The Communications Plan for a frigate was as follows:

**UHF**
- Ship/ship tactical communications - six
- Ship/ship intership RATT - one
- Ship/Air communications - one

**VHF**
- Ship/Air - one

**HF**
- Ship/Ship tactical communications low power - three
- Ship/Ship tactical communications medium power - one
- Ship/Ship tactical communications high power - one
- Ship/Shore strategic communications high power - one

In addition, extra VLF/HF receivers were required for Broadcast reception and shore/ship answering/mobile fixed services.

**The basic ICS1 installation** provided the following:

**MCO**
- 2 x RATT Broadcast bays
- 3 x RATT Tactical bays
- 2 x taping up bays
- 1 x CJC HF receiver
- 2 x B40D receivers
- 1 x B41/FAZ
- 1 x 618/CAS
- 1 x FM12
- 1 x KL7 bay

**CCR**
- 1 x C&M Desk
- 8 x CJA receivers
- 6 x TDA units - these provided a 25mW RF output which was fed to the WBA/WBB
- 3 x CJD receivers (1 spare)

**CCR Annex**
- 3 x WBA - HF Wideband Amplifier - 1kW max.
- 1 x WBB - MF/HF Wideband Amplifier - 500W on MF and 1kW on HF
- 1 x EY(2) - Transmitter aerial exchange - fed to the HF filters, ETA (Whip AWF Port side Flag Deck) or the ETB (Mainmast - AHR 5 wire MF Aerial)
- 1 x EAW(3) - Transmitter common aerial system - HF filter 3-11.5MHz
UHF Office

2 x 691/CUH - one set to Normal channelling and one set to Alternate
5 x 692/CUJ
1 x 693/CUJ
1 x FSA(1) - Frequency Standard
1 x 689 - VHF International Maritime Mobile
1 x 86M

Upper Deck - 2 x 638 Liferaft sets

Differences

1. Waikato was a one-off. She had two ETA/AWFs, sited either side of the Flag Deck. One TDA was wired to one WBA but could be tied to any aerial. One other WBA could be used to the other ETA/AWF with the third WBA being used either as a single channel (1kW), two channel (330W) or three channels (110W). The WBB being connected to the ETB (240kHz - 3 MHz). She also had a 618 in the MCO with the AWH on the Starboard side which was sited aft of the Bridge Wing.
2. ICS2 -
   a. Transmitter Drive Units were TDCs. TDA's had to be manually tuned from the C&M Desk, whereas the TDC's were automatically tuned when the pressel switch was pressed on the microphone at the C&M Desk.
   b. Receivers were CJM's.
   c. MF DF set was the FM16 with SQA Auto Alarm.
   d. Emergency set was Type 641/CJM (SSB 100W) and this was sited in the CCR. The aerial was an AWN with Aerial Matching Unit which was sited on the starboard side of the Flag Deck.
   e. Canterbury had two filter units for the Main Roof broadband which gave coverage in two bands, 3-11.5Mhz and 8-24Mhz.
MF/HF Aerials

Prior to the advent of Comist/ICS, the main Tactical communication links between ships in a Task Force were carried out using VHF/UHF (Line of Sight systems). However, with pickets operating out to several hundreds of miles from the main force, the communication problem was rather difficult. There were two things to consider - gapless cover and low probability of intercept. This meant that communications had to be achieved using ground wave and sky wave propagation giving 360 degree coverage with the minimum possibility of interception of long range sky wave transmissions. It was important that the right type of aerial was used to achieve this.

The following had to be taken into consideration:

1. The takeoff angles from the aerial. Whip aerials had low vertical takeoff angles especially at the higher HF frequencies.
2. The horizontal radiation pattern. Whip aerials were prone to influences from the ship's superstructure. They gave maximum radiation patterns in one particular direction only.
3. There was insufficient deck space available for transmit aerials to be effectively separated from the receiving aerials.
4. An aerial was required to give an all round 360 degree horizontal radiation pattern.
5. The same aerial had to have broadband characteristics to enable multiple transmissions.
6. The aerial had to be able to provide ground wave as well as short and medium sky wave transmissions.

Following successful experiments on HMS Sheffield in the early 1950's, the Royal Navy were able to determine that using parts of the ship's superstructure was a viable option for broadband aerials.

There were two types of aerial that were principally used - the folded monopole and the sleeve aerial. The Leander Class frigates used the folded monopole and in the later years, Canterbury also used sleeve aerials. For now, the folded monopole will be discussed.

Waikato commissioned with her Main Roof aerial system consisting of the HF and MF sections joined together but separated by many insulators. This aerial was very heavy and was prone to crashing down onto the upper deck during storms. The MF section was made up of five wires that fed into the ETB on the Main Mast. The HF section was also made up of five wires that fed from the RF Transformer at the rear of the Flag Deck, fanned up to the spreader bar and then directly connected to the Fore Mast. This was essential to the 360 degree horizontal radiation pattern and was known as "mast excitation". The vertical and horizontal wire parts of the aerial and mast all radiated. This ensured that all round coverage was achieved by ground wave and sky wave as dictated by the frequencies being used. The HF RF transformer was also grounded, which meant that the Flag Deck was used as a counterpoise.
The above pic shows the MF/HF broadband for all RNZN Leanders from the mid 1980s onwards. The MF section has been separated and was directly connected to the funnel.
Changes

1. Aerials

The transmitting MF/HF aerials were all sited midships with the AWN Receive whips being sited with one on the Turret, two either side of the Bridge wing, two either side aft of the funnel and two whips on the Seacat Deck. These whips were hinged and were lowered during flying operations. Some of the Leanders also had an active receive aerial in the shape of a bird bath which was sited starboard, aft on the Quarterdeck.

The two transmit whips were originally placed either side of the Flag Deck but these were later shifted aft of the funnel and the two receive whips moved forward to the Flag Deck positions. This may have been as a result of Waikato adding the 8-24 MHz filter drawer in the early 80's. On first tuning up on 16MHz, there was a flash and RF arc'd over to the Port 20inch SP throwing a signalman across the Flag Deck. Whether the Port AWF was in use at the time, it is not known, but the arcing may have been caused as a result of the two aerials transmitting simultaneously with the 20inch in close proximity. Canterbury didn't have this problem as 20in SPs weren't carried.

The receive whips were originally AWNs but these were replaced with AWYs.
Southland's "Bird Bath" receive aerial - to the left of bunting

Receive satellite communications were added in the early 80's and four passive aerials were placed either side of the Flag Deck - Fore and Aft.

Canterbury showing the Starboard aft Satcom Rx aerial, to the right of the funnel (the loop on top of the cross) and to the right of that, is the Sleeved whip aerial. Note that the MF aerial has gone. This was no longer required with the introduction of GMDSS.
The RAN and RNZN had been allocated a channel on the USN’s FLTSATCOM (Fleet Satellite Communications), utilising the RAN's A11B3 channel.

Canterbury 1991 showing major differences. AJEs had been replaced with dipoles.
Canterbury 2004 - upper deck profile aft of the funnel had completely changed. Note the Inmarsat terminal (International Maritime Satellite system) sitting above the hangar. The RNZN has replaced the long haul strategic communications system with commercial satellite facilities. The FLTSATCOM was still in place but being used for real-time tactical communications.

2. Equipment

a. UHF/VHF - the 691/692/693/CUH/ CUJ/86/TR1987 equipment was originally replaced with AN/ARC 159 (UHF) and AN/ARC182 (VHF). These were then replaced with the WSC-3 units.

b. HF -
618/CAS replaced with 643/CJP which was shifted to the CCR.
ICS system was completely ripped out and replaced with RF Harris transmitters and receivers (see pic below).

c. Crypto -
Off-line - KL7 replaced by RACE - Canterbury and Waikato both equipped with RACE prior to their deployments to the Middle East for Operation Armilla 1982/83. Top Secret, Flash, encrypted messages (CO's Eyes Only) from the Admiralty, were received daily advising of possible threats.
On-line - UHF Voice - originally BID510, then KY28 (Nestor) and then by KY58 (Vinson).
On-line - RATT - Receive - Jason (Bid580) replaced by KW46.
Canterbury CCR 2004 - Harris TXs (100W) on left which fed into the HF Broadband. Harris RXs on right. These were placed forard side of the CCR on Stbd side - note the outer bulkhead. The LMA was then the Engineers Office and the Diesel Generator had been removed.

Canterbury CCR 2004 - these are Harris 500W HF TXs. These fed into sleeved whips. This TX and the bench to the right of it, is where the Control and Monitoring desk used to sit. Behind the bulkhead to the right is the MCO.
Miscellaneous Equipment

1. A piece of equipment that was not thought about or rarely used, was the Underwater Telephone for communicating with submarines. The model that was in use in the RNZN in the early 80's was connected to the KMM and able to be used on CW and Am Voice. Experiments were carried out between Canterbury and another frigate to see if RATT was possible - it was. The only thing that had to be taken into account was that sound travelled faster underwater than in air and the baud speed on the printers had to be adjusted to 50 bauds. An ideal secure medium that was never put to operational use.

2. The Leanders were ideal communications platforms. Not only could they provide tactical information within a Task Force, but they could also relay communications over UHF and HF using UHF to UHF, UHF to HF, HF to UHF and HF to HF. Traffic could be relayed within a Task Force, aircraft, ship/shore and shore/ship.

3. The introduction of the Broadcast crypto system KW46 in the late 80's changed the Broadcast concept as we knew it. No longer were ships able to read other ships' traffic - all but general messages were only able to be copied by ships that had traffic specifically addressed to them. This also did away with the majority of off-line traffic. This was basically the forerunner of the internet email system. International maritime traffic followed suit in the early 90's with the introduction of Inmarsat-C - a small SATCOM system that provided two-way data only for the dissemination of distress, safety, urgency, navigational and individual ships' traffic. This saw the demise of professional maritime radio officers. Similarly, the end of the Leanders in the RNZN saw the passing of a communications era that is never to be repeated - the long haul strategic communications network and the expertise required to operate it.