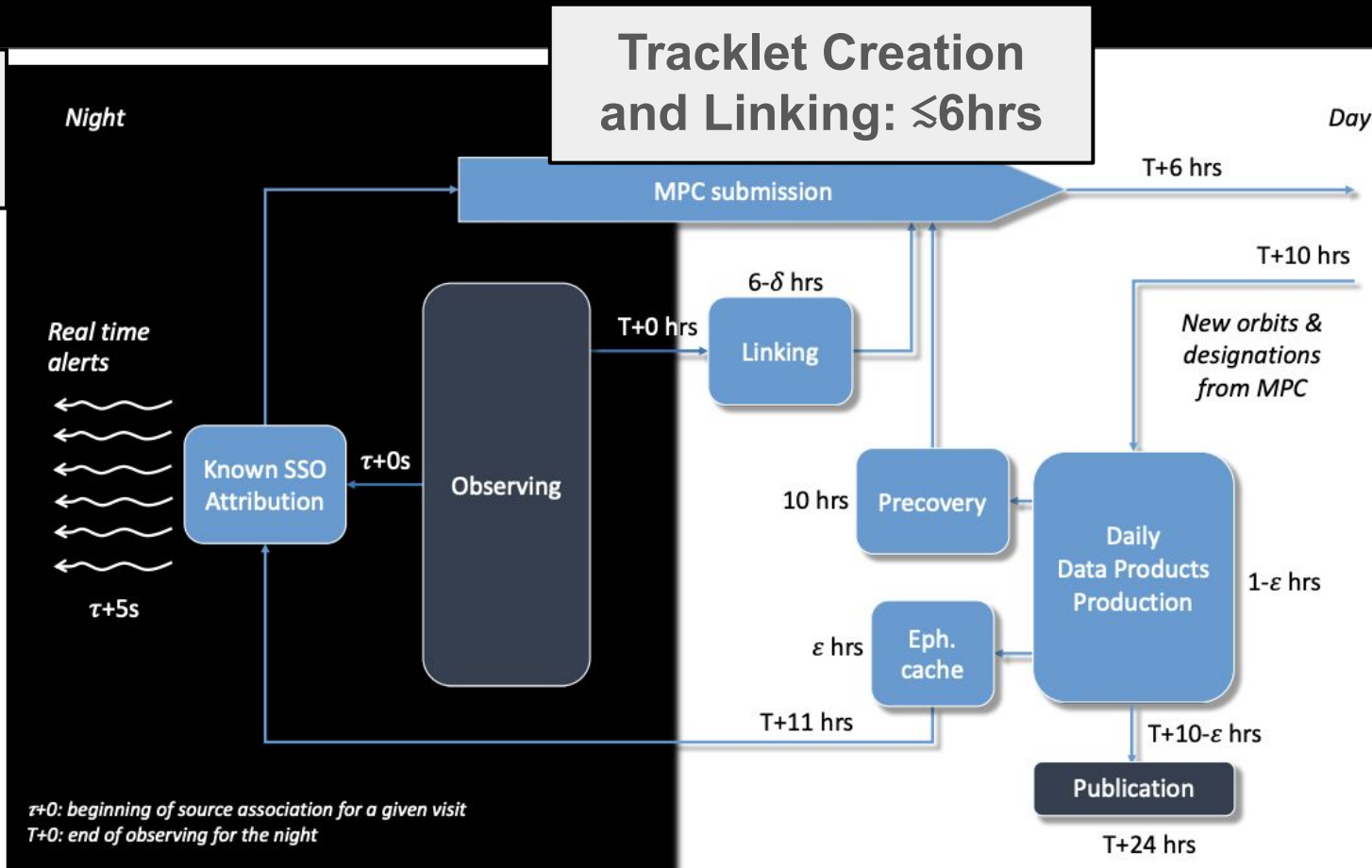
MPC : LSST Data Flow

Notes on Timing



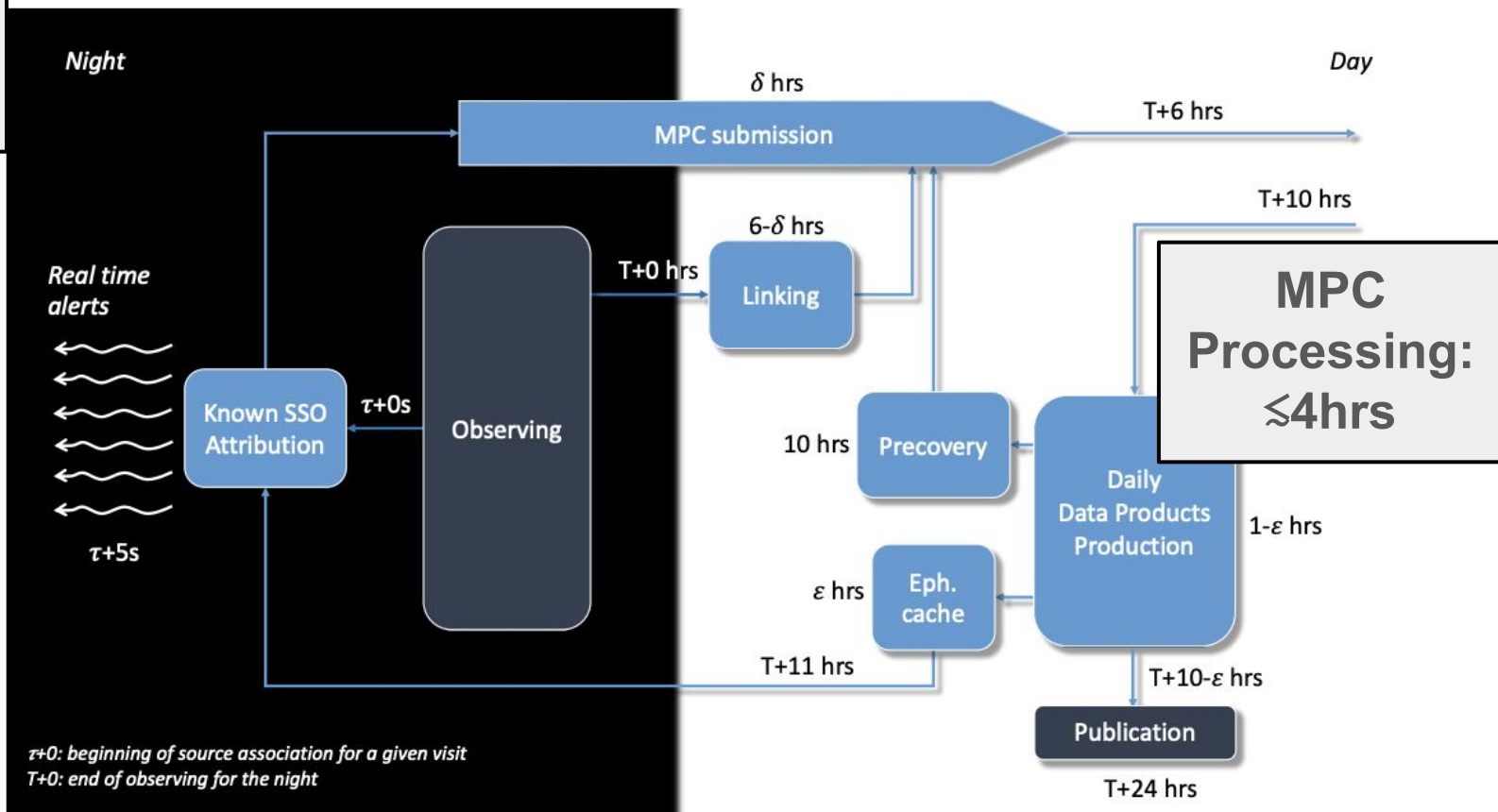
MPC : LSST Data Flow

Notes on Timing



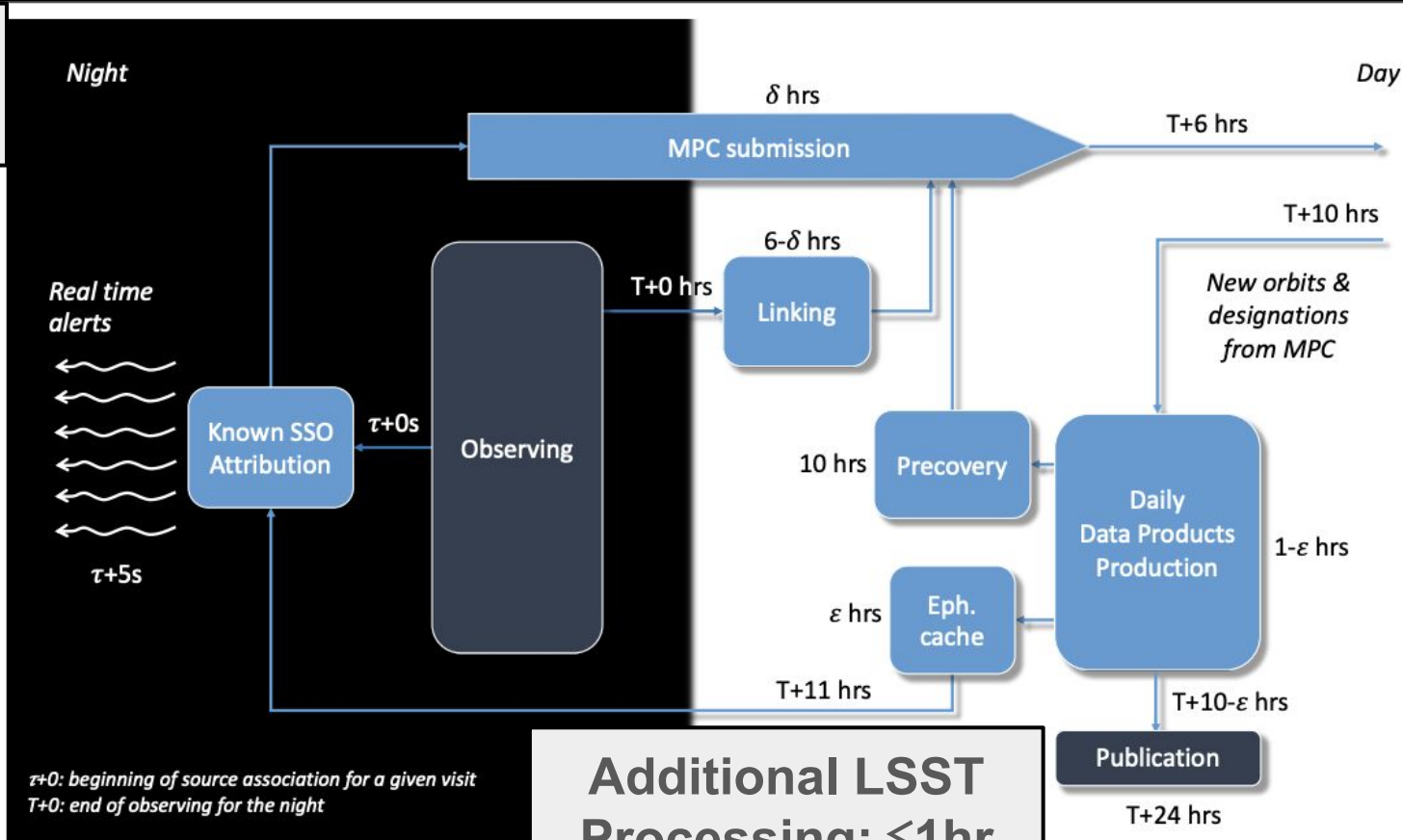
MPC : LSST Data Flow

Notes on Timing



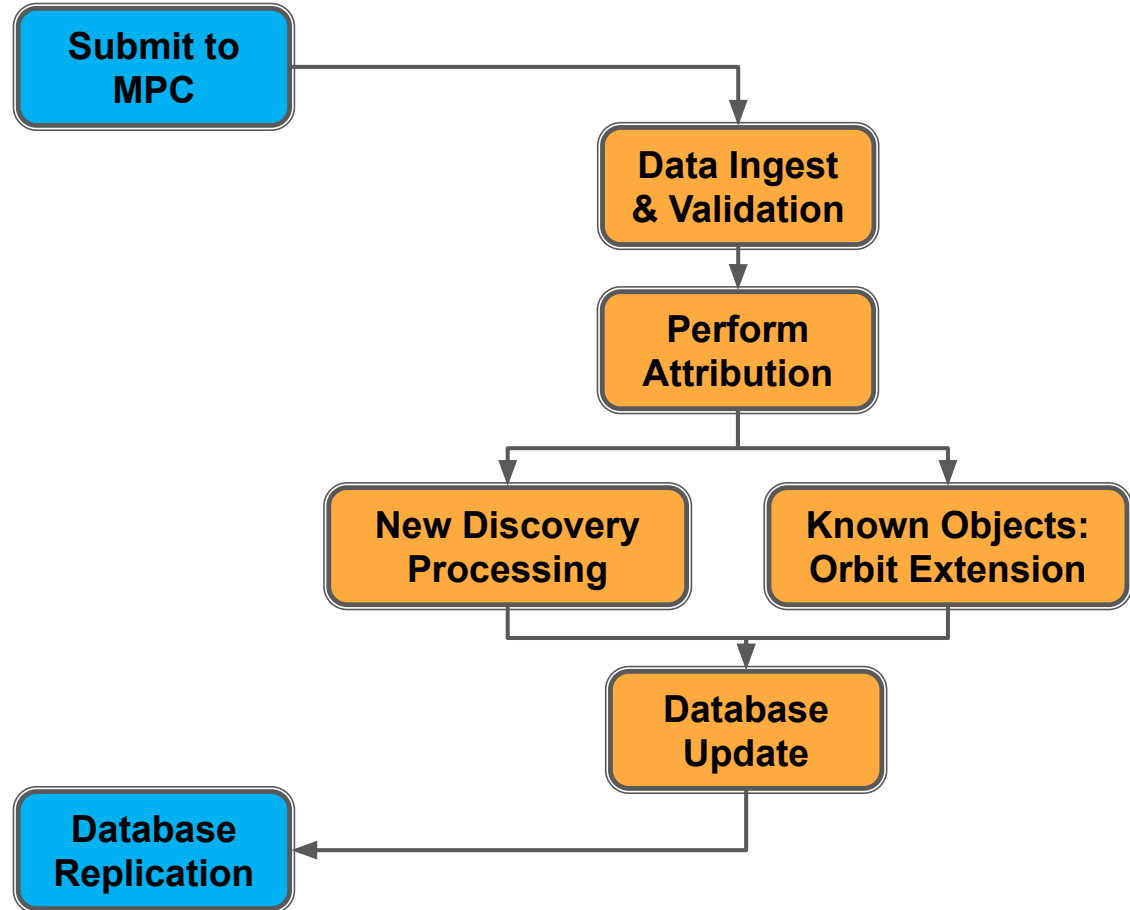
MPC : LSST Data Flow

Notes on Timing

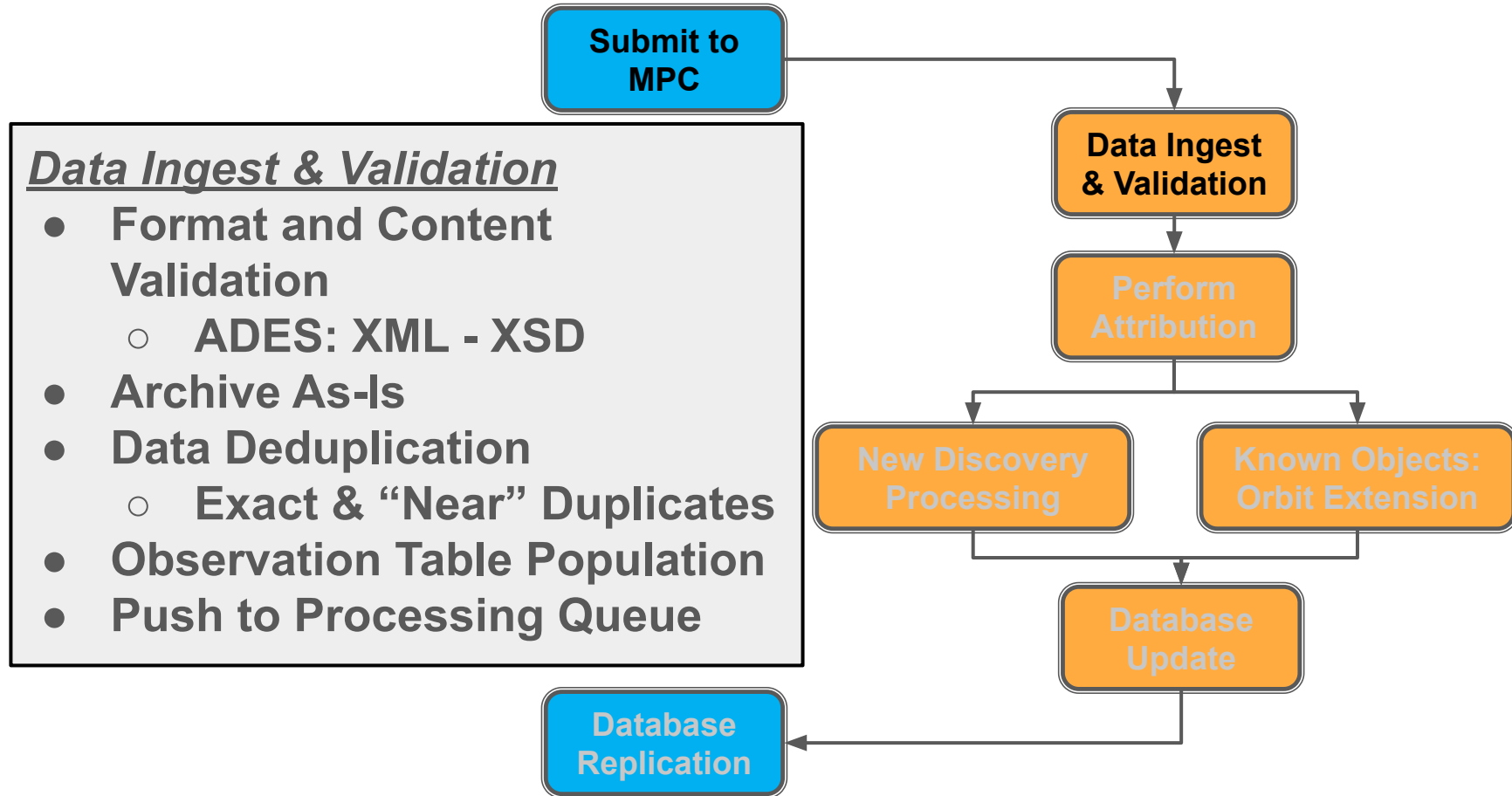


MPC Processing Overview

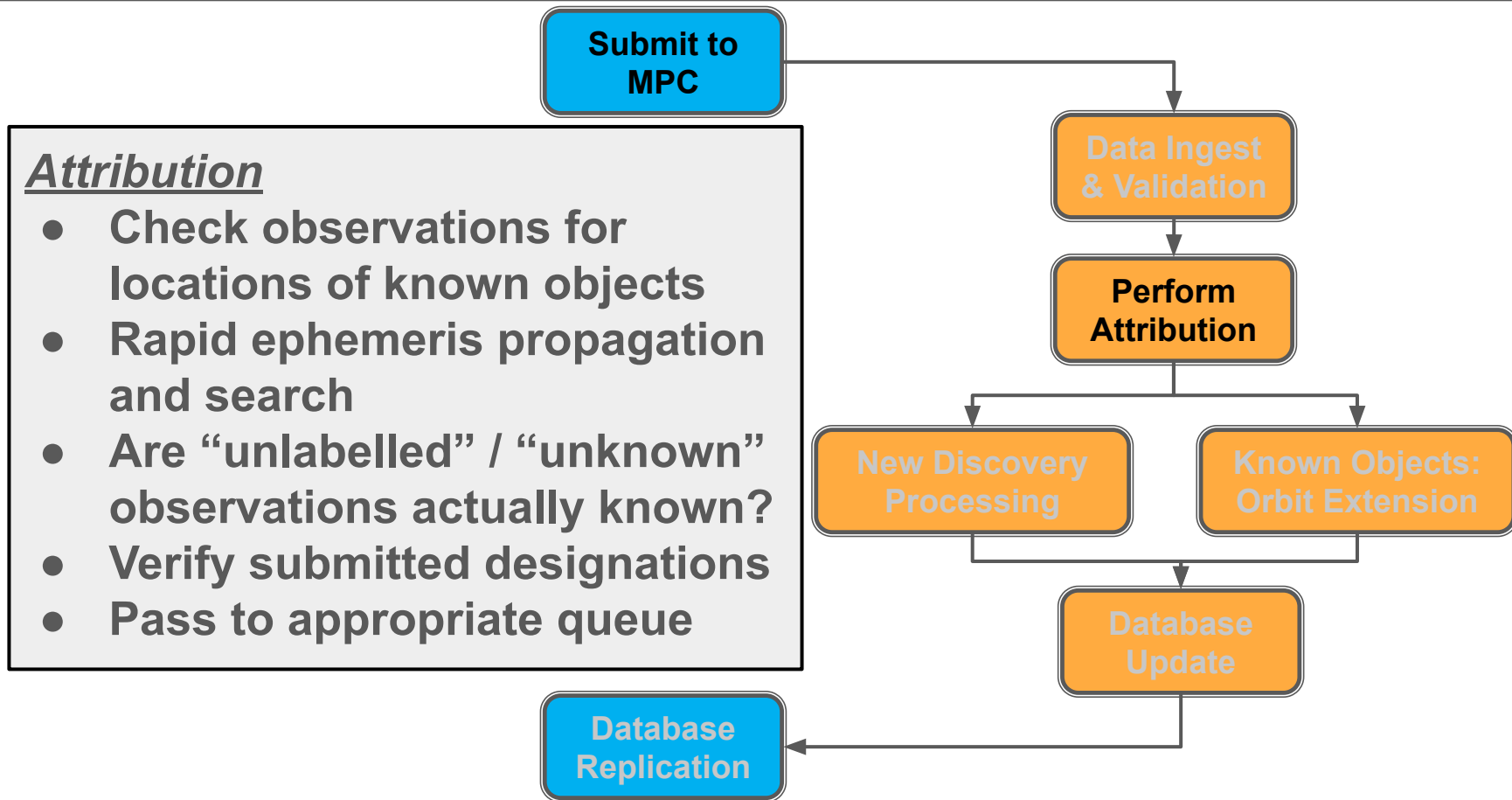
Key MPC Processing Steps



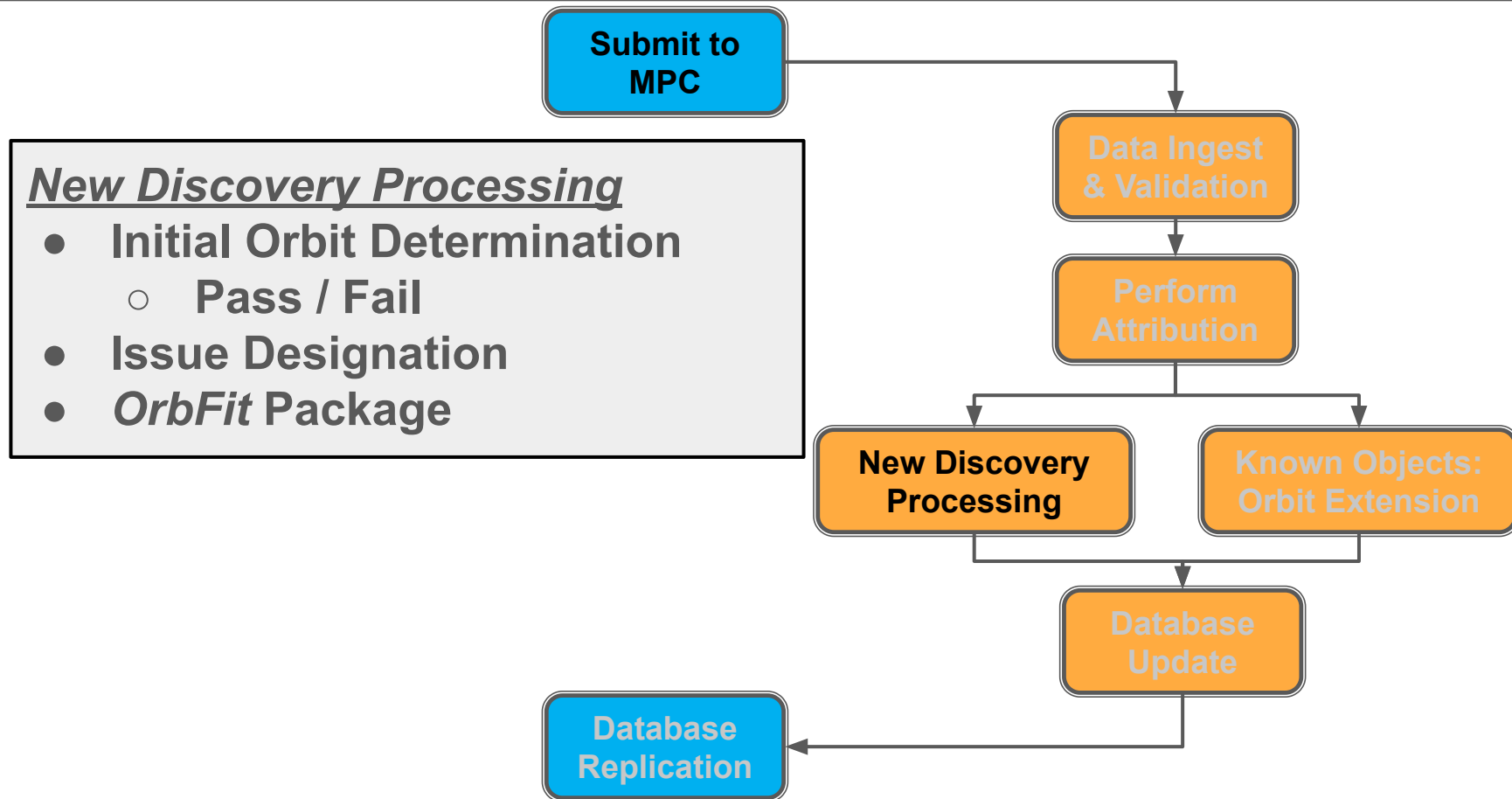
MPC Processing Overview



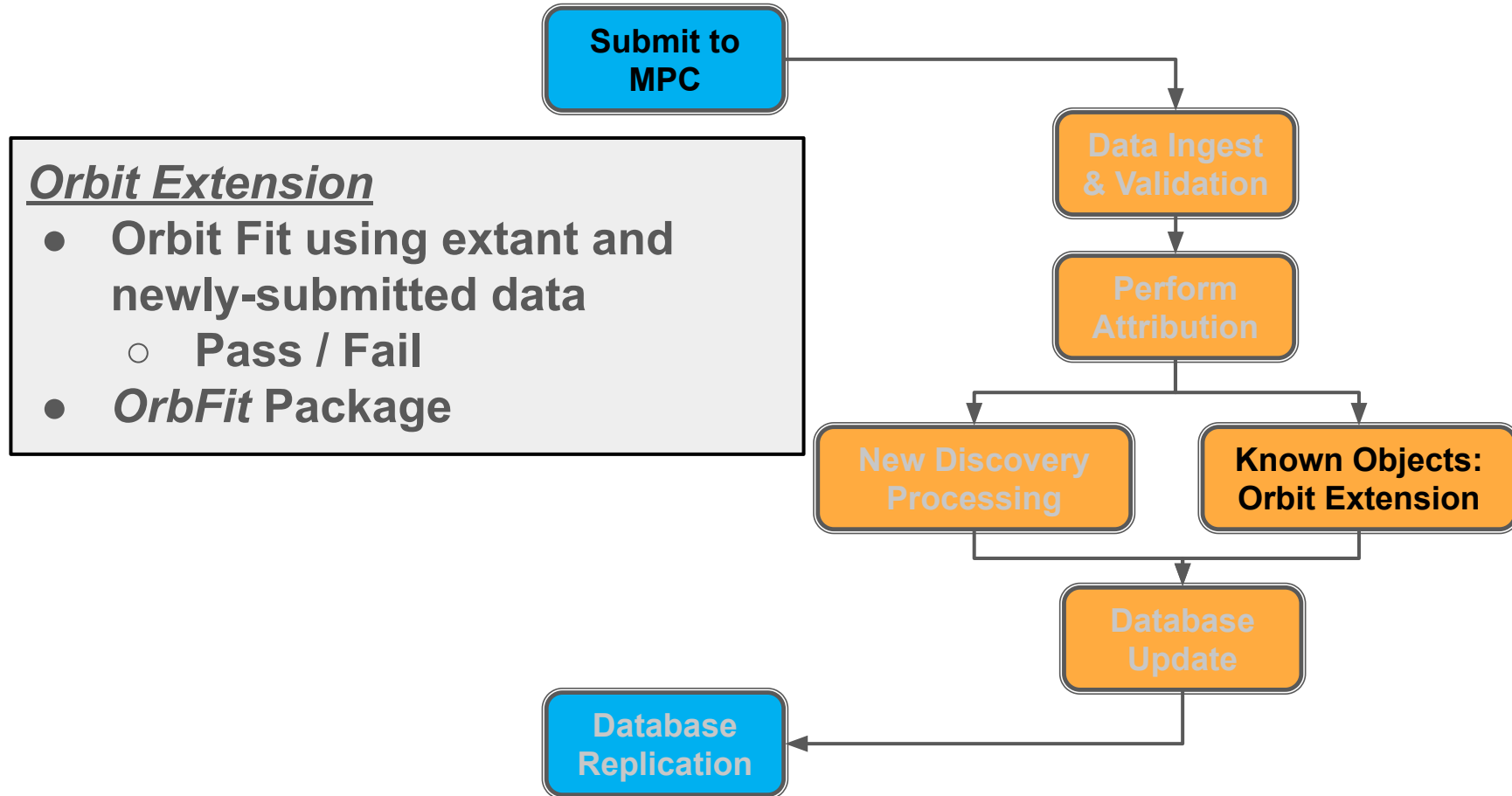
MPC Processing Overview



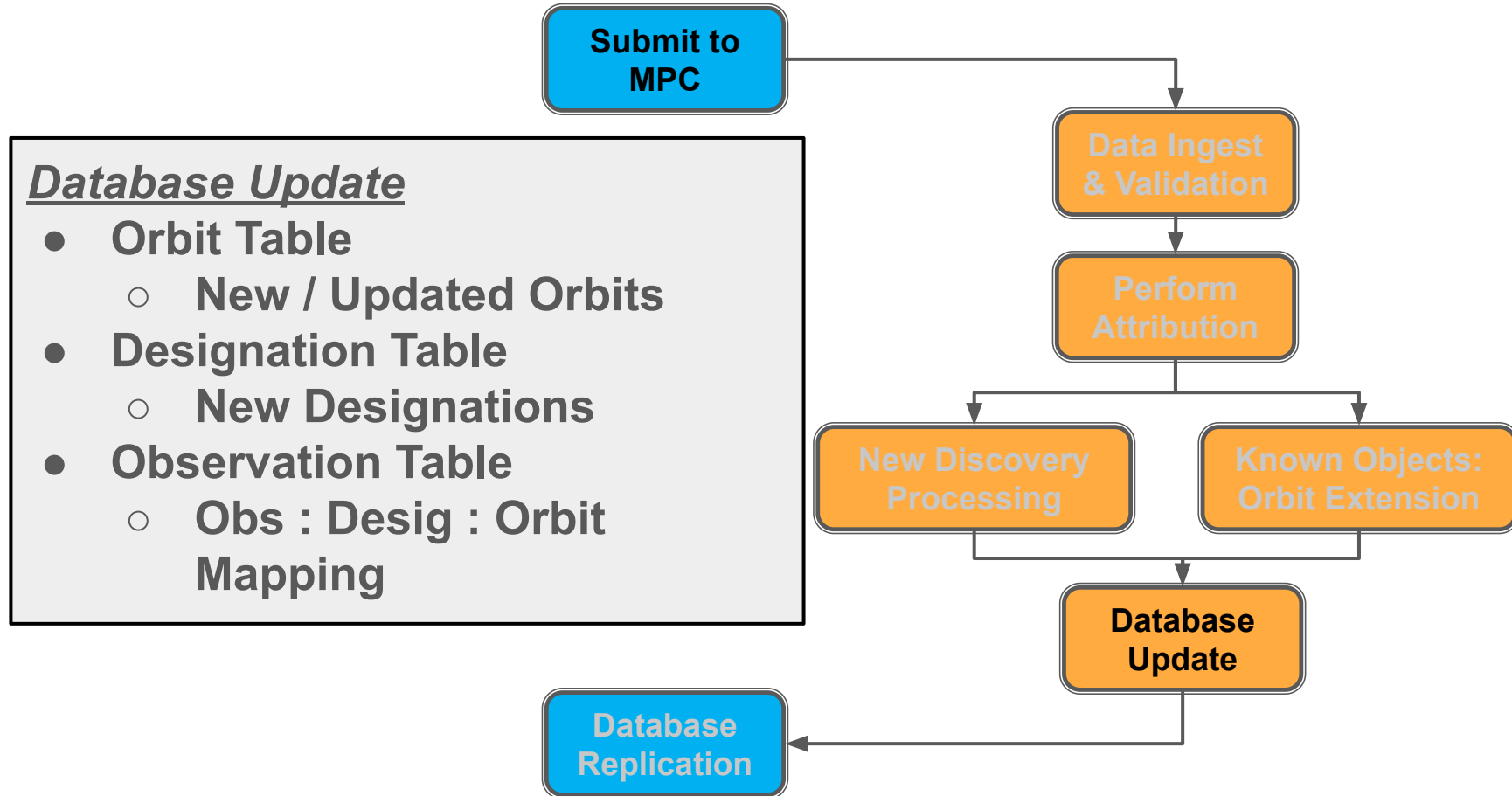
MPC Processing Overview



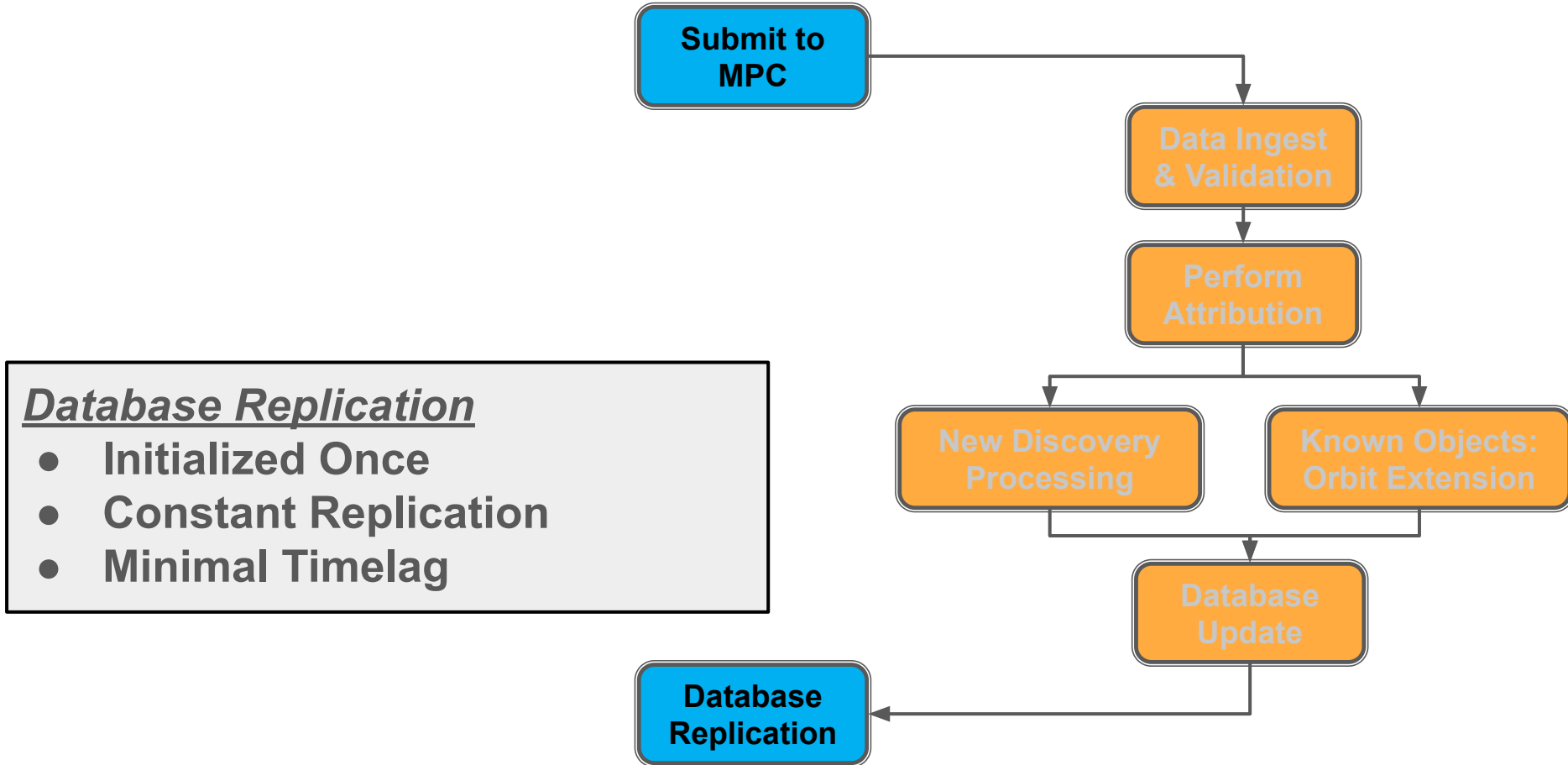
MPC Processing Overview



MPC Processing Overview



MPC Processing Overview

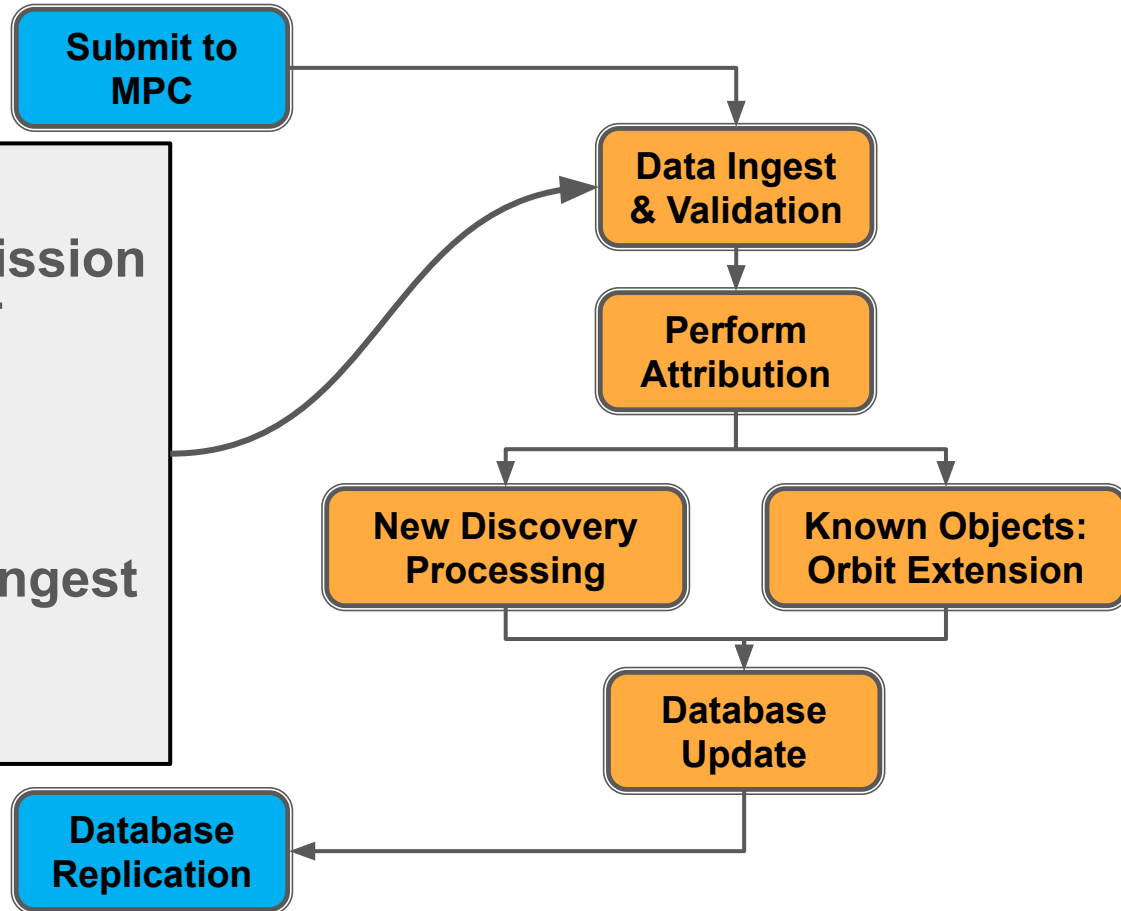


MPC Processing Overview

Timing

Ingest & Validation

- Single-Thread per Submission
- ~15 min for largest LSST submission
 - Restructure: limited parallelization
- Need to retain ability to ingest multiple submissions in parallel

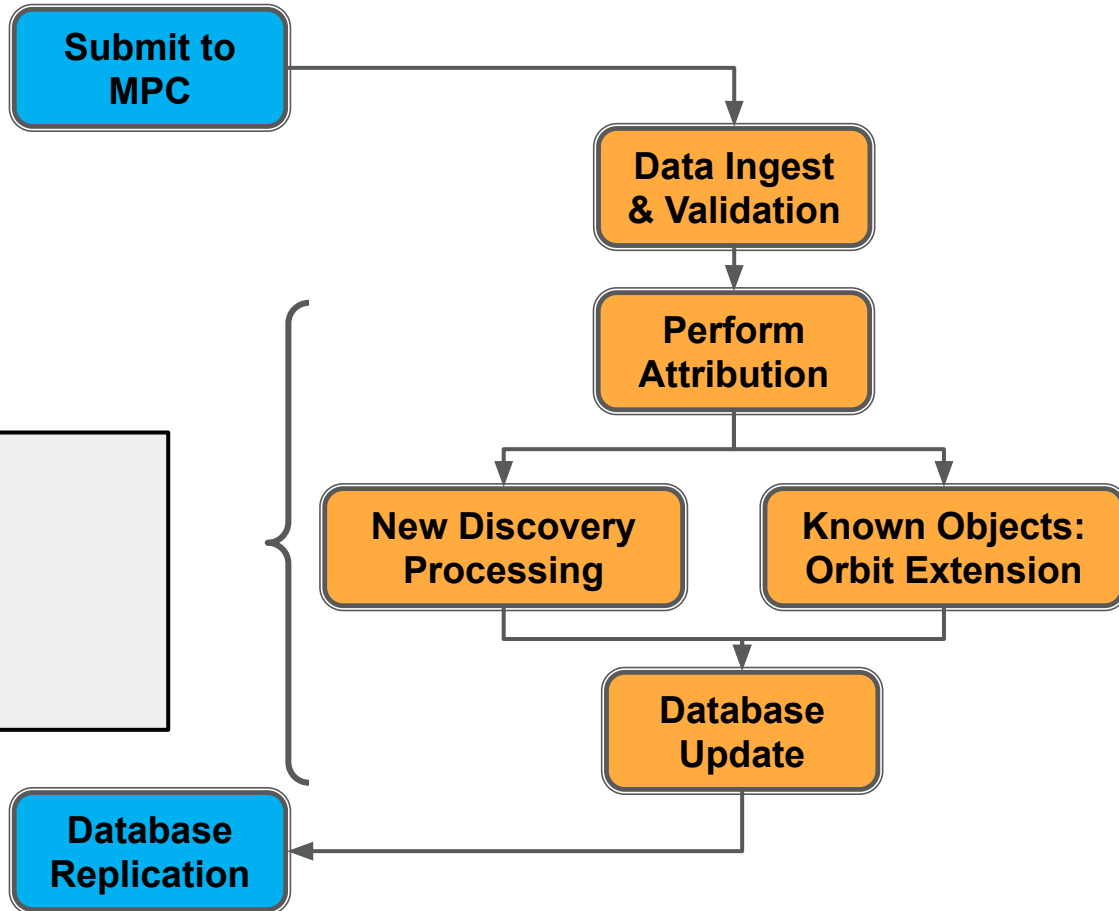


MPC Processing Overview

Timing

Processing

- Highly Parallelized
- ~10 - 15s per tracklet
- 100s - 1,000s of CPUs

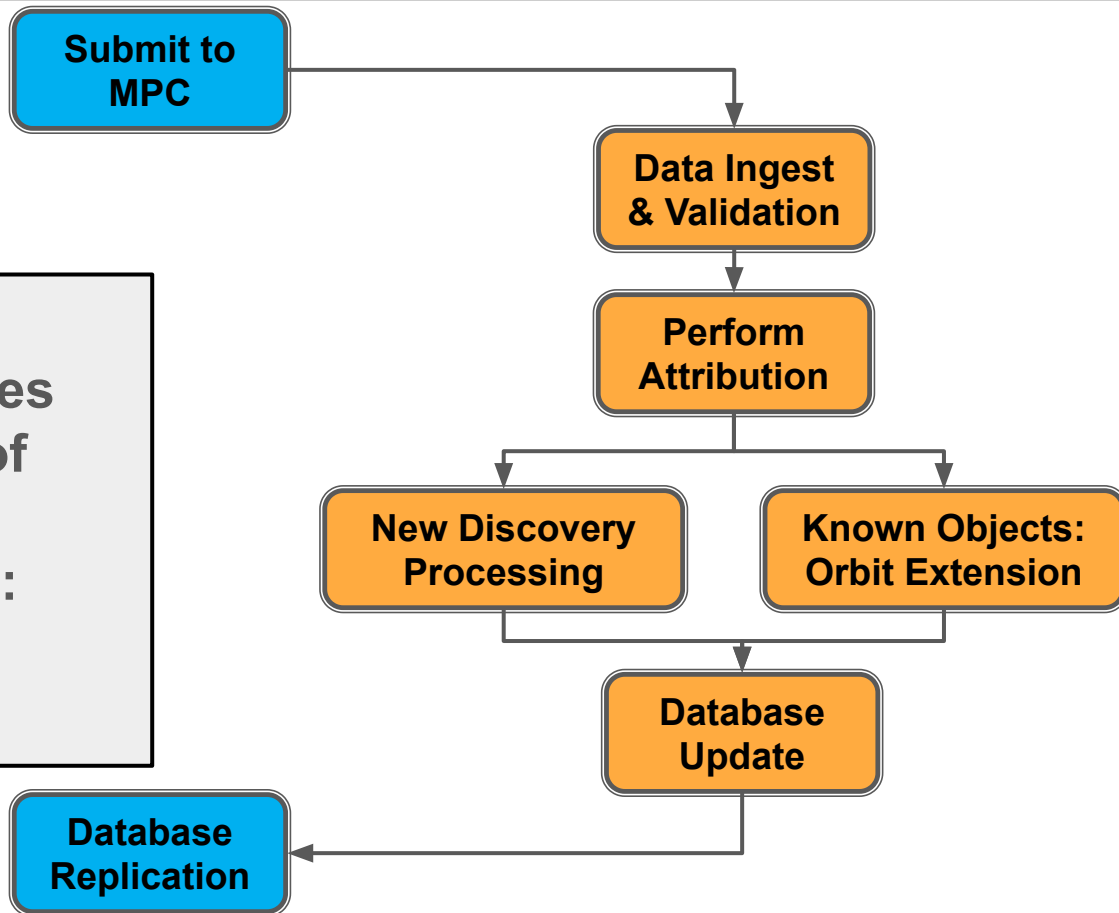


MPC Processing Overview

Timing

Data Return

- Constant database updates
- Time delay is a function of submission size
- Typical LSST submission:
 - First: ~ 15 min + ϵ
 - Final: ~ 2 hrs



Data Exchange Challenge

Data Exchange Challenge

Exercising Key Processing Steps

LSST Survey Simulation

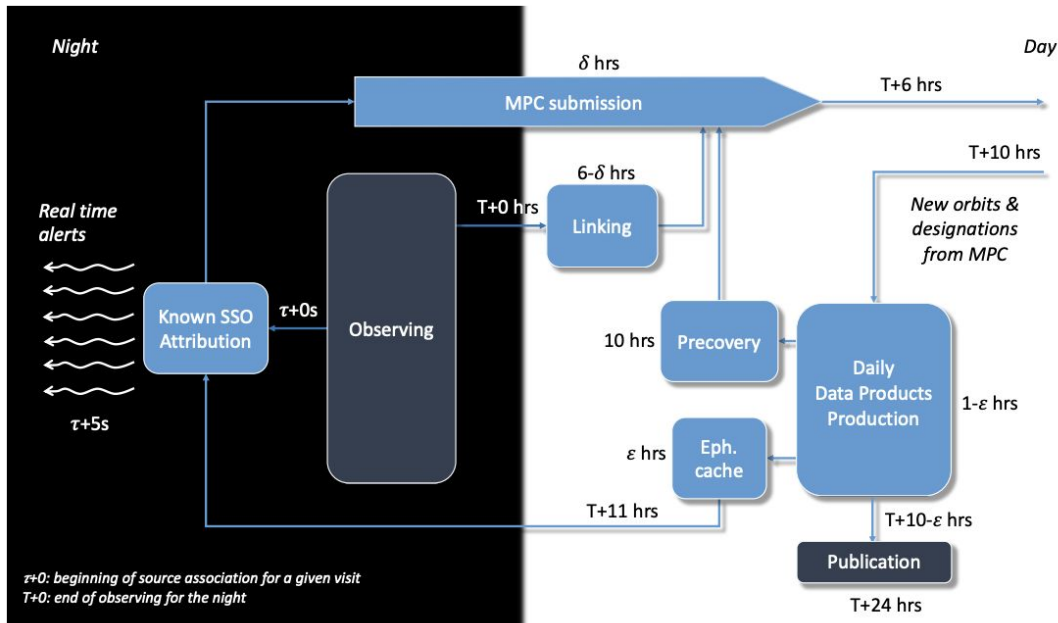
- Known Objects & Simulated New Objects

Tracklets

- Form & Link

Submissions

- Construct & Submit
- Known & New



Data Exchange Challenge

Exercising Key Processing Steps

Precursor Steps...

LSST Survey Simulation

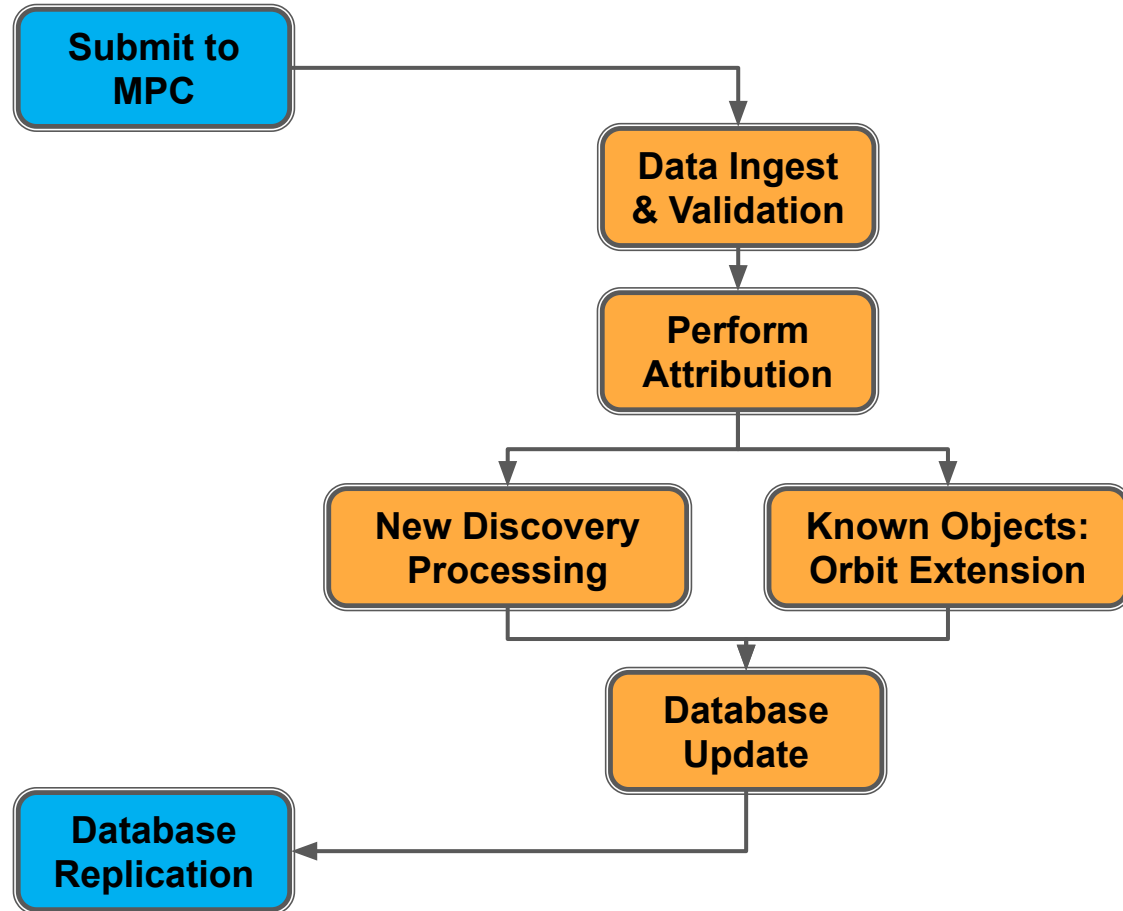
- Known Objects &
- Simulated New Objects

Tracklets

- Form & Link

Submissions

- Construct Known & New

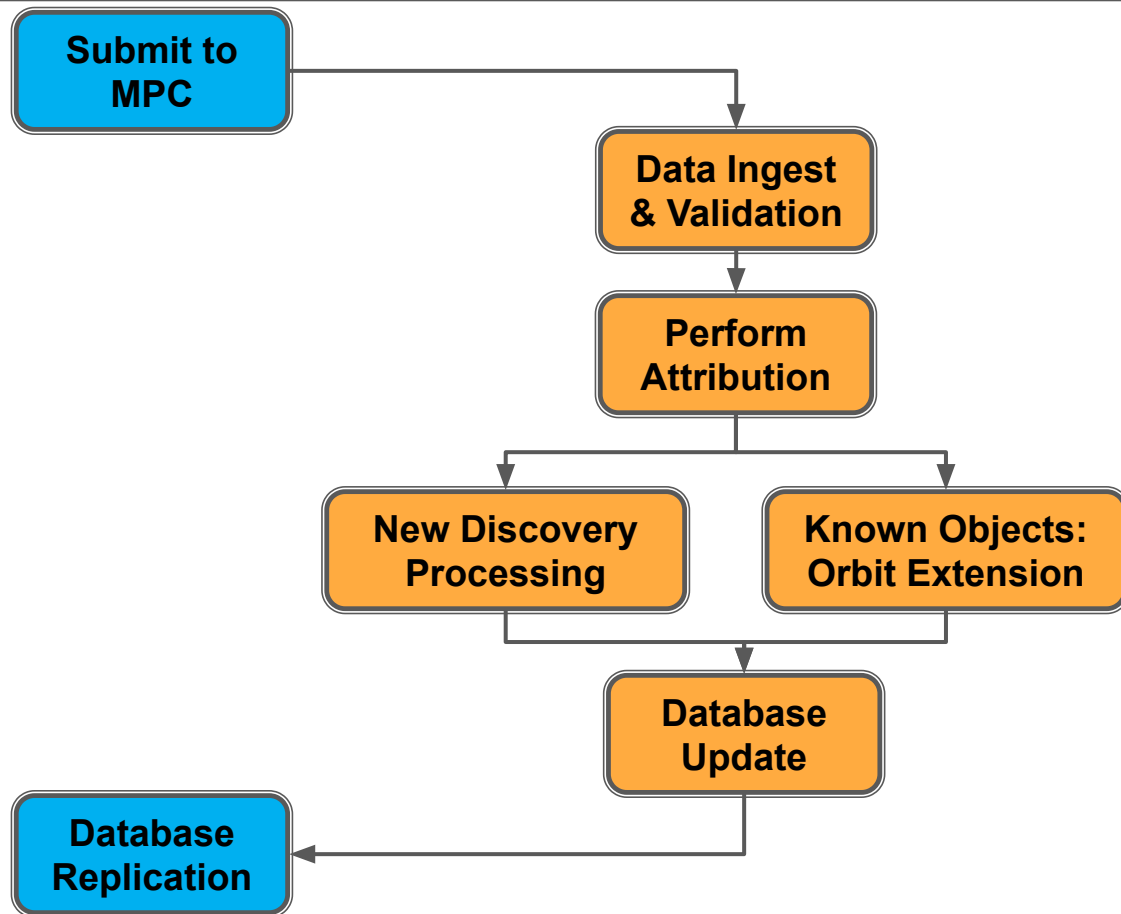


Data Exchange Challenge

Exercising Key Processing Steps

Precursor Steps...

- MPC “Sandbox” Pipeline Initialization



Data Exchange Challenge

Exercising Key Processing Steps

Submit Night "A"

- Known & New
- Direct to AWS S3 Bucket

Submit to MPC

Data Ingest & Validation

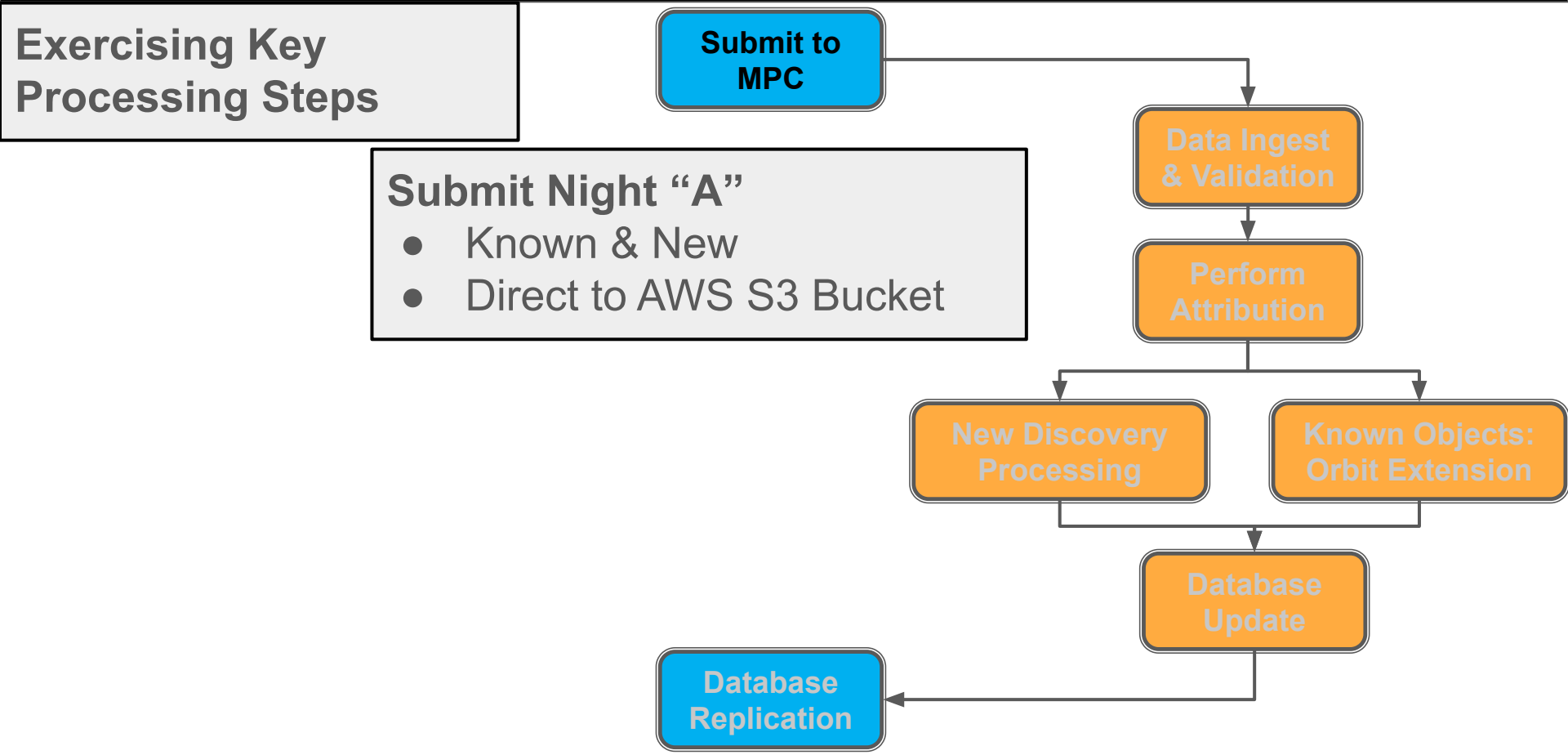
Perform Attribution

New Discovery Processing

Known Objects: Orbit Extension

Database Update

Database Replication

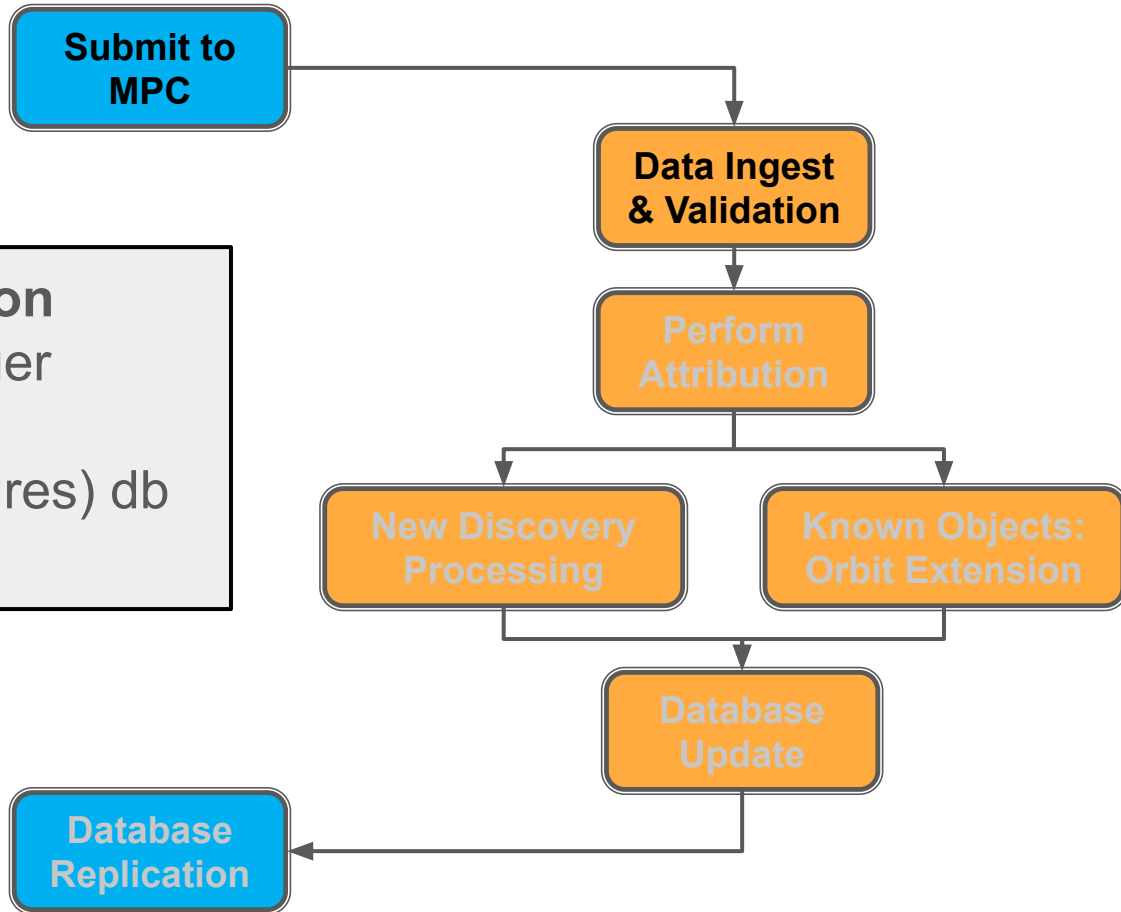


Data Exchange Challenge

Exercising Key
Processing Steps

Data Ingest & Validation

- AWS Lambda Trigger
- EC2 Processing
- AWS Aurora (Postgres) db
- AWS SQS Queue



Data Exchange Challenge

Exercising Key
Processing Steps

Processing

- AWS SQS Queues Monitored
- Asynchronous Processing on private servers
- Containerized OrbFit

Submit to
MPC

Data Ingest
& Validation

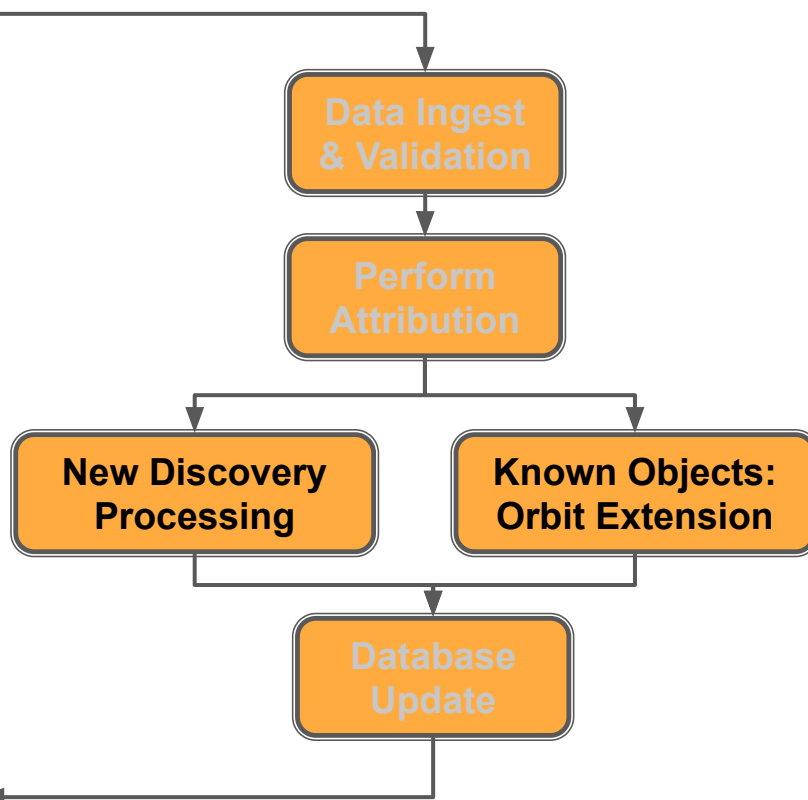
Perform
Attribution

New Discovery
Processing

Known Objects:
Orbit Extension

Database
Update

Database
Replication

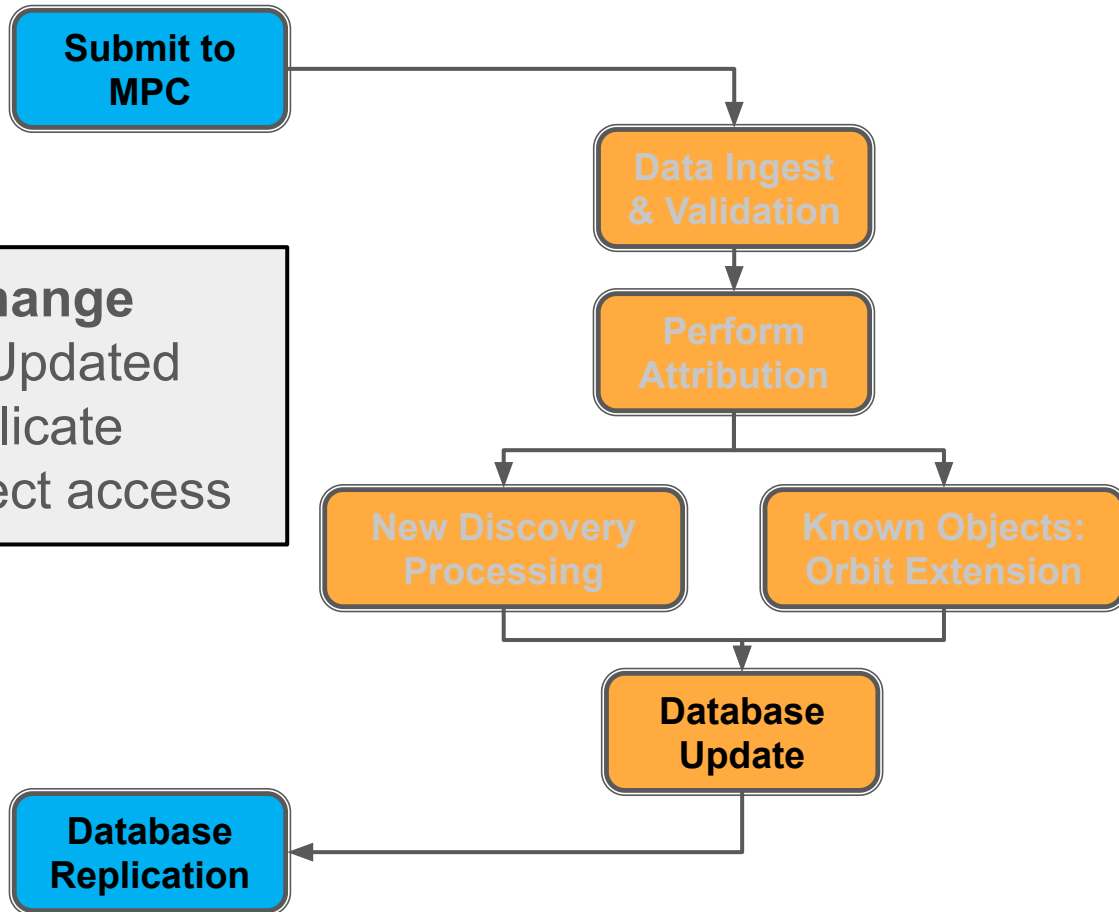


Data Exchange Challenge

Exercising Key
Processing Steps

Data Update & Exchange

- AWS Aurora db Updated
- LSST did *not* replicate
 - Provided direct access



Data Exchange Challenge

Exercising Key Processing Steps

Simulate Second Night

- New Designations applied
- Submit Night "B"

Submit to MPC

Data Ingest & Validation

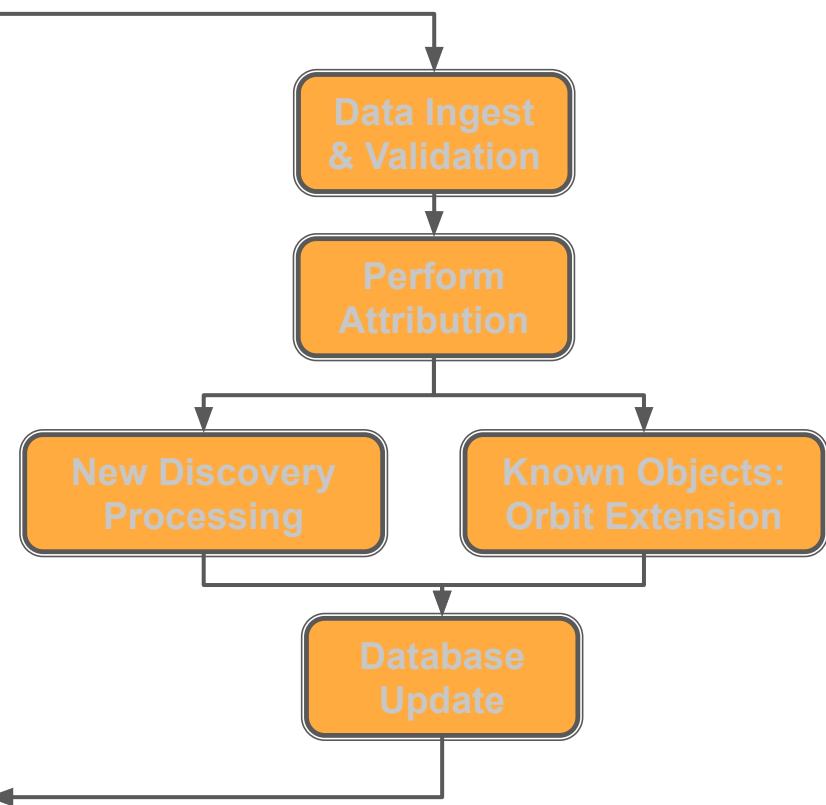
Perform Attribution

New Discovery Processing

Known Objects: Orbit Extension

Database Update

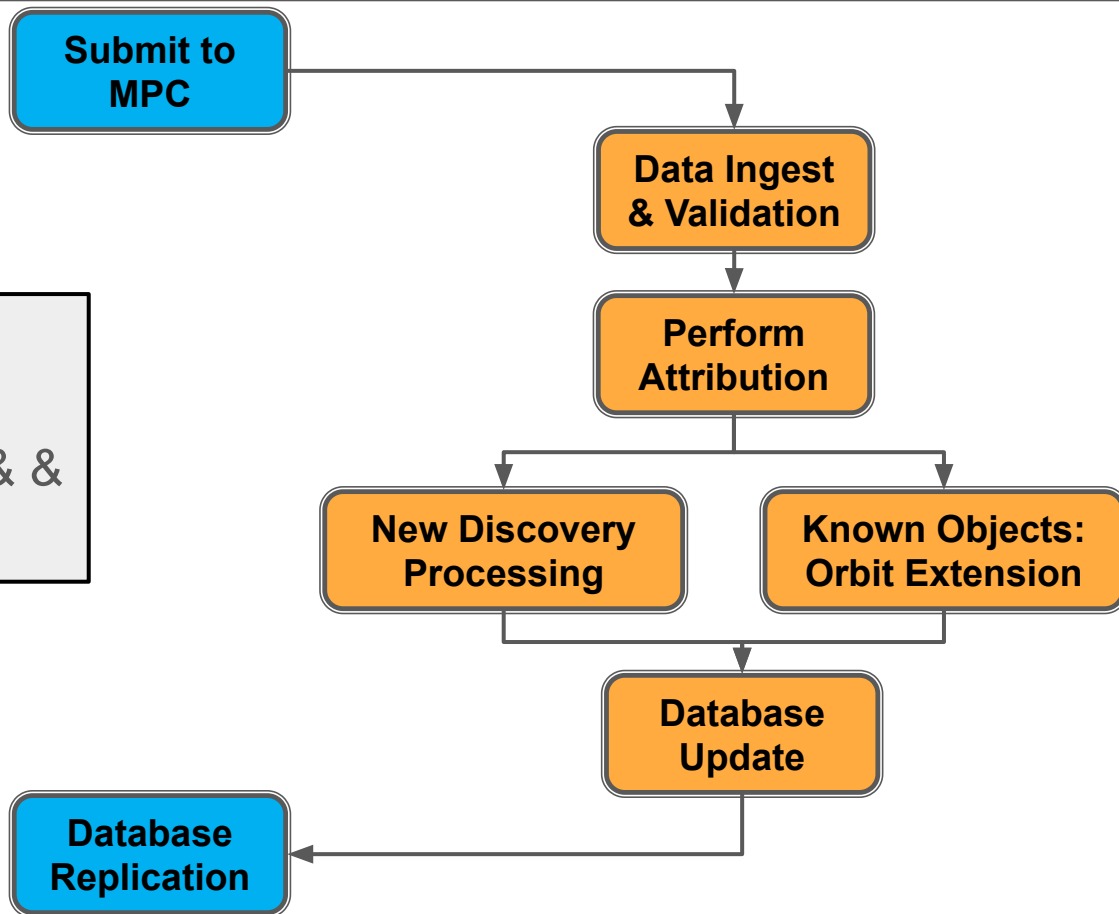
Database Replication



Data Exchange Challenge

Zero-Touch

- MPC processing steps all triggered & run automatically



Data Exchange Challenge

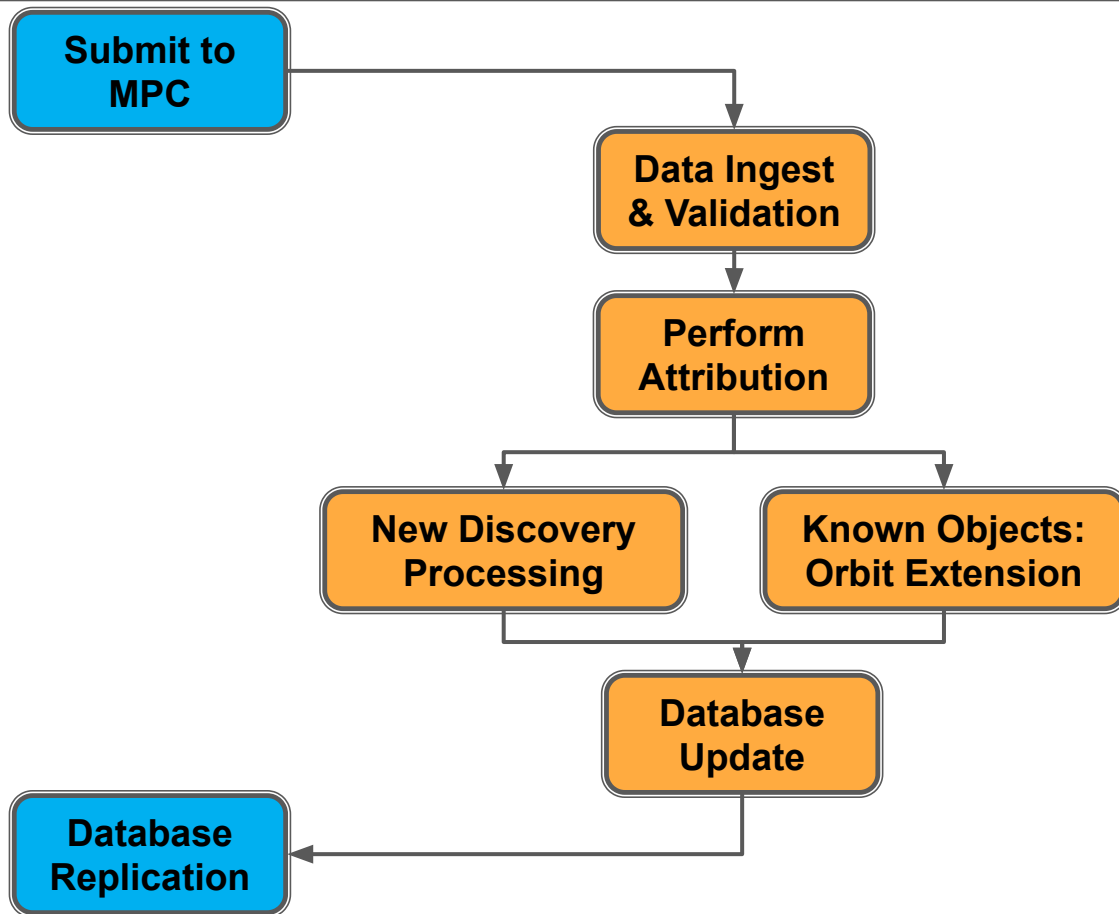
Next Steps

MPC

- Add automated attribution
- Improve ingest rate
- ...

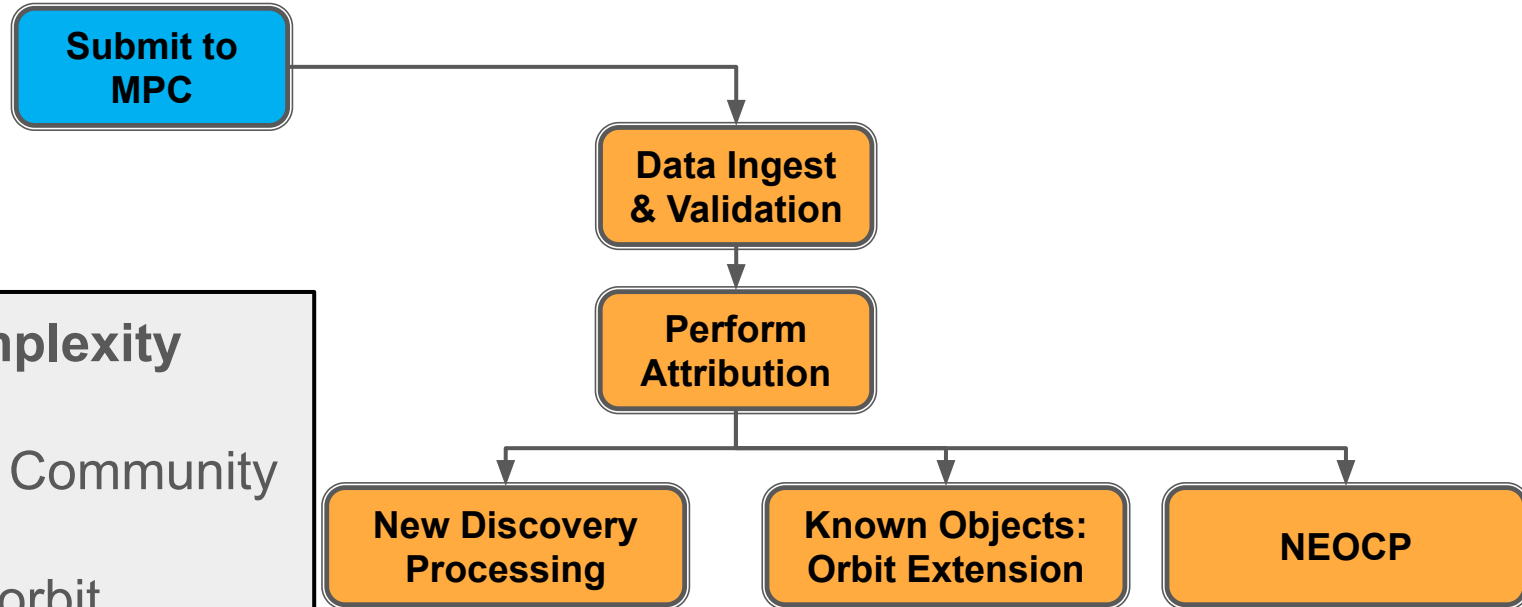
LSST

- Simulate night-to-night automation
- Add false positives
- ...



NEOs, NEOCP & System Migration

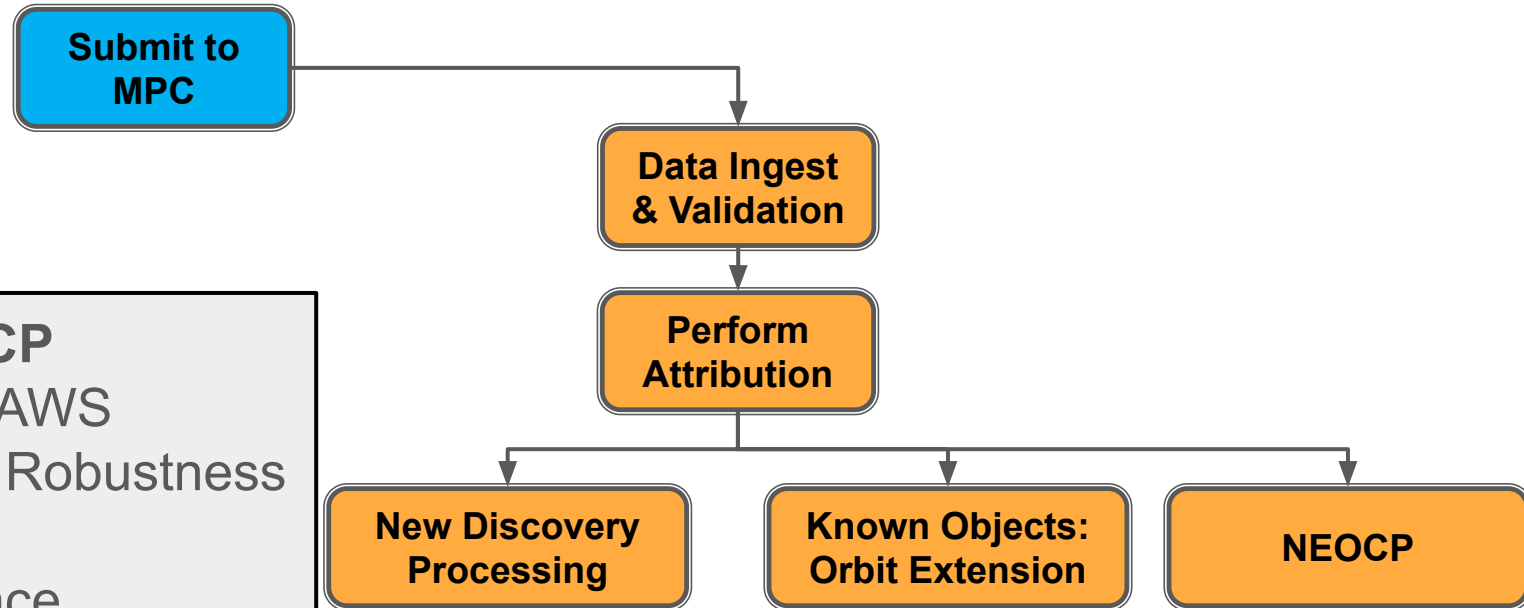
NEOs...



Real Life Complexity

- NEOCP!
- Facilitates Community Follow-up
- Real-time orbit updates
- Local Servers

NEOs...



Migrate NEOCP

- Deploy to AWS
- Increased Robustness
- Improved Performance
- Containerised OrbFit Approach
- Improved Orbital Accuracy

Data Migration



Currently Deployed

- RoR Trigger
- Private Server Processing
- Local Postgres db
- Local Queues

Migrate

Sandbox System

- AWS Lambda Trigger
- EC2 Processing
- AWS Aurora (Postgres) db
- AWS SQS Queue

Service Deployment

OrbFit Orbits

- Used and exchanged during MPC:LSST Exercise
- Uses new “mpc_orb.json” format
 - Format is being finalized for release
- Database of ~1.1M *orbfit* orbits is now populated
 - Data is being finalized for release
- Access to orbits
 - Database replication
 - API
 - Web-Search Tools
- Expected Fall 2022

Updated Ephemeris Service and Attribution Service (MPChecker)

- Database of *orbit* orbits supports new services
- Precalculated Chebyshev polynomial representations
 - Enables fast ephemeris calculation
 - Supports rapid attribution
- Code development is in place
- Containerized deployment currently being developed
- Expected Release
 - Ephemeris Service: Early Fall 2022
 - Attribution Service: Late Fall 2022

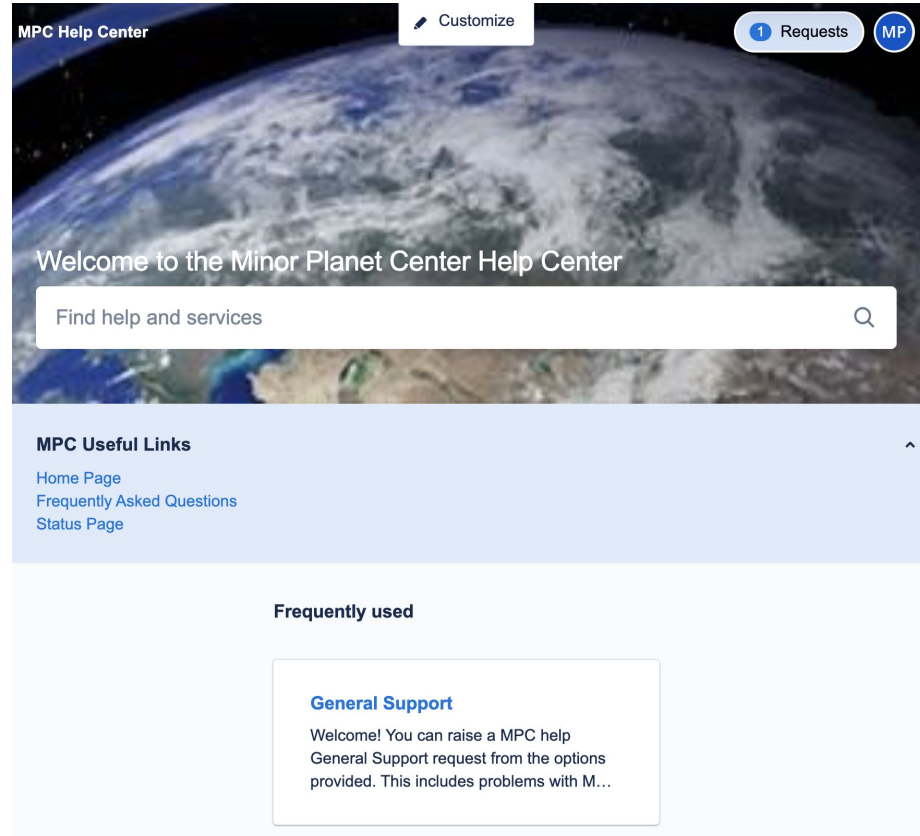
Improved API Access

- *orbit* orbits
- Designation / Identification Look-up
 - E.g. (483593) = 2004 MA6 = 2008 GW23
- Ephemeris Service
- Attribution Service
- NEOCP Data
- ...

Service Deployment

Suggestions

- *Please let me know if you have any suggestions for services and/or data products !*
 - <https://minorplanetcenter.net/contact>
 - <https://mpc-service.atlassian.net/servicedesk/customer/portals>



The screenshot shows the MPC Help Center interface. At the top, there is a header with the IAU logo and the text 'The International Astronomical Union Minor Planet Center'. Below the header is a large image of Earth from space. In the top right corner, there are buttons for 'Customize', 'Requests' (with a '1' notification), and 'MP'. Below the image, there is a search bar with the placeholder text 'Find help and services'. Underneath the search bar is a section titled 'MPC Useful Links' with a list of links: 'Home Page', 'Frequently Asked Questions', and 'Status Page'. Below this is a section titled 'Frequently used' with a box for 'General Support' that contains the text: 'Welcome! You can raise a MPC help General Support request from the options provided. This includes problems with M...'