

* ch # 12 *

* Multiple Access *

Example 12.1 :

The stations on a wireless ALOHA network are maximum of 600 km apart. If we assume that signals propagate at 3×10^8 m/s.

⇒ Maximum propagation time (T_p) = ??

Sol:

$$T_p = \frac{600 \times 10^3}{3 \times 10^8} = \boxed{2 \text{ ms}}$$

⇒ Back-off time (T_B) = ?? with the following k.

$$T_B = R \times T_p \text{ or } R \times T_{fr}$$

→ Average trans. time for a frame.

→ When $k=1$ ⇒ range is $\{0, 1\}$

the station needs to generate a random number with value 0 or 1.

$$\therefore T_B = R \times T_p = 0 \times 2 \text{ ms} = \boxed{0}$$

OR

$$= 1 \times 2 \text{ ms} = \boxed{2 \text{ ms}}$$

→ when $k=2 \Rightarrow \text{range} = \{0, 1, 2, 3\} \Rightarrow$ ~~since~~

$$T_B = 0 * 2m = \boxed{0}$$

$$\text{or} = 1 * 2m = \boxed{2 \text{ ms}}$$

$$\text{or} = 2 * 2 \text{ ms} = \boxed{4 \text{ ms}}$$

$$\text{or} = 3 * 2 \text{ ms} = \boxed{6 \text{ ms}}$$

نم اختيار
عدد وائي
من 0
 $2^k - 1$

→ when $k=3 \Rightarrow \text{range} = \{0, 1, 2, 3, 4, 5, 6, 7\}$.

$\therefore T_B$ can be 0, 2, 4, ..., 14 ms.

* لو كانت $k > 10$ ، فعادة ما يتم تجنب ذلك بـ 10.

Example 12.2 :

A pure ALOHA network transmits 200-bit frames on a shared channel of 200 kbps.

What is the requirement to make this frame collision-free?

سؤال:

الوقت الذي يحتاجه
frame واحد
→ Average frame transmission time (T_{fr})

$$T_{fr} = \frac{200 \text{ bits}}{200 \text{ kbps}} = \boxed{1 \text{ ms}}$$

الفترة الزمنية التي
تحدث فيها التصادم
Collision
→ Vulnerable time = $2 * T_{fr}$

$$= 2 * 1 \text{ ms} = \boxed{2 \text{ ms}}$$

Example 12.13:

A pure ALOHA network transmits 200-bit frames on a shared channel of 200 kbps.

What is the throughput if the system (all stations together) produces.

- (a) 1000 frames per second.
- (b) 500 frames per second.
- (c) 250 frames per second.

حل:

⇒ frame transmission time $T_{fr} = \frac{200}{200k} = \boxed{1 \text{ ms}}$

- (a) 1000 frames per second.

Throughput: $S = G \times e^{-2G}$

هي متوسط الـ frames الي بنشأها النظام
أثناء وقت إرسال الـ frame واحد.

⇒ 1000 frames per second ⇒ 1 frame per 1 ms.

∴ $G = 1$

↓
 $\boxed{\begin{array}{l} \text{دقيقة ثانية} \\ \text{في 1000 ms} \end{array}}$

$S = 1 \times e^{-2} = \boxed{0.135}$ frames per frame-time

$S = 0.135 \times 1000 \text{ ms} = \boxed{135 \text{ frames/sec}}$

(b) 500 frames per second $\Rightarrow \frac{1}{2}$ frame per millisecond.

$$\therefore G = \frac{1}{2}$$

$$S = G \times e^{-2G} = \boxed{0.184 \text{ frames per frame-time}}$$

$$S = 0.184 \times 1000 \text{ ms} = \boxed{184 \text{ frames/sec}}.$$

(c) 250 frames per second. $\Rightarrow \frac{1}{4}$ frame per millisecond.

$$\therefore G = \frac{1}{4}$$

$$S = G \times e^{-2G} = 0.152 \text{ frames per frame-time}$$

$$S = 0.152 \times 1000 \text{ ms} = \boxed{152 \text{ frames/sec}}$$

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⇒ Example 12.4 :

A slotted ALOHA network transmits 200-bit frames on a shared channel of 200 kbps.

What is the throughput if the system (all stations together) produces

- (a) 1000 frames per second.
- (b) 500 frames per second.
- (c) 250 frames per second.

Sol:

$$\Rightarrow T_{fr} = \frac{200}{200k} = \boxed{1ms}.$$

- (a) 1000 frames per second.

→ 1000 frame per second ⇒ 1 frame per 1 ms.

$$\therefore \boxed{G=1}$$

$$\Rightarrow S = G \times e^{-G}$$

$$= \boxed{0.368} \text{ frames per frame-time}$$

(b)

⇒ 500 frames per second ⇒ $\frac{1}{5}$ frame per millisecond

$$\therefore \boxed{G = \frac{1}{2}}$$

$$\Rightarrow S = G \times e^{-G} = \boxed{0.303} \text{ frames per frame-time}$$

© 250 frames per second $\Rightarrow \frac{1}{4}$ frames per millisecond.

$$G = \frac{1}{4}$$

$$S = G \times e^{-G}$$

$$= \boxed{0.195} \text{ frames per frame-time.}$$

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Example 12.5: A network using CSMA/CD has a bandwidth of 10 Mbps. If the maximum propagation time (including the delays in the devices & ignoring the time needed to send a jamming signal, as we see later) is 25.6 μ s.

سؤال 12.5

What the minimum size of the frame?

Sol:

* $\Rightarrow$

frame transmission time

$$T_{fr} = 2 \times T_p$$

↑
propagation time

$$= 2 \times 25.6 \mu$$

$$= \boxed{51.2 \mu s}$$

$\Rightarrow$ worst case: a Station needs to transmit

for a period of 51.2 μ s to detect collision.

الحد الأدنى لحجم الإطار
هو 51.2 μ s

* $\Rightarrow$ The minimum size of the frame :

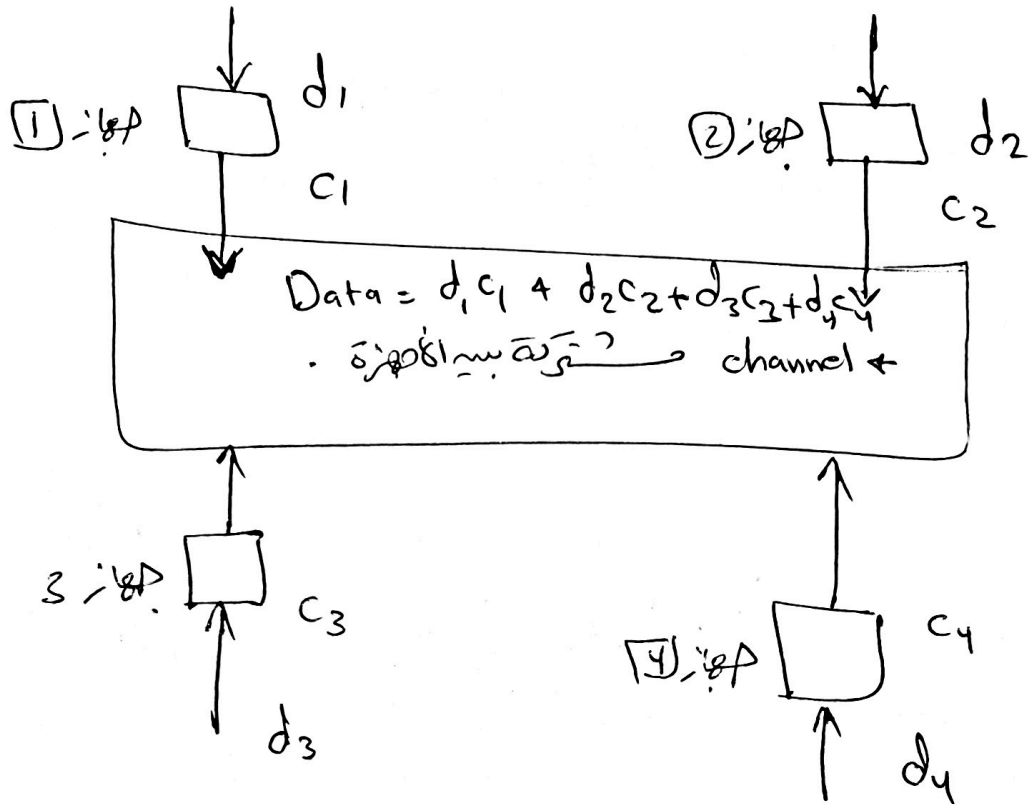
$$10M \times 51.2 \mu = \boxed{512 \text{ bits}}$$

or 64 bytes.

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⊙ (CDMA) Code division multiple access ⊙

[1] كل جهاز موجود في شبكة الإنترنت له $code$ ، مثلاً للجهاز [1] له $code$ (C_1) والجهاز [2] له $code$ (C_2) و...
 كل جهاز له $code$ فكل $code$ آخره ، فالجهاز [5] له $code$ (C_5) والجهاز [6] له $code$ (C_6)



2] في CDMA : الجزء 11 مكوّن من d_1 Data طبقات هي ما نعرفه هي
تحتوي من الأصناف والعناصر ، وكل الأجهزة الأخرى معها
Data

3] ایڈاٹا : فہرست سے مجموع حاصل کردہ code نکال دیا۔ data

← ۸ bit : code ضرب نموده بهایی در خانه chips (در خانه ~~code~~ code)

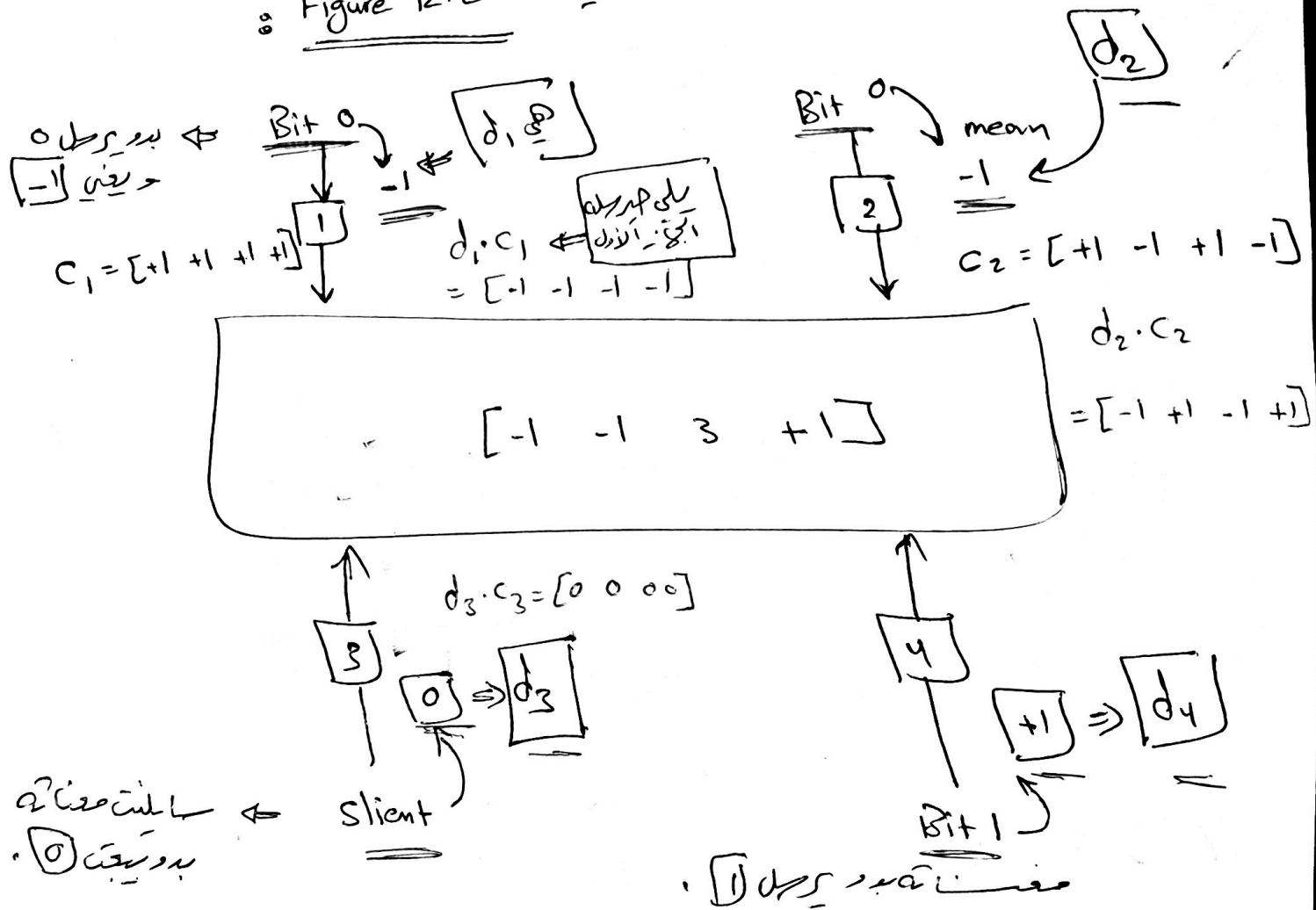
Ex:

⑦

$C_1 \Rightarrow \begin{bmatrix} +1 & +1 & +1 & +1 \end{bmatrix} \rightarrow \text{Gibby}$

- ⊛ الجوز الواحد إما يرسل 0 يعني -1
 أو 1 يعني +1
 أو silent يعني 0

Figure 12.26 دمج الكود



$$C_3 = [+1 +1 -1 -1]$$

$$C_4 = [+1 -1 -1 +1]$$

$$d_4 \cdot C_4 = [1 -1 -1 +1]$$

#	+	-1	-1	-1	-1	الرمز 1
		1	+1	1	+1	2
		0	0	0	0	3
		+1	1	-1	+1	4
		-1	-1	-3	+1	5

(8) الكود النهائي

لو جهاز (٩) بعد يعزف جهاز (١) شويقت ؟!

الكل :

لدا اكلية $\Rightarrow$ $-1 \quad -1 \quad -3 \quad +1$

code الجواز الاول (C1) $\Rightarrow$ $+1 \quad +1 \quad +1 \quad +1$ ^{مميز *}

$$\begin{array}{r} -1 \quad -1 \quad -3 \quad +1 \\ \hline \end{array}$$

مجموع جدول = $\boxed{-4}$

$\Downarrow$

مميزت $\boxed{5}$

$$\boxed{-1} = \frac{-4}{4} = \frac{-4}{\text{عدد خانة } C_1}$$

لو جهاز (٩) بعد يعزف الجهاز ثلثه جهاز (٣) :-

لدا اكلية $\Rightarrow$ $-1 \quad -1 \quad -3 \quad +1$

$C_3 \Rightarrow$ $+1 \quad +1 \quad -1 \quad -1$ ^{مميز *}

$$\begin{array}{r} -1 \quad -1 \quad 3 \quad -1 \\ \hline \end{array}$$

مجموعهم = $\boxed{0}$

client

$$\boxed{0} = \frac{0}{\text{عدد خانة } C_3}$$

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Sequence numbers (codes) تكونت من جريبه Walsh tables

$$W_1 = [+1]$$

← الخانة الأولى

لو كسبنا أكثر من خانة

$$\begin{array}{|c|c|} \hline +1 & +1 \\ \hline \end{array} \Rightarrow \text{للبيانات الأولى } (C_1)$$

$$\begin{array}{|c|c|} \hline +1 & (-1) \\ \hline \end{array} \Rightarrow \text{للبيانات الثاني } (C_2)$$

لو كسبنا 4 أجهزة

$$W_4 = \left[\begin{array}{cc|cc} +1 & +1 & +1 & +1 & \Rightarrow C_1 \\ +1 & (-1) & +1 & (-1) & \Rightarrow C_2 \\ \hline +1 & +1 & (-1) & (-1) & \Rightarrow C_3 \\ +1 & (-1) & (-1) & +1 & \Rightarrow C_4 \end{array} \right]$$

← العكس

table يكون إما 2 أو 4 أو 8 أو 16 أو 32 أو 64 أو ...

⇒ Example 12.6 : Find the chips for a network with

- (a) Two Stations,
- (b) Four Stations.

Sol :

⇒ Figure 12.29

→ we can use the rows W_2 & W_4 .

(a) For two-stations. ⇒ $\begin{bmatrix} +1 & +1 \\ +1 & -1 \end{bmatrix} \begin{matrix} \rightarrow c_1 \\ \rightarrow c_2 \end{matrix}$
 $[+1 \ +1] \text{ \& } [+1 \ -1]$

(b) Four Stations ⇒ $\begin{bmatrix} +1 & +1 & +1 & +1 \\ +1 & -1 & +1 & -1 \\ +1 & +1 & -1 & -1 \\ +1 & -1 & -1 & +1 \end{bmatrix} \begin{matrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{matrix}$
 $[+1 \ +1 \ +1 \ +1]$
 $[+1 \ -1 \ +1 \ -1]$
 $[+1 \ +1 \ -1 \ -1]$
 $[+1 \ -1 \ -1 \ +1]$

⇒ Examples 12.7 : What is the number of sequence if we have 90 stations in our network ?

Sol : $\begin{matrix} (N) \\ \uparrow \\ \# \text{ sequence} \end{matrix} = 2^m$

choose $m = 7$.

$$\therefore N = 2^7 = \boxed{128}.$$

Example 12.8

Prove that a receiving station can get the data sent by a specific number if it multiplies the entire data on the channel by the sender's chip code and then divides it by the number of stations.

58.

data on channel:

$$\dots \hat{a}_1 \hat{u}_1 \in W_1 \quad \& \quad D = (d_1 \cdot c_1 + d_2 \cdot c_2 + d_3 \cdot c_3 + d_4 \cdot c_4)$$

⇒ The receiver wants to get data sent by Station 1 multiplies these data by c1.

د. $c_1 = (d \cdot c_1 + d_2 \cdot c_2 + d_3 \cdot c_3 + d_4 \cdot c_4) \cdot c_1$ (۱) جو صفت:

ثانيًا, Data crisp
• $C_1 \in (D)$

حاصل
ضرب ای بود
بنویس آخر
با ۵
لانه هم ضرایب

$$= d_1 \cdot \underline{c_1 \cdot c_1} \Rightarrow \text{الكلود ضرب نفسه}$$

$$1) = d_1 \cdot N \Rightarrow \text{رطاطلى كود خانانة الكلود (N)}$$

ملا اسم مع عدد الخانات (N) بطبع d_1

مصحف الدار [ياي رجبى] هـ: ١ # [2]