

Using real-time FPGA technology for developing an automated vessel performance and reporting system

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Casper Technologies:

- mission is to assist the shipping industry to exploit the technologies of today by providing flexible solutions which improve the transparency and efficiency of shipping companies operations
- utilizes Hardware in the Loop (HIL) / Field Programmable Gate Arrays (FPGA) technologies for data acquisition, real-time analysis and control



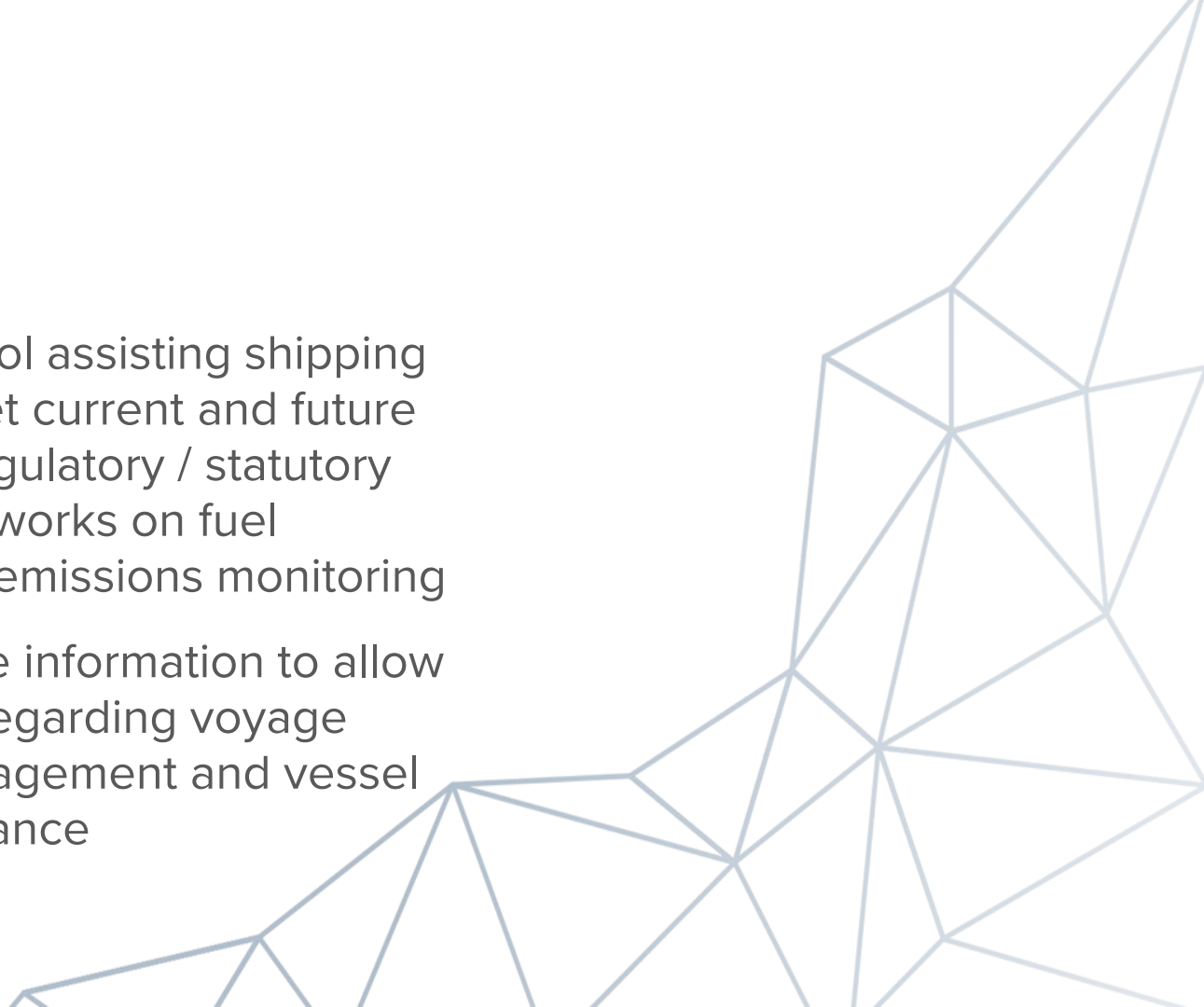
Casper Technologies:

- has acquired extensive, hands-on, experience in the shipping industry
- has developed G4 Vessel Reporting & Monitoring System (VRMS), a fully automated, proprietary HW/SW reporting system evaluating vessels' performance in real time



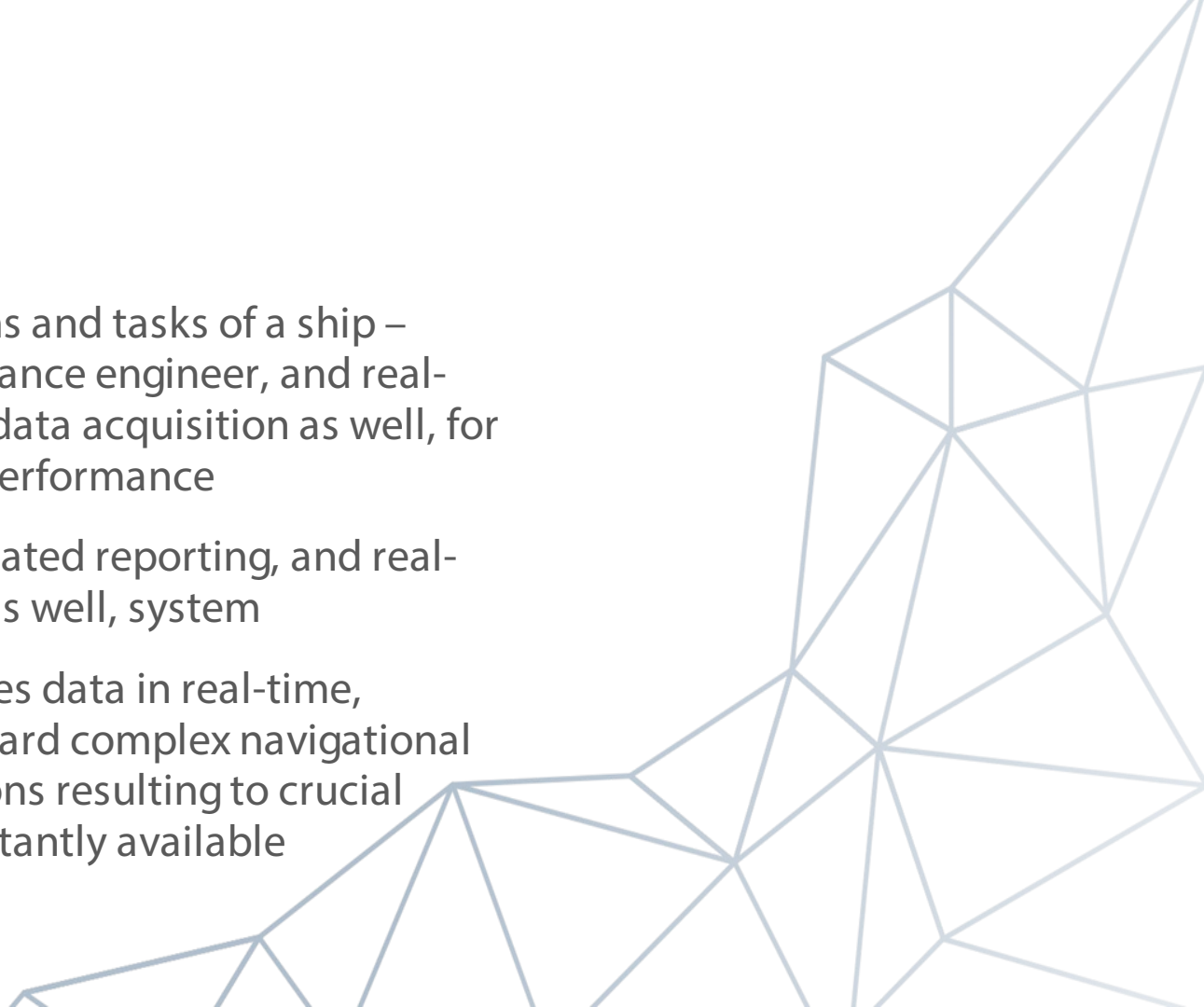
G4 VRMS

- is an innovative tool assisting shipping companies to meet current and future challenges and regulatory / statutory compliance frameworks on fuel consumption and emissions monitoring
- provides adequate information to allow decision making regarding voyage performance management and vessel technical maintenance



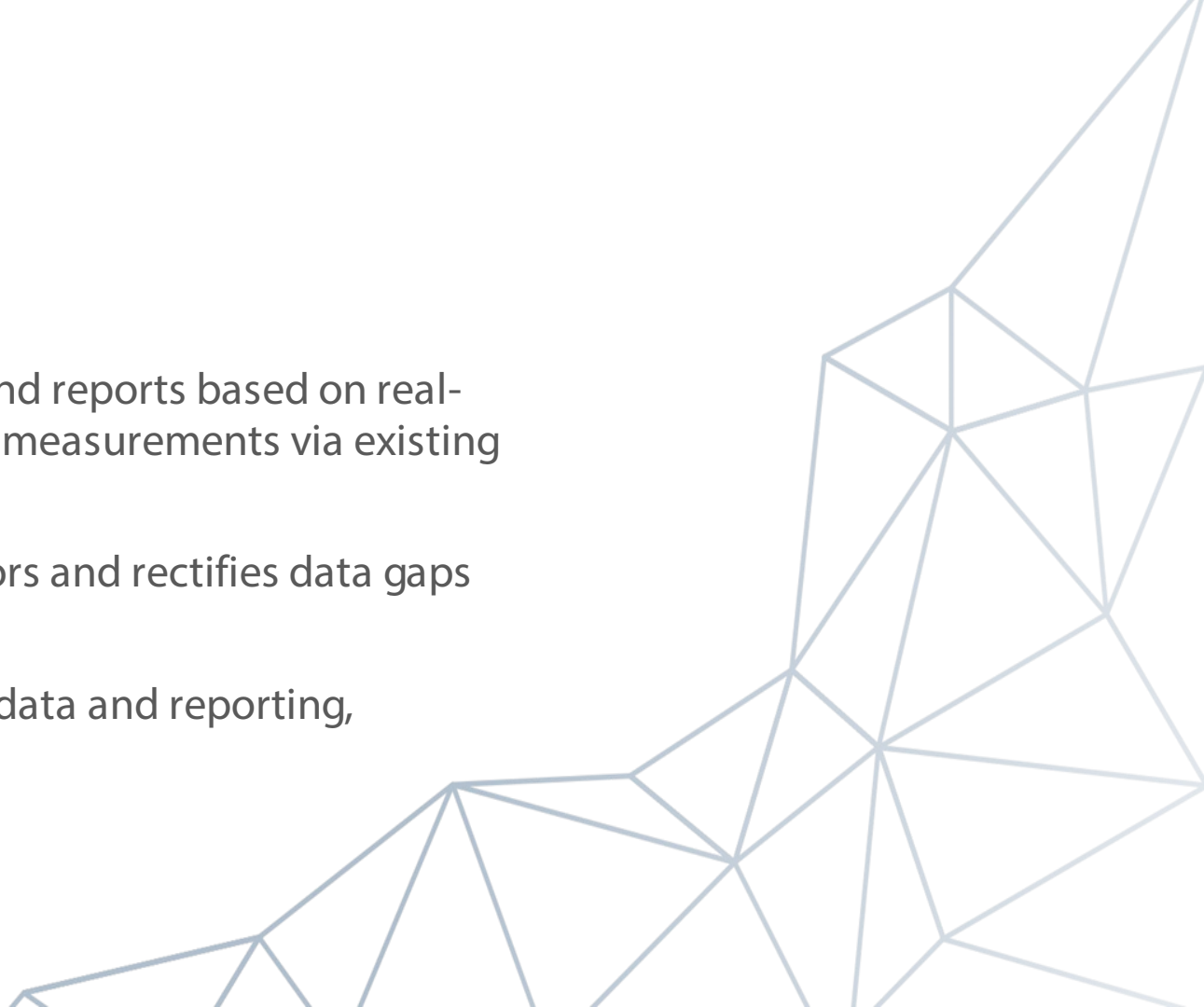
G4 VRMS

- performs the functions and tasks of a ship – riding virtual performance engineer, and real-time, military-grade, data acquisition as well, for maximizing vessels' performance
- is the first fully automated reporting, and real-time data validating as well, system
- processes and analyses data in real-time, performing in this regard complex navigational and voyage calculations resulting to crucial information made instantly available to crew and office



G4 VRMS

- generates data sets and reports based on real-time, high frequency, measurements via existing vessel sensors
- validates vessel sensors and rectifies data gaps on real time
- guarantees superior, data and reporting, accuracy and quality



G4 VRMS

- is the only VRMS creating and distributing fully automated reports
- dramatically reduces human activity for reporting and for addressing regulatory requirements as well
- monitors relevant data and provides fully automated reports on a voyage specific, and daily as well, basis for serving better the requirements of shipping companies



G4 VRMS

- generates instant alarm notifications on the basis of real-time vessel data
- notifies both vessel & office whenever a critical condition is identified
- uses the same HIL / FPGA technologies as satellites, bridges, military locations and airplanes do
- is based on an extended “sea trials” type of data (and experience as well) collection period, effectively including all vessel G4 history in terms of relevant data sets (ML).



G4 VRMS

G4 fully automated reporting on a voyage-to-voyage basis includes:

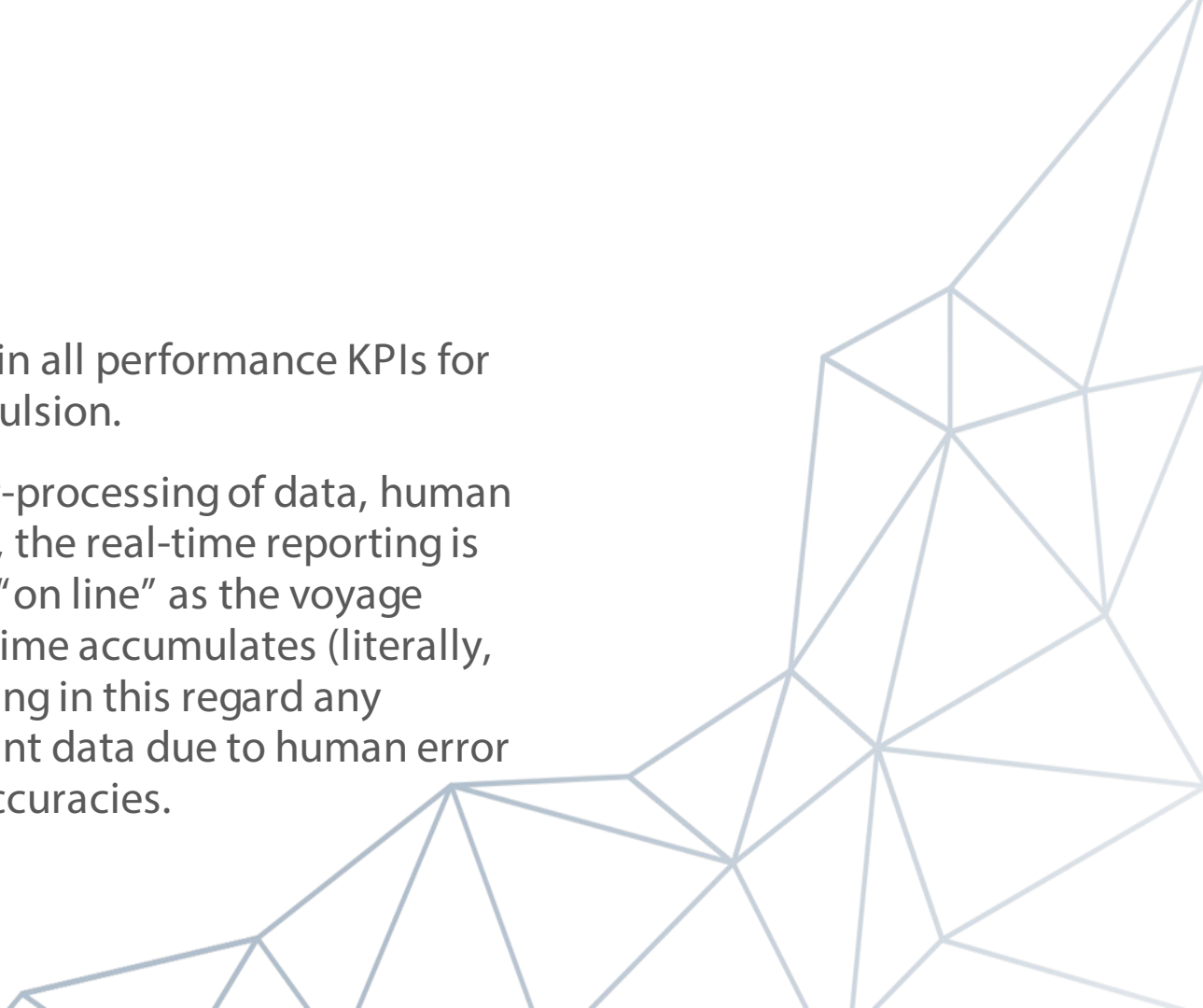
- Passage overview, sailing and interruption reports (Ballast & Laden)
- Port overview, STBYs and operation reports
- Noon reports (local time)
- MRV reports (EU, UK, China)
- IMO DCS reports



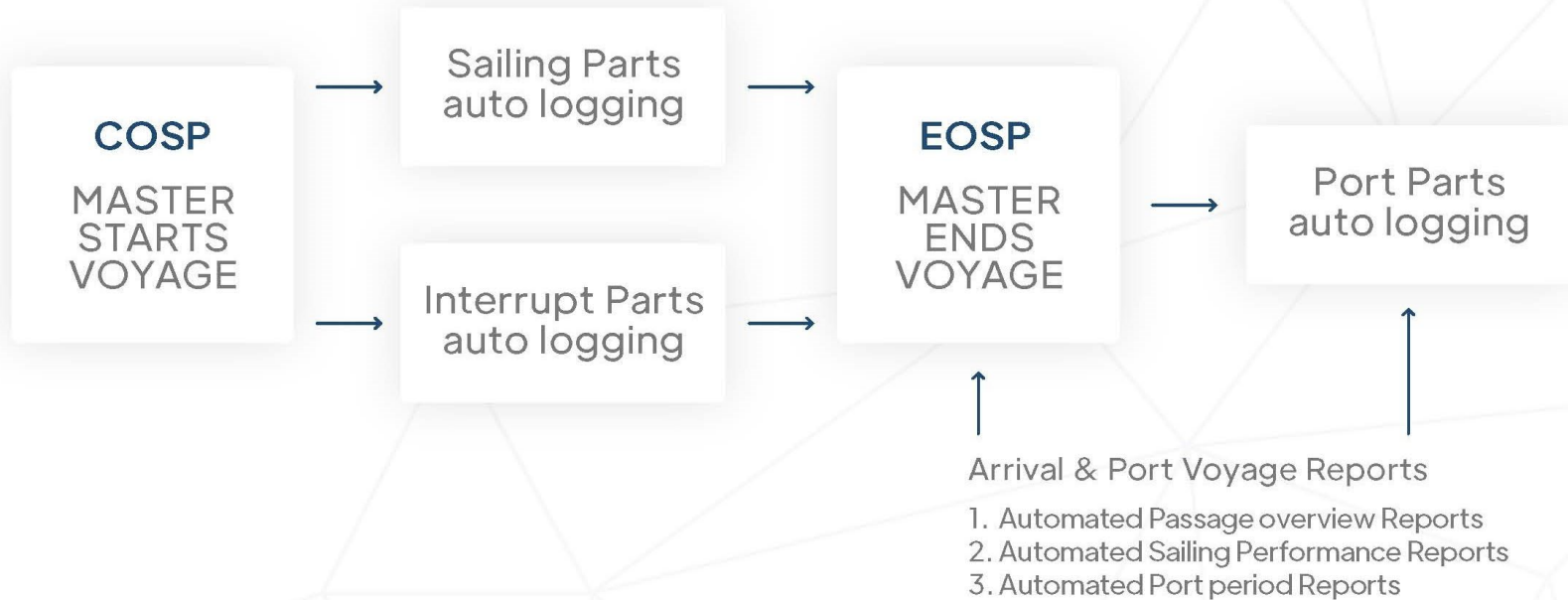
G4 VRMS

The above reports contain all performance KPIs for emissions, hull and propulsion.

There is no need for post-processing of data, human input or activity; instead, the real-time reporting is actually prepared by G4 “on line” as the voyage evolves and the voyage time accumulates (literally, on “real time”), eliminating in this regard any chance of losing important data due to human error and data processing inaccuracies.



G4 VRMS

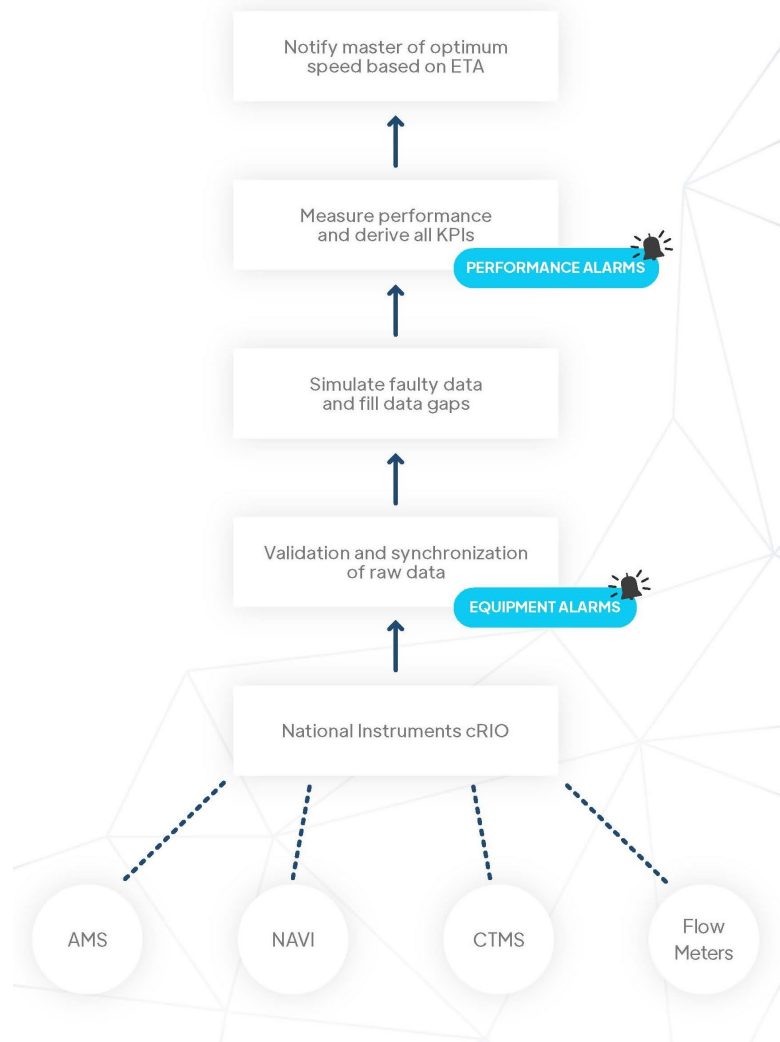


G4 VRMS

Real-Time Performance & On board Speed Optimization

G4 offers an insight, among others, in vessel fuel consumption, hull cleaning status, weather conditions at the time of voyage.

The above insight is the basis of informed decisions and of the optimization as well of vessel performance in terms of fuel and voyage time savings.

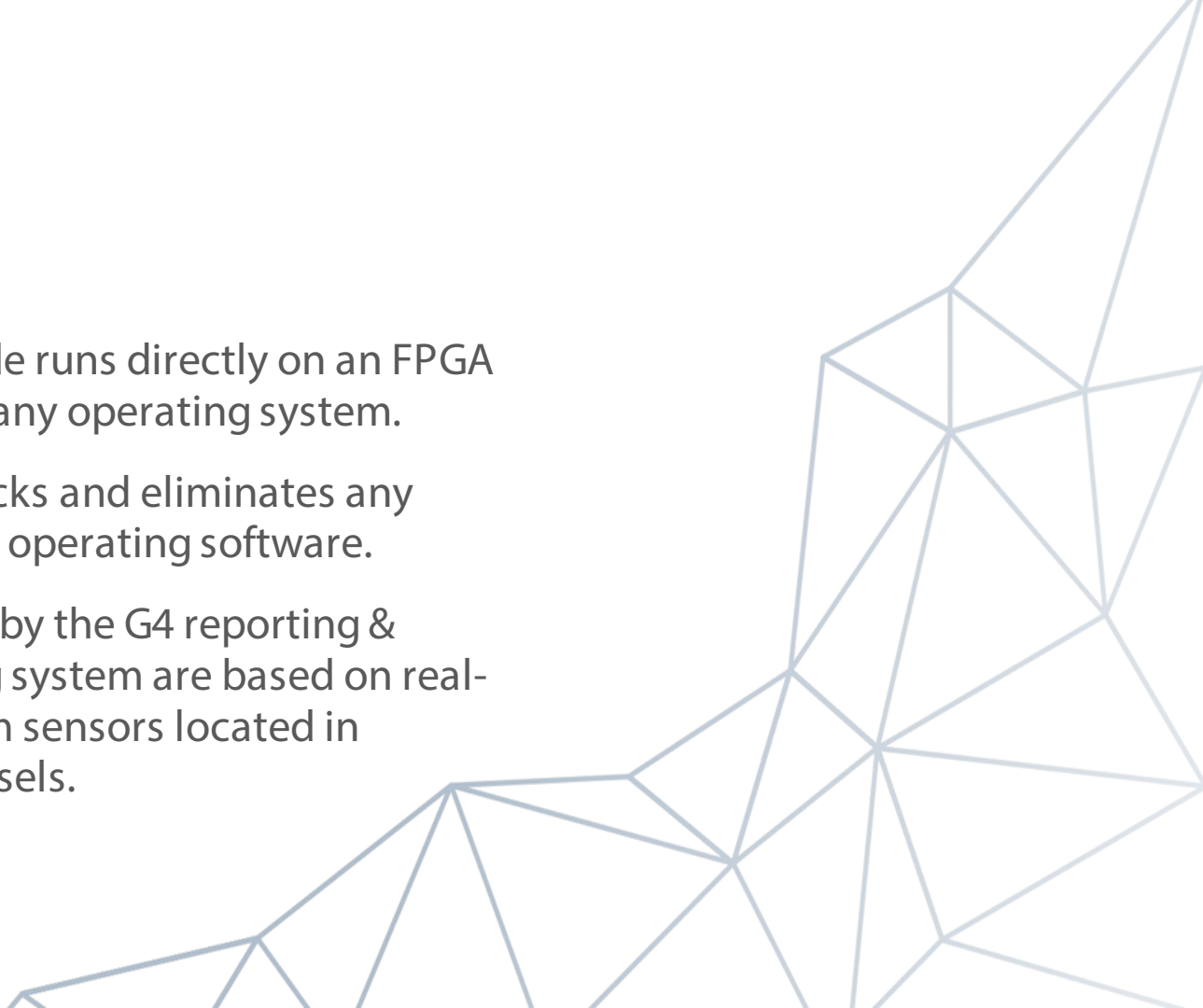


G4 VRMS

The system software code runs directly on an FPGA chip, independent from any operating system.

This prevents cyber attacks and eliminates any vulnerabilities related to operating software.

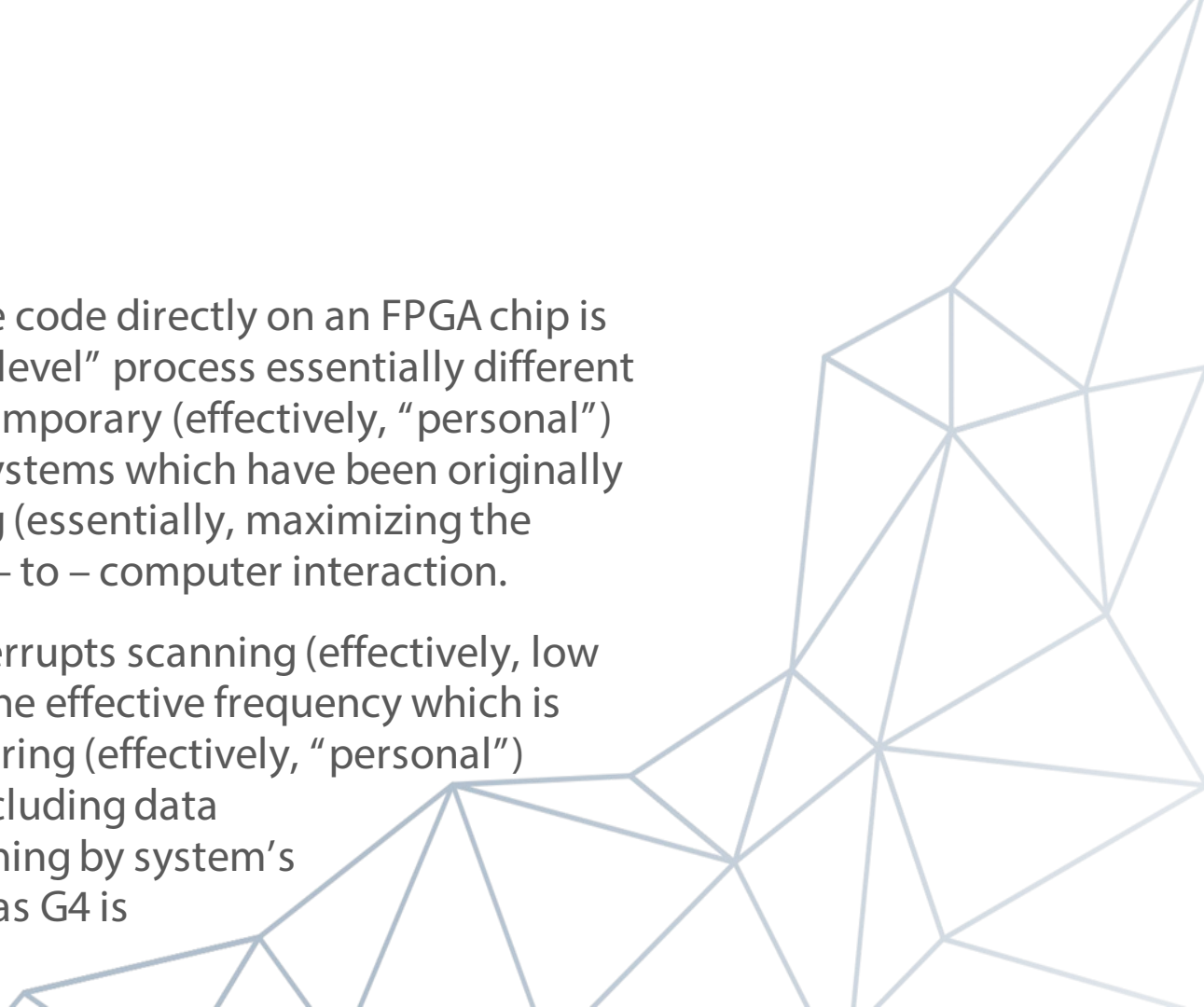
The data sets generated by the G4 reporting & performance monitoring system are based on real-time measurements from sensors located in different parts of the vessels.



G4 VRMS

Running system software code directly on an FPGA chip is a (computing wise) “low level” process essentially different to the processes of contemporary (effectively, “personal”) computing / operating systems which have been originally developed for optimizing (essentially, maximizing the effectiveness of) human – to – computer interaction.

No operating system interrupts scanning (effectively, low frequency sampling) at the effective frequency which is typical / standard for sharing (effectively, “personal”) computing resources, including data acquisition devices scanning by system’s CPU, is applicable as far as G4 is concerned.

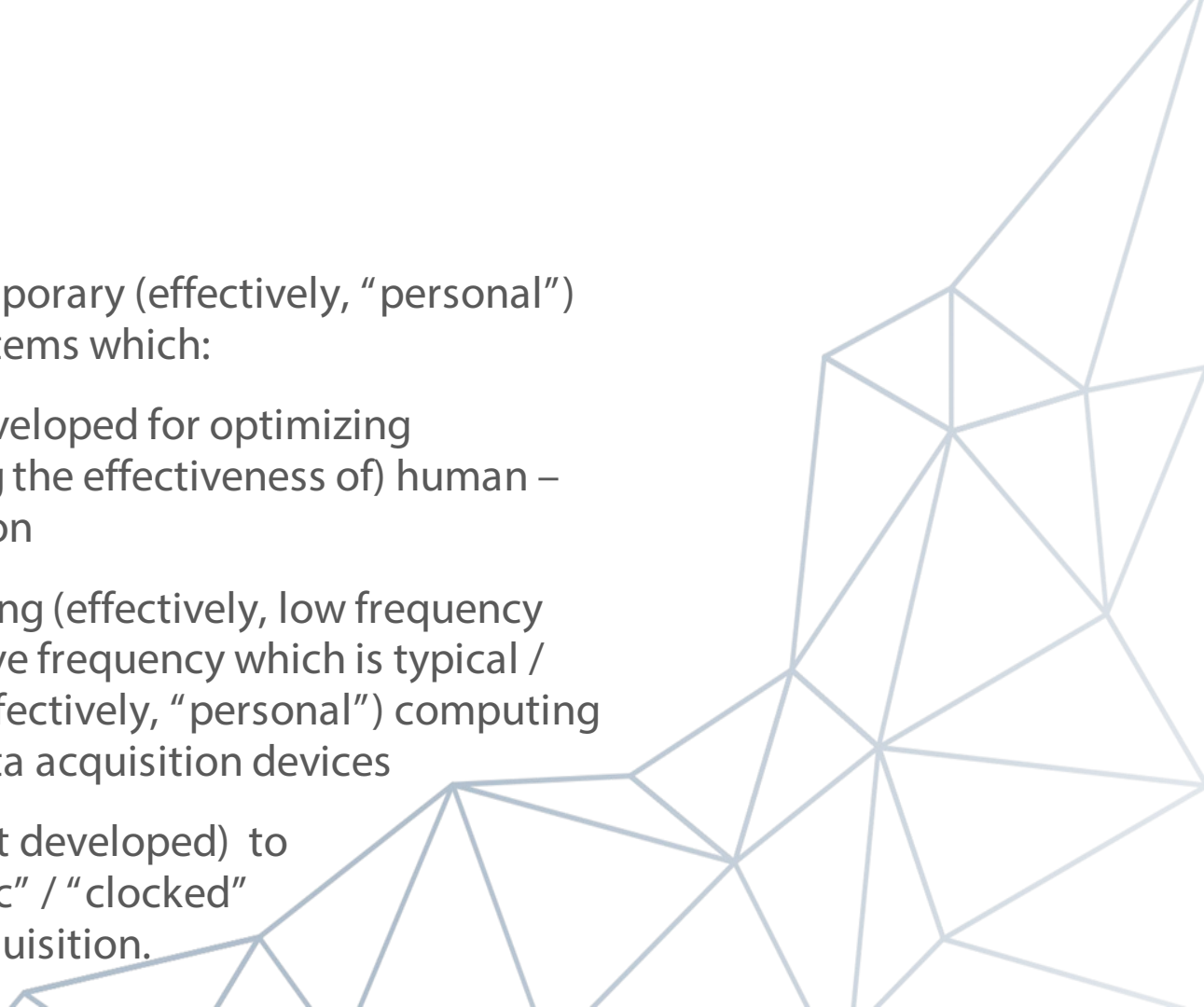


G4 VRMS

As a matter of fact, contemporary (effectively, “personal”) computing / operating systems which:

- have been originally developed for optimizing (essentially, maximizing the effectiveness of) human – to – computer interaction
- utilize interrupts scanning (effectively, low frequency sampling) at the effective frequency which is typical / standard for sharing (effectively, “personal”) computing resources, including data acquisition devices

are simply not capable (not developed) to provide “time deterministic” / “clocked” / “time stamped” data acquisition.



G4 VRMS

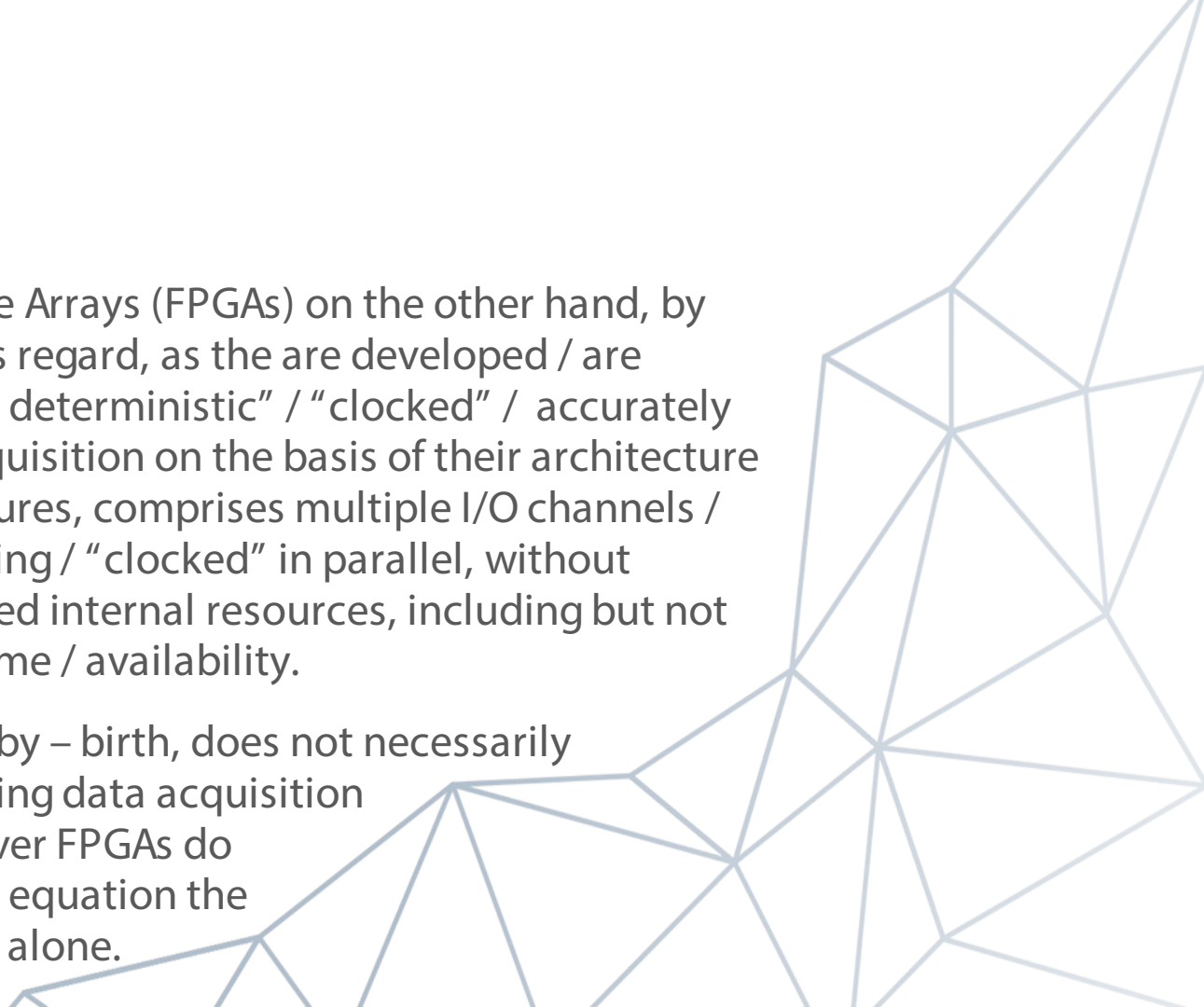
The above are to be further considered in conjunction with other “non ideal” data acquisition actual sensor s and systems conditions, such as:

- asynchronous combined operation of more than one contemporary (effectively, “personal”) computing / operating systems, including but not limited to AMS, individual sensors’ processors / processing systems and buffers thereof, as well as other than FPGA VRMSs
- irregular pulse operation of flow meters sensors, where each pulse is calibrated to stand for a fixed volume or mass quantity and not for an instantaneous value of fuel flow rate

G4 VRMS

Field Programmable Gate Arrays (FPGAs) on the other hand, by birth, do not suffer in this regard, as they are developed / are capable to provide “time deterministic” / “clocked” / accurately “time stamped” data acquisition on the basis of their architecture which, among other features, comprises multiple I/O channels / blocks effectively operating / “clocked” in parallel, without necessarily utilizing shared internal resources, including but not limited to a single CPU time / availability.

FPGAs above advantage by – birth, does not necessarily balance all issues regarding data acquisition mentioned above, however FPGAs do entirely remove from the equation the issues induced by VRMSs alone.



G4 VRMS

In addition to the above, Field Programmable Gate Arrays (FPGAs) also do offer the best possible circumstances , tools and possibilities for managing the above remaining issues caused by AMS, individual sensors' processors / processing systems and buffers thereof, as well as by irregular pulse operation of flow meters sensors.



G4 VRMS

The G4 very high frequency (effectively, continuous) data acquisition sampling is the exact reason for the G4 real-time, remarkably high, data accuracy and quality, as well as for the G4 capability of automated rectification of data gaps.

As Mr. Spyridon Moraitis, Casper Technologies Technical Manager, has recently pointed out during a certain occasion: “Ships (of today) are (to a certain, quite significant, extent) already digital; humans (and reporting or computing / operating, “personal” systems, throttled down by human activity / interaction as well) on the other hand, are not!”

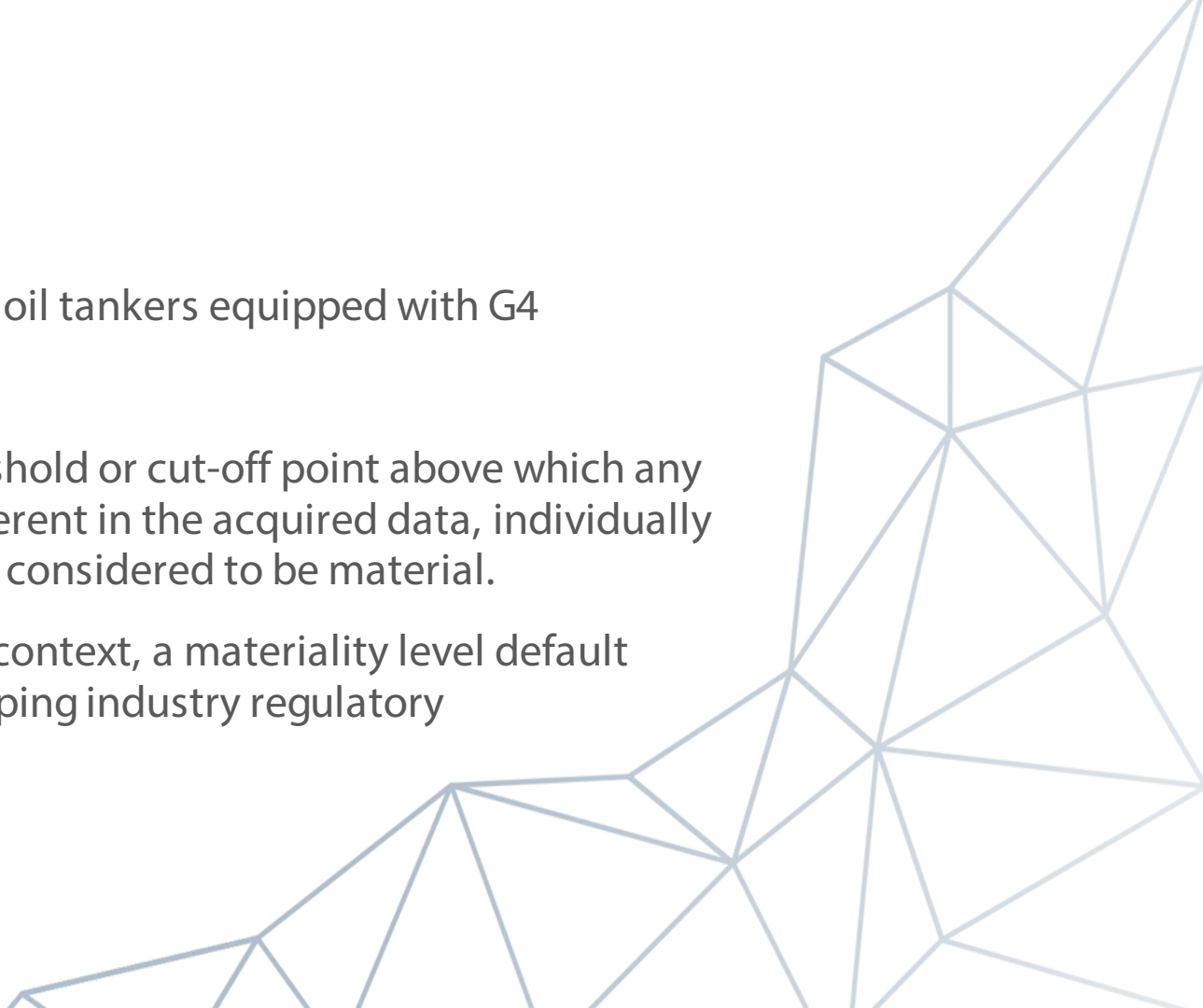


G4 VRMS

Results from a fleet of 10 oil tankers equipped with G4

Materiality level:

- The quantitative threshold or cut-off point above which any erroneous entries inherent in the acquired data, individually or taken together, are considered to be material.
- In the same as above context, a materiality level default value in line with shipping industry regulatory standards is 5%.



G4 VRMS

Uncertainty:

- A parameter, associated with the result of the determination of a quantity, that characterises the dispersion of the values that could reasonably be attributed to the particular quantity, including the effects of systematic as well as of random factors, expressed as a percentage, and describes a confidence interval around the mean value comprising 95 % of inferred values taking into account any asymmetry of the distribution of values.
- In the above context, an uncertainty default value in line with industry regulatory standards, is 10%.

1	38	38	38	38
2	31	31	31	31
3	35	35	35	35
4	29	29	29	29
5	5	5	5	5
6	4	4	4	4
7	32	32	32	32
8	13	13	13	13
9	30	30	30	27
10	5	5	5	5
	222	222	222	219

1.38%	2.72%	0.73%	1.61%
0.89%	4.13%	0.86%	1.96%
0.01%	2.02%	0.52%	0.85%
0.06%	1.39%	1.04%	0.83%
0.05%	0.85%	0.16%	0.35%
0.10%	0.36%	0.63%	0.36%
0.02%	2.02%	0.81%	0.95%
4.17%	1.13%	1.76%	2.35%
0.06%	2.96%	1.97%	1.66%
4.89%	1.18%	1.42%	2.50%

0.00%	10.63%	0.00%	3.54%
0.00%	9.43%	0.00%	3.14%
0.00%	4.64%	0.00%	1.55%
0.00%	0.00%	0.00%	0.00%
3.74%	3.73%	0.00%	2.49%
0.00%	0.00%	0.00%	0.00%
0.00%	1.76%	0.00%	0.59%
0.00%	5.85%	2.23%	2.69%
4.30%	7.24%	1.96%	4.50%
0.00%	0.00%	0.00%	0.00%



An IT solution for enhancing vessels performance by applying “big – data” / “AI” / “ML” approaches

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Thank You!

