

ANNEX

Annex 1: Byzantine General's Problem and Byzantine Fault Tolerance

Byzantine Generals' Problem

The Byzantine Generals' Problem was conceived in 1982 as a logical dilemma that illustrates how a group of Byzantine generals may have communication problems when trying to agree on their next move.

The dilemma assumes that each general has its own army and that each group is situated in different locations around the city they intend to attack. The generals need to agree on either attacking or retreating. It does not matter whether they attack or retreat, as long as all generals reach consensus, i.e., agree on a common decision in order to execute it in coordination.

Therefore, we may consider the following requirements:

- Each general has to decide: attack or retreat (yes or no);
- After the decision is made, it cannot be changed;
- All generals have to agree on the same decision and execute it in a synchronized manner.

The aforementioned communication problems are related to the fact that one general is only able to communicate with another through messages, which are forwarded by a courier. Consequently, the central challenge of the Byzantine Generals' Problem is that the messages can get somehow delayed, destroyed or lost.

In addition, even if a message is successfully delivered, one or more generals may choose (for whatever reason) to act maliciously and send a fraudulent message to confuse the other generals, leading to a total failure.

If we apply the dilemma to the context of blockchains, each general represents a network node, and the nodes need to reach consensus on the current state of the system. Putting in another way, the majority of participants within a distributed network have to agree and execute the same action in order to avoid complete failure.

Therefore, the only way to achieve consensus in these types of distributed system is by having at least $\frac{2}{3}$ or more reliable and honest network nodes. This means that if the majority of the network decides to act maliciously, the system is susceptible to failures and attacks (such as

the 51% attack).

Byzantine fault tolerance (BFT)

In a few words, Byzantine fault tolerance (BFT) is the property of a system that is able to resist the class of failures derived from the Byzantine Generals' Problem. This means that a BFT system is able to continue operating even if some of the nodes fail or act maliciously.

There is more than one possible solution to the Byzantine Generals' Problem and, therefore, multiple ways of building a BFT system. Likewise, there are different approaches for a blockchain to achieve Byzantine fault tolerance and this leads us to the so-called consensus algorithms.

Annex 2: Quality control documents used in Maresmar

The following are some of the quality controls and labels used in Maresmar.

FECHA:									
Confraria	CUBETA 1			CUBETA 2			CUBETA 3		
	1 PINZA	0 PINZAS	PIEZAS TOTALES	1 PINZA	0 PINZAS	PIEZAS TOTALES	1 PINZA	0 PINZAS	PIEZAS TOTALES
Cabrera									
Guillermo Navaro									
Antonia segunda									
Coral									
Funky									

Notas:									
Viveza:	Muy vivos	Normal	flojo	Muy Flojos					
Asepecto:	Muy humedos	Humedos	Secos	Muy secos					
Bridas:	Con brida	Sin Brida							
Temperatura:									

Figure 1 Claw quality control sheet

L'AMPOLLA

18/04/2019

Confraria	UNLOADING / DESCARGA				ALIVE / VIVO		MORTALITY / MORTALIDAD		Kg Compensation		PZ
	DELIVERY / ENTREGA	UNLOADED / DESCARGADO	Kg DIF.	%	Kg	%	Kg	%			
Blue Crab	275,05	274,30	4,75	1,7%	266,00	97,0%	8,30	3,0%	-	0,00	4a6

Confraria	CUBETAS	Kg Brutos	Tara	Kg Netos	Kg Vivos	Kg Muerto	%	KG +5%	Abonar €	Nº Despatado / cubeta	
Cabrera	26,00	227,00	67,80	159,2	152,50	6,70	4,2%	-	1,26	5,04 €	0
Guillermo Navaro	0,00	0,00	0,00	0,0	0,00	0,00	#DIV/0!	-	#DIV/0!	#DIV/0!	0
Antonia segunda	7,00	72,00	28,90	43,1	42,00	1,10	2,6%	-	1,06	4,22 €	0
Coral	6,00	62,00	27,00	35,0	34,50	0,50	1,4%	-	1,25	5,00 €	0
Funky	6,00	64,50	27,50	37,0	37,00	0,00	0,0%	-	#DIV/0!	#DIV/0!	0
	45,00	425,50	151,20	274,30	266,0	8,30					

Notas:										
El producto tiene buena viveza. Todas las piezas bien enbridadas.										

Figure 2 Blue Crab quality control sheet

Maresmar MARESMAR S.L.
LONGITUDINAL 6-107
08040 BARCELONA
NIF: ESB62369764

Nombre Comercial: **BUY DE MAR 600-800**
Denominación científica/Especie: **CANCER PAGURUS**

Capturado en: **FAO 27.6 NOROESTE DE ESCOCIA**
Arte de pesca: **MASAS Y TRAMPAS**
Presentación: **VIVO**


CONSERVAR ENTRE 3 Y 8°C

Lote: 0000506205
GTIN: 98435234700252


ES
12.07184/B
CE

Peso Neto: KG
1,00

Fecha de producción: 06/05/2019
Fecha de envío: 06/05/2019



(01) 98435234700252 (3102) 000100 (10) 0000506205



Scanned with CamScanner

Figure 3 Maresmar sticker for Brown Crab

Annex 3: Smart tags and IoT costs

Smart tags		NFC	RFID
Tag	Price/unit	0,30 €	0,30 €
	Units	5000	5000
Scanner	Price/unit	400,00 €	500,00 €
	Units	5	5
SUBTOTAL		3.500,00 €	4.000,00 €
TOTAL		7.500,00 €	

IoT devices	Smart Thermometer	Model SAP-AP-3G	Model SAP-AP	GPS device
Price/unit	67,00 €	178,00 €	88,60 €	14,99 €
Units	4	3	2	2
SUBTOTAL	268,00 €	534,00 €	177,20 €	29,98 €
TOTAL	1.009,18 €			

Annex 4: IoT specifications

Smart thermometer model ST-2000



- **Temperature Range:** -30C to 60C (-22F to 145F)
- **Accuracy:** +/- 1.1C from -30C to -18C (+/- 2F from -22F to 0F)
+/- 0.55C from -18C to 50C (+/- 1.0F from 0F to 122F)
- **Temperature Resolution:** 0.1C/F over Temperature Range
- **Battery Life:** Up to 5 Years. 2-4 years typical
- **Temperature Sample Rate:** Programmable 3 to 60 minutes
- **Report Interval:** Programmable from every hour to once a day.
- **Start-Up Delay:** Programmable from 10 minutes to 24 hours
- **Alert Indicator:** On Sensor blinking LED, Text to phone, email, push notification via app and optional phone call.
- **Alert Thresholds:** High and Low temp limits and high and low temp limit duration. Unlimited threshold rules. Battery Low and Battery Replace alerts.
- **Wireless:** 802,11 b/g/n up to 600 ft outdoor line of sight. Indoor 300 ft line of sight.

Annex 5: Phase 5: future implementations

From a long term point of view, once the four previous phase will have been already implemented and the complete model will be smoothly working, some future implementations could be taken into account to even improve or bring new capabilities to the supply chain system.

New identification methods

Identification on the vendor verification system is done via the vendor smartphone App but there is not a current biometric identification method, meaning one worker could tell his password to another worker and then cheat on the verification mechanism. Therefore, implementing personalized identification methodology through physical characteristics of each worker could solve this problematic.

Many smartphone have already incorporated fingerprint identification to unlock the cell phone and it could be interesting to incorporate this technology to enter the vendor verification system. In the same way, some smartphone like the iPhone with iOS 12 provide Face ID technology that could also be used as a verification method.

Leveraging from the different technologies smartphone have incorporated could help to build an even more trustful solution with improved features to add on the current studied implementation.

Certified Quality Reader (CQR)

The company Seafood Analytics has recently launched Certified Quality Reader that uses electrical currents, or bioelectrical impedance analysis, to provide instant freshness data for tested fish. The tool measures the rate at which the cells inside fish change over time, depending on storage conditions.

It also generates a Certified Quality Number (a score between 0 and 100, with 100 being top quality and 0 indicating complete spoilage) for quick reference, as well as U.S. Food and Drug Administration and European sensory equivalent scores.

CQR is still being used for a limited number of species with a device being used uniquely for each specie, however, the company is aiming to introduce new species to become a gamechanger in the seafood industry.



Figure 4 CQR device

Once CQR will be able to analyse different species with the same device, investing on it should definitely be considered as measure to enhance safety and quality even more.

DNA testing

In order to have an irrefutable knowledge of the species you have in front of you, DNA testing is the best option to be sure about it. InstantLabs provides real-time DNA testing device, The Hunter, that certifies seafood DNA in a matter of hours and not days as it is normally required.



With this device, *Maresmar* will be able to provide certainty to clients about the product they are buying without discussion.

Figure 5 DNA testing device

Reactivating Marisco Planet

Maresmar used to sell seafood via an e-commerce platform called Marisco Planet, but had to quit it as it was not worth it. First of all they were facing logistic problems as carriers were charging 20 € for each delivery to customers. The second difficulty came due to the lack of trust attached with online buying fresh seafood

Reaching a favourable agreement with the transport company together with the Blockchain implementation could result in an increase of the e-commerce sales. Blockchain solution provides a credible and traceable source of truth to boost customers' confidence and reactivate Marisco Planet as all the online platform deployment is already built.



Figure 6 Marisco Planet logo