Qnect23 EC Forum

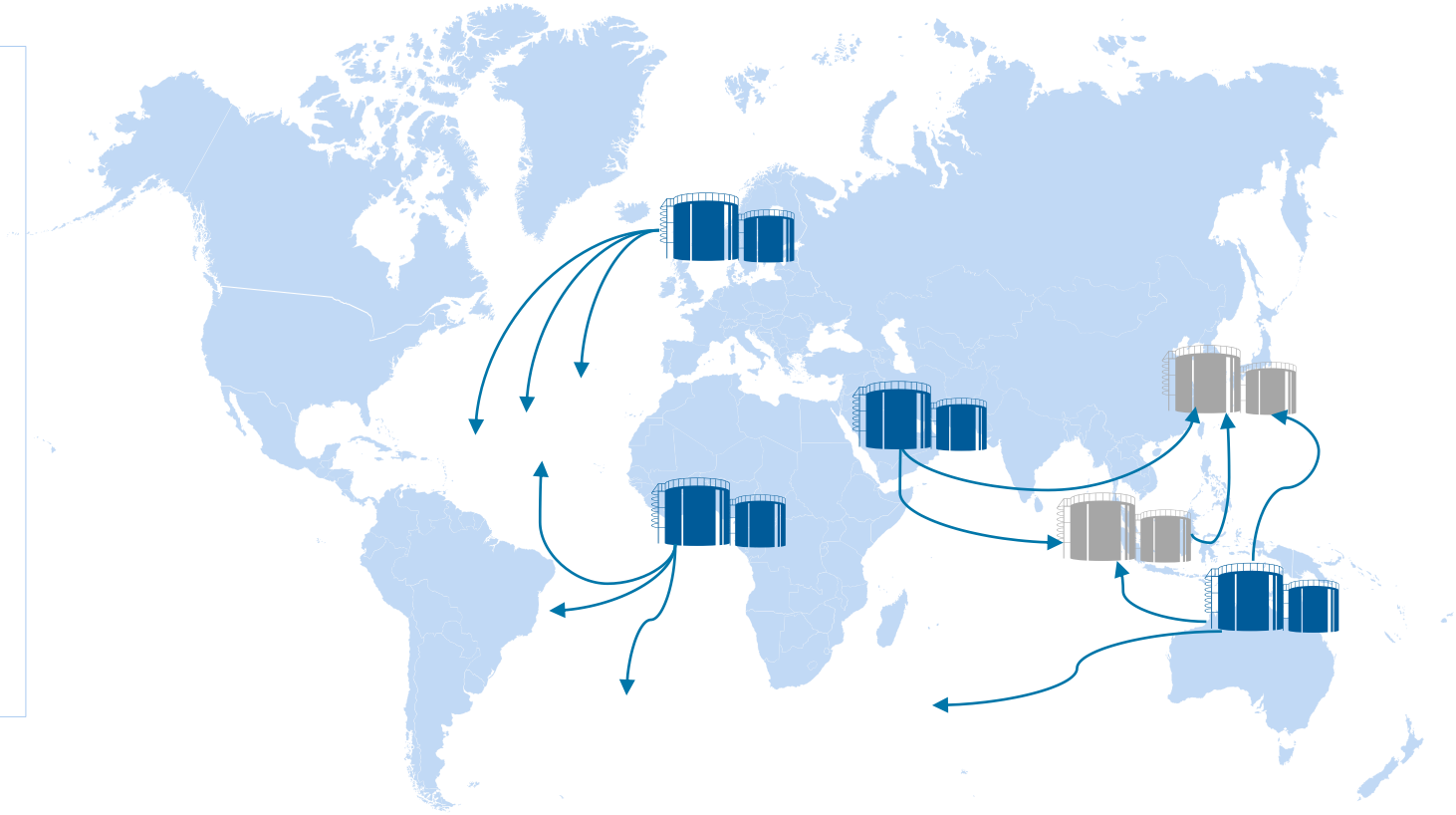
# New Voyage Model

Hanne Austad & Inge Norstad

# New Voyage Model

## Background

- Originally designed for upstream
- Foothold in other market segments
- Industry is changing
- Grown out of the original design
- New data structures to support current and future business models





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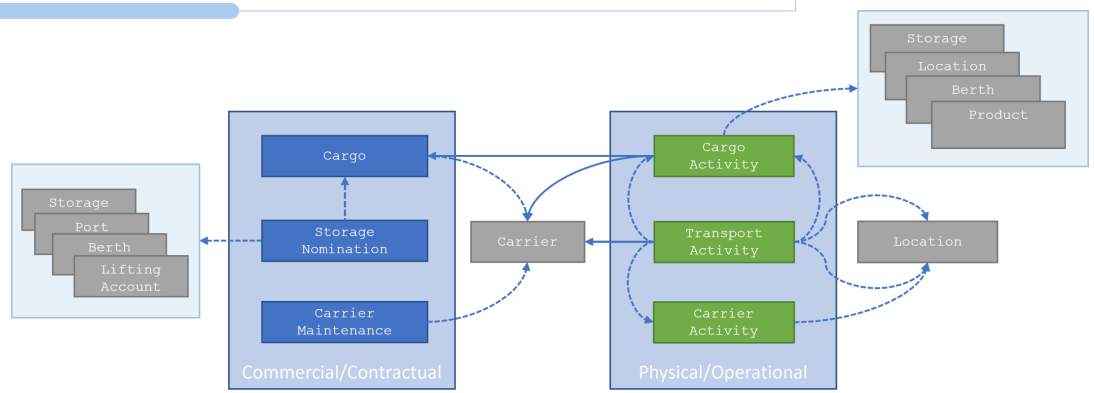
# New Voyage Model

## New Requirements

- Maximize profit and honor contractual commitments
- Resources are constrained – berths, carriers etc
- External conditions with operational impact (tidal)
- Identify opportunities (spot, charter out)
- Ensure that the plan that can be “operationalized”
- Tight operations need views with finer granularity
- Need to capture more operational details

## Challenges with old model

- Hybrid - mix of commercial and operational attributes
- Requires more configuration and customization
- Does not scale
- Separate commercial/contractual from operational/physical





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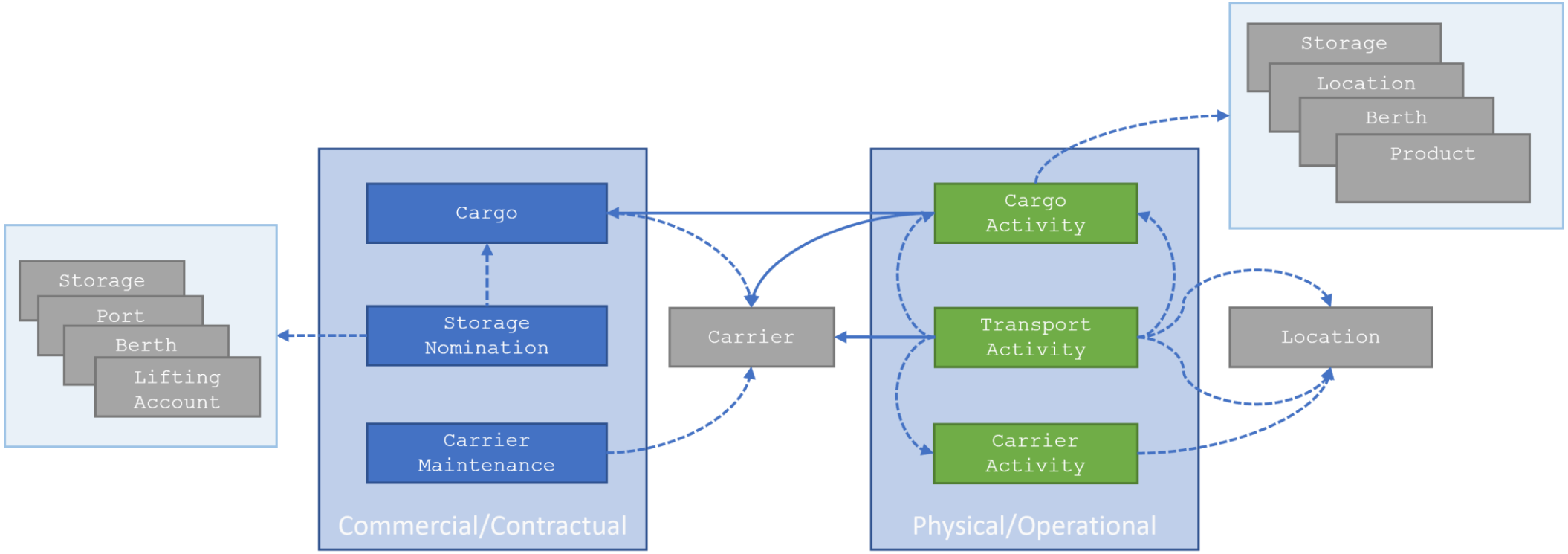
# New Voyage Model

## Data Model



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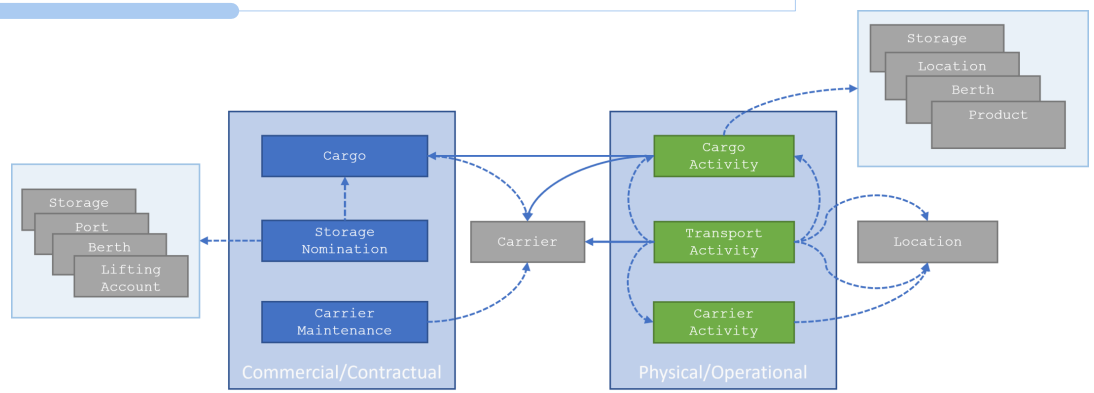
# New Voyage Model

## Explicit Nomination Types (new)

- A nomination is either a LIFTING or a DELIVERY
- Nominations that are linked to a storage (operator view)
  - LIFTINGs decrease the storage level
  - DELIVERYs increase the storage level
- Nominations without storage link (counterparty view)
  - No impact on storage balance
  - Capture commercial and operational details for the “counterparty” side of the transaction
- Two-way storage support is inherent
- Storage type becomes “informational” only

## Implicit Nomination Types (old)

- All nominations must refer to a storage
- Export storages - nominations are liftings
- Import storages - nominations are deliveries
- LNG import terminals with reload capabilities
  - Typically handled with negative volumes





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# New Voyage Model

## Multi-Parcel Support

VIEW CARGO DETAILS

Cargo Name: LNGX-LNG-BETA-2024-0195 | Cargo Status: Tentative | Carrier Name: TS6 - Ananke
Master | Laytime | Surveyor
Agent | Comments

### LIFTING NOMINATIONS

| Storage Name | Parcel No | Nominated Date | Nominated Start of Lifting | Nominated Qty | Nominated Unit | Nominated2 Qty2 | Nominated2 Unit | Berth | Lifting Account Name | Loading Port | ADP Year | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS6 - LNG Export | | 2024-02-23 | 2024-02-23 12:00 | 141,000 | m³ | | | TS6 - Jetty 2 | TS6 - LNGX LNG Beta DES | TS6 - Home Port | | |

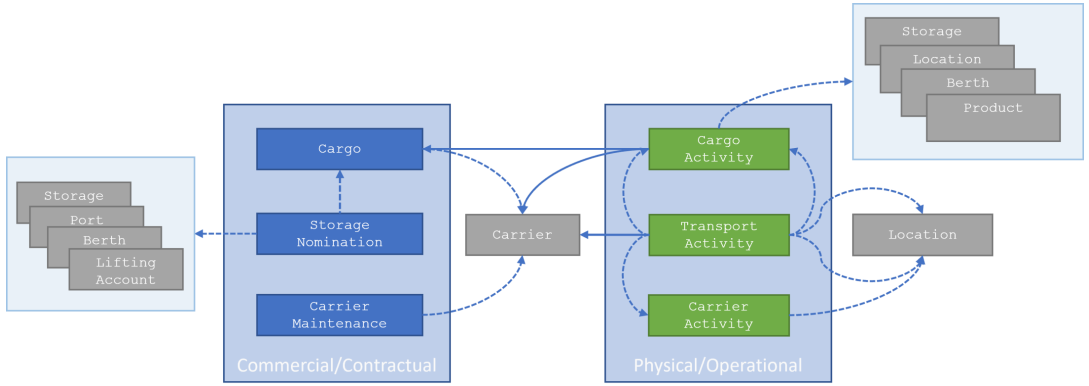
### DELIVERY NOMINATIONS

| Contract | Delivery No | Cargo Status | Nominated Date | Nominated Start of Unload | Nominated Qty | Nominated Unit | Incoterm | Delivery Port | Buyer Cargo Name | ADP Year | Comments | Carrier Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS6 - LNG Beta DES | | Tentative | 2024-03-04 | 2024-03-04 00:00 | 100,000 | | | TS6 - Brazil | | | | TS6 - Ananke |
| TS6 - LNG Beta DES | | Tentative | 2024-03-07 | 2024-03-07 00:00 | 41,000 | | | TS6 - Brazil - Rio | | | | TS6 - Ananke |

### VOYAGE

Voyage Template | GENERATE VOYAGE

| Category | Activity Type | Daytime | End Date | From Location | To Location | Distances [nmi] | Speed [knots] |
|---|---|---|---|---|---|---|---|
| Transport | Ballast | 2024-02-04 16:30 | 2024-02-22 22:00 | TS6 - India | TS6 - Home Port | 7,000 | 16.00 |
| Cargo | Pilot In | 2024-02-22 22:00 | 2024-02-23 06:00 | TS6 - Home Port | | | |
| Cargo | Connecting | 2024-02-23 06:00 | 2024-02-23 11:00 | TS6 - Home Port | | | |
| Cargo | Loading | 2024-02-23 11:00 | 2024-02-23 22:45 | TS6 - Home Port | | | |
| Cargo | Disconnecting | 2024-02-23 22:45 | 2024-02-24 01:45 | TS6 - Home Port | | | |
| Cargo | Pilot Out | 2024-02-24 01:45 | 2024-02-24 09:45 | TS6 - Home Port | | | |
| Transport | Laden | 2024-02-24 09:45 | 2024-03-03 15:00 | TS6 - Home Port | TS6 - Brazil | 3,584 | 18.17 |
| Cargo | Pilot In | 2024-03-03 15:00 | 2024-03-03 23:00 | TS6 - Brazil | | | |
| Cargo | Unloading | 2024-03-03 23:00 | 2024-03-04 07:20 | TS6 - Brazil | | | |
| Transport | Laden | 2024-03-04 07:20 | 2024-03-06 23:00 | TS6 - Brazil | TS6 - Brazil - Rio | 1,500 | 23.56 |
| Cargo | Unloading | 2024-03-06 23:00 | 2024-03-07 03:33 | TS6 - Brazil - Rio | | | |





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# New Voyage Model

## Multi-Parcel Support

VIEW CARGO DETAILS

Cargo Name: LNGX-LNG-VICTOR-FOB-24 | Cargo Status: Tentative | Carrier Name: TS6 - Ganymede
Master | Laytime | Surveyor
Agent | Comments

LIFTING NOMINATIONS

| Storage Name | Parcel No | Nominated Date | Nominated Start of Lifting | Nominated Qty | Nominated Unit | Nominated2 Qty2 | Nominated2 Unit | Berth | Lifting Account Name | Loading Port | ADP Year | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS6 - LNG Export | | 2024-08-07 | 2024-08-07 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor FOB | TS6 - Home Port | | |
| TS6 - LNG Export | | 2024-08-07 | 2024-08-07 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor FOB | TS6 - Home Port | | |
| TS6 - LNG Export | | 2024-08-07 | 2024-08-07 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor FOB | TS6 - Home Port | | |
| TS6 - LNG Export | | 2024-08-07 | 2024-08-07 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor FOB | TS6 - Home Port | | |

DELIVERY NOMINATIONS

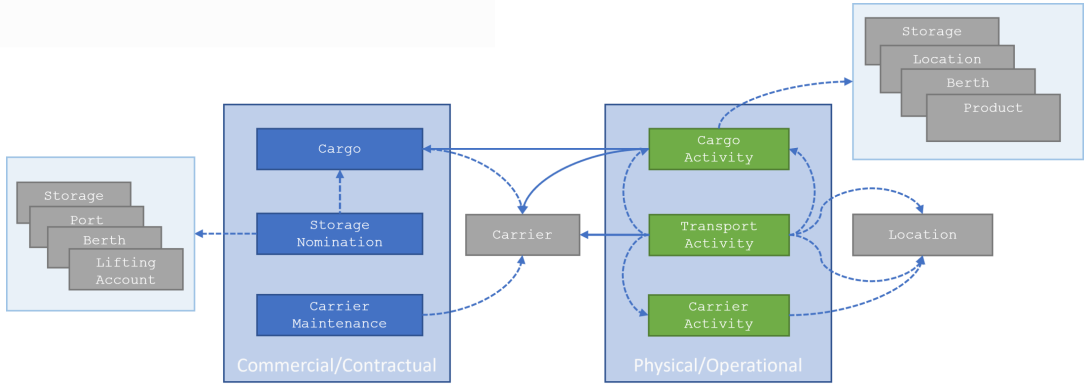
| Contract | Delivery No | Cargo Status | Nominated Date | Nominated Start of Unload | Nominated Qty | Nominated Unit | Incoterm | Delivery Port | Buyer Cargo Name | ADP Year | Comments | Carrier Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

No records found

VOYAGE

Voyage Template | GENERATE VOYAGE

| Category | Activity Type | Daytime | End Date | From Location | To Location | Distances [nmi] | Speed [knots] |
|---|---|---|---|---|---|---|---|
| Cargo | Pilot In | 2024-08-06 17:00 | 2024-08-07 01:00 | TS6 - Home Port | | | |
| Cargo | Connecting | 2024-08-07 01:00 | 2024-08-07 06:00 | TS6 - Home Port | | | |
| Cargo | Loading | 2024-08-07 06:00 | 2024-08-07 21:00 | TS6 - Home Port | | | |
| Cargo | Disconnecting | 2024-08-07 21:00 | 2024-08-08 00:00 | TS6 - Home Port | | | |
| Cargo | Pilot Out | 2024-08-08 00:00 | 2024-08-08 08:00 | TS6 - Home Port | | | |





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# New Voyage Model

## Multi-Parcel Support

VIEW CARGO DETAILS

Cargo Name: LNGX-LNG-VICTOR-DES-20 | Cargo Status: Tentative | Carrier Name: TS6 - Europa
Master | Laytime | Surveyor
Agent | Comments

### LIFTING NOMINATIONS

| Storage Name | Parcel No | Nominated Date | Nominated Start of Lifting | Nominated Qty | Nominated Unit | Nominated2 Qty2 | Nominated2 Unit | Berth | Lifting Account Name | Loading Port | ADP Year | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS6 - LNG Export | | 2024-08-19 | 2024-08-19 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor DES | TS6 - Home Port | | |
| TS6 - LNG Export | | 2024-08-19 | 2024-08-19 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor DES | TS6 - Home Port | | |
| TS6 - LNG Export | | 2024-08-19 | 2024-08-19 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor DES | TS6 - Home Port | | |
| TS6 - LNG Export | | 2024-08-19 | 2024-08-19 08:00 | 45,000 | m³ | | | TS6 - Jetty 1 | TS6 - LNGX LNG Victor DES | TS6 - Home Port | | |

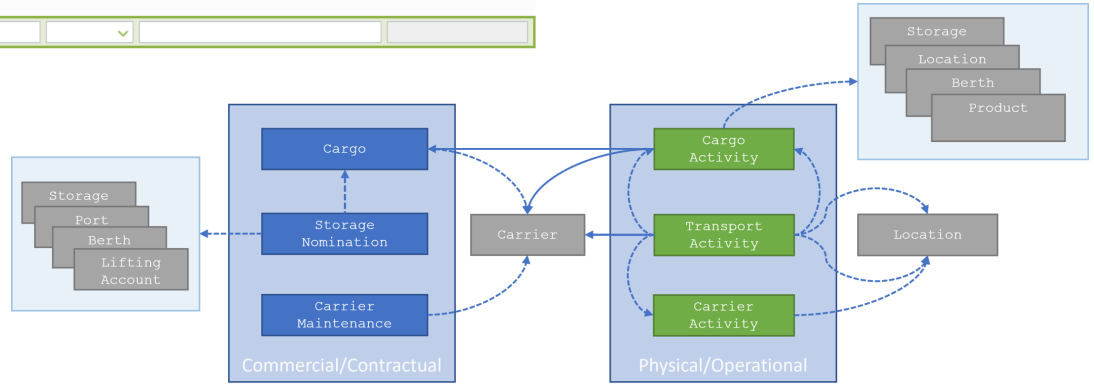
### DELIVERY NOMINATIONS

| Contract | Delivery No | Cargo Status | Nominated Date | Nominated Start of Unload | Nominated Qty | Nominated Unit | Incoterm | Delivery Port | Buyer Cargo Name | ADP Year | Comments | Carrier Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS6 - LNG Victor DES | | Tentative | 2024-08-27 | 2024-08-27 07:30 | 180,000 | | | TS6 - Portugal | | | | |

### VOYAGE

Voyage Template | GENERATE VOYAGE

| Category | Activity Type | Daytime | End Date | From Location | To Location | Distances [nmi] | Speed [knots] |
|---|---|---|---|---|---|---|---|
| Transport | Ballast | 2024-08-10 02:30 | 2024-08-18 17:00 | TS6 - Portugal | TS6 - Home Port | 3,304 | 16.00 |
| Cargo | Pilot In | 2024-08-18 17:00 | 2024-08-19 01:00 | TS6 - Home Port | | | |
| Cargo | Connecting | 2024-08-19 01:00 | 2024-08-19 06:00 | TS6 - Home Port | | | |
| Cargo | Loading | 2024-08-19 06:00 | 2024-08-19 21:00 | TS6 - Home Port | | | |
| Cargo | Disconnecting | 2024-08-19 21:00 | 2024-08-20 00:00 | TS6 - Home Port | | | |
| Cargo | Pilot Out | 2024-08-20 00:00 | 2024-08-20 08:00 | TS6 - Home Port | | | |
| Transport | Laden | 2024-08-20 08:00 | 2024-08-26 21:30 | TS6 - Home Port | TS6 - Portugal | 3,304 | 20.98 |
| Cargo | Pilot In | 2024-08-26 21:30 | 2024-08-27 05:30 | TS6 - Portugal | | | |
| Cargo | Unloading | 2024-08-27 05:30 | 2024-08-27 20:30 | TS6 - Portugal | | | |
| Cargo | Pilot Out | 2024-08-27 20:30 | 2024-08-28 04:30 | TS6 - Portugal | | | |





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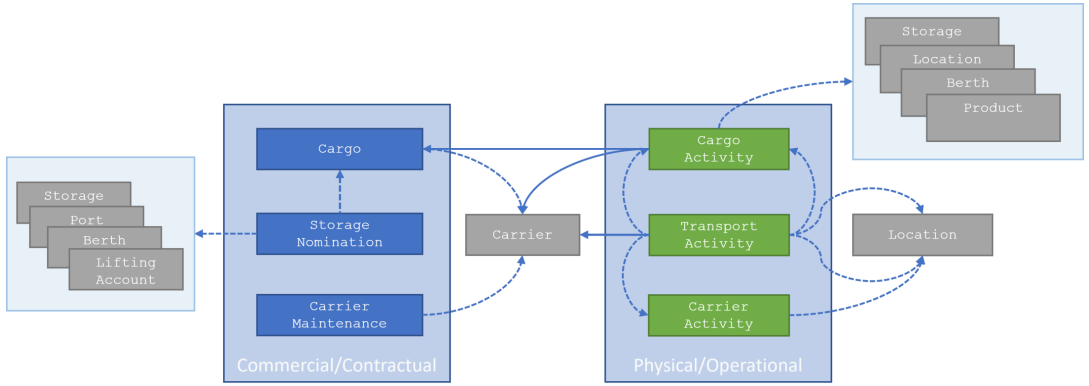
# New Voyage Model

## Multi-Parcel Support

| From Date | To Date | Product Group | Carrier | Maintenance Type |
|---|---|---|---|---|
| 2024-01-01 | 2026-01-01 | | | *Dry Dock Maintenance |

### CARRIER MAINTENANCE

| Maintenance Type | Carrier Name | Start Window Date | End Window Date | Daytime | End Date | Duration days | Location |
|---|---|---|---|---|---|---|---|
| *Dry Dock Maintenance | TS6 - Euanthe | 2024-04-01 | 2024-07-01 | | | 20 | TS6 - Japan |
| *Dry Dock Maintenance | TS6 - Europa | 2024-04-01 | 2024-07-01 | | | 20 | TS6 - Korea |
| *Dry Dock Maintenance | TS6 - Cyllene | 2024-07-01 | 2024-10-01 | | | 15 | TS6 - Portugal |
| *Dry Dock Maintenance | TS6 - Erinome | 2024-07-01 | 2024-10-01 | | | 15 | TS6 - Portugal |
| *Dry Dock Maintenance | TS6 - Callisto | 2024-10-01 | 2025-01-01 | | | 10 | TS6 - Malaysia |





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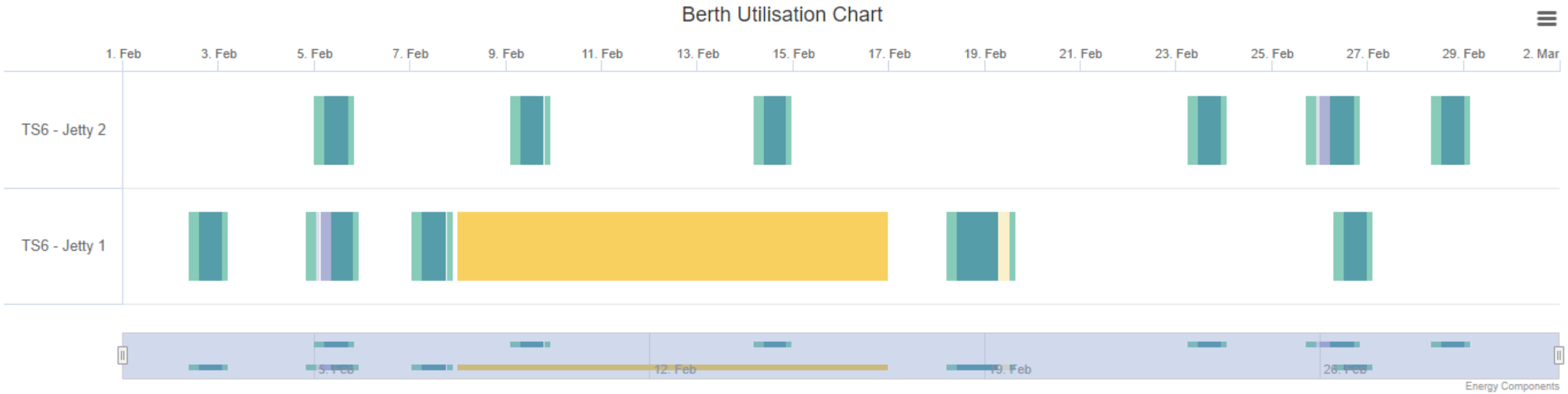
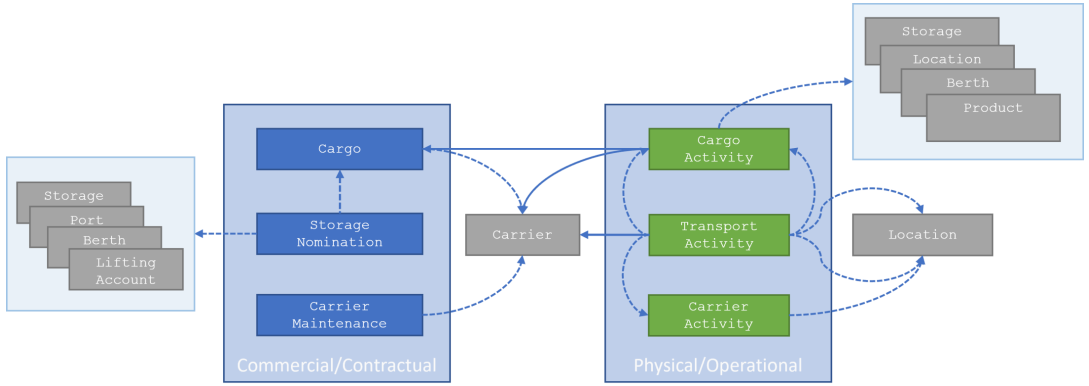
# New Voyage Model

## Enhanced Visualization - Granular View of Operations



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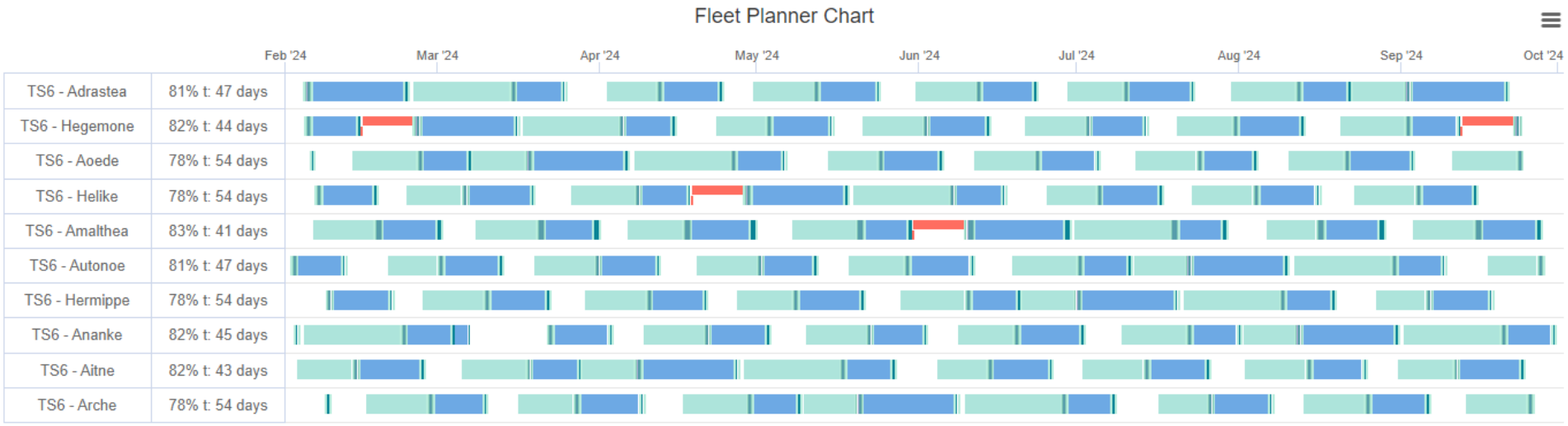
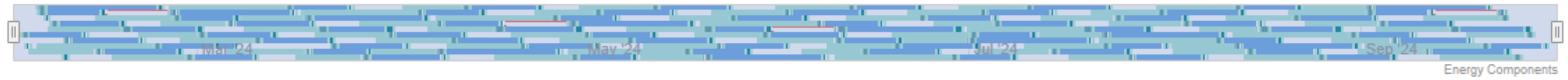
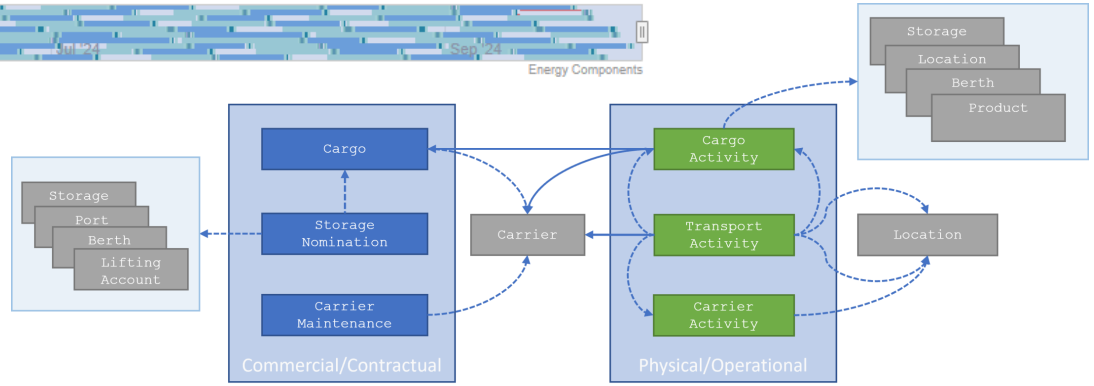
# New Voyage Model

## Enhanced Visualization - Granular View of Operations



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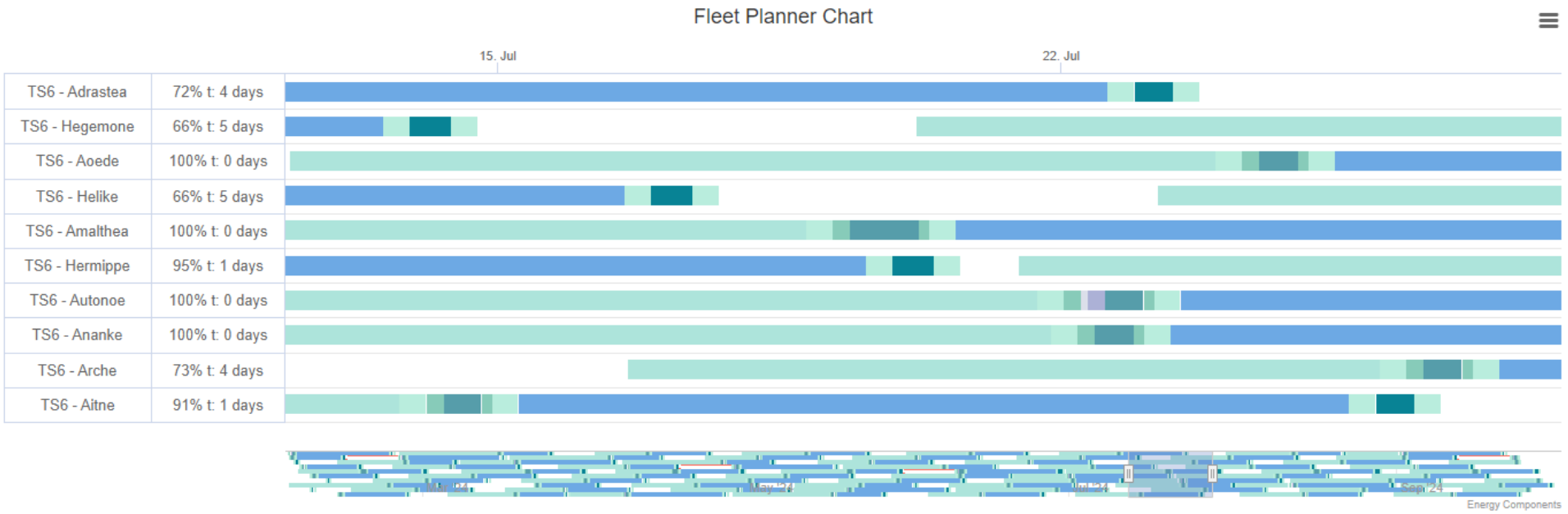
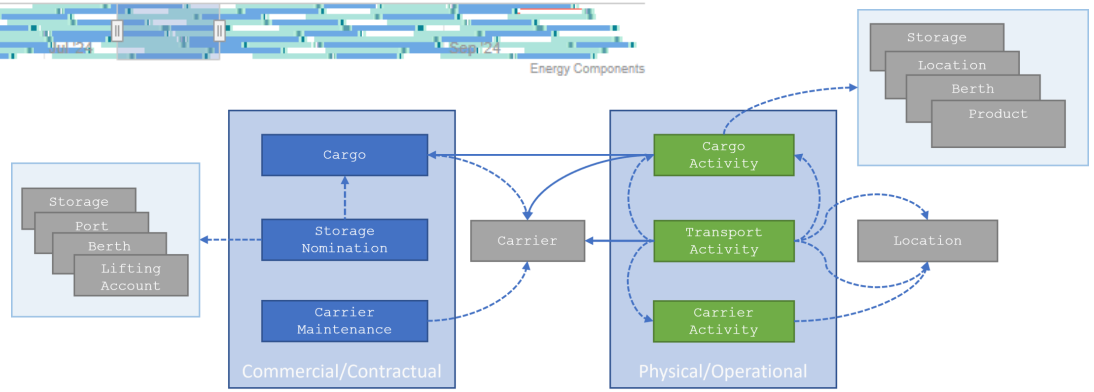
# New Voyage Model

## Enhanced Visualization - Granular View of Operations



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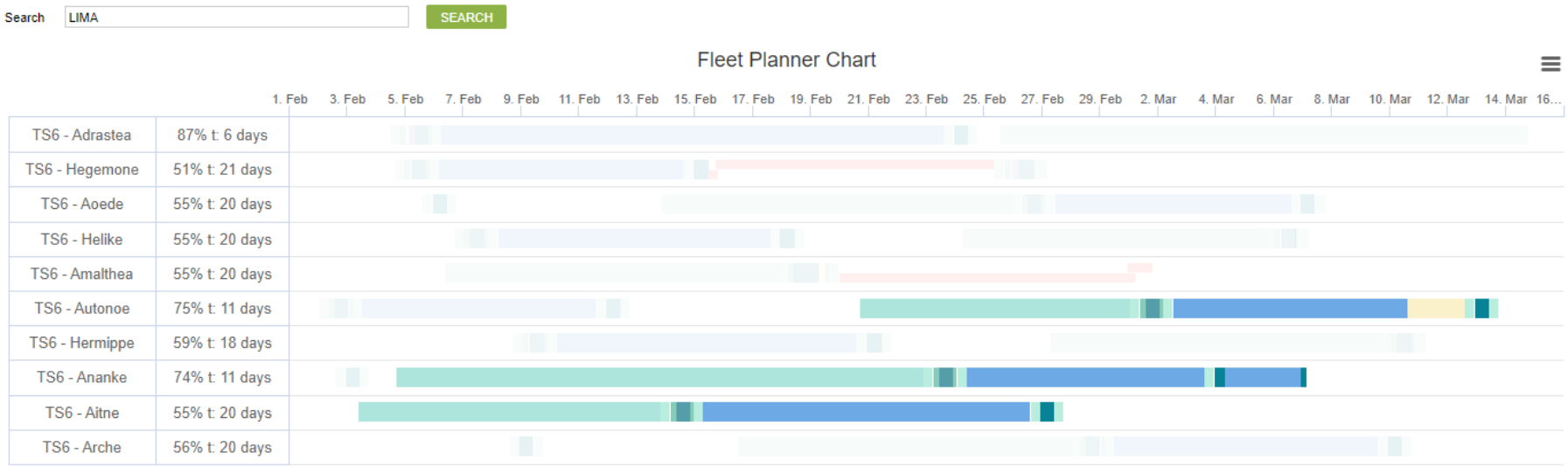
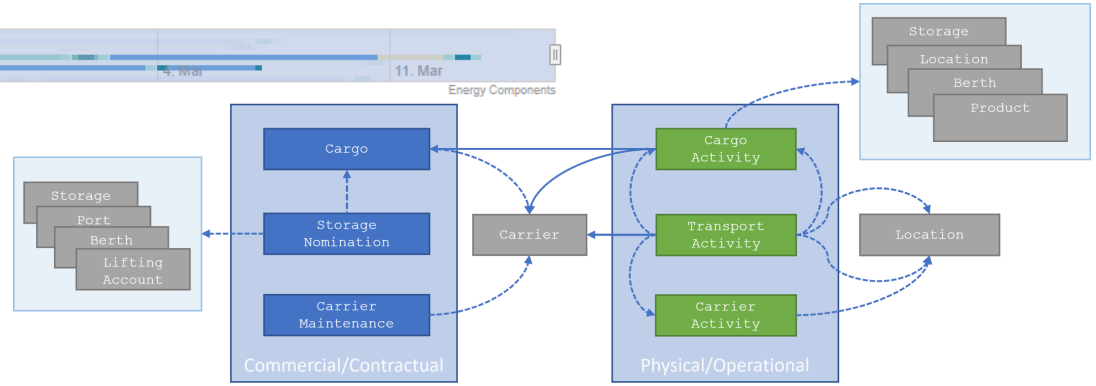
# New Voyage Model

## Enhanced Visualization - Granular View of Operations



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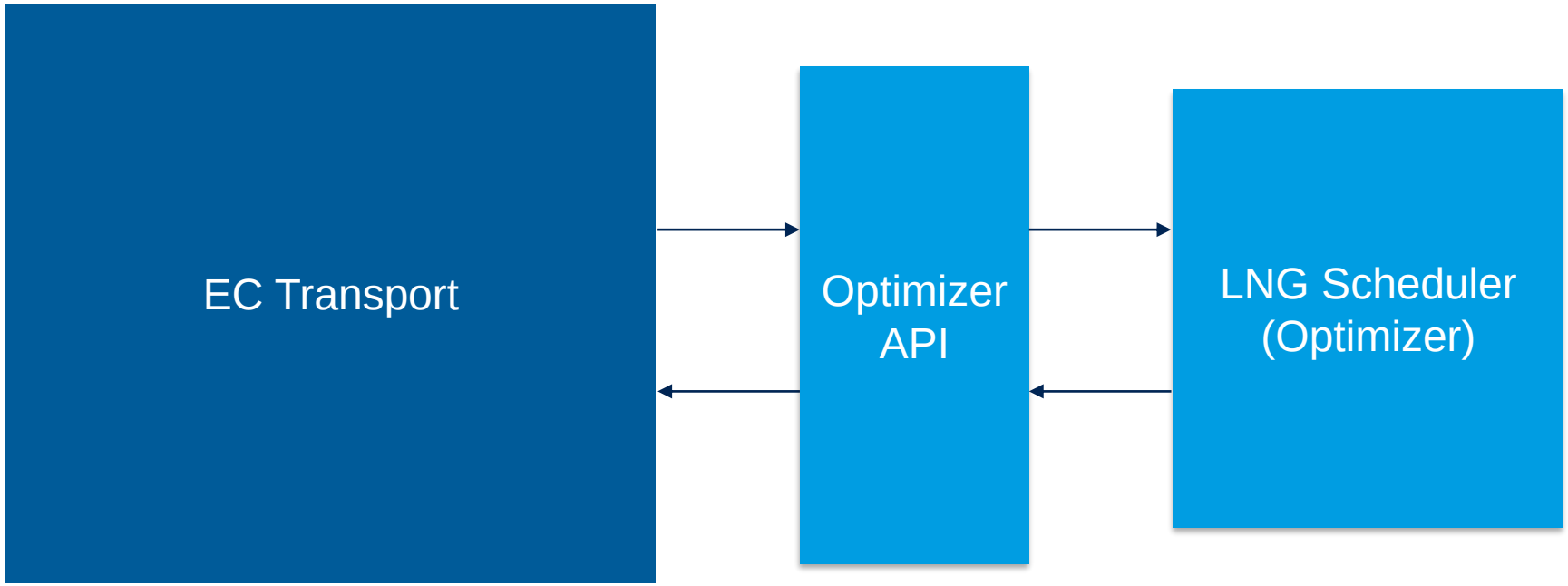
# New Voyage Model

## The optimizer





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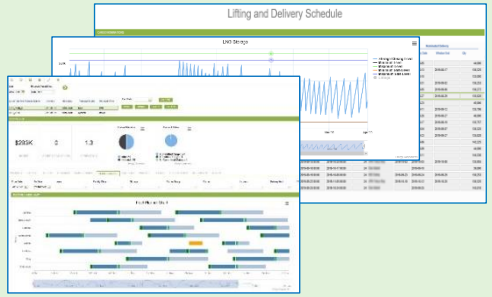
# New Voyage Model

## LNG Scheduler



Clients:
- ADNOC LNG
- LNG Canada
- INPEX
- Nigeria LNG

*Integrated with **EC Transport***

Quickly creates plans that **maximize profit** by **optimal utilization** of fleet capacity to **fulfil contractual commitments** and take advantage of **market opportunities**.

Provides **portfolio-wide decision support** for offtake and dispatch scheduling, and fleet management.

**INPUT**

Takes into account all relevant decision elements and constraints for managing an optimized portfolio-wide schedule for cargo and fleet operations.

**Production**
- LNG production forecasts
- Storage tank size and safety levels

**Vessels**
- Vessel size, speed profile, availability
- Charter rate, bunker consumption profile
- Dry dock requirement: time window and location

**Demand requirements**
- Delivery ex ship (DES) contracts: delivery time, quantity, destination
- Free on board (FOB) contracts: loading time window, quantity
- Spot opportunities

**Port and berth restriction**
- Tidal and workhour restrictions
- Berth availability

**OPTIMIZE**

Leverages advanced analytics techniques to solve the optimization problem efficiently, in the matter of seconds, not minutes, hours or even days.

**LNG Scheduler**

Using mathematical optimization and guided by expert domain knowledge, LNG Scheduler employs a **heuristics procedure** to create optimized –
- Annual Delivery Program (ADP)
- Shipping Delivery Schedule (SDS)

*Respect all constraints:*
- *Find feasible schedule, i.e., no storage, vessel, contract delivery, port and berth constraint violation*

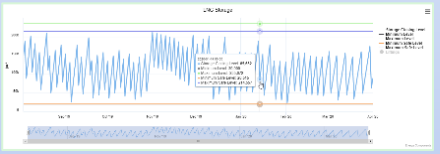
*Objective:*
- *Maximize profit from delivering to spot and opportunistic demand*
- *Minimize shipping costs by optimizing vessel speed*
- *Avoid voyage charter*

**OUTPUT**

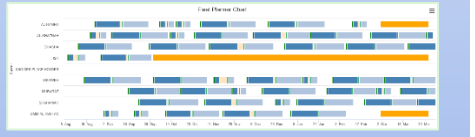
Delivers optimized and robust offtake and dispatch schedules with increased profitability with minimized need for vessel chartering and curtailments, whilst helping to identify opportunities.

**Cargo Lift and delivery schedule**

**Storage plan**



**Vessel operation schedule**





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# New Voyage Model

## How does the New Voyage Model fit with the LNG Scheduler?

- The optimization algorithm and underlying data structure is based on optimization models from maritime transportation (Ship routing and Scheduling)
- The data structure is more vessel (carrier) oriented, while the old EC model was storage oriented
- The New Voyage Model leads to more accurate and flexible scheduling:
  - Multiple loading ports / storages
  - Multiple deliveries (parcel cargoes)
  - Third party LNG providers (buying LNG in the market)
  - Carrier maintenance optimization
  - Purge and Cool down operations
  - Dynamic fleet management (optimizing charter out opportunities)


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# New Voyage Model

## Problems with the old model

- All cargoes were roundtrips
- Starting and ending in the same export location
- Relatively easy to optimize
- Hard to model the real world accurately
  - Multiple loading locations
  - Dry docking
  - Cool Down operations
  - Charter out opportunities

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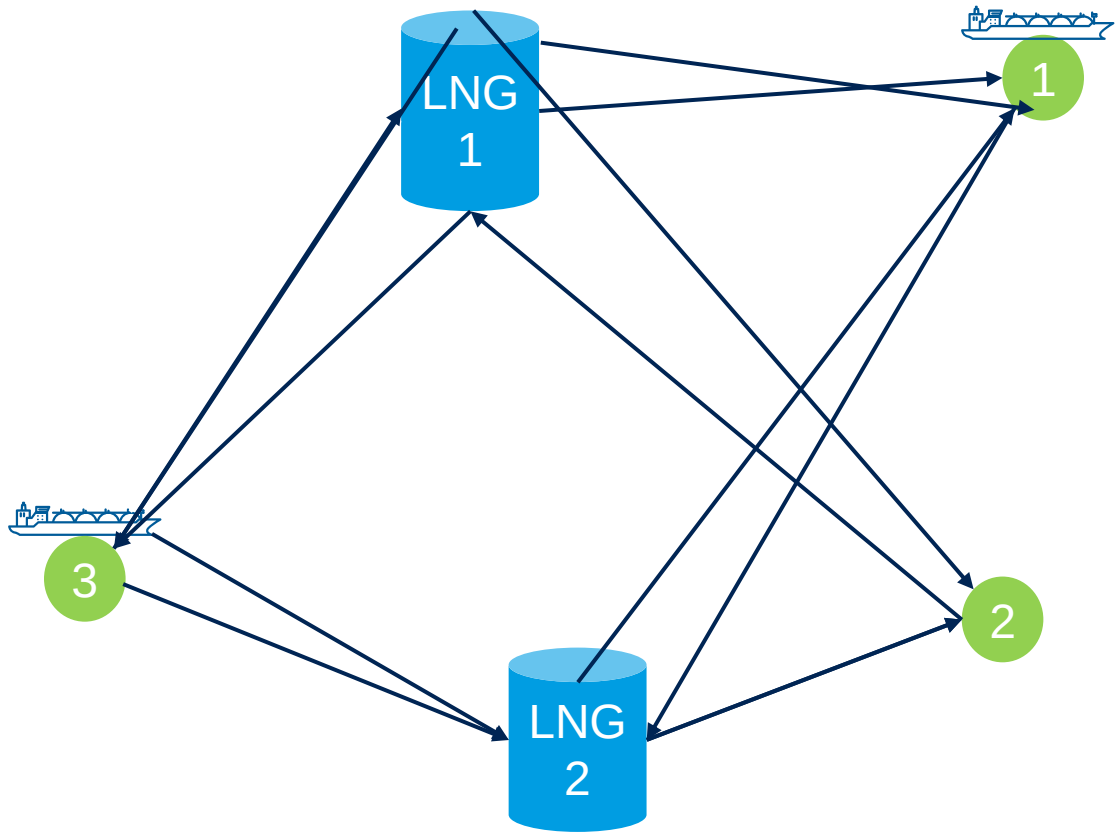
# New Voyage Model

## Multiple loading locations

- Carrier doesn’t have to start at Export location
- More routing options
- Give more flexibility and better fleet utilization





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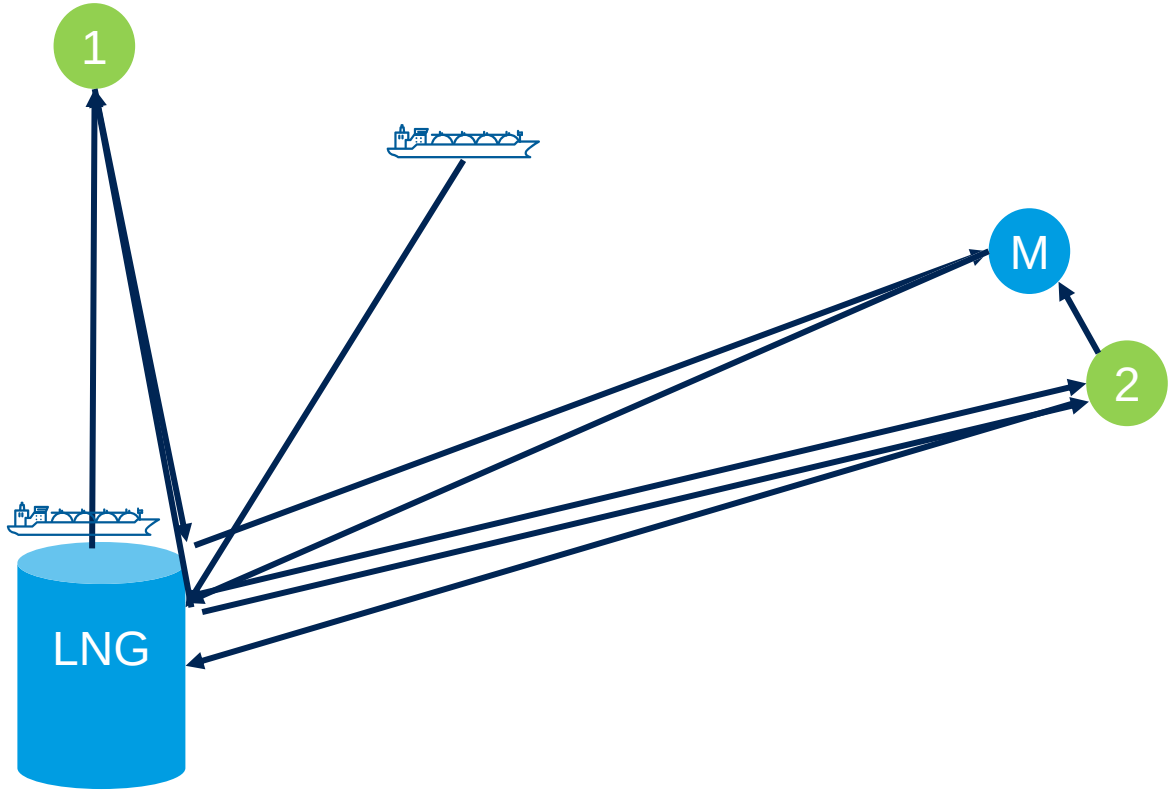
# New Voyage Model

## Carrier maintenance (dry docking)

- Carrier maintenance
  - Location
  - Duration
  - Starting time window
- The old model created unnecessary ballast sailing legs
- Optimizer tries to make the last delivery close to the dry dock location
- Reduces total sailing distance and hence the costs





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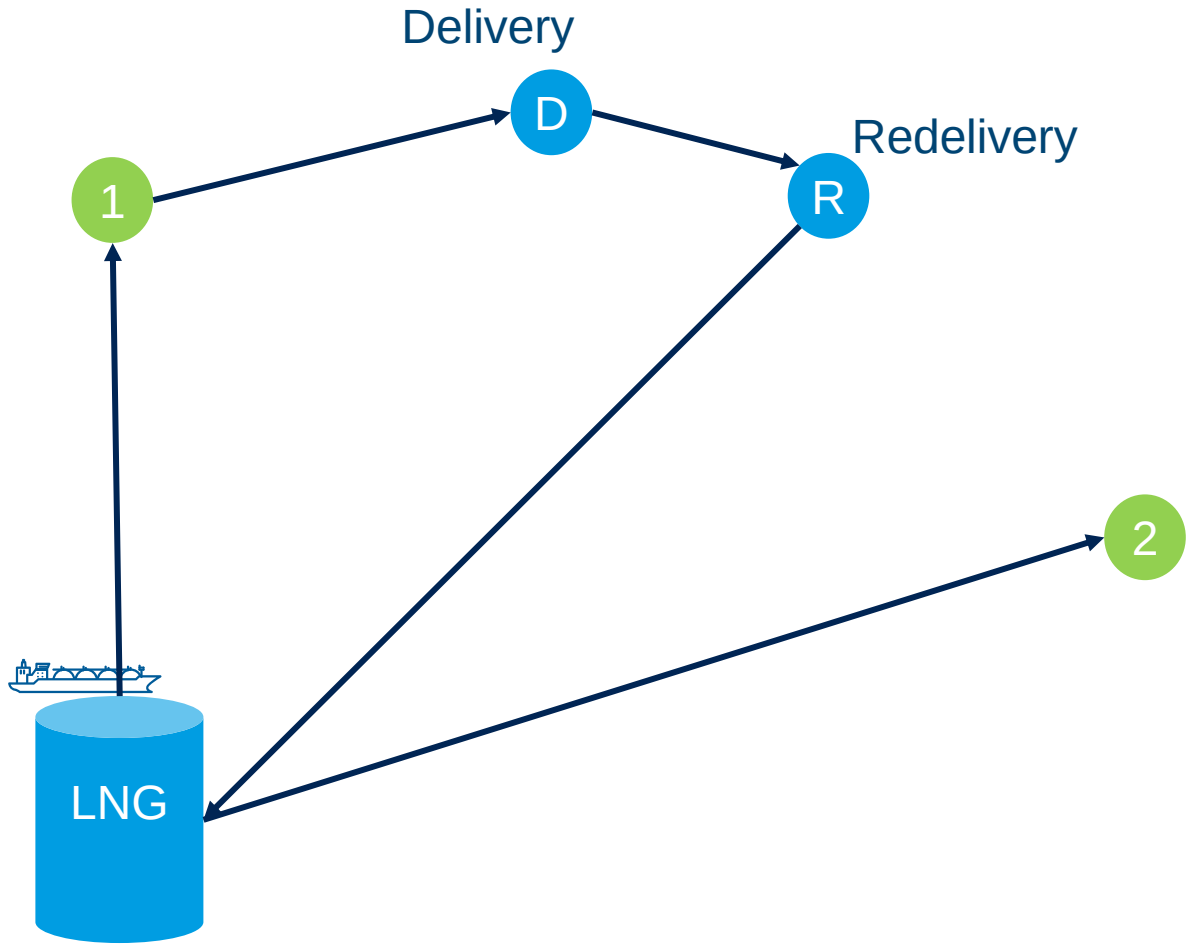
# New Voyage Model

## Charter out opportunities (Dynamic fleet management)

- Time charter or voyage charter
  - Starting time window
  - Duration
  - Starting location (delivery port)
  - Ending location (redelivery port)
  - Revenue (lumpsum or daily rate)
- Significant effect on maximizing profit





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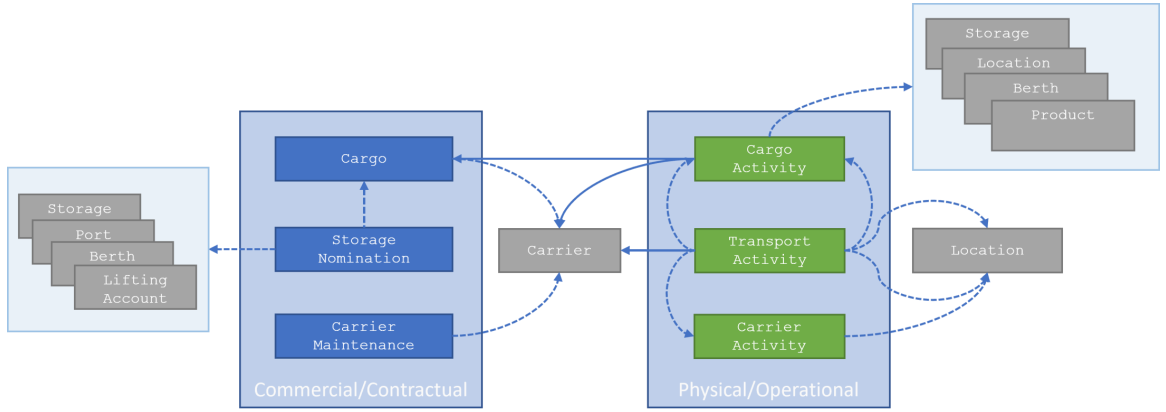
# New Voyage Model

## Summary

- Separate Commercial/Contractual vs Operational/Physical model
  - Improved multi-parcel support
  - Capture information about execution of plan
  - Insight through powerful visualization
  - Better foundation to build on
- New Voyage model fits very well with the optimization model in the LNG Scheduler





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