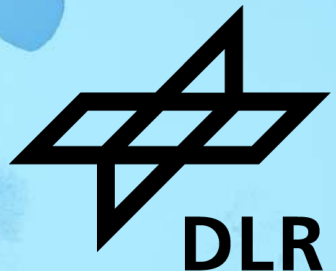


REMOTE MASTER AND AUTONOMOUS NAVIGATION

The Concept of Remote Operators in contrast to the Conventional Master





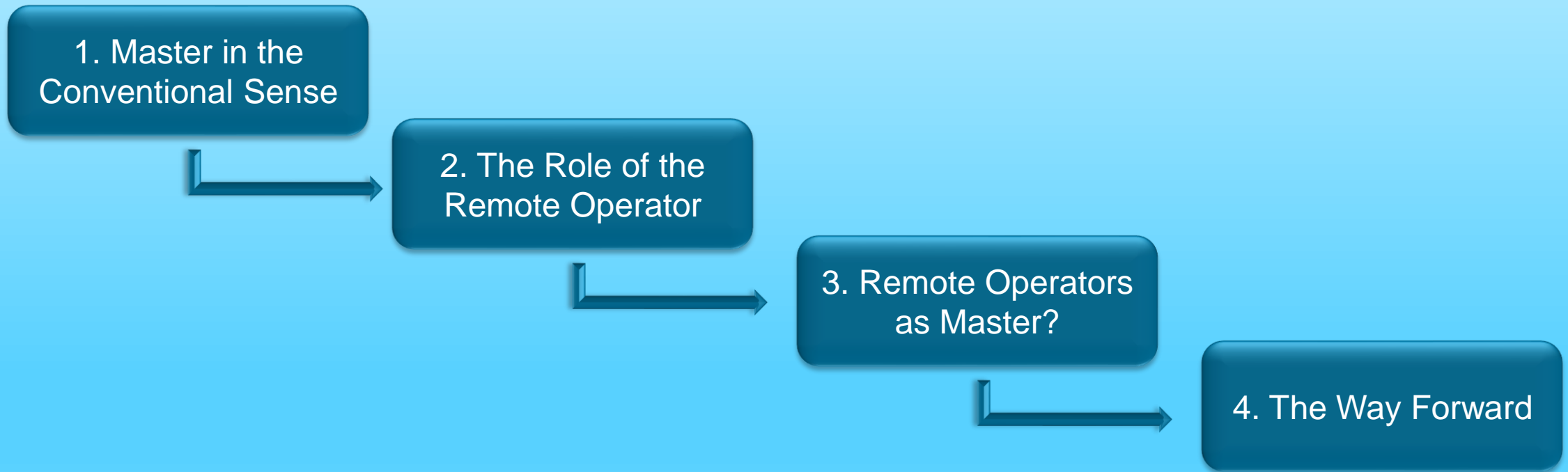
„The Flying Dutchman“, by Charles Temple Dix, around 1860

Does the Remote Operator constitute a master in the sense of UNCLOS?

1. Master in the Conventional Sense



Does the Remote Operator constitute a master in the sense of UNCLOS?



The background of the slide is a reproduction of the painting "The Flying Dutchman" by Michael Zeno Diemer. It depicts a three-masted sailing ship with red and white sails, tilted precariously on a dark, stormy sea. In the distance, jagged, dark rock formations rise from the water under a dramatic, cloudy sky with golden light breaking through. A dark blue horizontal bar is overlaid at the bottom of the image, containing the title text.

MASTER IN THE CONVENTIONAL SENSE

Master in the Conventional Sense



Art. 94 UNCLOS: Duties of the flag State

Section 4: “[*Every State shall take measures for ships flying its flag*] necessary to ensure:

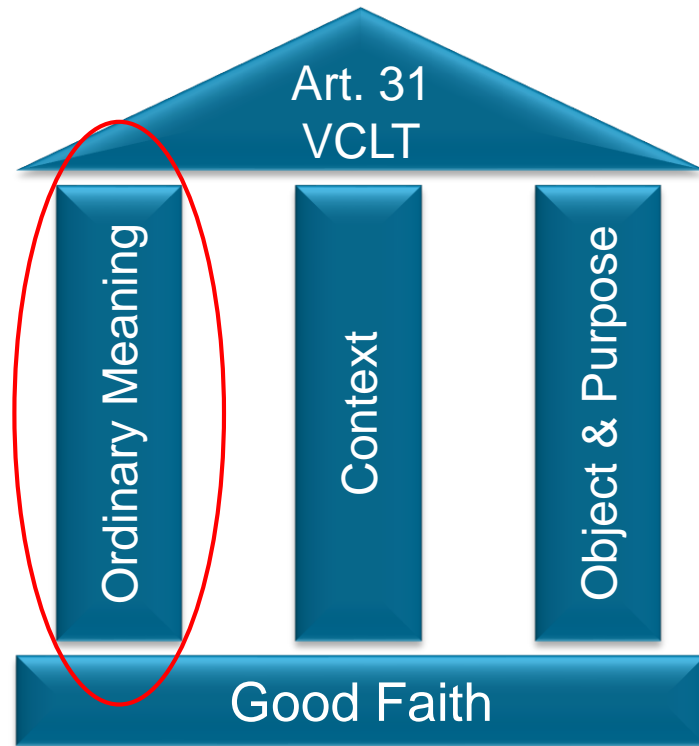
(b) that *each ship is in the charge of a master* (...) who possesses appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering”




Physical presence not explicitly required



Remote Operator = Master

Master in the Conventional Sense



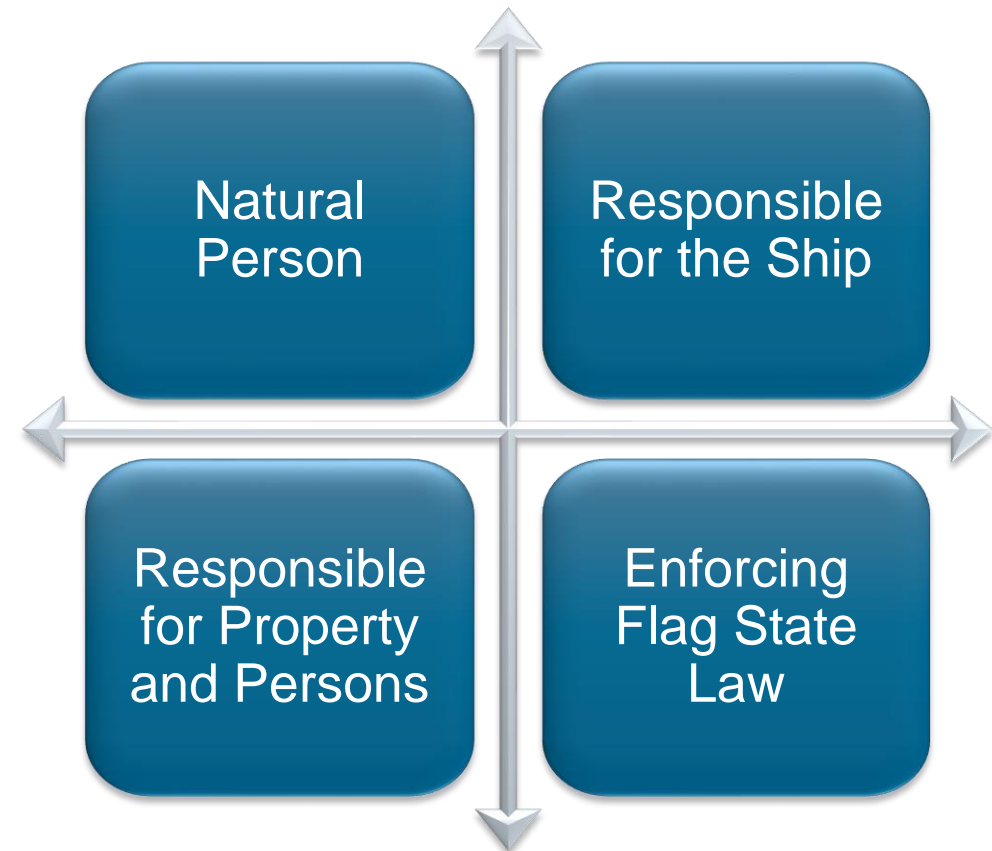
-  History of the Master
-  Typical Duties
-  Actual Practice

Master in the Conventional Sense

History of the Master

- Dates back to ancient times
- Some continuity through the ages
 - Largely unchanging role
 - Despite changes in society

Definition in National Legal Systems



The Master's Responsibilities

Four Main Aspects

A

Safety of the Ship

Responsible to keep the ship out of danger and make all navigational decisions that are necessary to ensure that the voyage is safe. Especially in time-critical and dangerous situations



B

Seaworthiness

Make sure that the ship is seaworthy before departing and keep the ship seaworthy throughout the voyage including

- ship's cargo
- maintenance of equipment
- working spaces and means of communication



C

Flag State Law

Responsibility to enforce regulations of the flag state including international law converted into national law as:

- COLREG
- SOLAS
- MARPOL



D

Coastal State Accountability

Contact and accountability towards the coastal and port State, e.g. in a port state inspection. In some cases even criminal liability before the coastal state as the master is both subject and target of the domestic laws





THE REMOTE OPERATOR

The Remote Operator

Ensure the Human Element

- Supervision and Intervention if necessary
- Fulfilling existing legal instruments
 - e.g. SOLAS, COLREG, STCW

Social Acceptance

- Greater sense of security in the society with people in charge



Remote Simulation Center LEAS Project, Fraunhofer FKIE, Hamburg 2023

Technical challenges

Look-out

- Resolution of distant objects
- A complete look-out requires complex camera systems
- Data throughput and video refresh rate



- Resolution: 4416 x 4428 (19.6 MPix)
- 1 Pixel ~ 1m² on a 5 km distance
- 50 m ships in the horizon
- Recognition of ships' silhouettes
- Limited identification of ship classes

Image Source: Alexander Klein, DLR

Technical challenges

Remote Operator

- Tremendous amount of raw data
- "Raw" video data clogs the ship's LAN
- Limited bandwidth of satellite and radio communication
- Challenge of video data compression
- Controller delay

120 MP at 30 Hz



Transmission Rate of
~ 150 MBit/s

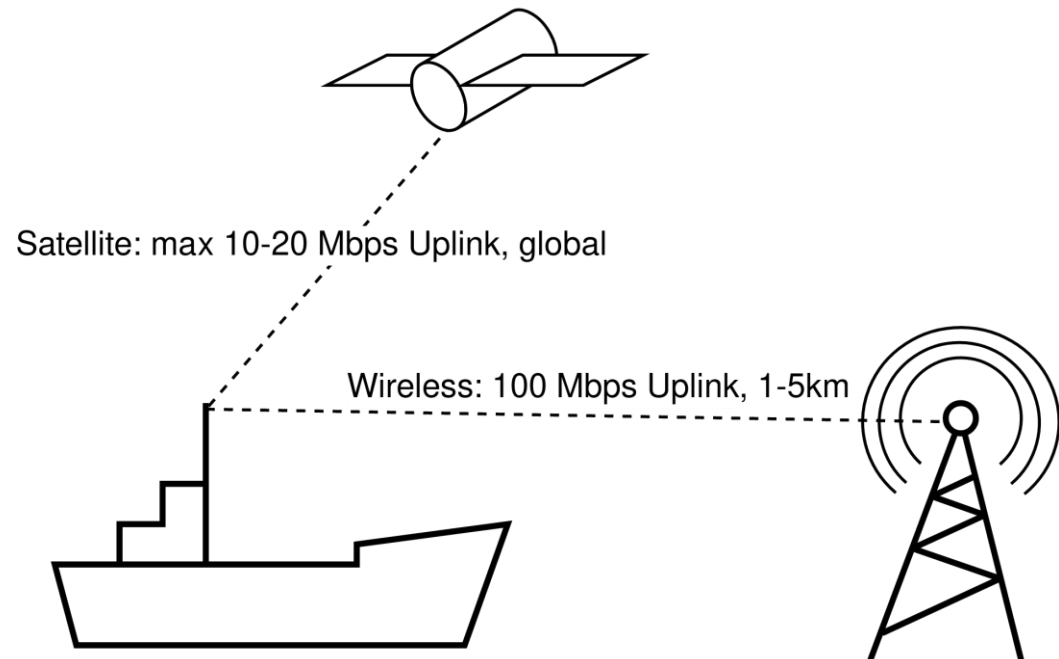


Image Source: Alexander Klein, DLR



REMOTE OPERATOR AS MASTER

Abilities of the Remote Operator

A

Safety of Navigation

Especially in time-critical and dangerous situations it is problematic for the Remote Operator to ensure safety. Latencies and delays might harbor a high risk potential



B

Seaworthiness

Remote Operator is not present on board to check seaworthiness himself before departing from a harbor. Responsibilities lie with the master himself and a delegation might cause problems



C

Flag State Law

Enforcement of the legal requirements, for example concerning marine pollution is also problematic when the remote operator is not on board.



D

Coastal State Contact

Contact with the coastal State can be ensured via means of telecommunication. However, the Remote Operator is also not available in person so noone could directly be held accountable for any violation





THE WAY FORWARD

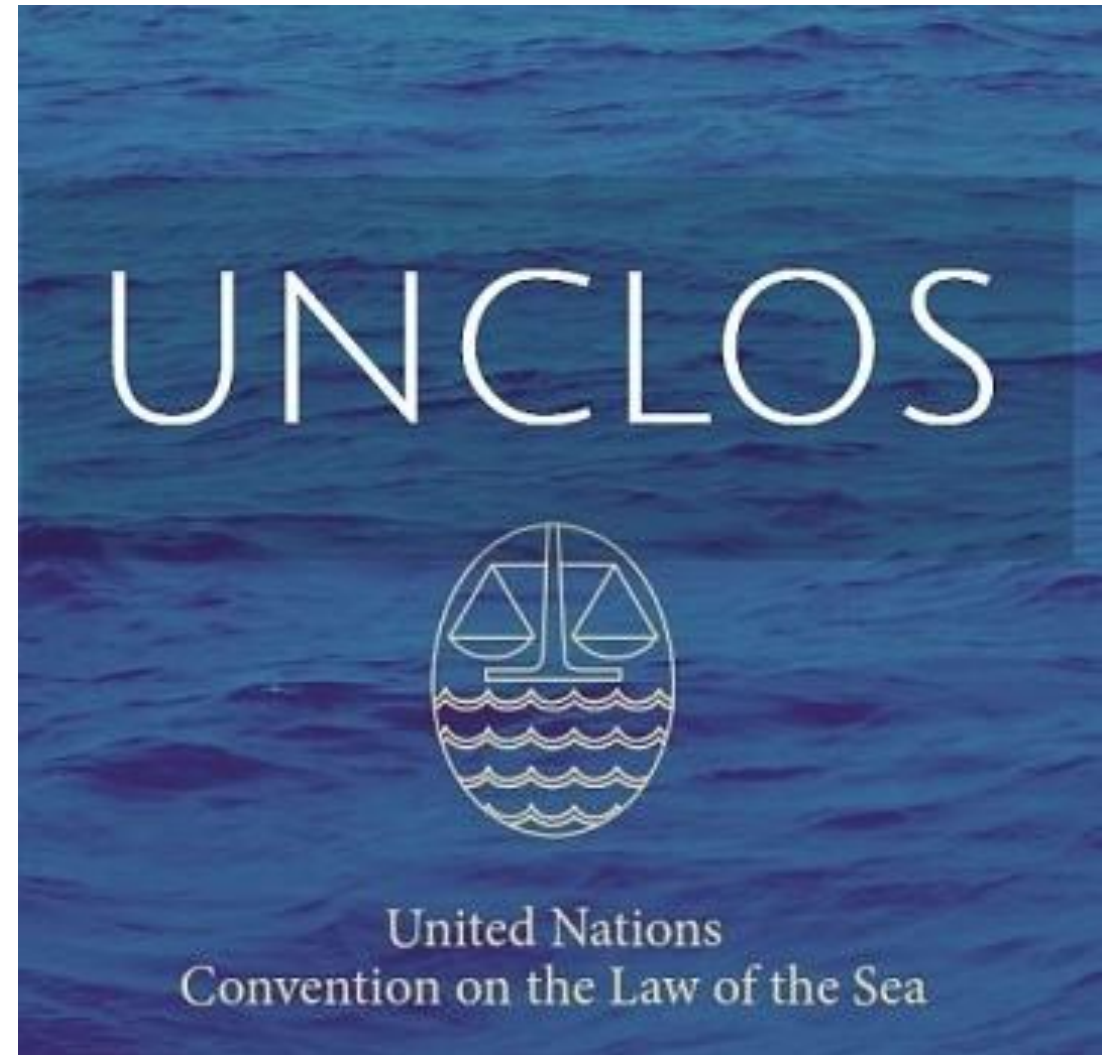
The Way Forward: Amendment / Interpretation

Amendment

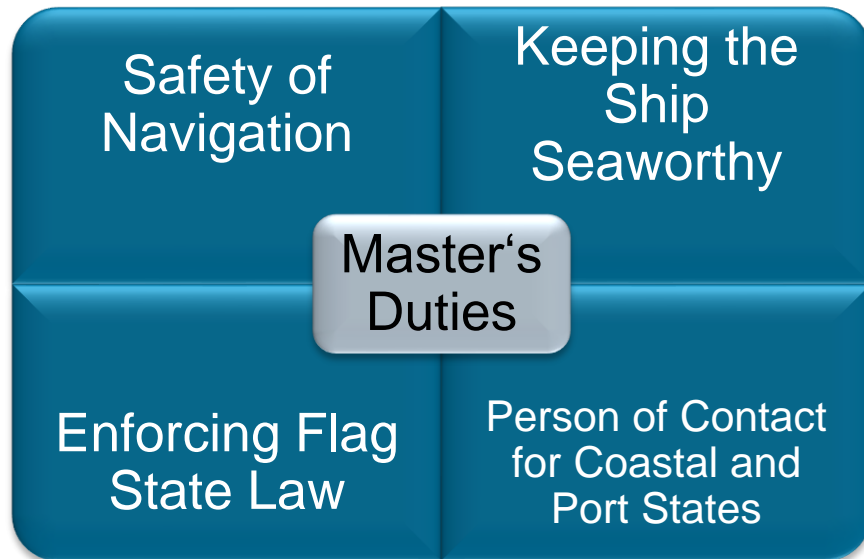
- Art. 94 (4): “(...) each ship is in the charge of a master *or remote operator* (...)”
- High threshold for literal change

Evolutionary Interpretation

- Linguistic change of the term „*Master*“
- Change of our understanding of a master



Conclusion



Problematic to fulfill Remotely

- High latencies and delays
- Not on board to personally supervise the situation

Does the Remote Operator constitute a master in the sense of UNCLOS?

Currently not, but maybe in the future

Thank you for your attention!

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