INGENIERÍA DE REDES

Grado en Ingeniería Informática

Ingeniería de tráfico de voz

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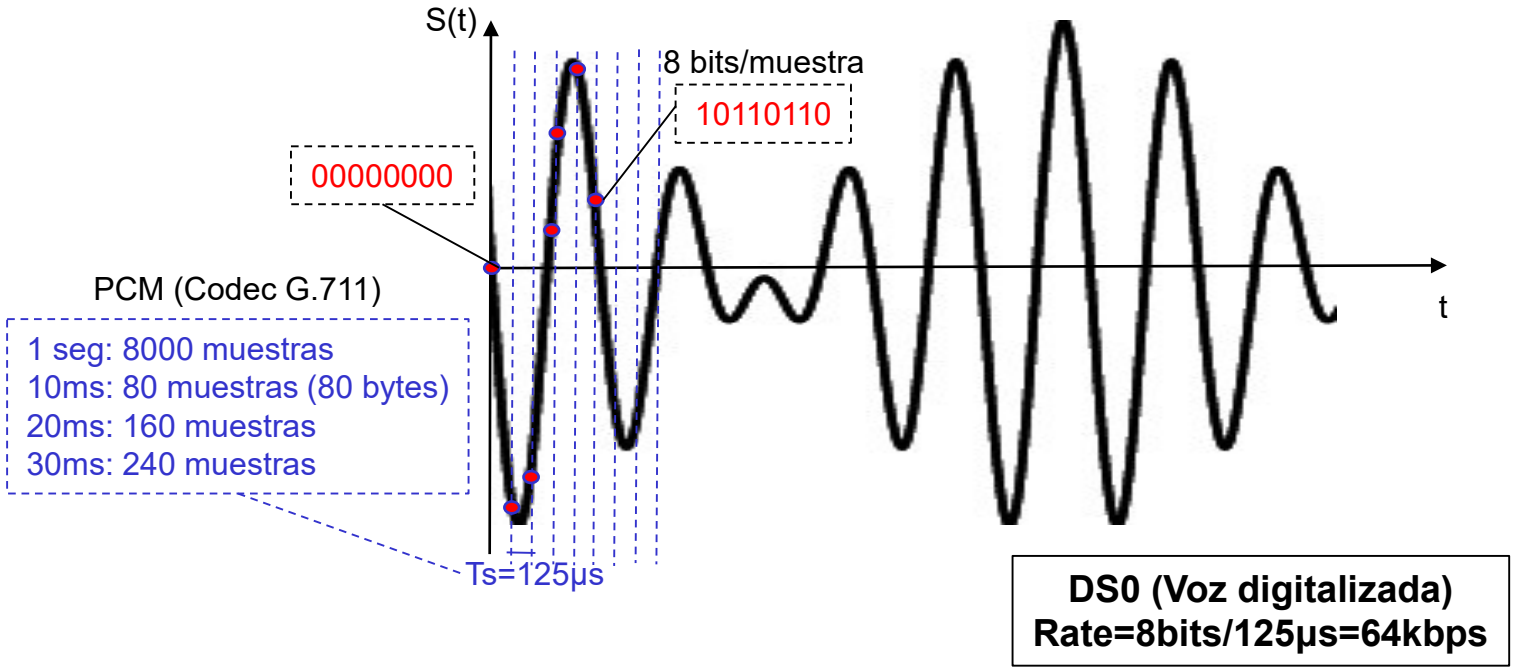
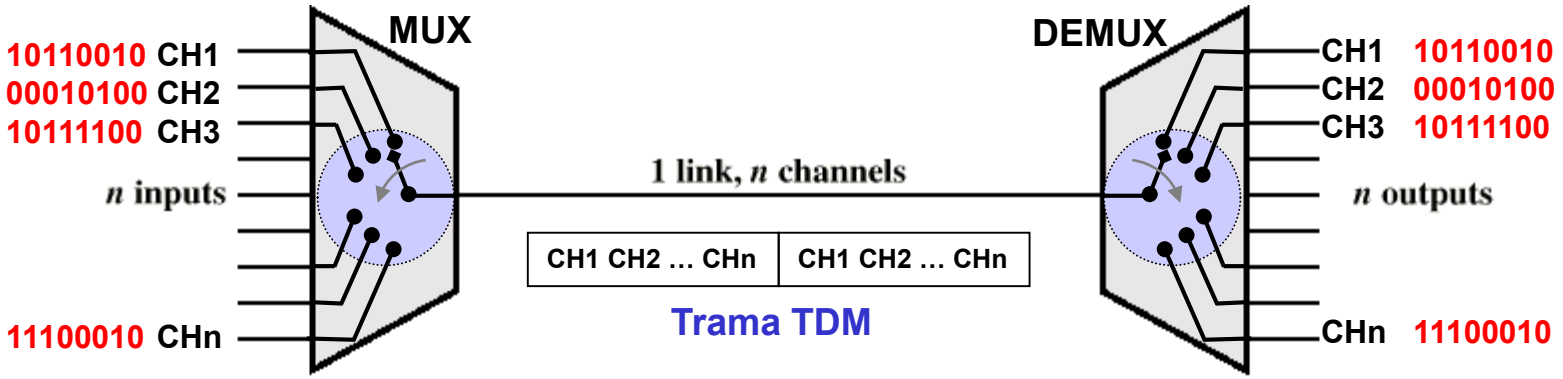
Digitalización señal voz telefónica

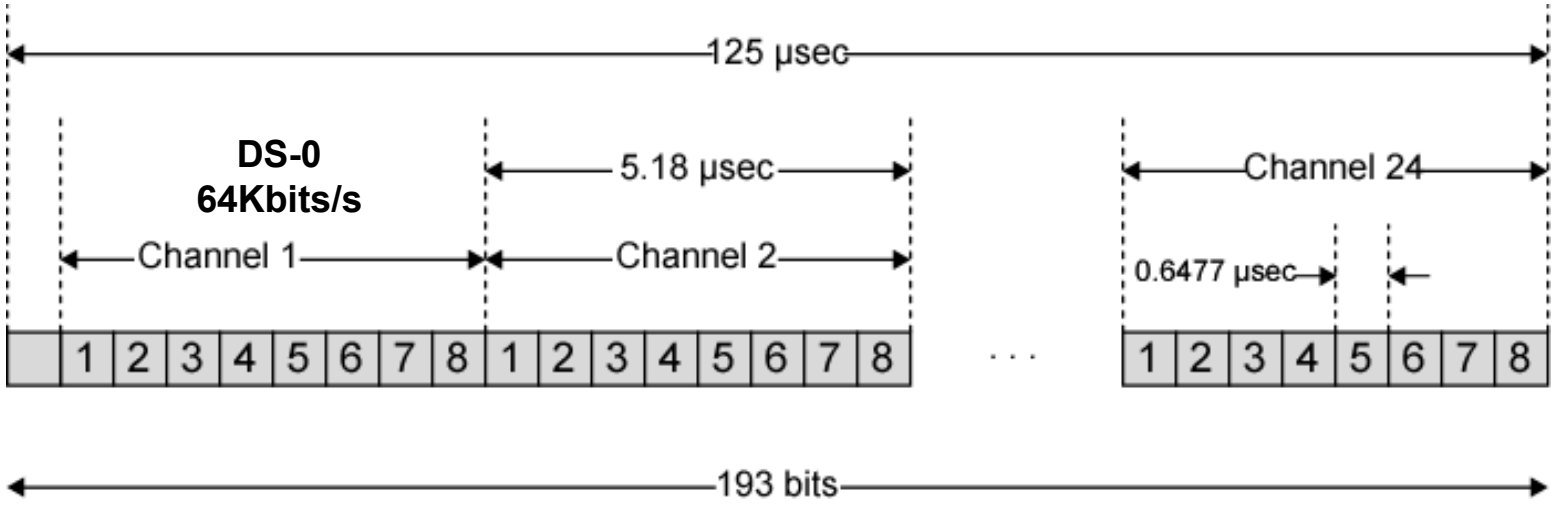
- Frecuencia máxima: f_{max}=4KHz
- Frecuencia de muestreo (Nyquist): $f_s=2 \cdot f_{max}$=8KHz
  - Periodo de muestreo: $T_s=1/f_s$=125μseg
  - 8000 muestras/seg



Multiplexación TDM



Formato de la trama DS-1

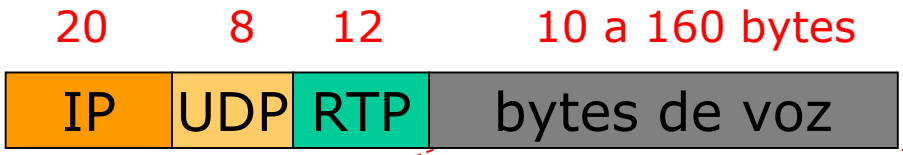


Jerarquía digital TDM

Digital Signal Designator	Data Rate	DS0 Multiple	T-Carrier	E-Carrier
DS0	64 Kbps	1	-	-
DS1	1.544 Mbps	24	T1	-
-	2.048 Mbps	32	-	E1
DS1C	3.152 Mbps	48	-	-
DS2	6.312 Mbps	96	T2	-
-	8.448 Mbps	128	-	E2
-	34.368 Mbps	512	-	E3
DS3	44.736 Mbps	672	T3	-
-	139.264 Mbps	2048	-	E4
DS4/NA	139.264 Mbps	2176	-	-
DS4	274.176 Mbps	4032	-	-
-	565.148 Mbps	4 E4 channels	-	E5

VoIP: Análisis del tráfico de voz

- RTP: Real-time Transport Protocol

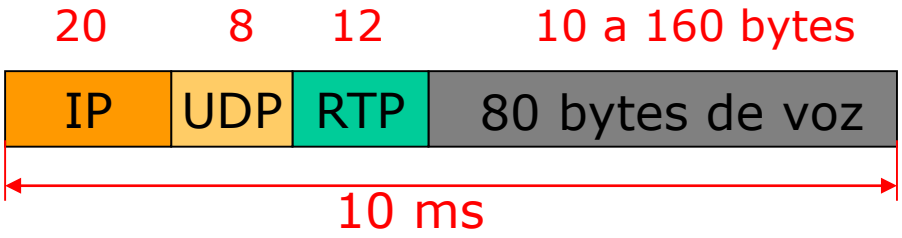


Tipo de codec

Codecs	Tasa binaria (Kbps)	Tamaño de la trama (bytes)	Método compresión	Tiempo entre paquetes (msec)
G.711	64	160	PCM	20
G.729A	8	20	CS-ACELP	20
G.728	16	40	LD-CELP	20
G.723.1	5.3	20	ACELP	30

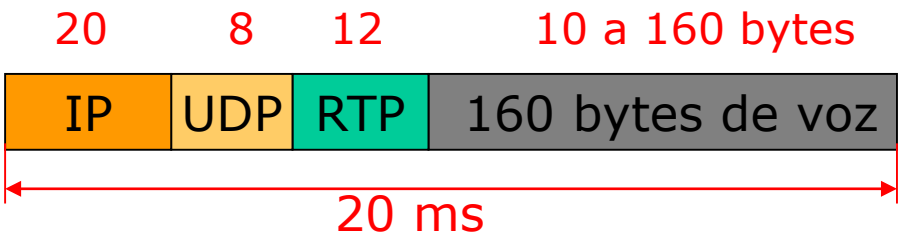
Análisis del tráfico de voz

- Importante el número de muestras/paquete
- Codec determina el tamaño de la muestra
- Ejemplo G.711 → 64 kbps
- Muestra de 10ms → 80 bytes



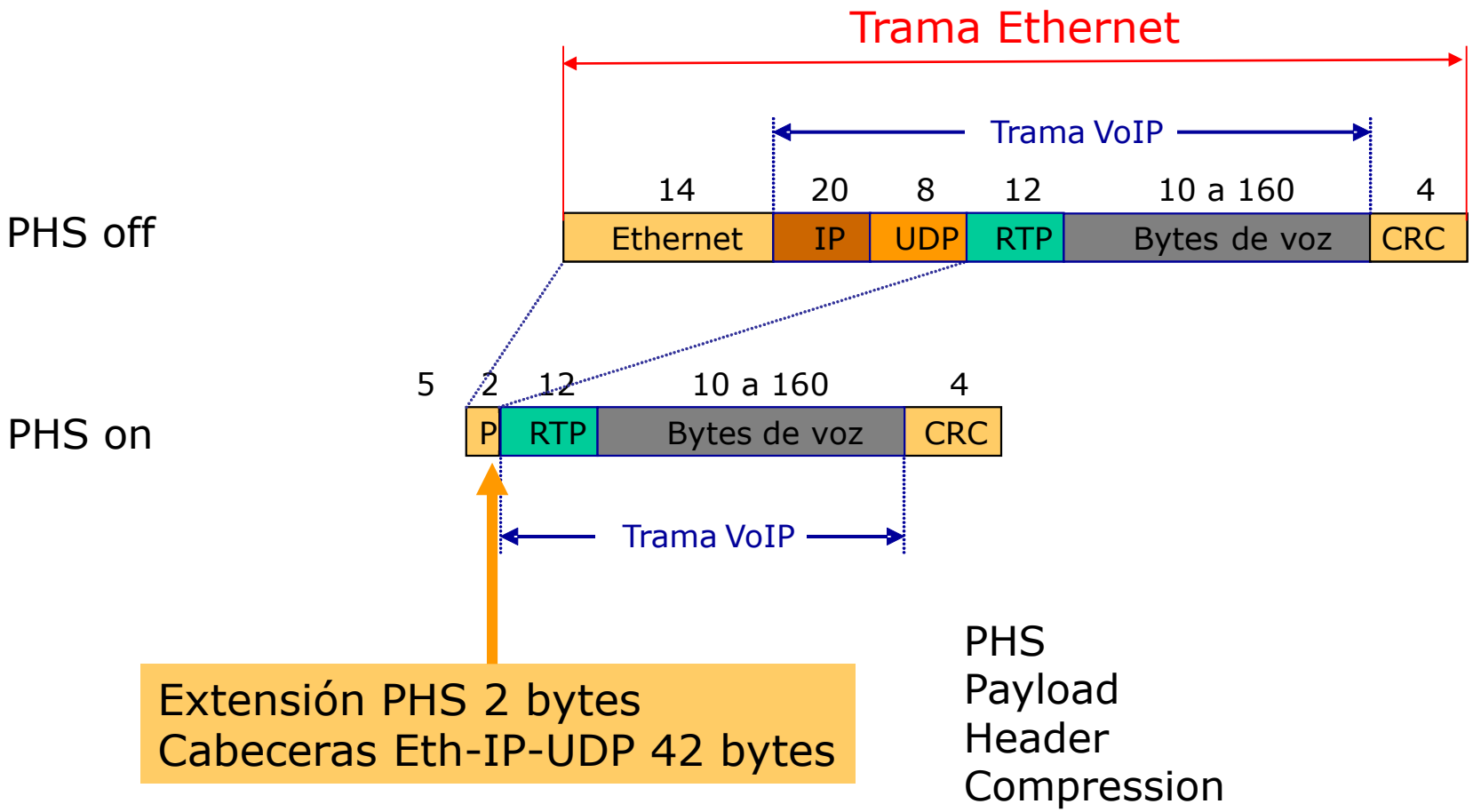
R = 120*8/10ms = 96 kbps

- Muestra de 20 ms → 160 bytes



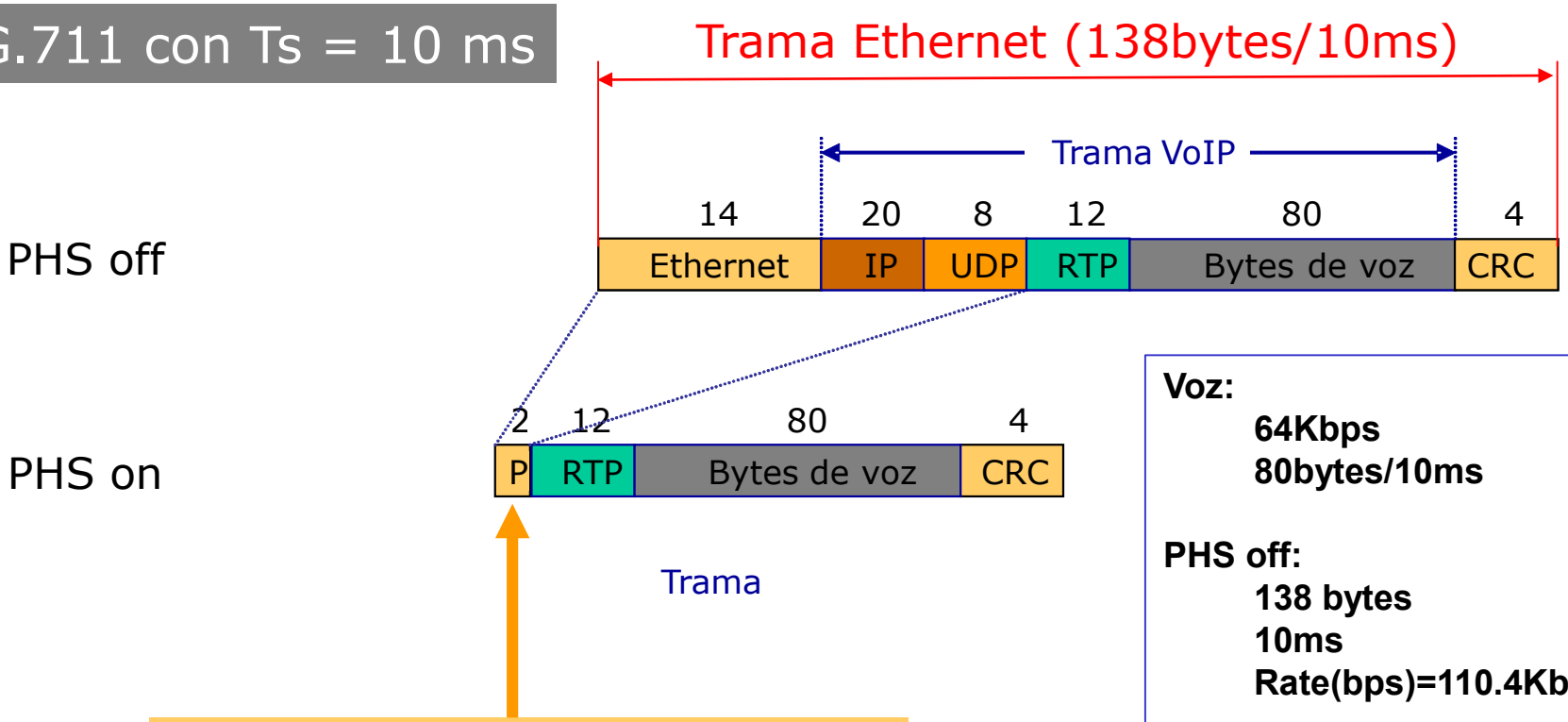
R = 200*8/20ms = 80 kbps

VoIP: Trama Ethernet



VoIP: Trama Ethernet

G.711 con Ts = 10 ms



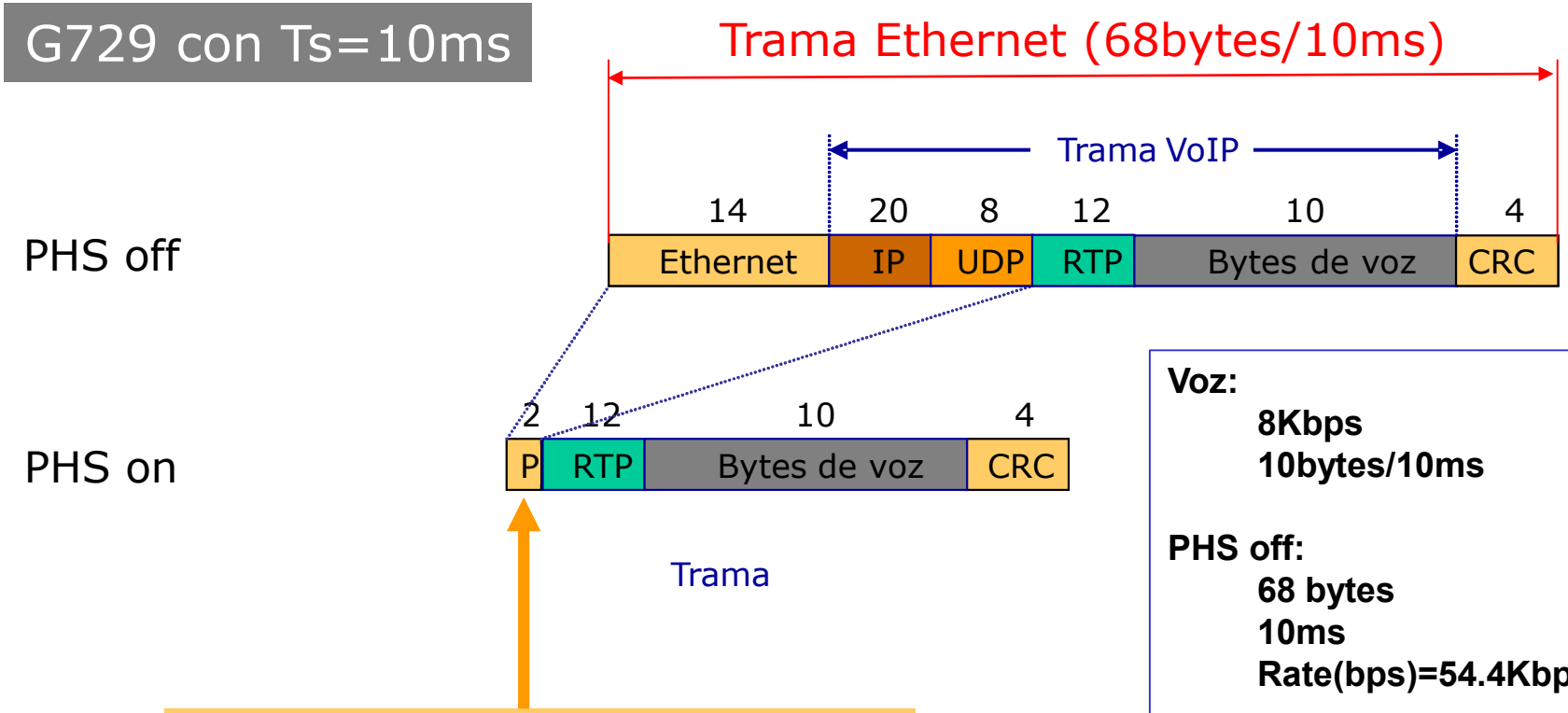
Voz:
- **64Kbps**
- **80bytes/10ms**

PHS off:
- **138 bytes**
- **10ms**
- **Rate(bps)=110.4Kbps**

PHS on:
- **98 bytes**
- **10ms**
- **Rate(bps)=78.4Kbps**

VoIP: Trama Ethernet

G729 con Ts=10ms



Extensión PHS 2 bytes
Cabeceras Eth-IP-UDP 42 bytes

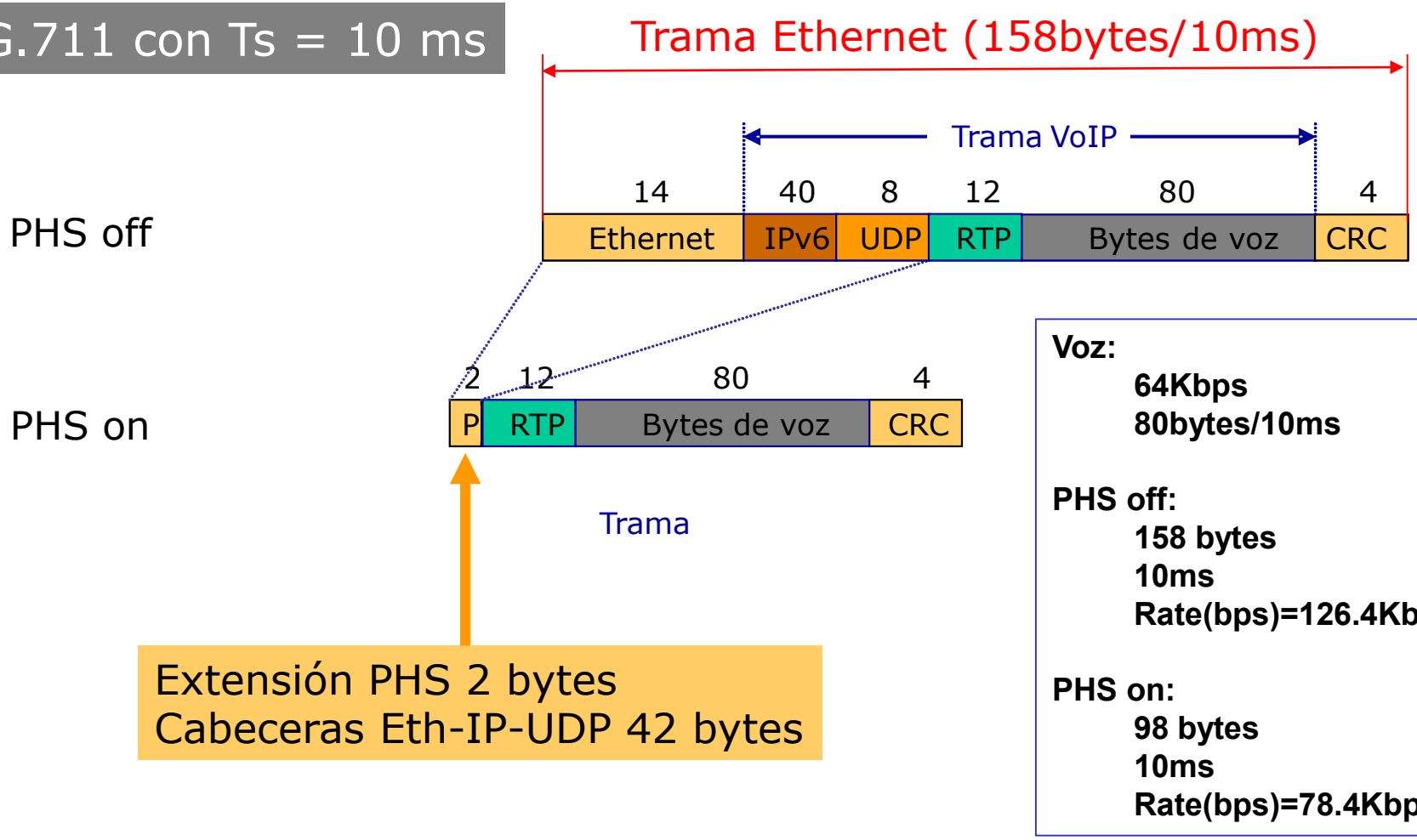
Voz:
- **8Kbps**
- **10bytes/10ms**

PHS off:
- **68 bytes**
- **10ms**
- **Rate(bps)=54.4Kbps**

PHS on:
- **28 bytes**
- **10ms**
- **Rate(bps)=22.4Kbps**

VoIP-IPv6: Trama Ethernet

G.711 con Ts = 10 ms



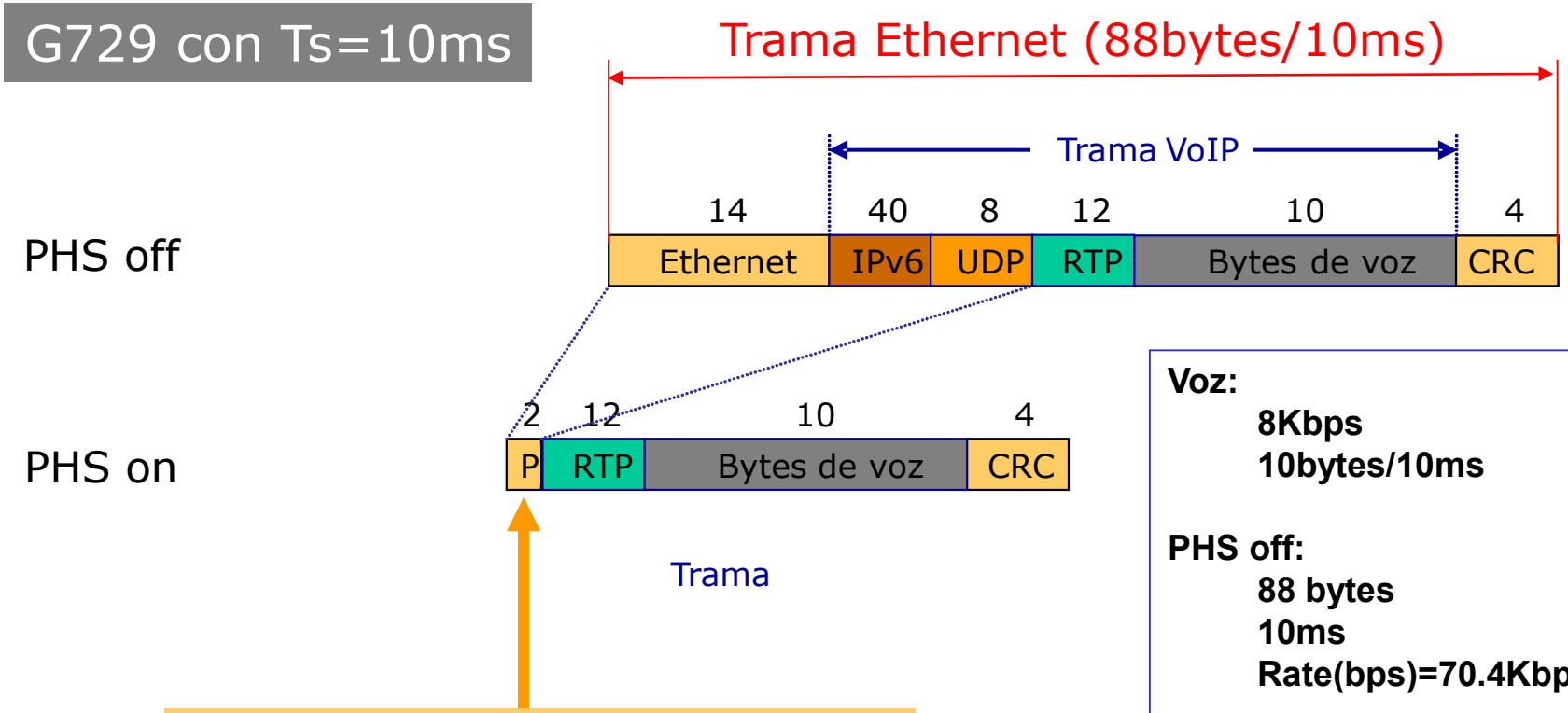
Voz:
- **64Kbps**
- **80bytes/10ms**

PHS off:
- **158 bytes**
- **10ms**
- **Rate(bps)=126.4Kbps**

PHS on:
- **98 bytes**
- **10ms**
- **Rate(bps)=78.4Kbps**

VoIP-IPv6: Trama Ethernet

G729 con Ts=10ms



Voz:
- **8Kbps**
- **10bytes/10ms**

PHS off:
- **88 bytes**
- **10ms**
- **Rate(bps)=70.4Kbps**

PHS on:
- **28 bytes**
- **10ms**
- **Rate(bps)=22.4Kbps**